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Abstract:

The most challenging and interesting topic in the field of Artificial Intelligence in today's world is Self-driving Cars. The problem demanding as the machine operates in a partially observable, continuous, and dynamic environment. In such an environment, the system should be contextually aware of the environment to the maximum possible extent and also should look after the driving task. Our project attempts to simulate the car driving task such an environment using a hybrid approach to check its practicability in solving a difficult real-world problem as rapidly as possible.

Keywords:- Self driving car simulation, self driving car, autonomous vehicles.

Introduction

In this article we will cover self-driving car methodology using the Udacity Open-sourced Self driving car simulator, Here we will cover how a self-driving car is implemented and this can be easily extended to different scenarios.

Self Driving a car is very essential in solving today's traffic-related issues. For eg. When humans wait on a signal and the signal turns green each driver takes a tiny amount of time to react to it and starts his car slightly delayed compared to that. As a result, time is wasted, but if we use self-driving cars. Then computers in cars can already predict when the signal will turn green and all the vehicles on that signal will move at the exact same time.

The Entire Process

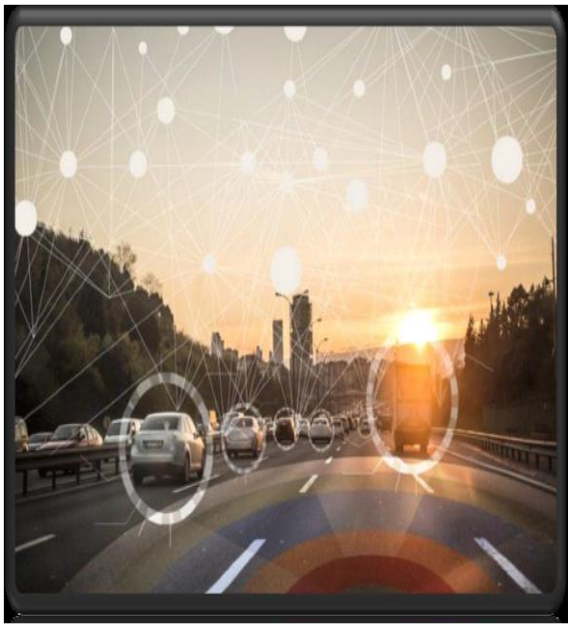
We will drive the car on the coaching track inside a simulator. As the car starts driving itself in the simulator, we will be taking images at each case in point of the drive. The images will be taken by a camera at every point that representing the training dataset and the label to each specific im-age will be going to be the steering angle of the car at that specific point.

These images then showed to a convolu-tion neural network and lets allow it to learn and how to drive it autonomously as the behaviour of the human driver. The important variable that our model will learn to adjust is the car's steering angle at any given instance. It will effectively adjust to

learning to an appropriate degree based on the situation that it finds itself.
In real-life self-driving cars the behavioural cloning technique is very useful and plays a huge and indispensable role.

Literature survey

Multiple industries are expected to have an innovative impact on fast-tracking the next wave of technological advancement in driverless cars. General Motors in 1939 exhibited the first concept of the automated vehicle, research in autonomous navigation was done from as early as the 1900s. It was possible to cut down the price in making autonomous vehicles with the help of artificial intelligence, sensor technologies, and cognitive science, researchers have got a step closer to realizing a practical implementation of a self-driving agent, before these techniques it was less effective and costly for development of these cars.
The latest methodology involving, computer vision, multiple sensors like cameras and Light Detection And Ranging (LiDAR), neural networks, and other techniques are enormously being researched upon and tested by several companies like Google, Apple, Tesla, and Uber as well as top foreign universities named university of Toronto and MIT.
Even if these techniques create a proficient administration, the end product can turn out to be exorbitant. the market price of commercial autonomous driving systems and the price of further research could be diminished if a system using only well-ordered, inexpensive cameras managed to relent superhuman performance. A self-driving car as a whole unit consists of numerous subsystems that work at the same time simultaneously to achieve seamless autonomous navigation. to drive in the right direction is an important part of driving a vehicle. to estimate the steering angle for a long, computers were used.
A commercially successful self-driving car is expected to pave the way to higher speed limits, smoother rides, reduced traffic collision, associated costs, and increased roadway capacity.



