Autonomous Vehicles Using Udacity's Self Driving Vehicles Simulator

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Abstract

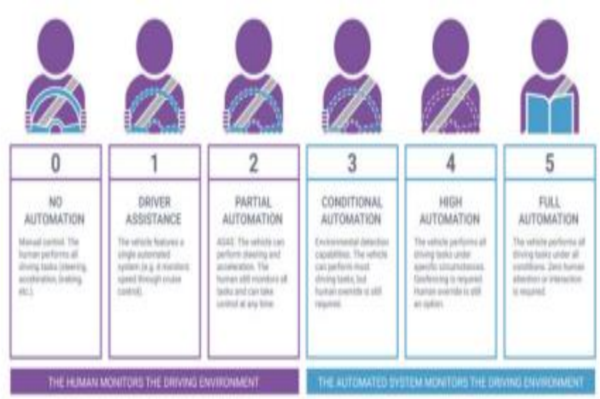
Nowadays, vehicles are focused on the automotive system to give human drivers a better ride. In the automotive sector various factors that make a vehicle work are considered. An automatic vehicle or non-motor vehicle can be called a robot vehicle in simple language. This vehicle is able to sense the surrounding area, roam and complete the power to transport people without human intervention. It is a major step in the development of future technologies. Automatic vehicles detect the surrounding area with Radars, sensors, satellites, night vision cameras, and highly sensetive GPS systems. These advanced technologies translate the information to track the locations despite changing conditions. Companies like Google, Volvo, Mercedes-Benz and Audi are at the forefront of making this vehicle a success [1]. We firmly believe that autonomous vehicles will soon become a daily need for survival by overcoming current challenges, as human being existence needs to be protected by secure, competent, affordable and efficient modes of transportation.

Keywords: *Self-driving vehicles, AI, Autonomous systems, udacity vehicle simulator, Machine Learning.*

1. Introduction

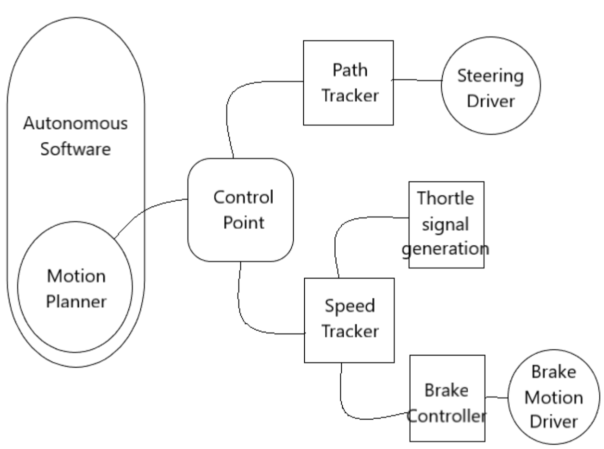
An autonomous automobile is a vehicle that can sense its current location and self drive without human intervention. The commuter does not have to carry the vehicle at any time, and the human passenger does not have to be in the vehicle at all. It can move between places without a person working for you. In order to be fully automatic, the vehicle must be able to move without the driver in a fixed area on unpaved roads. A self driven vehicle can travel at any type of location just like any other vehicle. The Engine Vehicles Association (EVA) presently identify six driving standards from Level zero (complete human driven) to Level five (complete independent vehicle). The EVA standards are approved by the Department of Transportation (United States) [2].

Fig 1: Levels of Automation Driving [11]



AI technology allow self-driving vehicle systems. Automotive developments use a lot of visual data from images, as well as neural networks and machine learning to design and develop models that know how to drive autonomously. Machine learning algorithms detect patterns in images and textual data, provided by mainly neural networks. The data comprise images from cameras in auto-driven vehicles as the neural network can be trained to recognize pedestrians, trees, robots, curbs, road signs, and other elements of any driving situations.

Fig 2: Block Diagram for Autonomous Driving



II. PROPOSED WORK

To introduce this technology we used a duplicate vehicle code made available on Git. Anyone can use a machine learning algorithm to train any driving model.

To use it in our project we will require

Git LFS,

Unity Game Engine,

Udacity Self-Driving Vehicle Simulator Github.

First we need to download the Unity installer according to the correct version of your license requirement, then start the installer. It will download the required items and start the installation process. Next we need Github LFS to manage large files. Large File Storage (LFS) restore large files such as files of audio video samples, datasets, and images with textual references within Git, at the same time to store up content in a remote server. The most popular servers are

GitHub.com

GitHub Enterprise [3].

Finally, we use a github project to build a simulator. Once the environment is set we begin to build our driving simulation.

III. WORKING

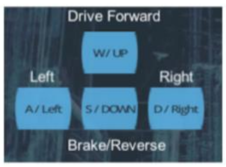
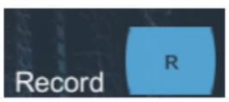
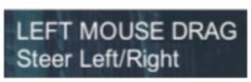
In this vehicle model we drive a vehicle and generate training data, this generated data helps our Machine Learning models to drive independently to test the model.

