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A SURVEY - MACHINE LEARNING TECHNIQUES IN SELF-DRIVING CARS

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Abstract

We all know that machine learning is one of the super driving technologies in the world. It is the one of the branches in Artificial Intelligence and in today's world many things around us are simply done by the technical improvements, so that we are living in our dream world, which we experience in some virtual world. One of such truly wonderful and amazing technologies is self- driving cars. We always see them in some video games or something like we imagine this as virtual reality. It is an autonomous car (driverless or independent car). Some companies like Google, Telsa, Audi, BMW, Ford, Volvo are developing or testing these autonomous cars. This all stuff sounds very interesting right!!! It is a real challenge to make a car autonomous but we made it possible truly rather than imagining it virtually. There are super exciting situations where this attempt became a huge success of driving a self-driving car, but there are still some challenges, we need to overcome so that the accidents/instances happened by Uber Company or any other won't repeat again in future. Machine learning is an essential and most important component of centralized electronic control unit (ECU) of any autonomous car. The algorithms in these computer-controlled cars are important for producing the surrounding environment, so that the actual task we wish is performed. The vehicles are maintained by radar sensors to monitor all the surrounding environment. They have benefits like reduction of harmful emissions, less traffic jams etc. A slight improvement with our technical issues would take this technology of self- driving cars to the next level. We will look into the algorithms used in self-driving cars in detail. We use algorithms of decision matrix algorithm, adaboosting, clustering algorithm, *K*-means, pattern recognition algorithms with classifications support vector machines, regression algorithms, etc. We will also discuss about the improvements/changes that have to be made to the existing one, so that it becomes leading technology used in our daily life.

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I. Introduction

In this modern era there are several advanced technologies have lighten up the advancement of self driving cars. A self-driving car, also known as an autonomous vechicle(AV), connected and autonomous vechicle(CAV), driveless car, robo-car or robotic cars is a vehicle that is capable of sensory its environment and moving safely with little or no human input. On behind of every latest technologies initially we will have both pros and cons. Coming to the self-driving cars the major advantages are traffic can be coordinated smoothy in urban areas to prevent traffic jams at busy times. Travelers would be able to take rest at overnight journeys. Here many countries are making significant contributions to the field. Although these countries are in various stages of adoption with respect to connected and computer-driven cars, more efforted is needed before these technologies can be reliably deployed on a large scale. Here sensor technology could identify the obstacles better and can also defect smaller and more subtle obstacles than humans. On the other hand, we have few disadvantages like security concerns there might be chance for hackers to get control over the vehicles software. Reading signs are the major challenges for robots. GPS and other technologies might not register the recent changes in road conditions and newly posted signs sometimes. Other few challenges like terrorists attacks, privacy concerns, possibility of crashes and security drawbacks…etc comes into picture. At the end of this paper you will get clear understanding of self driving cars technologies.

Also few modifications and ideas to overcome the drawbacks of these technologies.

II. Algorithm

The common machine learning algorithm used in autonomous driving cars are classified as supervised algorithms and unsupervised algorithms. They are again classified which is discussed below.

(1) Supervised Algorithms: This type of algorithms learn using training dataset until the desired level which promises minimal errors. Supervised ML Algorithms are further classified as regression and dimension reduction algorithms.

(2) Unsupervised Algorithms: These algorithms learn by making sense of data at hand. They do not use training datasets. They divide the data into group based on similarities between them. These algorithms first try to find identifiable patterns within the data. The two types of unsupervised ml algorithms are clusting and association rule learning. Now, let's go deeper into the inner working of self-driving car algorithms.

(3) Regression Algorithms: These types of algorithms are used for predicting event. It depends between two or more variables. These variables are estimated, and the effects of the variables are compared on different scales in the regression analysis. Repetitive aspects of the environment are used by these regression algorithms to form a statistical model of the relation between the position of a specific object within the image and that particular image. Through image sampling, the statistical model can provide a speedy online detection.

(4) Pattern Recognition Algorithms: The advanced driver-assistance systems obtain images that replete with an array of data from the surrounding environment. To recognize the relevant images containing a specific category of objects, the data needs to be filtered. This pattern recognition algorithms are also called as data reduction algorithms as they are designed to rule out unusual data points. These algorithms help in filtering the data obtained through the sensors by detecting object edges and filtting line segments and circular arc combined in many different ways by pattern recognition algorithms, it provides ultimate features for recognizing an object.

(5) Cluster Algorithms: These cluster algorithms are specialized in discovering structure from data points. In any of such cases if the images are not clear and if they are not identified then it becomes difficult for the system to detect and locate objects in the surroundings. Clustering algorithms define the class of problem and class of methods. In general, these techniques are established using centroid-based and hierarchical modeling approaches. All clustering techniques focus to organize the data into groups having the latest commonality. Two mostly widely used clustering algorithms for autonomous cars are *K*-means and multi-class neural networks.

(6) Decision Matrix Algorithms (DMA): DMA are especially used for decision making. They are designed for systematically identifying, analyzing

and rating the performance the relationships between sets of values and information in them. Gradient boosting (GDM) and Ada-boosting are most widely used DMA in autonomous cars. The moves of self-driving cars are determined by these algorithms. So, whether the car needs to brake or accelerate, or whether it needs a left or right turn, etc. the answer to such questions is determined by the accuracy of these algorithms.