Methodology

first download the simulator to begin our behavioural training process.

Then start driving the car in a simulator using keyboard keys with that we will be able to train a convolution neural network to monitor the controlled operation and movement of the vehicle.

the autonomous mode will replicate the data according to our driving. Using users behaviour hence the term behavioural cloning, then the neural network will copy the data from our driving through the keyboard and will understand how to drive the car in a particular instance.

Aim and Objectives

To overcome the problem with minimum capital investment and loss of human lives as human life is very important.

The purpose of a Self-driving car project is to build a better autonomous driver. The car should reach its destination without falling off the track, with accelerating and braking at appropriate places. This chapter covers the problem statement of the project in brief and the higher-level solution approach used

Implementation

Software and Hardware Requirements :

- Software:–

Unity3D, Unity Hub, Visual Studio 2019, Windows 7 or up, Blender, Photoshop

- Hardware:–

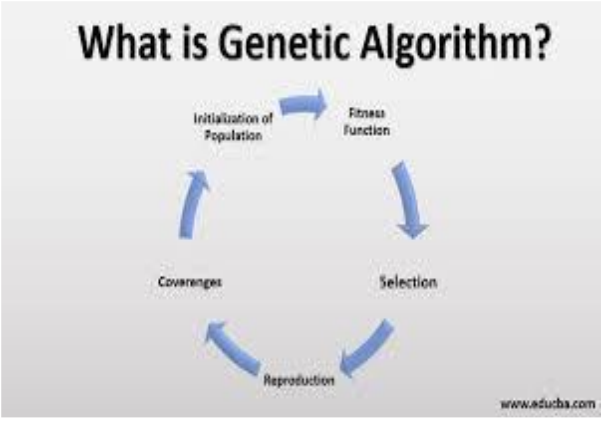
64Bit/32Bit OS, Intel i3 5th gen or higher, minimum 8 Gb Ram, Intel integrated graphics,NVidia 4GB GPU 940Mx or higher

Unity Simulator User Instructions

1. Clone the repository to your local directory, please make sure to use Git LFS to properly pull over large texture and model assets.
2. Install the free game-making engine Unity if you don't already have it. Unity is necessary to load all the assets.
3. Load Unity, Pick load exiting project, and choice the self-driving-car-sim folder.
4. Load up scenes by going to the Project tab in the bottom left, and navigating to the folder Assets/1_SelfDrivingCar/Scenes. To load up one of the scenes, for example, the Lake Track, double click the file LakeTrackTraining.unity. Once the scene is loaded up you can fly around it in the scene viewing window by holding the mouse right-click to turn, and mouse scroll to zoom.
5. Play a scene. Jump into game mode anytime by simply clicking the top play button arrow right above the viewing window.
6. View Scripts. Scripts are what make all the different mechanics of the simulator work and they are located in two different directories, the first is Assets/1_SelfDrivingCar/Scripts which mostly relate to the UI and socket connections. The second directory for scripts is Assets/Standard Assets/Vehicle/Car/Scripts and they control all the different interactions with the car.
7. Building a new track. You can easily build a new track by using the prebuilt road prefabs located in Assets/RoadKit/Prefabs click and drag the road prefab pieces onto the editor, you can snap road pieces together easily by using vertex snapping by holding down "v" and dragging a road piece close to another piece.

Genetic Algorithm :)

- A genetic algorithm is a search heuristic that is inspired by Charles Darwin's theory of natural evolution. This algorithm reflects the process of natural selection where the fittest individuals are selected for reproduction to produce offspring of the next generation

