ILR #5

Adam Yabroudi- Team A

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Teammates: Tushar Agrawal, Pratik Chatrath, Sean Bryan

Individual Progress

This week my focus was on getting the UAV up and flying. Unfortunately I was unable to do that because of lots of problems that arose. I was able to get a lot of subcomponents successfully working, though, and will detail those.

Rewired the Power System

After talking to Birds Eye View Aerobotics (BEVA), we realized that for our specific motors we were supposed to put the 3S batteries in series. To do required a lot of rewiring so as to meet that goal, keep the wiring clean, and keep the signal wires away from the power wires (routing throughout the vehicle.

Got the motors and servos working off the Pixhawk

Last week the motors were checked electrically off a bench top test using the power source. This week I got the motors working off the Pixhawk which required a lot of initial code calibration, ensuring the motors were connected to the correct ports, and also running everything off of the actual power system to achieve common ground between the Pixhawk and the ESCs. I ran into problems with the ESCs originally which I'll detail in the problems section. I also was able to get the servos working properly off of the code although their limits still need to be tuned/calibrated.

Got the RC controller configured

After debugging problems with the PPM encoders, I was finally able to receive RC controller inputs on the Mission Controller software that was connected to the Pixhawk. What should have been a plug and play operation with a calibration sequence proved to be time consuming and faulty especially since I think 2 of the channels on our controller are shorted together and thus reducing our 8 channels to 7 channels. Thankfully we only need 7 control signals for our vehicle so after figuring out the problem I was able to rearrange the signal mapping to get 7 independently controlled signals. Also certain signals need switches, some need the joysticks, and some need continuous control knobs. Making sure each signal got the appropriate mapping was also time consuming but finally figured out.

Updated Firmware

Since we are using code that is in beta, the firmware has an expiration date. The code that we had was going to expire on December 6th. Since we were running into so many coding issues with recalibration and would have had to update the firmware anyway in a week or two, I went ahead and updated the firmware this week. It was mostly risk mitigation for the future.

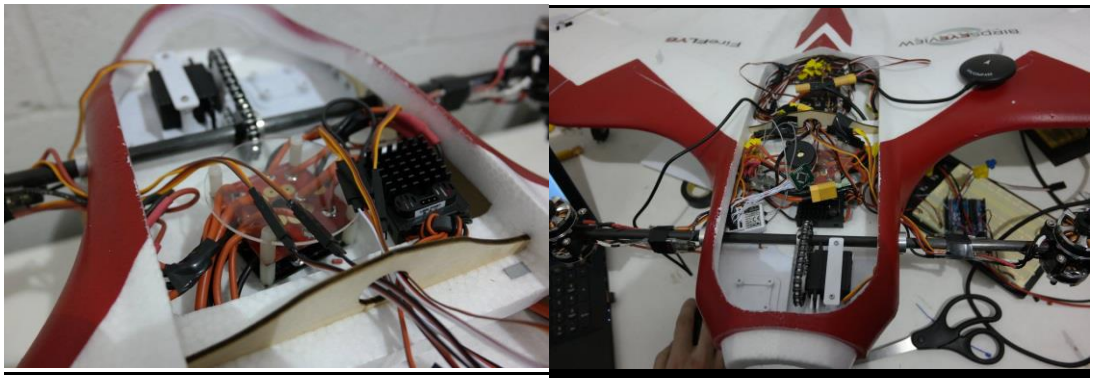

Figure 1: FireFly6 last week (left) and this week (right). Power distribution was completely redone and signal and control wires were connected. Additional hardware was also added such as the GPS, radio receiver, safety switches, and the actual batteries that we will be using for our flights.

