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Machine Learning Based on Road Condition Identification System for Self-Driving Cars

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Abstract:- Modern self-driving cars heavily rely on visual inputs to make decisions and it contains resolving significant computer vision issues. The development of deep learning has opened up a number of opportunities to enhance those computer vision issues and hence be able to enhance performance in autonomous driving applications. The primary function of vision-guided systems is object segmentation to comprehend the surroundings. This study uses deep learning techniques to create an effective model of the best path to follow an item on a self-driving vehicle. And helping with improved decision-making to locate the least expensive routes during navigation.

I. INTRODUCTION

In recent years, modern transportation has advanced to self-driving cars as intelligent robots thanks to the rapid development of Artificial intelligence. Even though there are many successful autonomous vehicles on the market today [1], [2], [3] studies are still being conducted to improve their capabilities [4]. The development of machine learning has been largely responsible for the success of self-driving cars [5], [6]. With the use of machine learning, many functions have been improved, including vision-based guiding to move about the surroundings precisely [6], identifying traffic signals [7], proposing the least expensive route, and more. Since self-driving cars have emerged as the newest trend in transportation, there are still plenty of things that may be improved. The purpose of autonomous vehicles in the future is to improve pedestrian and passenger road safety, safe navigation and parking, and travel time reduction by finding the fastest routes. It also aims to regulate traffic flow generally and minimize environmental pollutants indefinitely [8], [9].

Countries and government organizations keep anticipations for higher level accuracies in automobiles in the future since numerous challenges come along as a result of their growth. However, autonomous vehicles have benefits like high reliability, high speed, lower government spending on traffic enforcement, less need for vehicle insurance, fewer redundant passengers, etc. [4], [8], [9], they also have drawbacks like the need to establish a legal framework and potential misuse by criminals and terrorists. Since the car manufacturer is responsible for the legal frame, the accuracy of autonomous vehicles is essential. The precision of the system's understanding of the environment has a major impact on its dependability. It must respond quickly and with great precision. Modern, cutting-edge technology is still unable to fully automate safe operation. Therefore, it is still necessary to confirm if the object segmentation performance exceeds human capabilities [4].

With new technologies, the industry must expand day by day, yet the issue is still unresolved in deep learning research. The goal of this proposal is to use deep learning to identify new techniques to improve performance. The era of safe and comfortable transportation in the future of autonomous vehicles is ambitious. Throughout this research, we hope to enhance performance through a more accurate road segmentation task. Testing on datasets other than prerecorded datasets, improving human-labeled data, and other issues are part of current research concerns. In this proposal, the literature review includes background information about self-driving automobiles. Next, we suggested a research action plan in the methodology section along with the research's anticipated contributions.

II. LITERATURE REVIEW

The concept of self-driving automobiles was initially proposed in the early 1990s, and the radio-controlled car was the first historical example to be presented[8]. The technology has been created for today's requirements with the help of several enterprises, universities, and research facilities. The Defense Advanced Research Projects Agency (DARPA) seedling project known as DARPA, an Autonomous vehicle, brought an artificial intelligence-related autonomous vehicle to the developmental domains[10]. Since then, several autonomous cars have been launched as the primary study field of artificial intelligence by Google, Tesla, and other significant manufacturers, researchers, and technology businesses[1], [3], [11].

As in the technological aspects, vision-based navigation enables a lot of features for self-driving. It includes several specific challenges compared to other automated robot types such as high accurate decision making with correct identification of surroundings. In the environment, understanding includes object recognition, object localization, distance measurement, object tracking, etc. Further, the objects are in wide ranges and are identified for different decision makings on vehicle navigation, Pedestrian, moving vehicles,

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obstacles, and traffic signals. Road identification is some crucial detection and the object recognition system has a high weight on the accuracy of the overall system. In today's autonomous vehicles, the perceptions through large sensory systems such as LiDAR and radar sensors with structured light, laser scanners, ultrasound, or time-of-flight, provided the vision to the robotic system[12]. Based on those sensors many data sets are collected[13], [14] and used for developing models for environment understanding[15]. Using many approaches, object segmentation has been improved. 2D object detection, 3D object detection, and 2D and 3D Image segmentation have been widely used for vision-based navigation systems. And many types of image types such as Stereo images, 3d Point clouds, and fish eye view images are used for image segmentation. And further to obtain high accuracy in real-time with a high frame rate as well as with low cost, now the approaches are toward RGB-based image segmentation. Hence, this research will be aimed at RGB-based image segmentation for reducing gaps and inaccuracies in existing systems.

In the same way, the other decision-making tasks have achieved high accuracy through machine learning and deep learning. Path planning with minimum cost, and reduce risk in navigation necessary decision making and also needs to be real-time. Hence, deep learning techniques such as CNN, RL based research are carried on to improve the systems. It has been identified that the accuracy improvement in decision-making systems still heavily depends on the environment understanding; hence, this research is focused on improving road condition understanding with image segmentation. Also, to enhance the overall decision-making in identifying traffic and improve the cost-effective path selection in the navigation.

