

MRSD Project 1

Individual Lab Report #03

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Teammates:

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Individual Progress

My main assigned task was to get Simultaneous Localization and Mapping (SLAM) module up and running on our system specifically for the ground vehicle computer - ZOTAC. SLAM module is essential for the proper high-level mission planning especially since in an indoor environment, GPS will not work and the robot will have to localize in the unknown environment.

Writing SLAM module from the scratch is out of the scope of the project. We had a couple of different options in mind. Our decision to use ORB-SLAM2 was due to its continued support and reliability in a diverse situation. Installing various dependencies was the first part. It took a couple of days to properly install the dependencies. After that, we compiled the ORB-SLAM2 package. A ROS-wrapper was also provided which we also compiled since various software components are integrated with ROS.

Next task was to install ZED camera ROS wrapper which will publish stereo images in ROS topic. ZED camera was publishing the images in a different topic than what ORB-SLAM2 package was expecting. So, I had to remap the topics for compatibility. I also wrote a launch file for ORB-SLAM2 package which was not provided. After that, when I ran the ORB-SLAM2 with the live camera feed, SLAM kept breaking for some reason. I will detail the debugging process in the challenge section. I also modified the configuration file for ORB-SLAM where I updated camera configuration, baseline among other things. After which, I performed small simple tests to check for SLAM accuracy and see if it was working properly.

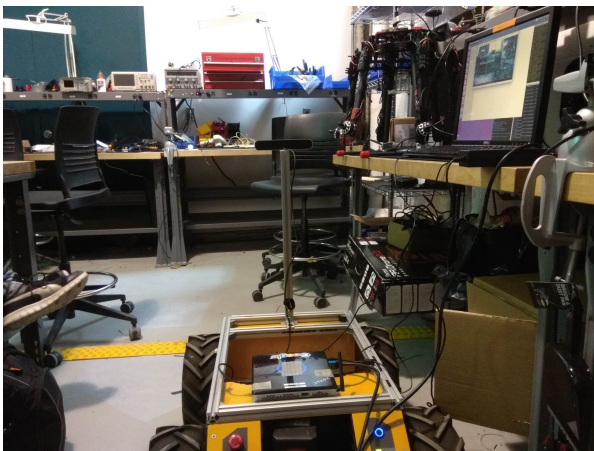


Figure 1: Right image shows features detected by Husky in left image

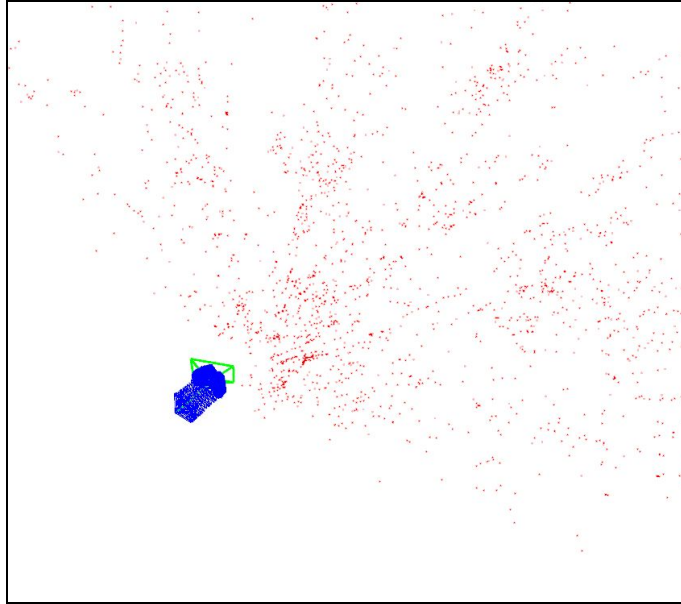


Figure 2: Husky moved forward and rotated 45° (Red points shows the 3D point cloud of the detected features, blue rectangles represents past camera position and green rectangle represents current location.)

Other major work was in UAV flight test. Akshit and I performed two outdoor flight test for the first time. Since none of us had the drone pilot license, we had to collaborate with AirLab's students who have the license. Clearly, outdoor tests were far risky in terms of potential damage to the UAV. We had to make sure everything was working properly. We performed 2 tests. At the end of the second test, because of poor landing, 2 propellers got chipped off. After the test, I noticed one minor mistake in arm attachment of one of the six UAV arms. I had to remove that one specific UAV arm and assemble it again.

[Flight Test 1 Video](#)

[Flight Test 2 Video](#)

Challenges

Installing dependencies was far more challenging than I had anticipated. Dependencies had their own dependencies which needed to be installed in the system. After some effort in searching on the internet, I was able to install all the dependencies and resolve any library version conflict and finally compile the entire ORB-SLAM2 package along with ROS wrapper.

I was stuck for a long time when SLAM kept breaking (lost tracking) for some reason. I played with parameters and settings. I also introduced a feature rich scene but with no improvement. One potential cause could have been low processing power of ZOTAC. Perhaps handling 30 fps HD image stream from ZED camera along with SLAM running was too much processing. We used ROS-bag to record ZED camera streaming and then replayed the stream without actually connecting ZED camera. But the result had no improvement on the SLAM. Finally, we decreased the resolution of the ZED camera to VGA 30 fps by updating ZED ROS wrapper. After which SLAM started working as expected. ORB uses vocabulary for feature extraction. Our guess is that vocabulary works only for VGA, not HD images. For now, the SLAM running on VGA looks good enough so we might not need high resolution.

Teamwork

Shubham was also doing ORM-SLAM2 integration on Jetson. Initially, I thought that installing ORB-SLAM2 would be similar in both ZOTAC and Jetson. But installing dependencies turned out to be different because ZOTAC has x86 architecture whereas Jetson has ARM-based architecture. Some compilation errors were common for both of us and some were different. He also faced the same SLAM breaking issue for high-resolution images. We helped each other out in solving the problems. UAV flight test as always requires a team effort to carry out. As mentioned in the last ILR, one of the ZED cameras was faulty. We returned that ZED camera, but the replacement hadn't arrived at that time. Akshit and Steve also wanted RGB images to fuse it with thermal images. We shared a ZED camera until we got one from the MRSD inventory.

Future Plans

I would be focusing on getting started with the robotic arm that will manipulate the fire extinguisher on the ground vehicle. While an exact solution is not yet finalized, most likely we will modify existing arm for our purpose. I might have to wait in case we need any specific hardware that is not available. Meanwhile, Shubham and I will also carry forward our work on SLAM integration with the control system in the state machine. Our sponsors want us to build one more UAV during the spring break which would also take a significant amount of time.