Challenges:

With every success in the previous section, there were corresponding issues:

Burnt out Voltage Regulator on Power Module

When switching from batteries in series to batteries in parallel, we doubled the voltage in our vehicle from 12V to 24V. The power module which is a piece of hardware that monitors the battery voltage, current, and outputs power to the Pixhawk is rated for 18V. I explicitly pointed this out to the BEVA engineer and was assured that the Power Module would be ok. Lo and behold, when I wired the batteries in series, the power module stopped working. After more testing it turns out that the voltage and current monitoring still works, just the power output doesn't. Luckily the BEC still can deliver power to the Pixhawk and so our vehicle still works without requiring new parts.

ESC and Motor Tests Initially Fail

Since it is very cramped inside the electronics bay of the vehicle, I attempted to test subassemblies outside the vehicle and then place them inside the vehicle once proven successful. I attempted to apply this principle with the motors as well and so I had a spare motor and ESC from home that I used to test Pixhawk integration with motors. Even after performing ESC calibrations, ensuring that there was common ground, and doing a host of other debugging processes, I emailed BEVA and asked if they had any suggestions. They believed it was because the specific make of my ESC was different from the ones on board the vehicle and recommended I try with our actual motors. When I did, the motors worked and I had no problems. Until now we are still not positive why my bench top test did not work (it should have) but in order to meet deadlines I just cut my losses and worked inside the vehicle for the remainder of the week.

PPM Issues

When attempting to get RC control on the vehicle, there were initially problems with the PPM encoders. The PPM encoders convert the 8 RC inputs into a single signal that the Pixhawk then interprets and uses to control the vehicle. We thankfully happened to buy two different versions of PPM encoders which helped with initial debugging. Originally I was having issues

with 2 channels (5 and 7) being combined by the same switch which was not supposed to happen. Based on online documentation the PPM encoder should have been plug and play and there was no need to do PPM calibration. I swapped out one PPM encoder for another and then got completely different results with all the values twitching even when I left the joysticks in neutral position. After diagnosing the problem of that issue to be related to power, I then noticed that channels 5 and 7 were still coupled and concluded that the issue was on the RC controller side. My solution was to flip channels 7 and 8 since our application only needs 7 channels anyways.

Coding Issues

Throughout the whole process of debugging hardware issues, I also had to interface with code. Due to limited documentation on the beta code I had to email BEVA many times to diagnose issues and error messages I was facing. The issues were varied in their nature, some small and simple to solve and some more troublesome. The last major issue that I still have not been able to solve is that the vehicle is reporting an issue of "Prearm: No external compass" even when I have an external compass and when I don't. It also does this every time I power cycle the board. I'm working with BEVA to figure this out because this is not typical behavior. Once we figure out the root of this issue, that should be the last bottleneck and enable us to fly our vehicle.

Teamwork:

This week I was mostly working on the vehicle alone while the others worked on the obstacle avoidance system integration and preparing for the other FVE tests. Sean worked with Pratik to make CAD models of the vehicle to help with sensor placement. Pratik then took these models, added the sensors, and aligned them for optimal coverage of the vehicle. He also worked on figuring out timing patterns of the sensors and is working to reduce timing bottle necks so we can run the sensors in tighter loops. Tushar worked on visualization of the sensor data to help with the FVE and also to lead into future coding plans with the obstacle avoidance system in the Spring.

Future Plans

Looking forward we are all working to meet the FVEs. Pratik is working on finding the most optimal pinging pattern to create tighter feedback loops from the sensors. He will try to finish that quickly so that Sean can install the sensors on the nose of the vehicle for FVE tests.

Tushar's goals will be to help Pratik with the pinging pattern algorithms as well as ensuring the vision system will be finalized for the FVE. Him and Sean are working on designing and fabricating test setups for Thursday. Also since I will have my hands full with getting the vehicle up and ready to fly, Tushar will be populating the PCBs to meet the MRSD pcb deadline.

I currently am the bottleneck of the group and the least likely to meet the December 3rd FVE. I need to get the vehicle up and fly by whatever means necessary. Depending on how fast the coding issues can be fixed, I will then attempt waypoint navigation but my main priority at this point is just controlled flight by RC controller using the Pixhawk and the onboard motors.