ILR06: Progress Review 7

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Team B: Arcus

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ILR06

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1. Individual Progress

Since the last progress review, I was responsible for the electrical revision, IMU calibration, and PixHawk [1]/PixRacer [2] integration with MAVROS [3]

1.1. Electrical Revision

1.1.1. Circuit Diagram

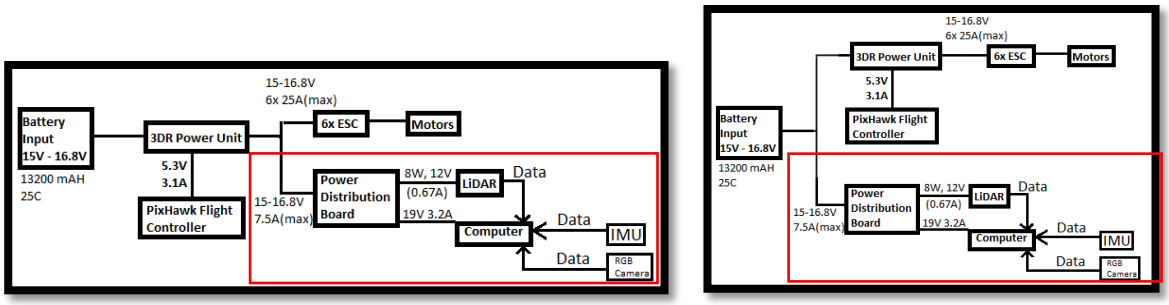

Figure 1: Electrical Diagram (a) Old connections with 3DR power module before the PDB; (b) New connections with the PDB in parallel with the 3DR power module

As seen in the Figure 1(a) circuit diagram, the 3DR Power module sat between the battery and PDB. This was done in order to monitor the current and voltage flowing through the PDB and ESCs.

However, the 3DR power module only forwards the battery voltage to the ESCs until it receives a signal from the PixHawk to cut off ESC power in cases of propeller collisions. These cases led to the PDB losing power, and hence the computer rebooting when the power was cut off temporarily. Placing the PDB in parallel to the 3DR power module bypasses this issue while having no change on the functionality of the PDB. The current and voltage monitoring was a desirable requirement and its absence doesn't affect the project.

1.1.2. Power Distribution Board

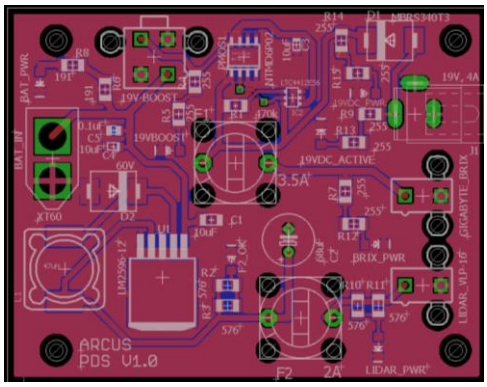

Figure 2: Revised Power Distribution Board

The revisions to the PDB are minor. The changes are summarized in Table 1

S.No	Old	New
1	XT-60 Drills – 3mm Diameter	Changed to 4.4mm Diameter
2	Resistor packages were 0402(US)	Changed to 1206(US)
3	C5 capacitor package was 0402(US)	Changed to 1206(US)
4	LEDs were through-hole	Changed to 1206 SMD

Table 1: Power Distribution Changes

1.2. IMU Calibration

It was inferred that there were no disturbances observed in the IMU reading from the brushless motors and other electronics. Hence, calibration was not required.

1.3. PixHawk Integration

The PixHawk [1] and the PixRacer [2] have a TELEM2 port which can be used to retrieve MAVLink data in a UART protocol fashion. This data includes the IMU readings, compass readings, battery voltage readings, and current readings. Upon referring to the hardware setup instructions at [4] and [5], a cable can be made with connections shown in Table 2.

TELEM2		FTDi	
1	+5v(RED)		NOT CONNECTED
2	Tx(out)	3	RX(Yellow) (in)
3	Rx(in)	4	TX(Orange) (out)
4	CTS(in)	8	RTS(Green) (out)
5	RTS(out)	9	CTS(Brown) (in)
6	GND	2	GND (black)

Table 2: PixHawk USB Integration [4]

The data acquisition is then possible as MAVLink messages through this UART connection. The logical diagram is shown in Figure 3. I followed the steps for Hardware Setup in [6] for an on-board computer with WiFi link to ROS. (MAVROS can be installed by following the steps given at [7]). I will be proceeding with the "Offboard Control Firmware Setup" to assign an RC switch for activation and deactivation of off-board mode. Following which, I will remove the props from the drone and run some test MAVROS codes (like in [8]) to check whether the off-board control is reliably working.

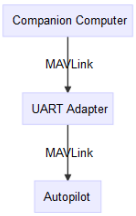

Figure 3: MAVLink message flow chart [6]

2. Challenges

Challenges were faced while looking for appropriate LED SMD packages and their Eagle packages. For the PixHawk/PixRacer integration, some time was spent to dcide what form of USB-TTL cable would be appropriate to be ordered. Earlier, an unpowered cable was ordered which relied on VCC being provided by the attached sensor. Hence, a new cable was ordered that drew power from the computer and was targeted for a 3.3V application.

3. Teamwork

Clare Cui was tasked with a few hardware refreshes like switching the GPS antenna, drilling new holes in the ground plane for the antenna mount, as well as designing a mount for the PixRacer. Angad began working on a reliable IMU integration for state-estimation into BLAM. He took a couple of days last week to bring the team's computers ready with the software sandbox required for developing mapping and localization code. He also set up git repositories and briefed the team with a version control method since we will be developing different parts of codes in parallel.

Logan helped our supervisor import the drone's CAD over the vacations. This was to assist her in the development of a simulator environment. In the beginning of this semester, Logan took care of scheduling the subsystem milestones and prevalently played the role of project manager at the beginning of the semester.

4. Plan

By the next Progress Review, we plan to have the Flight controller integrated with the onboard computer and tested for off-board control. We plan to have the new hardware integrated, as

well as the spare revised PDB, fabricated and soldered. We also plan to have the IMU pre-integration for localization ready.

References

[1] "Pixhawk Flight Controller," Px4 Autopilot, [Online]. Available: https://pixhawk.org/.

[2] PX4, "PixRacer," [Online]. Available: https://pixhawk.org/modules/pixracer.

[3] O. S. R. Foundation, "MAVROS," [Online]. Available: http://wiki.ros.org/mavros.

[4] PX4, "Companion Computer for Pixhawk class," [Online]. Available: https://dev.px4.io/pixhawk-companion-computer.html.

[5] FTDi. [Online]. Available: http://www.ftdichip.com/Support/Documents/DataSheets/Cables/DS_TTL-232RG_CABLES.pdf.

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[7] PX4, "MAVROS Installation," [Online]. Available: https://dev.px4.io/ros-mavros-installation.html.

[8] PX4, "MAVROS Offboard Example," [Online]. Available: https://dev.px4.io/ros-mavros-offboard.html.