

Individual Lab Report #10

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Team H (PhoeniX)

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Team-mates:

Shubham Garg

Parv Parkhiya

Zhihao Zhu

Individual Progress

The tasks to be completed by the Progress Review 11 for me were: -

1. Coordinate with other team-mates in mounting extinguishing mechanism on the UAV and UGV
 - a. Testing the extinguisher mechanism on the UAV
 - b. Port the thermal servoing code from SVD to the systems for FVD
 - c. Rosserial and thermal camera driver installations on UAV and UGV
2. Understanding and writing a behavior tree for the UAV
3. Testing the behavior tree on the actual drone

Mounting and Testing the extinguishing mechanism:

1. UAV
 - a. The team had already made mounts for the UAV but the only remaining task was to connect the pipes to the motor and test if the motor can suck water from the bottles and shoot water at a larger distance. I tried to connect the pipes to the motors, but I was not successful as there were still leakage issues and hence, I asked Parv for help and he completed this task.
 - b. The other important task was to mount the teensy, relay and figuring out the power supply for the pump. I used a UBEC (24V to 12V) to power the pump from onboard 24V coming from the drone.
 - c. After connecting all the hardware i.e teensy, relay and the pump; I used the code from SVD to automate the actuation, the code from last semester was not structured properly and had a few bugs. After bug resolution, I thoroughly tested if I was able to actuate the pump by publishing to the ROS topic.
 - d. Using our original strategy to have a pipe in front of the pump to help us reduce the loss in range from the propeller thrust, I designed and printed a square pipe (Figure 1), but attaching the pipe on the pump is still a challenge as we need a really accurate angle-of-attack estimate in order to have a full range from the pump.



Figure 1: Pipe for the pump

- e. Another important task was to mount the thermal camera on the drone since there was no special mount created for the thermal camera, I modified the mount for the realsense camera to accommodate the thermal camera which can be seen in Figure 2. I installed the ROS drivers for the camera and ported the code (fire detection) from last semester and did bench testing on the pipeline.

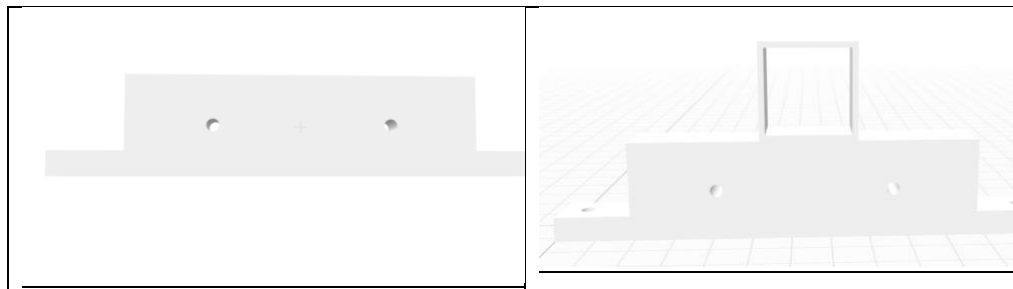


Figure 2: Before and After (DJI Camera mounts)

2. UGV

- a. The UGV also went through the same process of thermal camera driver, rosserial installation but powering the pump from the UGV was complicated and since I have used the UGV very little, I asked Shubham to complete the wiring and then I took over for the software stack.
- b. To mount the extinguisher on the UGV (I, Shubham and Parv) had to collectively mount the UR5e arm on the husky. We got help from Kevin Zhang (R.I. Ph.D. student) and it took us upwards of 2 hours to mount everything and to properly complete the wiring of this complex assembly.

Understanding and writing the behavior tree (UAV) + Testing:

1. Behavior Tree is like a complex state machine which has fallback nodes in case a task assigned to the robot failed. The AirLab has made a ROS interface around this idea and

we were told to use it by our sponsor (since we are going for a competition it would be imperative to have a common framework for all the robots across all the teams).

2. It was difficult to understand the internal working of the behavior tree and after spending some time on it, I and Parv started to write a behavior tree for the FVD.
3. It took us 2 days to write the behavior tree and the next step was to debug the tree in a semi-simulation environment.
4. After testing it, we deployed it on the drone for actual flight test
5. I and Parv did a successful validation of the various tasks which the drone was supposed to perform, the tree was performing as we expected it to be. To test the full mission pipeline we did multiple missions but sometimes I had to abort the test if I felt the UAV was going to hit the walls of the window, but overall the FVD mission is ready just the window detection code needs some more improvement and robustness.

Challenges:

1. Testing the behavior tree on the drone: we had 2 crashes (in one crash the window fell on the drone!).
2. Attaching the pipe in front of the pump to maximize the projectile range.
3. Mounting the UR5e arm on the husky

Teamwork:

Shubham was primarily on husky autonomous missions using the behavior tree and he was also working on improving sensor fusion and the DWA planner on the husky. Zihao was supplementing him for some tasks. Parv was working with me on the UAV and he also worked on the global planner for both the systems.

Future Plans:

The plans for the next presentation are to do missions with UAVs and UGVs (like a rehearsal for the FVD):

1. Shubham – Work on the husky planner which gives a sub-optimal trajectory while entering the opening
2. Parv – Work on a common map frame for UAV and UGV using the communication subsystem and put that in his global planner
3. Akshit – UAV missions with improved window detection
4. Zihao – Work on husky behavior tree