Michael Bass, Drupad Khublani, Khaled Nakhleh,
Zhiyang Ong, Venkata Pydimarri 11/29/2018

Obstacle Detection via Stereoscopic Imagery and Deep Learning

Project Description

Obstacle detection and avoidance is a well-recognized problem in the world of self-driving vehicles. Although there are many methods to detect obstacles, for our project we have decided to investigate obstacle detection via stereoscopic imagery and machine learning. We believe that a CNN will be capable of learning the divergence of approaching obstacles received from left and right vantage points. For our project we plan to perform data collection and data analysis. Although many machine learning projects focus solely on the data analysis, we believe that we will learn significantly through the exercise of data collection.

To perform data collection, we plan to modify an RC rover by mounting two cameras approximately one foot above the ground, with each camera capable of rotating in three dimensions. It is our goal to acquire and label the images in real time to reduce the amount of post processing required. To do this, we plan to use a small form factor computer, such as a NUC, running a python script and mount it on the rover. The NUC will collect images from the left and right cameras simultaneously and store the images in directories labeled according to whether or not there is an obstacle. We will perform multiple data collection events, and each event will be wholly marked as containing an obstacle or not.

The second step of our project will be feeding the stereoscopic imagery into a CNN. The data collected by the rover will contain RGB channels and will be recorded in 1080p. We recognize that this format may be too cumbersome and excessive. Our initial plan is to use grayscale versions of the image and reduce the resolution. Other than this we are not planning to preprocess the image in any other manner. We will base our CNN model on inception-based CNNs due to their ability to learn objects and patterns of varying sizes. Ultimately our CNN will perform binary classification and determine whether a stereoscopic image does or does not have an obstacle. If we are successful in binary classification, we will analyze more challenging questions such as object recognition and obstacle distance.

Division of Labor

Work completed so far includes: Michael has modified the rover by mounting rails onto the left and right edges, and cameras using a PVC structure. Khaled has written a python script using OpenCV to capture images from each camera, label the images as to whether or not there is an obstacle, and store them appropriately. Khaled and Michael collected initial data to aid in the initial phases of CNN design. And Venkata and Drupad have researched different CNN architectures including Siamese and inception-based models.

Proceeding, Khaled and Michael will jointly work on data collection and placing the rover in multiple environments with differing obstacles. Venkata and Drupad will develop the CNN architect and begin training the model. Drupad will investigate the use of TAMU supercomputers, and whether the Colab environment will handle our training requirements. Once the data collection is finished, all team members will finalize the CNN network, interpret the results, and collective write the project report.