Individual Lab Report #4

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Team F: Rescue Rangers

Teammates:

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1. Individual Progress

1.1. Overview

During the past two weeks, I worked majorly on the following tasks:

1. DJI Matrice 100 setup, calibration, and testing (team task)
2. DJI Onboard SDK – Hardware and Software setup (individual task)
3. Initial study on human detection in thermal images (individual task)

Apart from these major tasks, Karthik and I collected some sound samples to test the feasibility of using human sound detection.

1.2. DJI Matrice 100 Setup, Calibration, and Testing

We began assembling the drone soon after we received it. It took us about five hours to complete the whole mechanical and electrical assembly.
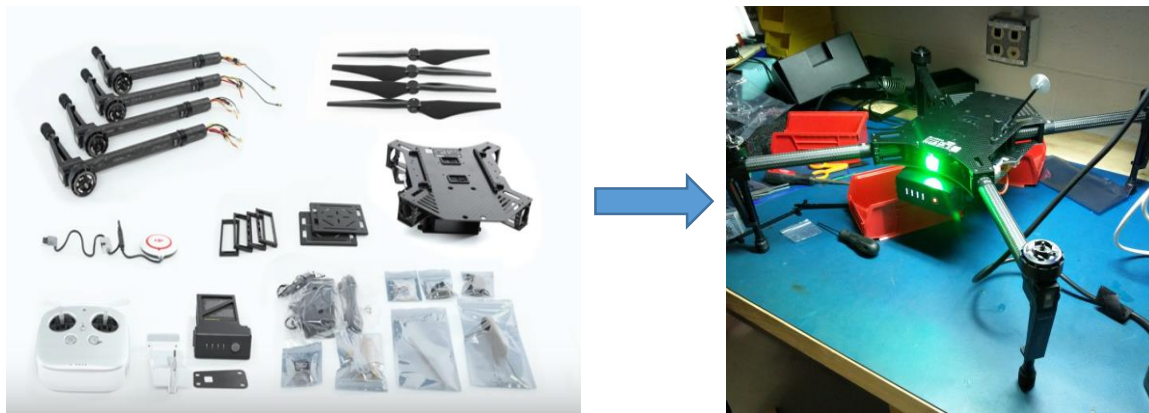

Figure 1: DJI Matrice 100 Assembly

We ran into some issues with calibration and had to repeat the process numerous times. We also ran into some issues with initial flight testing using DJI GO app. We had to contact DJI support to get help on some of the issues we were facing.

Eventually, we were able to test remote-controlled flight in a few days. And then, after Karthik's successful work with DJI Mobile SDK, we were able to test autonomous waypoint following on the simulator.

1.3. DJI Onboard SDK: Software and Hardware setup

DJI's onboard SDK allows us to connect our own Onboard Embedded System (OES) to our Matrice 100 using a common serial port (TTL UART). Figuring that we might need to connect our own OES to the drone in case we face issues with DJI Mobile SDK, I started work on the Onboard SDK in parallel with Karthik's work on Mobile SDK.

Software setup:

1. Installed Ubuntu 14.04.1 – Lubuntu on Odroid XU4
2. Installed ROS Indigo for Ubuntu ARM on Odroid XU4
3. Began reading on how to set up communication with drone using Onboard SDK

Hardware setup:

1. Realized the need for Odroid XU4 Shifter Shield to convert Odroid's 1.8V output to 3.3V required by the drone's UART Port
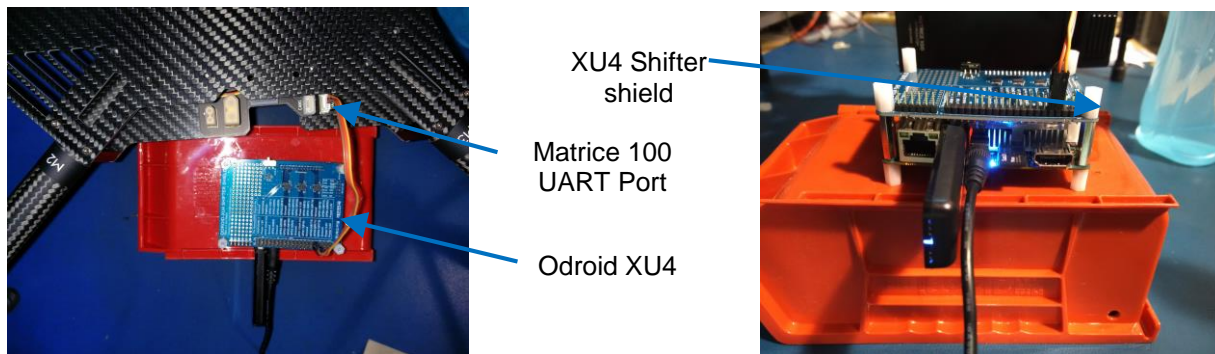2. Connected Odroid XU4 (Shifter shield) with the drone's UART port

