CSC 578 NNDL - 2020

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Class Project - Part B

Leveraging Deep Learning Methods For Autonomous Driving

Introduction

Nowadays, you can see the popularity of automatic cars and even companies who developed this kind of car, people are going crazy after new features of the cars. Behind making a successful automatic car there are a couple of things which are considerable e.g Machine learning algorithms, Artificial intelligence and cool deep learning techniques [1] but it is so fascinating that how CNN revolutionized over the years specially commercially[2]. That is not a new thing for scientists. They have been testing automatic cars since it started in the 1980s by scientist Ernst Dickson, also we show that in the NNDL's textbook by Michelle. Automatic car have grading from 0 to 5 which shows the car capability which is widely known as sea level grading.[1]

Automatic cars have a grading system which assures safety of the car and also it measures how fully automatic a car it is. For an example car with zero level grading[1], they need basic assistance, they're not fully self driven, while five level grading means the car doesn't need a driver.It is a totally driverless car without steering and without a pedal. Also this kind of gradings is known as sea level grading[1] for automatic cars. After the first experience of of self driving car by Mr. Dickmanns many scientists came together to experiment fully autonomously driving cars, they also achieved milestones in the way heads up they are able to make a car with 98% self driving. Although it started in the 1980s almost 40 years back I said four decades back,still until 2010 automatic cars were not industrialised. After that they started advanced research in this domain. [2]They started digging more into lane markings, path recognition, Road detection, optimisation of cars, safe driving, and etc. After years of research and data now driverless cars are a cool thing now.

Description:

Generally, making any of the self driving cars you require large data so that you can confidently predict the outcomes. There are a couple of techniques that are really useful in the automatic car driving some of them are recurrent neural network, deep convolutional neural network, and deep reinforcement learning[1].

Dave-2[2]
There are many simulations that helped deep learning features using the driverless car.Dave 2 is one of the important most of the time that happened that training data is not sufficient that human drivers only can perform the operation. So with the help of Nvidia[2], it is possible to record huge amounts of data so that cars won't go off track or off the road because of drift. So for that basically they use three cameras which are left camera right camera and Centre camera[2] which you can see in the image below.
Output of the steering wheel angle will give in to the Nvidia Drive it will adjust for shift and rotation. All the cameras will check the position of the road and the other vehicles also provide random shift and rotation then it will send it to CNN where data will be used and leveraged to make predictions. Here neural networks come into play and play a big role in decision making. As you can see from the image below that way output will be sent to CNN which is contained of neural net and neutrons using back propagation we can achieve perfect angel.[1] Also you can see other fig of the hidden layer neurons and convolution layer[2]

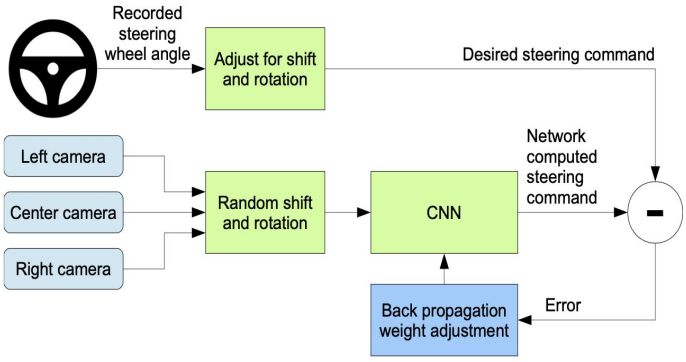

Figure 2: Training the neural network.

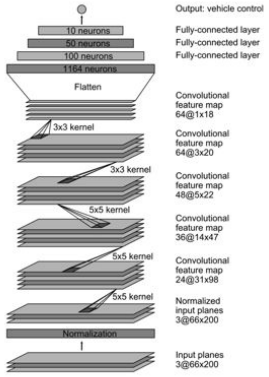

Figure 4: CNN architecture. The network has about 27 million connections and 250 thousand parameters.

So how self driving cars works it is explained below. first, we need to recognise the path perception and localisation of the local environment with the help of deep learning, the Nextep is to identify high-level path planning and detection then the Next step is to identify behavioural attribution which comes under low-level path planning, what is for the safety monitoring and all the output will send to the vehicle. It is really important that a car can operate autonomously by perceiving the output needed at the time. There several software which helps in driving scene perception and localisation.

There are also many other objects which are important in this process to the object 2-D image detection and also 3-D bounding box detector[2]. Another important aspect of autonomous driving is navigating maps and routes.[1] deep learning for path learning and behaviour attribution plays a big role in the self driving cars as well in the roots. While navigating the route things you should consider like overtaking merging Road and giving way to another vehicle, deep learning helps in this kind of decision making for an autonomous vehicle.[1] the big milestone scientists were able to achieve with the help of deep learning that is collision free route and calculating the risk.

As below you can see that graph of different simulations which provide neural network architecture is divided into problem space neural network architecture sensors they are using and a small description about them.

As below you can see the table of different simulation from survey paper,

Name	Problem Space	Neural network architecture	Sensor input	Description
ALVINN [110]	Road following	3-layer back-prop. network	Camera, laser range finder	ALVINN stands for Autonomous Land Vehicle In a Neural Network). Training has been conducted using simulated road images. Successful tests on the Carnegie Mellon autonomous navigation test vehicle indicate that the network can effectively follow real roads.
DAVE [111]	DARPA challenge	6-layer CNN	Raw camera images	A vision-based obstacle avoidance system for off-road mobile robots. The robot is a 50cm off-road truck, with two front color cameras. A remote computer processes the video and controls the robot via radio.
NVIDIA PilotNet [112]	Autonomous driving in real traffic situations	CNN	Raw camera images	The system automatically learns internal representations of the necessary processing steps such as detecting useful road features with human steering angle as the training signal.

Discussions

There are many points to discuss here, well we are into self-driving cars. Currently there are many hypotheses, many discussions, many different ways to achieve and perceive and also doing the same task. So there are also many debates[1] going on regarding whether they should choose cameras or LiDAR[1], using machine learning techniques versus deep learning techniques. And many things like that so we can say that from the survey we did and research papers we have read it is debatable about choice of selection for your model but best advice is to follow the initial rule. Few other important points while working with neural networks is to consider one of the below issues. There are many debates on selection of the weights and biases, selecting hidden layer and activation forms.

However, They key get away here using any methods and technique is ensuring safety of passengers and not only that but also safety of other vehicles. Most importantly how it reacts to the unlearned problems which arise during the unpredictable time. Although, large amounts of data make it more reliable, there are still many companies already started commercially using it[1].

Conclusions

From this survey we can say deep learning is really crucial in autonomous car driving.
From the above survey we can conclude that there are several techniques and methods we can leverage in the self driving car with the help of deep learning and neural networks. Also we think that it plays a huge role in upcoming time[1]

In addition, Techniques like CNN[2] and other advanced techniques help in Dave-2 and learning unlearned tasks while performing operations like, Path selection, vehicle detection and collision free routes. The main benefit of using convolution neural networks[2] is that you don't need to manually decompose[2]. So we can say that CNN will be really helpful in Deep Learning for driverless cars.

References.

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