Fly Sense

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Team C: FlySense

Teammates: Nihar Tadichetty, Joao Fonseca, Harikrishnan Suresh, Nicholas Crispie

ILR 02

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Individual Progress

During the past week I have contributed to following aspects of our system:

a. Mapping:

I started with defining the problem a little more by studying and talking to some of the people working in this area. I understood that the goal of our system is to show to the pilot the obstacles surrounding the aircraft in real-time and color-code them according to level of risk. For this purpose, we are more concerned making a 2-D map rather than a 3-D map. So, I did some more research and came across 3-D mapping framework based on octrees. We found a ros package, octo-map which implements the same research paper.

The octomap ros package allowed us to create obstacle occupancy map using the Velodyne VLP16 LIDAR. We conducted a few tests to check how well the octomap package performs in a static and a dynamic environment. Both the tests were performed outside the MRSD lab. The environment was chosen such that there are only few obstacles apart from the walls. The idea was to test the mapping in an ideal condition.

Static test:

The LIDAR was mounted at a height so as to get more obstacles and less of ground. Also, it was ensured that the Field of view of LIDAR is not blocked in the setup. This can be seen figure1.

Figure 1Static test Setup

The results obtained from the test were satisfactory and are shown in the figure 2.

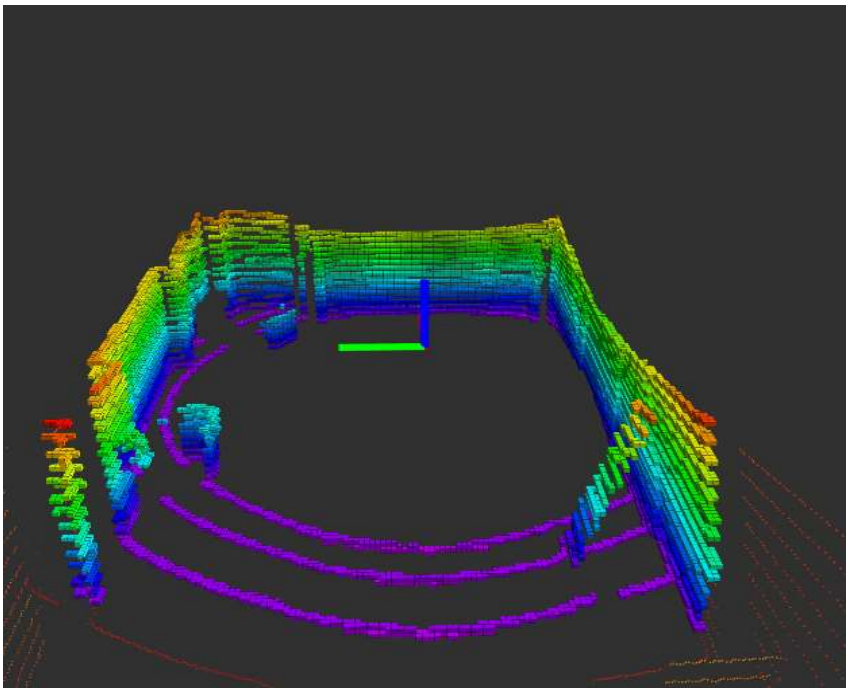

Figure 2Static test results

Dynamic Test:

In the dynamic test we moved a podium in front of the lidar at a very slow speed to see how octomap responds to the change in environment. Figure 3 shows the setup for that.

Figure 3 Dynamic Test Setup

The results are shown in Figure 4.

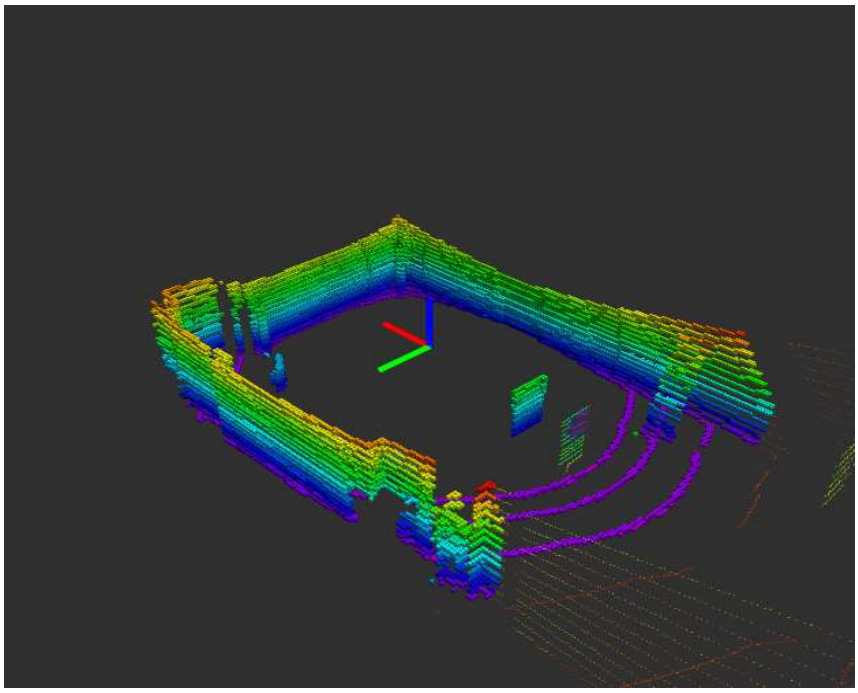

Figure 4 Dynamic Test Results

As can be seen from the figure 4, the obstacle map hasn't updated in 4 seconds even though podium was moved.