It comprises independently trained multiple decision models whose predictions are combined to generate the overall prediction while minimizing the possibility of errors.

III. Problems Encountered and Solutions to be Referred

Self-driving cars are one of the advanced technologies and it becomes very common technology in our future. Considering the opinions of the experts as well as public, it is good but not so good enough. So, we have to clearly understand the problems we encounter using these self driving cars and provide them with a clear solution.

Firstly, present produced self-driving cars, sometimes should be led by drivers manually and cannot be left independent while it's driving as it cannot handle trickly situations. This is because driving requires many complex-social interactions, which is still a big challenge for these autonomous cars. It can recognize only the features/instructions given by humans through programming. Also, the maps to be designed for these self-driving cars are also somewhat difficult, we have to design it mentioning each and every small thing in the environment. Also, bad whether conditions are another big challenge, we have to design the sensors corresponding to different whether conditions, so that it can be used anywhere at any time. Cybersecurity is another issue, we have to make the network to be more safer and also our information need to be encrypted so that it doesn't get hacked. Sometimes, they are prone to accidents and has to be avoided by making it case sensitive to all situations in the surroundings. According to a survey done on travelling with self-driving cars, a car stopped nearly 12 times out of 7 times thinking that shadows of trees and objects are its obstacles. So, it should have a property of identifying a real object and its shadow. These are some of the problems we encounter during travelling in these self-driving cars and the solutions and all other related works will be discussed in the entire paper.

IV. Related Work

We have referred to the project done by the company Waymo LLC, which offered the only commercial autonomous car as of February 2020.It offered the car to a price of $2.25 billion. Actually, Google's self-driving car project was renamed as Waymo. The most important communication happens via the two screens mounted on the head rests.

The company's engineers developed a tool that where the camera installed in the devices help us to see what the sensors are actually assuming on the lane and communicate this message to the passengers, so that they would become alert. So, they designed this with a very clear view that the information captured from sensors is interpreted into an abstract animated map. This map uses 2 colors, dark blue for roads, light blue for the rest. The route which you are travelling is shown in green colour to show the contrast. Other signs like traffic lights, crosswalks are shown on the displays, abstract shapes of pedestrians, cyclists, etc. are also visualized and represented in detailed way through laser points of sensors.

Figure 1. This figure shows a self-driving car detecting the vehicles which are around it.

It can recognize the small differences through movements and colors. Rather than the real shapes of there cyclists and pedestrians other non-living objects are just shown in abstract shapes like buildings. Any live/emergency situations like traffic jams are distinctive with flashlights.

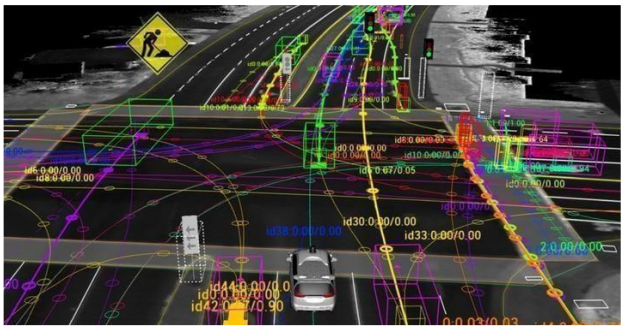
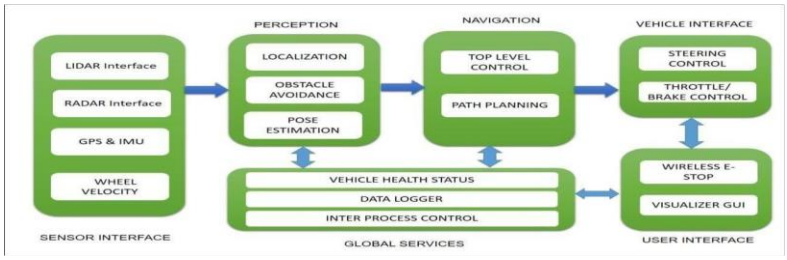


Figure 2. Showing the process how the lidar based sensors on the cars analyze the surroundings.

Another experience to the travellers in the car is that, whenever a vehicle stops at a place or if something unusual happens on the road, the sensors interpret the message and highlight the event happening over there. It also has a feature that the camera changes its angle and can view the entire roadmap at a time. Apart from this 3-D map, it possesses 2D status layer which gives information all about the progress of ride and decisions made by the car i.e., it shows the case sensitive decisions like when a car has to stop (in case if a pedestrian is crossing a road, etc.). With these visual information, ride is not complete. It also requires audio communication. It was 2 different types of audio-communication, one used for pleasant communication and the other for complex situations voice and visual communication is amazing considering this technology. But, this company is trying to reach out the visually impaired and other disabled people, so that everyone can utilize these case with an case.

V. Flowchart



VI. Conclusion

With all these machine learning algorithms, self-driving cars function and give us a great riding experience. Keeping the limitations apart, we can really enjoy this technology with more technical advancements in future. It can perform the tasks like controlling, navigation, etc. with more accuracy compared to a human driver. Further study of machine learning with more depth night help us to reach our virtual dream of these self-driving cars in the near future.

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