THE ARLISS PROJECT

An international effort to build and test prototype satellites

What it is and how we did it

The Goal

Working alongside Electrical and Mechanical Engineering capstone teams, our task was to design and build a small rover that fits inside a standard 12 oz. soda can. This rover will be dropped from a rocket at 12,000' AGL, land safely on the ground ad drive itself to a predetermined set of GPS coordinates.

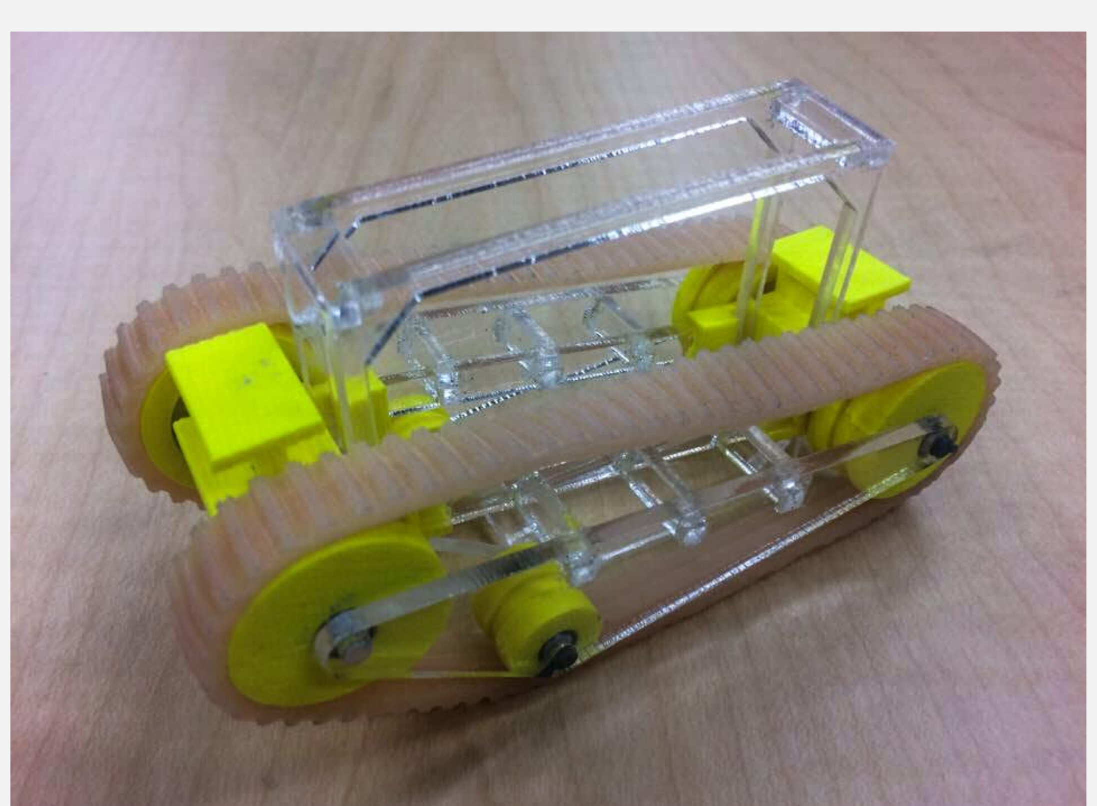
As the Computer Science team, our job was to develop the software package for the rover. This included being able to lock on to and drive towards the GPS coordinates, as well as an obstacle avoidance system that uses a camera to detect and avoid rough terrain or objects such as rocks that our rover would get stuck on.

Implementation

We implemented our software by splitting it up into separate tasks. The tasks we came up with were: parachute deployment, GPS navigation, obstacle avoidance, getting unstuck from obstacles, and hitting the finish pole. In addition, many tasks were implemented utilizing the onboard camera, which we had to create obstacle detection software for.

Parachute Deployment

Once the rover is dropped from the rocket, we had to determine at what point to deploy the parachute. We accomplished this by tracking the GPS coordinates height, and deploying the parachute once we dropped below a certain altitude. This way, the wind won't carry us as far as if we deployed the parachute immediately.