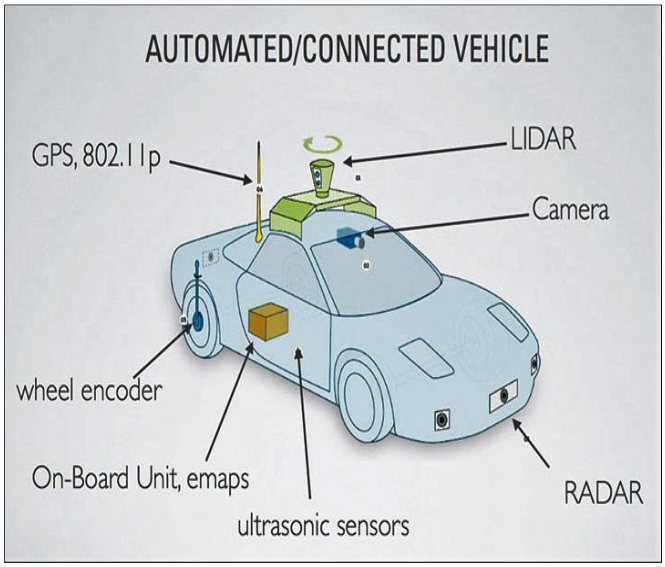


Back-propagation

- Back-propagation is just a way of propagating the total loss back into the neural network to know how much of the

loss every node is responsible for, and subsequently updating the weights in such a way that minimizes the loss by giving the nodes with higher error rates lower weights and vice versa.

Architecture Of A Self Driving Car

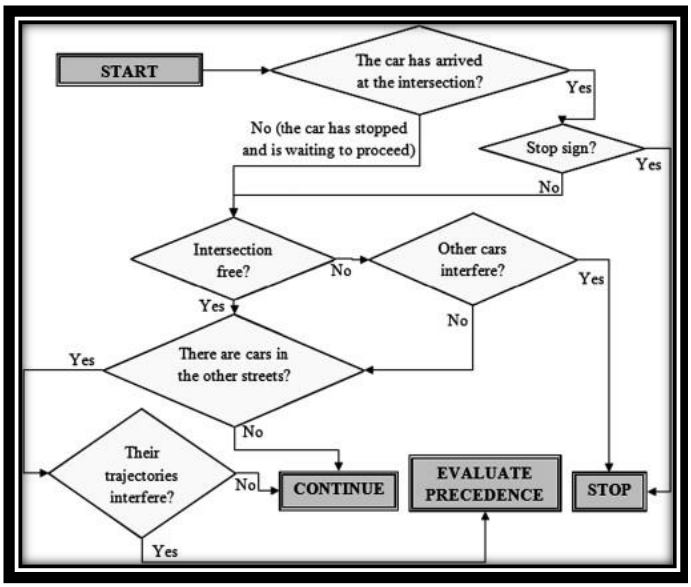


As mentioned, a self-driving car comprises several sub-modules integrated. Here, we explore the basic system design to understand how a modern self-driving car functions.

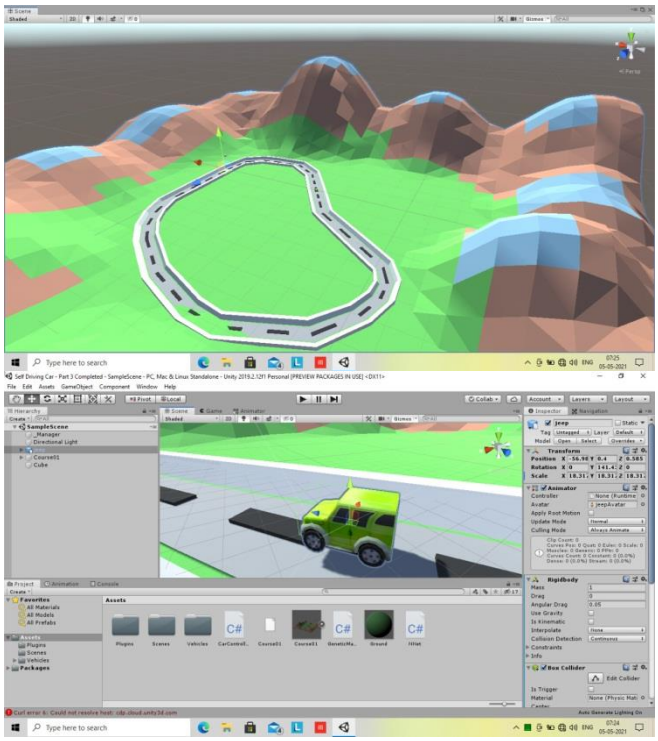
Key Physical Components (Generalised)
- **Cameras** — Provide real-time obstacle detection to facilitate lane departure and track roadway information (like road signs).
- **Radar** — Radio waves detect short & long-range depth.
- **LIDAR** — Measures distance by illuminating the target with pulsed laser light and measuring reflected pulses with sensors to create a 3-D map of the area.
- **GPS** — Triangulates position of the car using satellites. The current GPS technology is limited to a certain distance.
- **Ultrasonic Sensors** — Uses high-frequency sound waves and bounce-back to calculate distance. Best in close range.
- **Central Computer** — "Brain" of the vehicle. Receives information from various components and helps direct vehicle overall.
- **Receiver/Antenna** — Communications device permitting the vehicle to communicate with other vehicles (V2V) using DSRC, a wireless communication standard that enables reliable data transmission in active safety applications.

