1 Executive Summary

Simultaneous localization and mapping (SLAM) is a popular technique used by autonomous vehicles for creating maps of an environment while tracking the location of the vehicle within the environment (Maxwell, 2013). This technique began to be developed in the late 1980's and has been described as the "Holy Grail" of autonomous vehicle research because it eliminates the need for prior knowledge of an environment. Current systems use sonar, pressure sensors, and/or infrared sensors to preform SLAM and these systems can be inaccurate. Our client, Dr. Choi, has requested our team develop a system that can be attached to a Thumper rover and is capable of preforming SLAM in an unknown environment.

For this project, three different SLAM systems were analyzed one of which was suggested by our client. The system our client has suggested uses two new devices, the ZED Stereo Camera and Jetson TX1 Graphical Processing Unit (GPU) to create 3D maps of any environment in real time. The other systems we analyzed used combinations of microcontrollers, laser range finders, bump switches, and compass models to create 2D maps of environments.

Through a series of feasibility and merit criteria analysis, the system using the ZED Stereo Camera and Jetson TX1 was determined to be the optimal system to preform SLAM in an unknown environment. These feasibility and merit criteria were determined through our client's specifications. After the ZED Stereo Camera and Jetson TX1 system was selected, mounts to attach the ZED Stereo Camera were designed and analyzed. A mount constructed out of PVC with a flat, rotating platform for the ZED Stereo Camera was selected.

Power supply, mapping ability, processing power were all analyzed for the ZED Stereo Camera and Jetson TX1 System and force analysis was conducted on the mount design. Using the engineering backgrounds of the group, these in-depth analyses allow for more insight to the entire project.

By equipping the ZED Stereo Camera to a Thumper rover using a rotating attachment, the rover will be able to visually map its environment and respond to stimuli as it navigates the environment autonomously. The use of visual mapping should allow the robot to move more precisely around obstacles so it will no longer need the pressure, sonar, or infrared sensors. Since there is already an existing protocol to have a robot respond to environmental stimuli, this system will be adapted for the use of a camera.