We have a large simulation screen to select the position and mode. First, we select a location by clicking on one of the group photos. Next, we select the mode: Training Mode or Independent Mode. When you select the mode, the vehicle appears first.

A. Training the Model

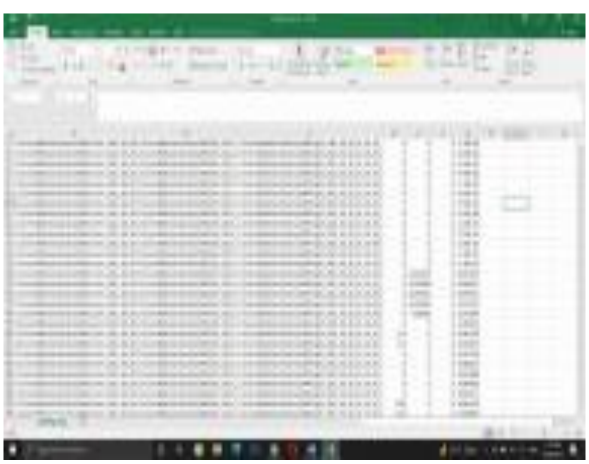
This mode drives the vehicle manually with driver and record driving performance. For this purpose we use pictures to train our machine learning model. The following table shows the various images used for this purpose:

Table 1: This table shows the different keys and their functionalities

Image	Function
	For driving the vehicle using keyboard
	To start a recording your driving behavior
	use the Mouse to give directions to the vehicle, drag the mouse to give directions
	Exit the training mode

The data values generated during the training phase gets stored into a CSV file and later they are facilitated in model training.

Fig 3: CSV file with data



B. Autonomous Mode

In this model, we test our ANN Model and check the performance of the model to self drive the vehicle accurately and the track is not lost while autonomous driving. We record the results accordingly.

IV. IMPLEMENTATION & RESULTS

When driving the vehicle in the video, we may lag somewhere, highly worthwhile is to watch an precise model drive a vehicle independently with perfection and not loosing the track of the road, get streaming of photo frames from the data set. Python libraries can make use of ML models to calculate best driving instructions by processing images, and then send it to the computer. All such instructions/ commands consist of steering angles and throttle accelerations, which change the vehicle's movement (speed). At the same time, system will get new pictures virtually in the form of frames.

V. TECHNOLOGY TOWARDS SELF DRIVING VEHICLES

In automatic vehicles many recent technologies like Artificial Intelligence, Machine Learning, Automatic control, computer vision, HCI, are incorporated with Mechatronics, which are inventions in highly developed domains in Information Science, data analytics and robotics [4]. Vehicle Automation technology (self driving automobiles) reveals the high quality of research and development of present era.

A. Vehicle navigation system

Vehicle navigation system in self driving vehicles is highly sophisticated; it is equipped with auto navigation system, the geographic information system and the global positioning system (GPS). Satellites are used to obtain location information such as altitude and altitude. The information obtained from all above equipments along with street information, generated by the neighboring systems and digital map databases, serves as source data. These are implanted in the analogous map model, in which graph algorithms like all source shortest path, Bellman-Ford algorithm and Dijkstra algorithm are used for intelligent planning and to enable the efficient layout planning. After some calculations, the self-driving vehicles can find the routes by themselves. With the information of the local area and the target destination, the route of the destination can be rescheduled as per route calculated by the route planning algorithm.

B. Locality Assessment System

Major intention of a site plan is to find out the location of the vehicle, which could be usually divided in related areas, complete area and hybrid area. By finding the related location, the current location of the self-driving vehicle is obtained by adding the distance traveled and the direction to the previous location. A typical location-based setup is based upon satellite, such as GLONASS, GPS, Beidou, Galileo etc. On the other hand, satellite signals are often disturbed by the climate changes, metropolitan atmosphere, and other conditions such as building and mountain, major contributors to faults and clatter in the neighboring signals, and therefore a completely limited area is inaccurate. The hybrid locality, where the vehicle is located, combines the features of the above two methods, is generally a popular method used to find out the location of a self driving vehicle, for example, Shanghai Jiaotong University's self-driving vehicle includes a standard location tracking device, which uses model Gmouse UB-353 USB GPS and Analog Device ADIS16300 INS (Yida, 2013) for finding the location details[5].

C. Universal Path scheduling

Universal Path scheduling is used to find the correct driving route between the source and the destination. We employed standard method algorithms, such as Dijkstra algorithm, Bellman-Ford algorithm, Floyd algorithm and heuristic algorithms (Seshan and Maitra, 2014) to mix EM datasets and calculated the suitable methods. Due to the international approach, editing took place in the established category and this is done in significant number.

