Individual Lab Report 2

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Team B: Arcus

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21 October 2016

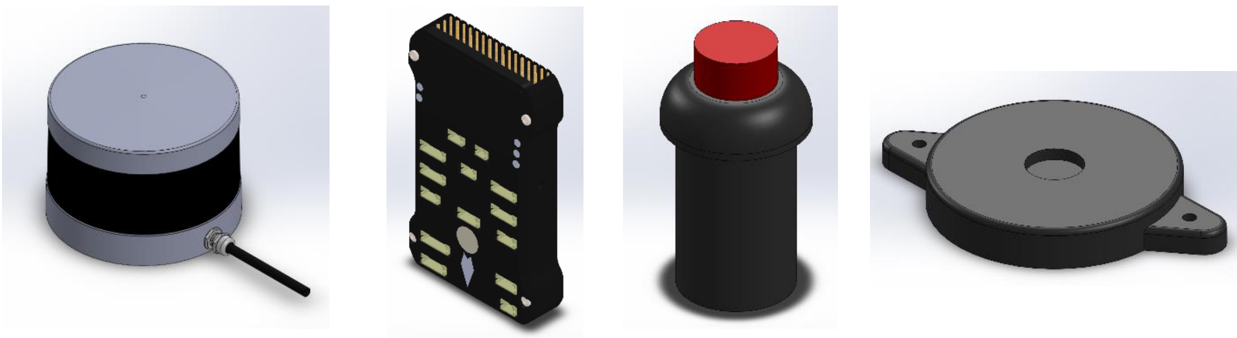
Individual Progress

I have taken on the task of designing for sensors and hardware integration onto the UAV as well as modeling the entire robot in CAD alongside Logan Wan. The task is still in progress and will span the next three weeks (completion by November 10 ideally), but I have made some headway into this project. To begin with, we broke out the list of parts to be created in SolidWorks, and the person assigned to each of those parts can be seen in Table 1. The current status of these parts can also be seen in the table.

Table 1: *Assignments and progress for CAD modeling*

PARTS	DETAIL	PROGRESS	WHO
Mechanical Hardware			
Chassis			Clare
Motor			Logan
ESC			Logan
Propeller			Logan
Sensing Hardware			
IMU		done	Clare
RGB Camera	completed physical model, still need cabling and FOV (185 deg)	IP	Clare
Velodyne	might need add'l cabling	done	Clare
Piksi GPS	need cabling	IP	Logan
Control & Power System			
Pixhawk	sourced at https://grabcad.com/library/pixhawk-1	done	Clare
Buzzer			Clare
Switch			Clare
3DR power management module			Clare
Computer (Gigabyte Brix)			Clare
RC receiver	dimensioned on paper	IP	Clare
Battery	dimensioned on paper	IP	Logan
Custom Parts			
Base/containment structure			Clare
Sensor mounts	preliminary ideas sketched on paper	IP	Clare/Logan

Thus far, I have sourced some of the CAD files online as well as recreated some parts in SolidWorks that were not available for download. I also drafted some design ideas in pencil for hardware mounts for the batteries and Pixhawk/RC receiver combination. The CAD parts that I have been able to find include the Velodyne Puck Lite from the Velodyne website, the Pixhawk flight controller from GrabCad, and the Pixhawk safety switch and buzzer from GrabCad. These parts can be seen in Figures 1a, 1b, 1c, and 1d, respectively.



(a) (b) (c) (d)

Figure 1: *(a) Velodyne Puck Lite sourced from http://velodynelidar.com/downloads.html, (b) PixHawk flight controller sourced from (https://grabcad.com/library/pixhawk-1) (c) PixHawk safety switch, and (d) PixHawk buzzer, both sourced from https://grabcad.com/library/px4-pixhawk-accessory-parts-1*

I was also able to find the CAD for the mvBlueFOC-MLC camera, but needed to make the lens and lens holder. Since these will stay together as one assembly, I decided to design the lens/holder directly onto the part. I hand-measured the lens and holder using calipers. The resulting part can be seen in Figure 2.

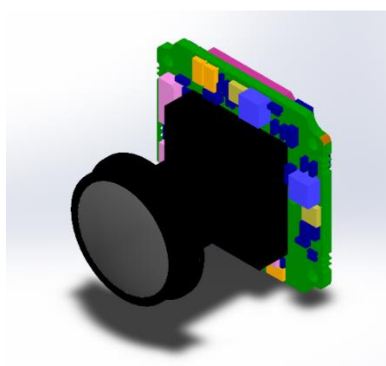


Figure 2: *mvBlueFOX-MLC camera was sourced from https://www.matrix-vision.com/USB2.0-single-board-camera-mvbluefox-mlc.html and I designed the lens and lens holder.*

Using drawings sourced from the Vectornav website, I was able to design the IMU, which can be seen in Figure 3. The IMU connector was represented as a rectangular box with accurate external dimensions. Since the occupied volume of each individual component is what is most important for creating the final assembly, we decided to allow these simplifications to save on time. Likewise, the female connector for the cord was simplified to a rectangular box. A cylinder was extruded to represent the cord itself, with its length being the bend radius. The reason it was important to capture the bend radius in the CAD model was so that we knew how much clearance we would have in between all of the components onboard the UAV when designing for hardware and sensor mounts.

