ILR #4

Adam Yabroudi- Team A

November 13, 2015

Teammates: Tushar Agrawal, Pratik Chatrath, Sean Bryan

Individual Progress

This week I had two major tasks. The first was to design the PCBs for our obstacle avoidance system. The second major task was to get the electrical system up and running for the FireFly6. Since there was a delay in getting the FireFly6 I also helped Sean out to get the UGV up and running as well.

Designing the PCBs for the Obstacle Avoidance

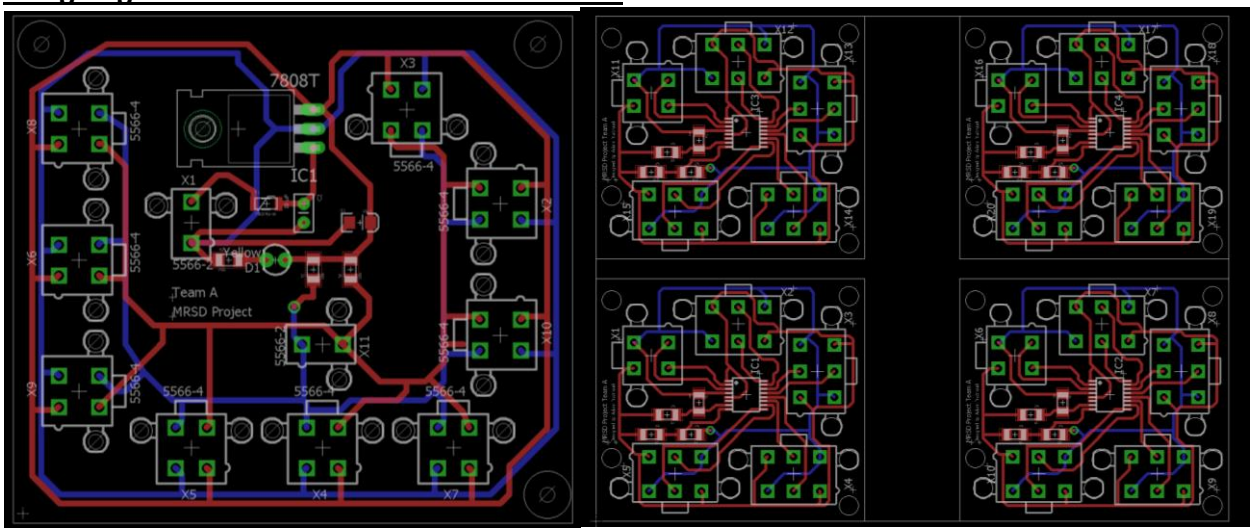

Figure 1: PCB layouts for master (left) and slave boards (right)

One of my tasks this week was creating the PCBs for our obstacle avoidance system. We wanted a design that was simple, easy to integrate, and very flexible. We also needed the system to be designed to minimize noise by keeping analog wires short. Our resulting structure was to create a single master board that handled power and pulled up the I2C lines. It would also have a connect to send the I2C to the Pixhawk. The slave boards would be connected to the master over a 4 wire bus (5V, GND, SCL, SDA) and would have an ADC that allowed for up to 8 analog inputs. The ADC we used was an adc128d818 because it met all our requirements and had the ability to have 9 different I2C addresses thus allowing us to have 9 boards around the vehicle all designed the same exact way and still be unique from the controller's point of view.

Electromechanical System (UGV and FireFly6)

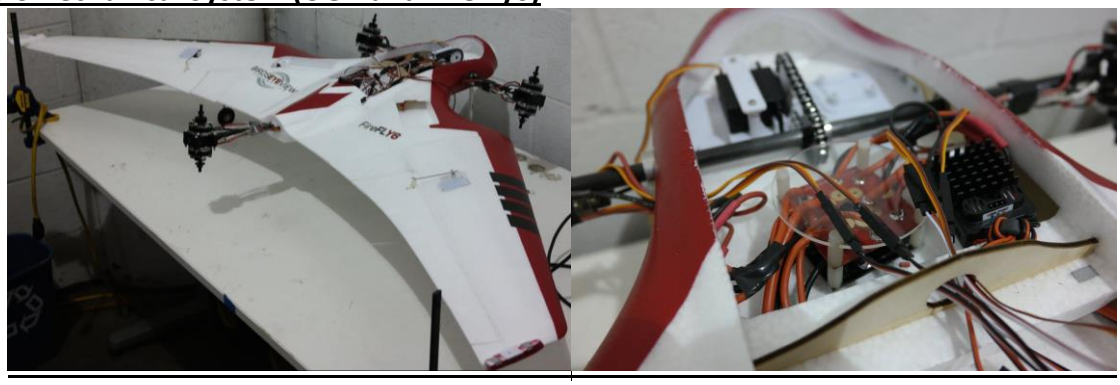

Figure 2: FireFly6 built mechanically (left) with power distribution and motor controllers complete (right)

Since we were waiting for the FireFly6 to arrive, Sean and I decided that spending time on the UGV would be beneficial down the road. Sean and I basically had to open up the vehicle, figure out what was supposed to be part of the pioneer and what wasn't, restore everything to it's original condition, and then test the vehicle after that. I helped with the electrical diagnostics and Sean worked on the rest.