GPS Navigation

For the rover's GPS Navigation functions, we are using an algorithm that determines the shortest path between two given GPS coordinates. The GPS will also keep updating new best routes per request from obstacle avoidance and unstack functions. Which means that the GPS function has to work flawlessly with both of these two functions to ensure the rover's safety and efficiency. How rover behaves during its driving is also critical, the GPS function will check if the rover is off-course by preset time interval and give route compensation if needed.

Obstacle Avoidance

The obstacle avoidance system ensures that our rover is not impeded on its way to the destination. Taking in filtered images from the obstacle detection software, this system does edge detection on the image find objects in the rovers path, and then decides how to best get around the object. This is done by treating the filtered black and white image as a matrix of pixels, and summing the number of edges to the left, right or in front of the rover and adjusting the direction of the rover to travel where the fewest edges are found.

Getting Unstuck from Obstacles

In case the obstacle avoidance fails, and we end up hitting an obstacle, we've developed an algorithm to help us get unstuck from what we hit. It works by first attempting to back up the rover, and if the rover doesn't move, back up in different directions until it does move. It detects if the rover has moved by checking the GPS coordinates. This algorithm works best if just the rover's path forward is blocked, but it can still easily move backward.

Find and Touch the Finish Pole

Once the rover get's within the GPS' error range of the finish coordinates, we have to search for the finish pole. This algorithm works by first searching for the finish pole by rotating in place and taking pictures, then aligning the rover in the direction of the finish, and moving forward, making periodic course corrections along the way.

Imaging

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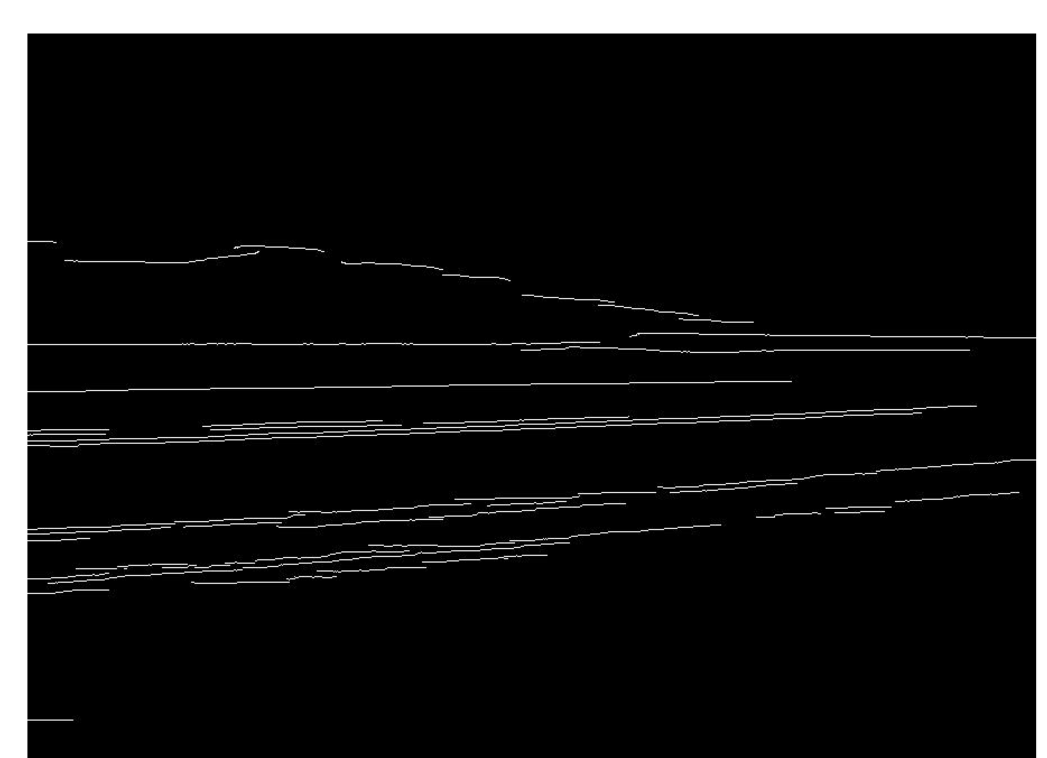

Meet the Team

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Sponsorship

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Oregon State UNIVERSITY