III. METHODOLOGY

In this project, autonomous cars get data from wireless sensor nodes that are situated in every starting point of the roads. Mainly they provide the current situation of the road with the number of vehicles in between the starting point to end point. These sensor nodes collect these data from communication with each sensor node that number of vehicles came into the road and vehicles went out from the road in a specific time period which is 30 minutes.

These sensor nodes send their data every 30 minutes to a cloud-based server to store the data. The server stores the data according to the day and time which is in 30 minutes. This server database keeps data with every day of the week within a time period up to recent 27 weeks.

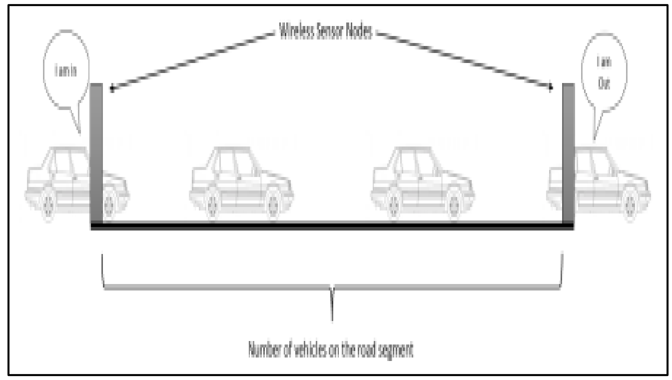

Fig 1: Basic System Model of the Project

For this project, we get only the number of vehicles and average speed of vehicles during the 30 minutes time period. The figure shows how servers keep the data according to days and times.

Table 1: Sample Data Set

	Day	Time	Rd_01 No. Vehicles	Rd_01 Avg. Speed (km/h)	Rd_02 No. Vehicles	Rd_02 Avg. Speed (km/h)	Rd_03 No. Vehicles	Rd_03 Avg. Speed (km/h)
0	Monday	00:00 - 00:30	5	55	10	73	2	78
1	Monday	00:30 - 01:00	6	63	5	85	4	68
2	Monday	01:00 - 01:30	2	71	5	88	5	50
3	Monday	01:30 - 02:00	2	77	6	83	6	53
4	Monday	02:00 - 02:30	5	55	4	84	5	53

This project gives a new model to predict the time that can be taken to pass a specific road. This will improve the productivity of autonomous vehicle systems that reduce the time consuming of the travel from one place to another place. One of the weaknesses of this project is time consuming to gather and process the data.

Throughout this project, we hope to enhance performance through a more accurate selecting road segmentation. Testing on datasets other than pre-recorded datasets, improving sensor-labeled data.

In this project, we gather the data from three different roads that start from the same position and end at the same position. As the below figure, number of vehicles and average speed of through the road in every 30 minutes of day up to 27 weeks. They are mentioned as road 01, road 02 and road 03.

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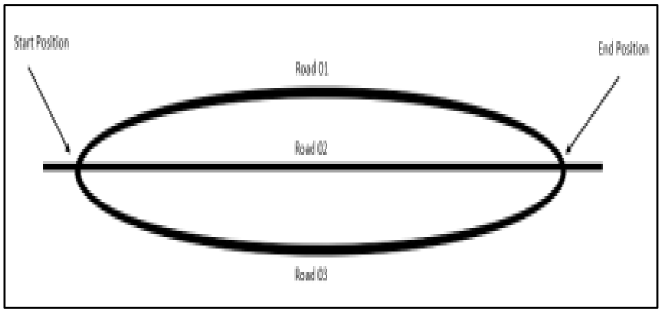

Fig 2: Assumed Three Roads for Project

Above figure shows the basic diagram of three roads. We assume that these three roads' distances are 25km, 35 km and 26 km respectively. On these roads, vehicles can travel 90 km/h maximum speed and 10 km/h minimum speed.

When a vehicle comes to this junction, the vehicle gets the current data from the sensor nodes and processes this data with past data from the cloud server. the flow chart of this process is as flows;

