ILR 9

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Project : Autonomous System for Aerial Search and Rescue

Progress

A large part of this review cycle was spent with the team on conducting various tests outdoors at the NREC site. Over the spring break, we did a lot of flights with various sensors and collected data to validate and test our algorithms. While conducting tests, we realized that the area at NREC is too small to have multiple regions of interests. Instead we decided to change our spring validation flight to be a sweep through the area with various signatures along the path. We also validated different settings like camera angle and speed of the drone to ensure the signature detection performs optimally. One finding was that the microphone was not performing as well as we would have liked when placed too close to the drone. Hence we finally decided to go with the approach of suspending the microphone from the drone and this seems to work better. We also had discussions on how to land and take off the drone with the microphone and if we need a separate winch mechanism to lower the microphone. But in the interest of time and other high priority items, we decided to stick with a simple mechanism to suspend the microphone and maybe control with our rescue servo to disengage it before landing, given that the rescue mission will be a separate flight. Below figures 1 and 2 are some screenshots of the signatures as seen by the sensors during flight.

Figure 1. Samples from the RGB camera

Figure 2. Samples from the Thermal camera

We also collected lot of sound samples and noticed that though most voice activity is captured by the microphone, there are some false positives as well which need to be dealt with. Figure 3 below shows how the sound sensor performed. The green circles indicate positions where there was true sound activity and the blue circles indicate positions that the microphone detected as sound activity. As can be seen there are a few false positives that need to be dealt with.

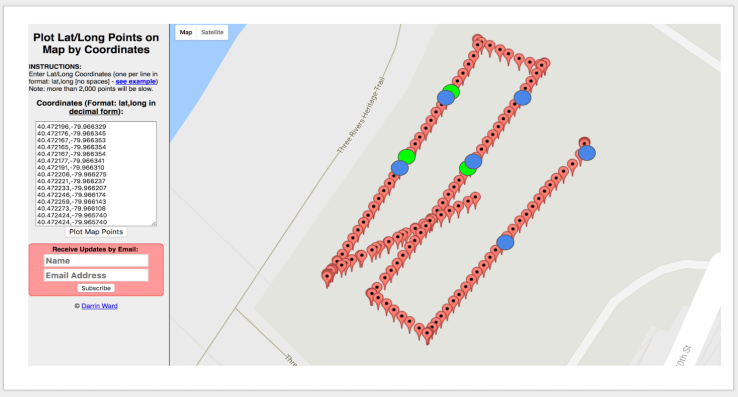

Figure 3 Sound sensor performance.

I also worked on modules to track the pose of the drone at all times during the flight. Changes had to be made to the app to get the necessary information for position, orientation as well as velocity and altitude of the drone. This information is very essential, since, our sensors do not have built in gps and so, we have to rely on precise time measurements and position of the drone to synchronize the sensor data with the drone location. This information is also by used by the module that finds the location of a human in an image to do a precise package drop.

In addition to above, I also worked on developing an SVM + HOG classifier in python just as a backup in case the other team members do not find time to migrate the existing Matlab code to python. I plan to test it in the coming week.

Team Progress

The team as a whole spent most of the time collecting data at the NREC site. We ordered a couple of mounts for the camera and worked on installing them on the system during spring break. Juncheng and Xiaoyang worked on refining their signature detection algorithms on the collected data. Sumit worked on the module to find the location of a human in an image so that the rescue drop can be done accurately.

Challenges

This week was the first time we did an end to end test of the system by actually flying the drone in the final site and processing the sensor data to see if we can find the location of the humans. We came across some issues and are actively trying to solve them. The signature

detection was not performing as well on this data and efforts are on to improve it. The sound detection doesn't work as well without suspending the microphone with a rope. We also noticed deteriorated performance if there is a strong wind. We also need to refabricate our rescue package drop mechanism since, the mount for the camera we ordered is based on suction and has to be mounted on a different surface than what we have right now. For this review, thought we showed end to end functionality, each of the individual components need to be hooked together to make an end to end system. One other thing we need to test is the network availability at the test site. The rescue drop works over wifi and so does the logging of the drone location to the server. Currently we are using the raspberry pi as the dhcp server and the other devices hooking onto this network. We need to validate the reliability of this approach when the drone flies far from the home location.

Goals for next ILR

My individual goal for the coming week would be to resume working on the backend system and continue making progress towards building an end to end system. I will also be working on refining the sound detection algorithm and conducting more tests to understand the nature of false positives and see if they can be reduced. A third thing that I intend to continue working on, is, to test the SVM+Hog implementation on the data we collected and see how it performs with the implementation that we already have. The last thing I want to get started on is to resume the effort of exploring other deep learning based approaches for signature detection to see if the performance can be improved.