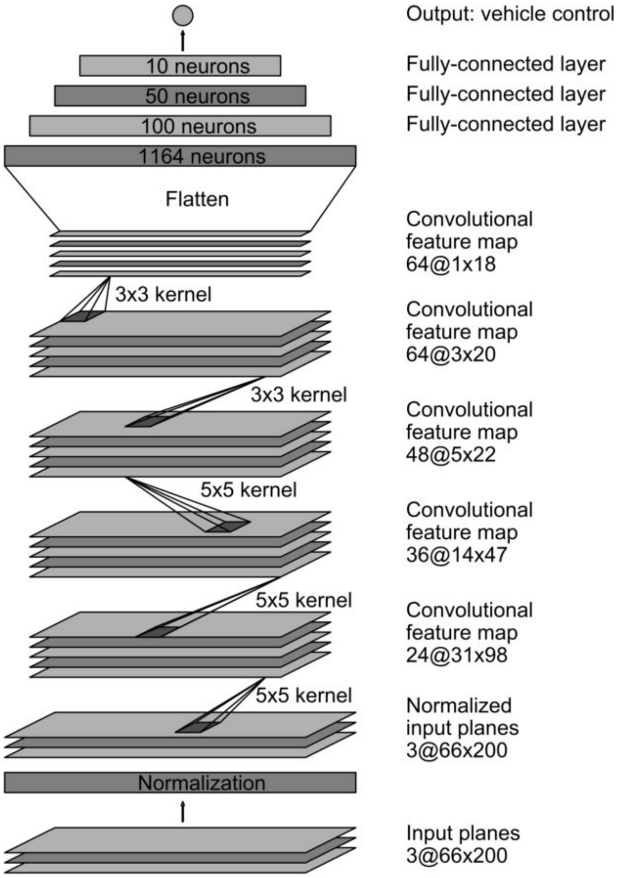
Architecture

The neural network architecture outlined in NVIDIA's blog post titled End-to-End Deep Learning for Self-Driving Cars was employed for this exercise.



Data is normalized using a Keras lambda layer and cropped using a Keras Cropping2D layer. To prevent overfitting, dropout is added on all the fully-connected layers.

Model Parameter Tuning

For the sake of simplicity, the model used an adap optimizer, thus the learning rate was not tuned manually.

Epoch number was tuned empirically based on when I saw the model converging during training. Ending just before converging should help prevent overfitting.

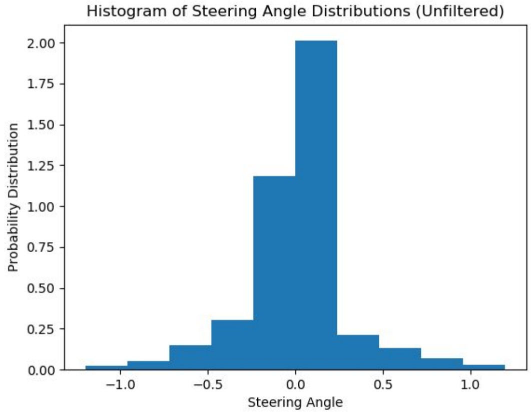
Data Collection and Preparation

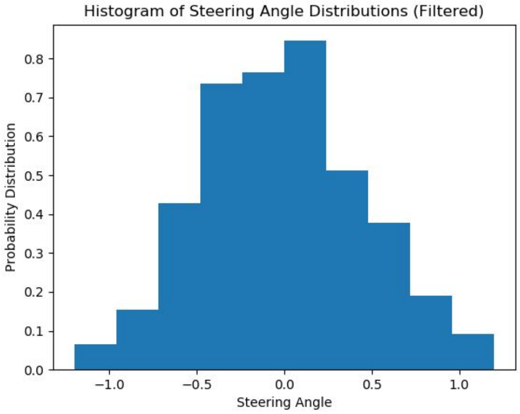
Data was collected from the following laps:

1. Forward Lap
2. Backwards Lap
3. Recovery Lap Forward
4. Recovery Lap Backwards
5. Turns Only Lap Forward
6. Turns Only Lap Backward

If the neural net was having difficulties with a particular part of the course, data regarding that scenario were added into the dataset ad-hoc.
The data I collected had a strong bias toward straight line driving. To account for this, images were added to the training set according to the following rules:

1. All frames with steering angles greater than 0.1 radians are added.
2. If a frame does not have a steering angle greater than 0.1 radians, it will only have a 5% chance of being added.

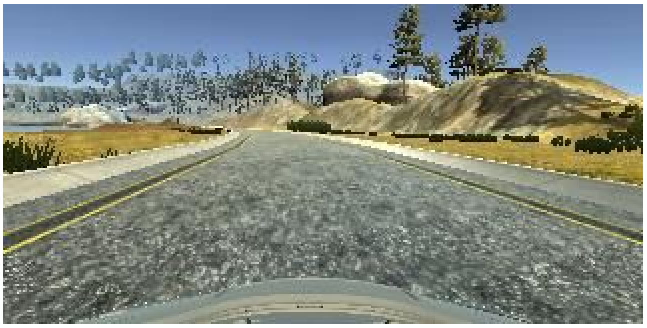




Additionally, the left and the right camera data were added when a straight drive image was added with a steering offset of 0.20. Adding this data helps teach the neural network what to do when veering off the side of the road.

Cropping and Preprocessing

As per usual, all input images were normalized, mean centered around 0.
Additionally, images were cropped such that only the road surface in front of the vehicle is used. As shown in the image below, as significant amount of the uncropped image is either part of the hood of the vehicle or areas part of the horizon and sky. These portions of the image are not necessary for training and may only confuse the network.



Uncropped Example Image