Neural Network Schematics for Prediction Analysis in Autonomous Vehicles

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*Abstract*

The paper is about the use of neural network schematics in the prediction analysis when it comes to the ones who are being driven around by the use of autonomous vehicles. People are accustomed to being driven around by human beings. Hence, when they encounter the aspect of vehicles without drivers then it becomes a concern to them. There are several features that are sought after. These features propose to reduce any issues that may arise with autonomous vehicles. From the ones used in detecting the best speeds to conserve gas usage, the ones that are capable of analyzing and detecting nearby pedestrians, the implementation of complex vehicles features to utilize driver locations from a stored database transmitted through online server road maps while maintaining privacy, and lastly advanced driver assistance systems. All these are aimed at improving the precision and accuracy of data all while maintaining the safety of the passengers and other road users.

# Motivation

During my Senior year of taking an artificial intelligence class I was challenged to construct an autonomous model vehicle. This simple rational agent was capable to detecting nearby objects as well as follow a path in which was created by pure black tape. What I learned from this project was how hardware and software communicate with each other. Here I was able to transmit instructions from a computer using C++ onto an Arduino microprocessor. The code contained necessary and simple deep learning algorithms that allowed the car to traverse its specified path and to detect objects.

The main components for making the car detect and predict objects or paths were an infrared sensor and an ultrasonic hardware module. The infrared sensor along with its code allowed the model vehicle to detect a dark line and once the vehicle detects this black line, the car will move forward, left, or right depending on the installed track. The ultrasonic sensor module is able to transmit a high pitch sound (so high that it was impossible to hear). This high pitch sound is propagated and this module is able to detect any nearby object due to the sound being echoed back in which the ultrasonic module captures this distance and performs a stop and readjusts itself. This simple project is what propelled my interest in neural network schematic within autonomous vehicles.

Neural networks have been used in a wide variety of domains. These domains range from marketing, healthcare, speech recognition, face recognition, and more. An artificial neural network is the functional unit of deep learning. Deep learning uses artificial neural networks which mimic the behavior of the human brain to solve complex data-driven problems. Deep learning in of itself is a part of machine learning which falls under the criteria for artificial intelligence.

Artificial intelligence, machine learning, and deep learning are interconnected fields where machine learning and deep learning aids artificial intelligence by providing a set of algorithms and neural networks to solve data-driven problems. It is common that within an autonomous vehicle that the main data-driven problem concerns the image prediction and analysis schematics. This feature permits these self-driving vehicles to detect pedestrians, stoplights, stop signs, road signs, and much more essential to driving.

Understanding how neural networks coexist with autonomous vehicles it is essential to explain how specific functionalities make this automatic detection possible. Each neural network contains three layers. Layer one is the layer responsible for storing in the input data. In the case of a self-driving vehicle, it will capture multiple photos of pedestrians, stoplights, and much more at a very quick rate. On a microlevel each photo will be captured and sent to the next layer called the hidden layer. The hidden layer is responsible for processing the data from the input layer. This hidden layer for image analysis in autonomous vehicles performs a multitude of techniques such as edge extraction, filtering, gamma correction, runtime transmission of data, and many more depending on the algorithm implemented.

For simplicity we can say that for one captured photo. There will contain an algorithm that will fetch from its database a similar result to the captured photo. The similarity comparison will analyze a photo’s color and pixel distribution patterns to detect any resemblances to other photos within the database of stored data. Regardless if the data matches of does not match the calculated result will be sent to the third layer which is the output layer. This output layer will perform the necessary task determined by the result of the hidden layer. Let’s say the image was not a match. The car will then repeat this fetching protocol until it finds a match. Once the car finds a match it will perform what is deemed the appropriate response according to the match. If the image detected is a nearby pedestrian than the car will possibly make a beeping notice, completely stop if the civilian is too close to the car, or possibly proceed with caution if the car finds the distance from it and the pedestrian are at a safe distance apart.

This simple neural network works well with describing an image processing schematic for detecting pedestrians. This is only one method of extracting data in which autonomous cars are capable of. The articles provided for this paper will assist in explaining further how neural networks can be utilized in autonomous vehicles. They will also provide more complimentary features that also assist in the creation of more unique neural network schematics for autonomous vehicles.

# Deep Q-Network Based Route Scheduling for Transportation Network Company Vehicles:

Mobile networks have been becoming a common feature with most people and also a desired medium through which a transportation network company (TNC) can be matched with potential passengers. The idea behing utilizing these apps is to reduce the time that the vehice stays idle looking for passengers and henece facilitates the maximization of the revenues. While it does this on the side of the vehicles owners it also reduces the time that the passenger has to wait to be picked. The route scheduling approach is critical not only for the owners of the TNC vehicles but also for the ones who are waiting to receive the service from the same.