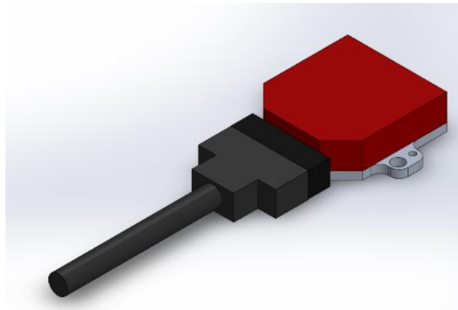


Figure 3: *IMU and cord assembly*

Finally, I have begun some preliminary designs into integrating the hardware onto the UAV. I took hand measurements of the RC receiver, the Pixhawk flight controller, and the batteries with a pair of calipers. Because there will be two sets of 4S batteries, one idea was to make two interlocking channels that would contain them, which would be set on top of the chassis. Upon further discussion with Logan, however, it might make more sense to integrate the batteries below the base plate, which would result in a lower center of gravity for the UAV, making it more stable. This would necessitate a roof for the channels as well as integration for the Velodyne and RGB cameras, since those will be placed beneath the base plate for certain. For the Pixhawk and receiver, I designed a container that would carry both of the two together and hang off the side of the base plate of the hexrotor. The reason for this would be to save space onboard the chassis, but, as this is just a preliminary design, it may be subject to change. All measurements and designs can be seen in Figure 4.

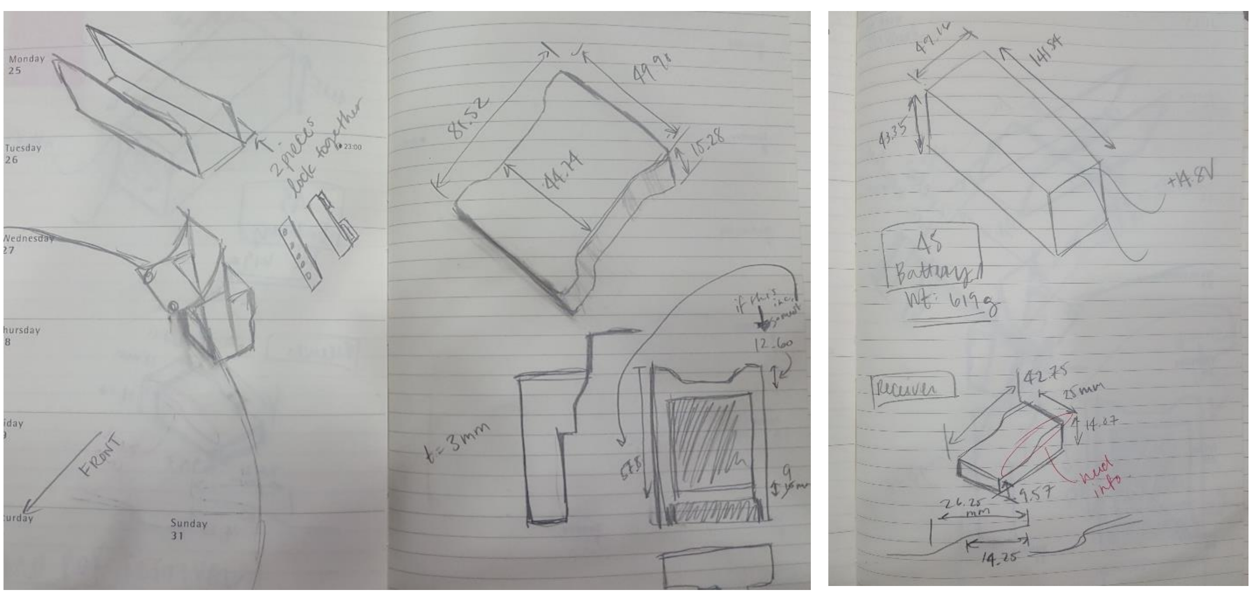


Figure 4: *Sketches and measurements for integrating the Pixhawk, receiver, and batteries onto the UAV.*

Challenges

Although there have not been huge challenges in terms of actually creating the parts in SolidWorks, time management and team communications about standards used in CAD have been an issue. In terms of time management, modeling all of the components of the UAV in SolidWorks is a large undertaking, so I will be trying to allocate some time each day towards modeling instead of trying to CAD several parts all at once. Additionally, because I have not done a lot of CAD modeling outside the context of a classroom, I am not as familiar with standards used to create organized, coordinated assemblies across multiple layers. I am currently working with Logan to bring me up-to-speed on best practices for this.

Teamwork

Maitreya Naik: Maitreya has been working on the PixHawk controller bring-up and worked with Angad in order to collect camera and IMU data for calibration. He is taking on the responsibilities for the power board schematic and will be conducting state estimation research.

Angad Sidhu: Angad has been investigating different SLAM algorithms such as a LOAM (Localization, Odometry, and Mapping), and BLAM (Berkeley Localization and Mapping). He has been running these algorithms on the datasets that we collected at the Lafarge Quarry with the Velodyne Puck.

Logan Wan: Logan has been fulfilling the project management role and organizing meetings and managing at a higher level. He was primarily responsible for the power distribution board conceptual design, has been helping me with the CAD responsibilities, and has been researching the software that we will be using for mapping (BLAM, LOAM, Kartographer, and Karto.).

Future Plans

Future plans for me entail a significant amount of additional modeling. I still need to model the chassis and several components in the power and control systems, which will be ongoing. I will also be designing the sensor mounts for the RGB cameras and the Velodyne within the next week. I will also be looking more heavily into BLAM since it appears that we are staying with this mapping algorithm so that I will be prepared when we get more heavily into software.

In terms of the team, we plan to have the IMU calibrated by next week, the power board schematic designed, and we will be further researching software architecture and creating a list of resources for it.