Capstone Project 2 – Milestone Report

1 DEFINE THE PROBLEM

Using the Donkey Car kit from the donkey car website, a self-driving RC car can be built with a small budget and parts ordered from the internet. The creator of the donkey car included documentations on how to assemble and install the necessary hardware and software, allowing users with none to little experience in robotics and DIY-skills to quickly get their hands dirty on a self-autonomous vehicle project.

I stumbled onto this project while looking for Capstone Project 2 ideas. I have always wanted to explore into the self-autonomous vehicle world and how the machine learning algorithms work under the hood inside these machines. My background in engineering had provided a foundation on how a machine, such as a vehicle, is created from the design, engineering, analysis and manufacturing perspective on the hardware side, but I have very little knowledge on how the software side of it work. So to understand more, I am using the donkey car as the platform and foundation of the Capstone Project, with the objective of learning and understanding the fundamental techniques of Computer vision coupled with machine learning using Keras to create, manipulate and validate the convolutional neural network (cNN), and ultimately find ways to improve the performance the existing cNN model.

2 IDENTIFY YOUR CLIENT

The straight forward answer to the potential client that this project could impact are any of the vehicle's OEMs (Original Equipment Manufacturers) such as Toyota Corp., General Motors, Volkswagen, but this could very easily expand into the public sector of government safety regulators, such as the National Transport Safety Board or state boards, who are trying to adapt to the implementation of self-driving vehicles on the road. And of course, companies that are already leading the self-driving car field such as Tesla, Waymo and Uber in the Silicon Valley.

Last but not least, with this kind of transport autonomy, there are opportunities that could be adapted into any environments that require the transport of goods, tools, or resources from an origin to a destination, such as a factory, hospital, or warehouse.

3 DESCRIBE YOUR DATA SET, AND HOW TO CLEANED/WRANGLED IT

One of the key features of this project is the acquisition of the data set. Part of the donkey car kit comes with a simulation package that is "built on the Unity game platform, uses their internal physics and graphics, and connects to a donkey Python process to use our trained model to control the simulate Donkey." However, I thought it would be beneficial to get the experience of gathering my own real-world data, so I procured some tape and created a test track.

Figure 1 - Track Layout

Pictures 1-3 show the onboard Donkey car camera of the test track

Figure 2

Figure 3

Figure 4

Once the data sets have been created, the initial stock Keras.py lay the foundation cNN models that the donkeycar developers utilized. Then it is possible to experiment and modify the neural network architecture, and evaluate the performances of the different layers.

4 LIST OTHER POTENTIAL DATA SETS YOU COULD USE

Other potential data sets I could use can be from another test track, or I could completely forego existing track and utilize the onboard simulation module for training and testing purposes. But Again, I thought creating the own track setup would be interesting.

The inherent issues with using my own track creation and the own donkey car kit is that the data acquisition is determinate upon the driver's ability, as well as the various electrical and mechanical performances of the vehicle, and the track material (carpet for this case). All of these variables will cause repeatability issues, which might render future data acquisition problematic and create discrepancy when it comes to training the data and testing the model.

To avoid these pitfalls, it is possible to use the simulator to acquire simulated data and test the training model separately, and utilize the model on the cart itself later to experiment with the real world performance.

5 EXPLAIN YOUR INITIAL FINDINGS

Initial finding shows that I'm a terrible driver. And that having a proper training set is difficult, it is time to evaluate the model using the simulated package instead of acquiring real world data.