All these tests were performed multiple times and the data was logged for further analysis. TO solve this problem, we started changing parameters of octomap package. By changing sensor model related parameters, we were able to increase the update rate but it still needs to be checked further.

b. Sensor suite selection:

I also started working on selecting the GPS/INS COTS system. My initial goal is to understand the accuracy required to generate accurate maps. According to my preliminary analysis we need 1 cm accuracy in position and 0.1 degree accuracy in orientation. I have found a few systems which provide such performance but are in the range of 2000 to 3000 USD. One alternative to using such high cost system is to use Piksi RTG gps receiver which costs 550USD along with a hobby grade autopilot like pixhawk which gives precise orientation estimate. I am exploring this option further.

Since the helicopter has automotive grade GPS/INS system, we can avoid working with a lower grade system by using Virtual Reality tags (like HTC Vive) instead of using a GPS/INS system for

Fall validation. This would ensure we could get accurate maps with least amount of work in pose estimation.

c. I also helped Joao developing visuals which describe the key scenarios/problems we are solving with our system. These can be seen in figure 5

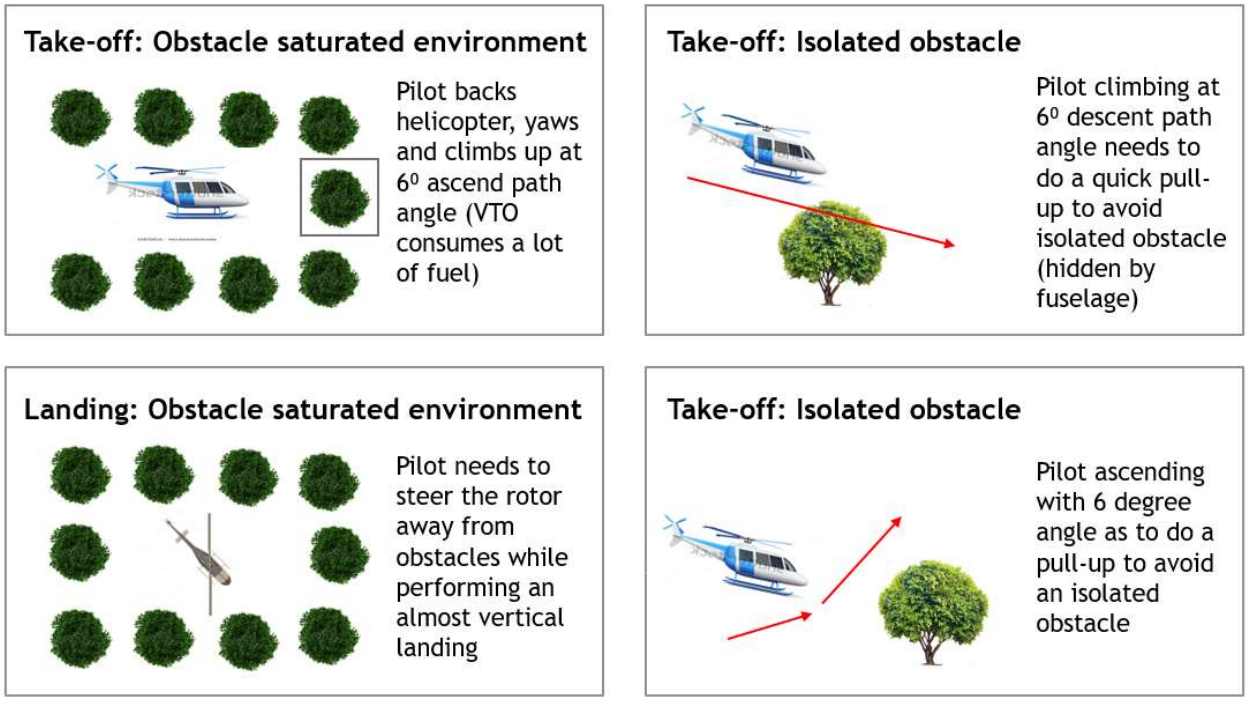

Figure 5 Kep Problem Scenarios for Helicopter pilots

Challenges faced

I wasn't familiar with using LIDAR and ROS. So, there was a bit of a learning curve. There's a lot of literature on mapping using LIDAR, so it was difficult to find what is relevant to our purpose. Talking to our project advisor helped in this regard.

Teamwork

After discussions we assigned Nick to be the project manager. Nick has put together a project management tool for us to keep track of the project. He is working on PCB design, design of fall validation experiment and testing each of the sub-systems to determine their usability.

Nihar is focused on the AR controller interface. He conducted tests on Holo lens and found out that it won't work for our pusposes.
Hari is working on mapping aspects of the system.
Joao is working on UI/UX aspects.

Plans

- Start development on Jetson TK-1
- Get pose estimate from Sensor suite
- Develop ROS nodes which publishes pose estimate.
- Implement communication protocol between sensing node and the AR controller.