Once the FireFly6 came in, we all worked together to get the initial components to come together. I took more of a lead on the electrical system and tested components as they were going into/onto the vehicle. We initially had some problems with extending the landing gear motors but were able to get that working.

Once the majority of the vehicle had been constructed, I then sat down and worked on laying out the motors and electronics inside the vehicle. This proved to be tricky for multiple reasons. One reason was that the holes on the vehicle for the wires were small making routing of wires very difficult. Also the holes prevented us from using some large connectors on the PWM wires. Furthermore, we ran into some trouble with the crimp tools forcing me to solder extensions to the wires which provided a stronger but less flexible electrical connection for the motors. In the end, power distribution was complete and all motors were proven to be functional and wired in the correct orientation.

Challenges:

Crimping:

One issue that I faced this week was with the crimping tools. I tried various combinations of hacks/solutions trying to get them to work but ultimately the crimps would break or fall off which was unacceptable from a reliability perspective. I then switched to soldering the wires directly and sealing the joints with shrink tubing which took more time and makes for a less flexible system because removing parts will now be destructive and difficult.

Landing Gear:

As per instructions, when we first got out vehicle we mounted the landing gear onto the frame. We also were instructed to use servo testers to extend the landing gear. I had servo tester code written for Arduino and proved that it worked on a spare motor. When we tried using the same code to test the landing gear motors, though, it failed. We assumed there were problems with the Arduino not supplying enough current and we tried using the power source, changing code, and other attempted solutions. In the end we realized that the landing gear had just been tightened too much and so it was mechanically preventing the landing gear from extending. After that it was a simple process to loosen the landing gear and everything worked.

Batteries:

As I was testing the electrical systems in the FireFly6, I tried placing a battery into the battery holder in the vehicle. I noticed that the battery was too big to fit correctly and immediately checked the specs online to make sure we had ordered the right battery. Based on the specs we had so I emailed BirdsEyeView Aerobotics trying to see where we had messed up.

It turns out there were 2 batteries with the exact same specs but different dimensions. I then worked with Keyla to return the large batteries and get the correct ones ordered.

Teamwork:

Teamwork occurred across the board this week but with me in particular it was mostly with Sean on the UGV, Pratik on the PCB design for obstacle avoidance, and with the whole team for constructing the FireFly6.

For the UGV collaboration with Sean, as mentioned above, I helped him diagnosis what systems were supposed to be connected to what ports and just tried to return the vehicle to its original state. The previous group who had used the vehicle had placed new voltage regulators and battery systems into the vehicle and so removing that and testing everything took some time.

In terms of PCB design, I had to work heavily with Pratik to understand what exactly he needed from me and how to design a system to meet his sensor requirements while reducing noise and keeping it compact for easy mounting. The collaboration happened on a conceptual/design level.

In regards to putting the vehicle together out of the box, we all participated in building the vehicle. It was our first time really interacting with the vehicle and so we wanted everyone to be a part of the fun.

Future Plans

Looking forward Tushar is going to work with Pratik to help visualize obstacle data for the UAV. He will also work to understand/fix the issue he is having with the Odroid periodically failing to capture images and finally he will try to dive into Pixhawk code to understand how to incorporate his vision system algorithms.

I'm going to be in charge of getting the FireFly6 up and flying. I want to have RC controller and waypoint navigation done by next week. That will ensure the system is functioning from an electromechanical perspective and that the Pixhawk is configured correctly in terms of parameters and control theory. It will also ensure that I can accurately communicate with it via my computer and have the infrastructure set up to lead into autonomous control coding.

Sean will be working on designing the layout of add-ons to the vehicle. This includes the addition of our obstacle avoidance system to the vehicle in addition to working on designing the underbelly. We want to ensure that the systems will all mesh from a layout perspective and that we won't affect flight control drastically with the new payloads.

Pratik will continue to iterate on the obstacle avoidance system. He want to build a prototype of the system that is as similar to actual conditions as possible without actually using our FireFly6. Sean will cut out a realistic model of the FireFly6 and Pratik will find exact mounting locations. He will also test the system next to spinning motors with propellers to ensure that the propellers aren't in the field of view of the sensors. The reason for not doing this directly on the vehicle is because the vehicle is made of Styrofoam and we can't iterate as much on the vehicle as we can on the mockup.