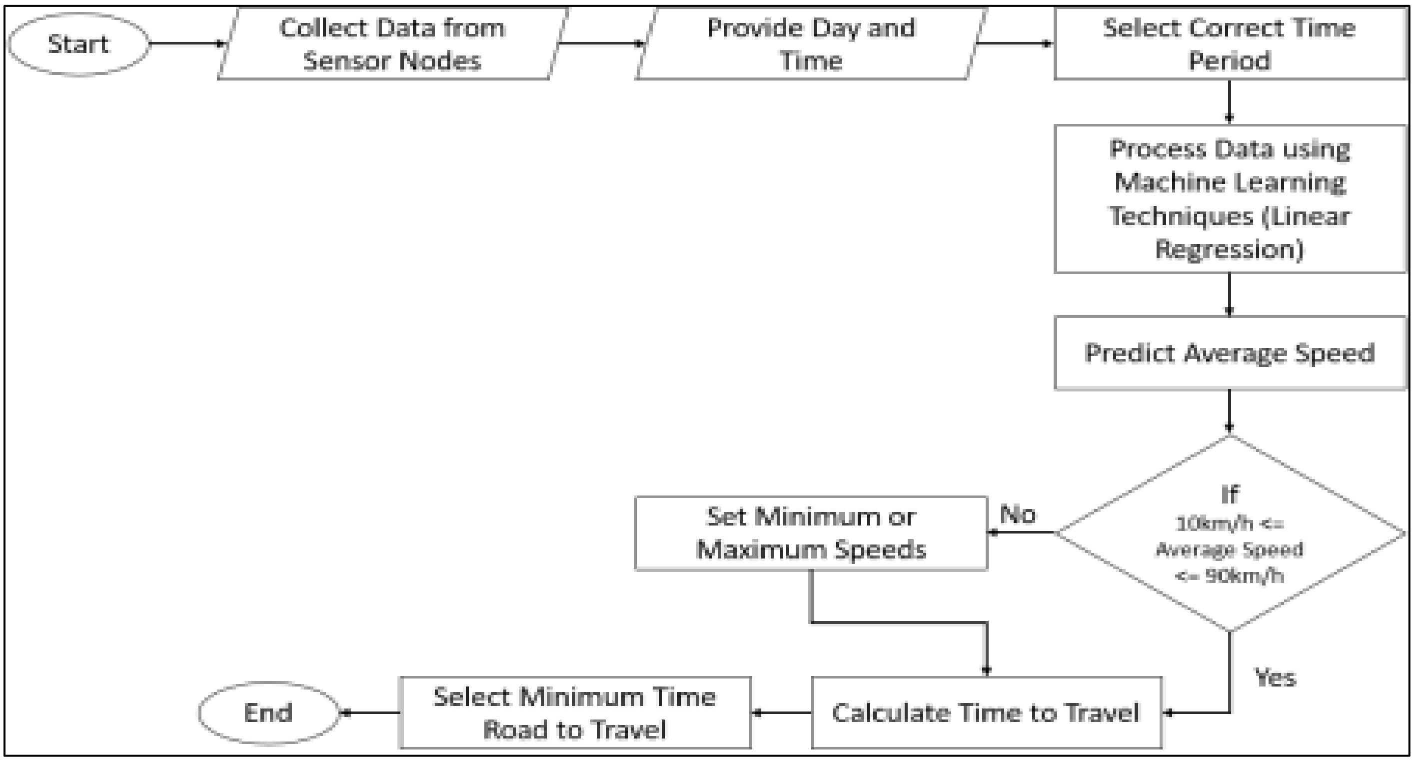

Fig 3: Flow Chart of the Project

When data is provided from the sensor nodes to the vehicle, the vehicle finds the data from the cloud server according to the day and time period. Then the machine learning technique starts to predict the average speed through the road according to the vehicles passing over these roads at the current time. Using the average speeds of the roads, the system will calculate the time taken to travel through the roads.

When processing the data according to the current situation, the system checks the correlation of data. The system will reduce the cost of the data using gradient descent technique.

IV. RESULTS

As the dry run, we provide the data to the system as follows;

- Number of vehicles in each road: 10 (We assumed all the road have same number of vehicles)
- Day: Monday
- Time Period: 10.30 am to 11.00 am

The results for the above inputs were shown in the figure below. From these results, the system can predict the road that vehicles need to travel within minimum time.

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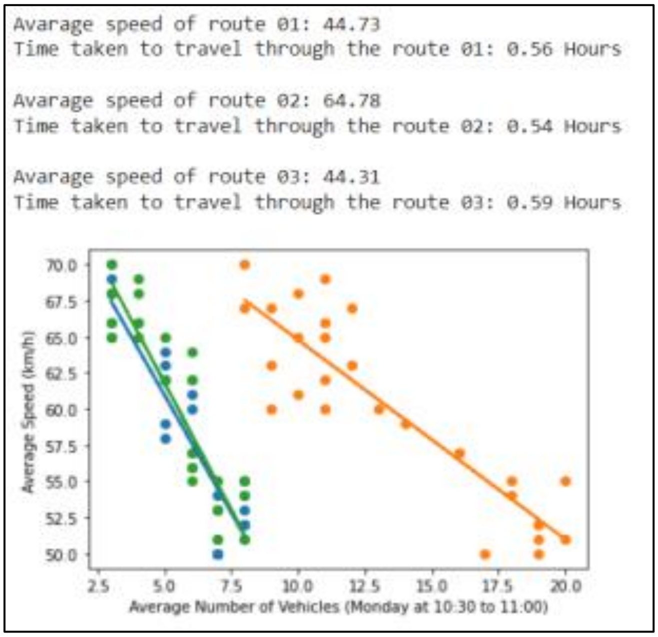

Fig 4: Results

V. CONCLUSION

Throughout this project, a depth study will be carried out on the current state of the art in surrounding identification. To conclude this project, we have collected the data from sensor notes and pre-processed the data by providing day and time from this. When the vehicle selects the time period for traveling it will help to predict the average speed use of machine learning techniques which leads to calculating the least cost path and minimum time.

The future work on this project can be extended to reduce the accident rates by identifying the minimal traffic path and vehicles are able to choose the quality road for their travel as well as the fuel consumption and energy consumption of the vehicle

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