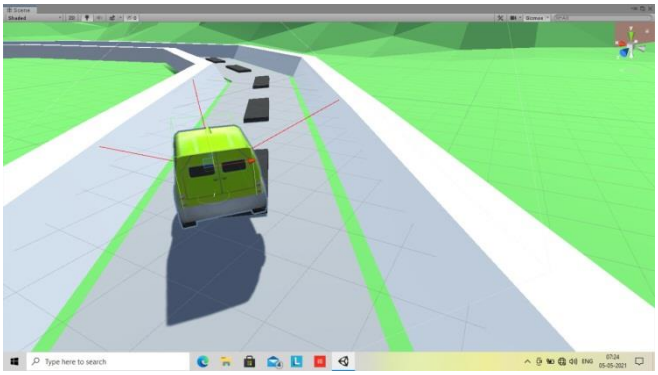
Apart from these physical components, the system can be divided into a **perception system** and a **decision-making system**. In general, a perception system helps the autonomous agent to accurately collect data from its surrounding environment to understand and map the same while the decision-making system takes care of the actual driving of the car based on all the information made available by the perception system.

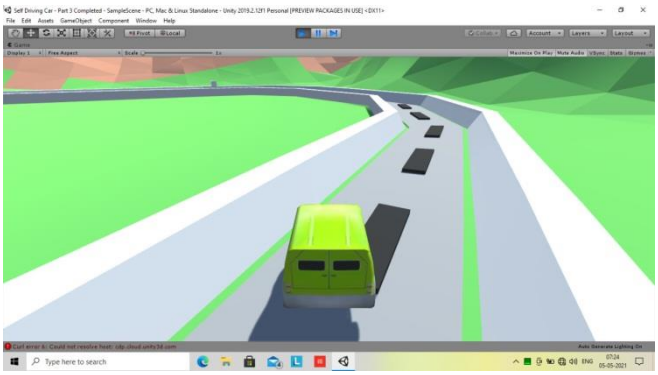
Flow chart

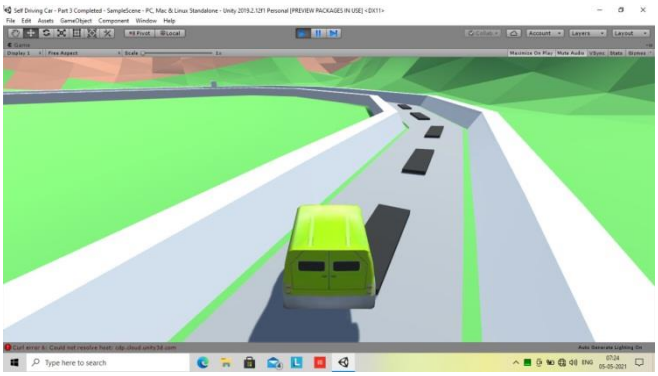


Results









Engineering design challenge

A Self-driving car is expected to have at least a human level of environmental awareness. This is carried out successfully using multiple sensors like cameras, LiDAR, etc. Apart from that, it should have a robust mechanism for navigation, path

planning, and manual control. more reliable algorithms, better object detection efficiency, sensor efficiency, safety and reliability, computational resources, and security are the Current engineering design challenges.SAE International (Society of Automotive Engineers) is used to measured autonomy in self-driving cars

Conclusion

The transition from self-driving cars with varying levels of autonomy to fully autonomous vehicles is yet to be made. However, modern AI technologies and machine learning development are making rapid leaps forward in this direction, and that is what's driving the industry forward.

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