XU4 Shifter shield

Matrice 100 UART Port

Odroid XU4

Figure 2: DJI Onboard SDK Hardware Setup: Connecting Odroid XU4 to the drone

1.4. Human Detection in Thermal images

Curious about how well explored this area is and what challenges we might face, I did some initial study on the problem. I found that little work exists in the literature, addressing the problem of people detection from oblique, top-down views in the thermal images taken from a height. The problem is much more challenging than that faced with RGB images due to the following reasons:

1. Significantly low-resolution images as compared to RGB (for us, it will be 640 x 512 for thermal versus 4240 x 2824 for RGB)
2. Unavailability of color or texture information
3. Much less work in the literature

Fortunately, I found a paper "People Detection and Tracking from Aerial Thermal Views", by Jan Portmann, Simon Lynen, Margarita Chli and Roland Siegwart, Autonomous Systems Lab, ETH Zurich. The paper gives us a good idea about how we could approach the problem. It suggests using a three-fold approach:

1. Background subtraction using ViBe method: to generate foreground candidate regions
2. Try out different detectors: HOG /LatentSVM trained on INRIA dataset
3. Tracker based on a particle filter approach

I also collected datasets suggested by the paper, and from some other sources available online, which could be helpful for us.

2. Challenges:

I faced following challenges during my work:

1. While setting up ROS on Odroid XU4: I faced unexpected issues while installing ROS-base - it was not able to fetch some packages needed for a successful install. I tried multiple times, looked up online but could not find a solution. Then, I reinstalled Ubuntu and went through the whole process again, only with one change – I updated Ubuntu firmware with the available software updates before installing ROS, and everything worked fine.
2. While calibrating DJI Matrice 100 *(team challenge)*: As mentioned earlier, we faced multiple challenges initially during the calibration process. We had to recalibrate the drone each time we started and still, DJI GO app would give us multiple errors while everything seemed fine to us. We sought help from DJI support and also referred to Chinese User manuals (which had more information than English ones) to eventually be able to bring the drone to working condition.

3. Teamwork:

Work done by individual team members:

- Team:
  - DJI Matrice 100 setup, calibration, and testing
- Juncheng Zhang and Xiaoyang Liu:
  - PDS PCB Schematic design: Final design for manufacturing
  - Human detection in RGB images from frontal view: They tested an HOG+SVM based algorithm on pedestrian dataset to achieve pretty decent results

- Sumit Saxena:
  - DJI Onboard SDK: Hardware and Software setup
  - Initial study on human detection in thermal images
- Karthik Ramachandran:
  - DJI Mobile SDK: He tweaked a platform available online and made use of DJI Mobile SDK to create an app where you can specify waypoints for the drone. We tested it using the simulator and it seems to work well.
  - Local search path generation v2.0: He improved the local search path generation software to generate GPS waypoints around a location of interest to form a spiral path rather than a circular path

It was really exciting for us when we received the drone. The whole setup, calibration, and testing were done in close collaboration. Additionally, I and Karthik also collected sound samples by keeping a mobile phone below the active (but not flying) drone and then shouting in close vicinity (see Figure 3 below). This was done in collaboration with Team I's 'Soybot'.

Figure 3: Sound sample collection: The propellers were running and being given thrust through RC. I and Karthik were shouting in close vicinity. Mobile phone to record the sound was kept on the ground.

4. Future plans:

Following are the tasks I plan to work on until the next PR:

1. Package drop assembly design and prototype:
   - Ideally, we would like to do this for our sponsor's Matrice 600. So, will need to look into getting access to it, or getting some drawings, if possible
2. Continue work on Onboard SDK: if we face any issues with waypoint navigation using MobileSDK
3. Work with Karthik to add more features to the waypoint navigation software
4. Test flight outdoors and select a site for FVE.