D. The insight of vehicle speed and route

The concept of autonomous vehicle location largely incorporates steering understanding and vehicle speed. A photoelectric code is often applied for velocity assessment, whereas both potentiometer code and photoelectric angle are used for giving directions. The Photoelectric angle code disc is a extensively used digital device, used for encoding, This device converts the angular displacement of an automotive vehicle in a digital signal output. We have two types of disc electric angle disc sensors: complete photoelectric code disc and a growing photoelectric code disc. Complete photoelectric disc attains vehicle angle by calculating the rotating entity in whole position, at the same time as incremental code electric code disc, the vehicle angle is computed by measuring the angular rotation that occurs during rotation of the rotating object, and by compiling the accumulation angle (Yongfeng, 2007) in contrast, a vehicle can use GPS / INS or an attitude and directional system (AHRS) to detect authenticity [6].This is a three-dimensional motion measurement system based on micro-electromechanical systems, consisting of a three-axis gyroscope, a three-axis measuring unit called as IMU, an electronic three-axis compass and three-axis moving sensor and devices. AHRS is able to provides timely 360-degree position data for both vertical and horizontal positions; as a result, it is extensively used in many automated control systems and testing systems.

E. Controlling the Vehicle

Vehicle speed and steering control are essential features for controlling the vehicle. In general, function of vehicle control is recognition of the condition of the vehicle and the improvement of the vehicle control system. To perform speed calculations and vehicle orientation, EM data including visual acuity, driving information, vehicle status, traffic regulations and driving target, are included as inclusion in the illustrations, in which vehicle control algorithm executes a track calculation that is then transferred to the vehicle control system [7]. Finally, the vehicle control system executes those commands to control the direction of the vehicle, speed, light, horn and many more.

VI. BENEFITS OF AUTONOMOUS VEHICLES

The benefits of autonomous vehicles are as follows

- The self driving vehicles may reduce the number of accidents
- It may reduce traffic congestion
- It may reduce CO_2 emission
- Use of Self driving vehicles may increase lane capacity
- It may lower the fuel consumption
- Better transportation accessibility
- It may reduce the travel time and transportation costs
- last mile services
- It is an effective and affordable mode for commutors
- It is more efficient parking

VII. CHALLENGES FOR AUTONOMOUS VEHICLES

A. Lidar and Radar

Lidars are costly but still attempt to attain the right balance among range and resolution in autonomous vehicles. If many autonomous vehicles were to drive on a given path, the lidar signals may obstruct with each another, and if numerous radio frequencies are available, will the range of the frequency be sufficient to sustain the large manufacturing of autonomous vehicles?

B. Conditions of the climate

The abnormal weather conditions like heavy rain, snow fall, and flooded road may affect the performance of automatic vehicle. The conditions like road dividers disappear may also be very dangerous. Can sensors and cameras track line marking if marking is hidden by oil, water, ice or garbage?

C. Conditions of the traffic and Laws

Automatic vehicles may have a problem with the tunnel or bridges? What are they going to do with the huge traffic that will bounce? Will automatic vehicles be returned to a specified line? How they will be given entrée to the vehicle pool route? And what about heritage vehicles that share the road for the next 3-4 decades?[8]

D. State and Federal Regulations

In the scenarios of the country like U.S, it has changed from state regulations to state-owned automatic motor vehicles. Some of the states have proposed a tax on automatic vehicles to prevent the increase of "zombie" vehicles circling outside commuter. Policy makers also drafted bills suggesting that all automatic vehicles should be zero-emission vehicles and it should be fitted with panic buttons. But will laws differ from one government to another to accommodate the laws of different states.

Accident Liability

How to deal with accidents caused by automatic vehicles? Manufacturer? A human passenger? Recent plans put forward that a standard Level five vehicle will not have a steering wheel or dashboard, so there is no possibility to be in charge of the vehicle in an urgent situation. [9]

E. Emotional Intelligence and Artificial Intelligence

While driving human drivers make use of subtle clues and vocal communication - such as eye contact with people walking around or assessing the expressions and body language of drivers driving the other vehicles - to make instant judging calls and guess the behavior. Can driver less vehicles be able to duplicate this connectivity? Can driverless vehicles have these life-saving emotions similar to manual drivers?

CONCLUSION

In this project the best performance is achieved by training models and removing parameters on the given tracks and then trying to achieve the same performance on different tracks. Comparative analysis shows that models that performed well on A track did not perform well on Track B, which is why there is a requirement to apply image enhancement and processing to attain real-time performance. The Machine Learning algorithms like CNN and RNN can be used to detect spatial features and transient features in databases to make this combination very useful in creating the fast and minimal calculation needed for neural networks. Installing repetitive layers of integration layers can reduce information loss and is not worth testing for potential projects. The interesting fact is to discover the use of a combination of existing data and relevant databases to train these models. After that we can find out the how a model can be trained for simulations and utilized into a real life scenario or vice versa. A lot of experimentations are being done in the automotive sector and this project contributes to an important part of it.[10]

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