The article deals with the need for the deep Q-network (DQN), reinforcement-based route scheduling algorithm and factors that it takes into consideration in addressing the best way to serve the vehicle owners and the passengers while increasing efficiency for the two parties. Delay times in which TNC drivers undergo are the extreme weather conditions, traffic, and the waiting time for the mobile application to process the user’s information.

Since vacant vehicles significantly affect the drivers’ long-term revenue, a team of computer scientists and engineers have developed efficient vehicle scheduling strategies to improve services to both the users and the drivers. The final product is a 3D sensor map which represents the competition among other vehicles in various locations relative to the customers. Their proposed scheduling algorithm will link both TNC drivers and pedestrians in the shortest amount of time to pick pedestrians up all while significantly reducing the vehicle vacancy time which will boost a TNC drivers’ source of revenue since cars are being occupied more frequently and quickly. The research this paper serves develops an optimization route scheduling model for TNC vacant vehicles based on deep reinforcement learning.

# Efficient and Privacy-Preserving Roadmap Data Update for Autonomous Vehicles

The autonomous vehicles need to have a way of accessing and processing data concerning their location and the online road map servers together with the various sensors along the road. This is primarily for the safety of the passengers, other vehicles and the public using the roads. There are some three factors that should always be a priority in the movement of the autonomous vehicles and that is the sensitivity to where the data is being transmitted from which is the hotspot, the distance of the other objects in relation to the vehicle proximity and lastly the route that it will use to get to its desired destination as per what the passenger had keyed in when requesting for it. Hence the software that is to be developed or acquired need to take these into consideration. This is not data that is static but one that is continuously updating depending on the changes that are taking place as the vehicle is in motion. Therefore, there is need for real-time processing and analysis of the big data being received.

This paper proposed an efficient privacy-preserving roadmap data update scheme for AVs to efficiently update the necessary online roadmap data from the server. They also address the importance of privacy sensitive information for each generated road pathway and based on this they minimized the communication overhead between the AV and the server while preserving the privacy sensitivity of the target segments. Specifically, the privacy sensitivity has three properties, i.e. hotspot sensitivity, proximity sensitivity and route sensitivity. An efficient algorithm based on k-anonymity and added privacy sensitive weightage values have been deployed and applied to each generated route.

# Speed Accuracy Trade-off in Pedestrian and Vehicle Detection Using Localized Big Data:

The object and pedestrian detection architectures are at the center of this paper as it seeks to balance the precision and the frames per second (FPS) that it receives. The paper is a guide on what to look for when it comes to the architectures for pedestrian detection and vehicle detection (PD/VD) architectures. With the aim of arriving at the most appropriate mean average precision (mAP) calculation along with a FPS balance for the systems that assist in the movement of the autonomous vehicles. These come in handy in safety as a bigger percentage of accidents are attributed to human error. The advanced driver assistance system (ADAS) address three dimensions: detecting the surrounding, planning routes and managing the autonomous vehicles themselves. These systems make use of image recognition to sense the location of the pedestrians and other vehicles on the road. The paper does a comparison on the merits and demerits of several deep neural network architectures with safety being paramount.

# Correlation between title and reference papers

The purpose of this paper was to demonstrate how different neural network schematics can provide different feature implementations within autonomous vehicles. Section II proposes a neural network reinforcement algorithm in which attempts to tackle a problem with Transportation Network Company Vehicles. This algorithm will decrease searching time for pedestrians and increase a driver’s daily revenue by allowing them to be paired with each other as frequently and quickly as possible. Section III uses its prediction based neural network to build efficient and updated roadmaps all while preserving the integrity of users private-sensitive data. Section IV visits convolutional neural network schematics. Here engineers have composed a strenuous amount of testing to see which architecture of them proves to be the most efficient and accurate in predicting if a captured image is a pedestrian or vehicle.

# Possible Projects

After conducting more research about neural networks my hopes is to someday work within the field of robotics. Why robotics? Unlike software seeing the creation come to life in the physical realm to me personally gives me the most gratification and appreciation for the process of development. The range of robotics is really wide. If I had to narrow down my options, I would love to work on a real sized automobile. The risks are at much higher stakes compared to my model creation. However, I feel that once that opportunity arises, I will be able to learn so much more about neural network implementation which can possibly trickle into other areas of this field.

# Conclusion

Several systems were proposed hoping that they will be utilized for future neural network prediction analysis models. The opportunities these features within autonomous vehicles allow will enhance efficacy and road safety amongst drivers and pedestrians. They eliminate the aspect of human errors, reduce the time wasted in connecting devices and passengers leading to increased savings for the vehicle owners and reduced waiting time for the passengers. These systems also lead to reduced bottlenecks in traffic flow as they seek the best alternative routes and improve on fuels efficiently. In a nutshell they lead to a better transport system that is completely reliant and dependent on autonomous vehicles having appreciated the benefits that they present.

##### References

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