Individual Lab Report 10

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Team A / The Avengers

Teammates: Tushar Agrawal & Pratik Chatrat

ILR10

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1. Individual Progress

Over the past two weeks, my main task was to redesigned and build obstacles for the SVE. I also assisted in small challenges and accomplishments centered on keeping our drone flying.

a. Obstacle Redesign and Build

Over the past few weeks, I've been iterating on our original concept for the obstacles. The original design called for a slightly taller -- and considerably more expensive -- set of obstacles. After some discussion, my teammates agreed to a refined obstacle set that raised the standards for the project while reducing the cost.

The new design can be seen in *Figure 1* below and a CAD mockup is shown in *Figure 2.* It consists of a backbone of two 2-inch PVC pipes with a base stand and a tarp "body" attached to a wooden frame. In effect, it's a glorified flag pole. Additionally, the obstacles are modular and disassemble for transport.

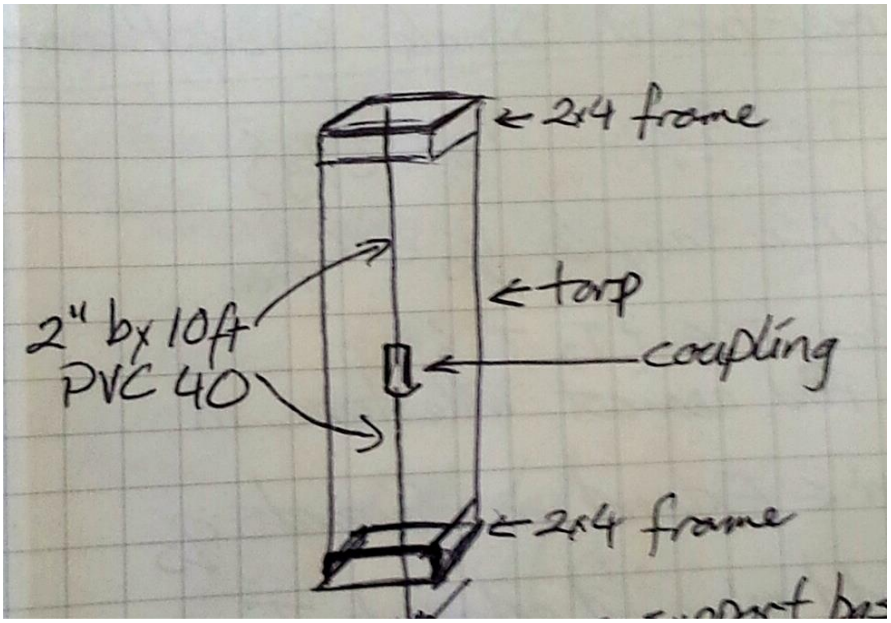

Figure 1: Updated Obstacle Design 6 Meters in Height

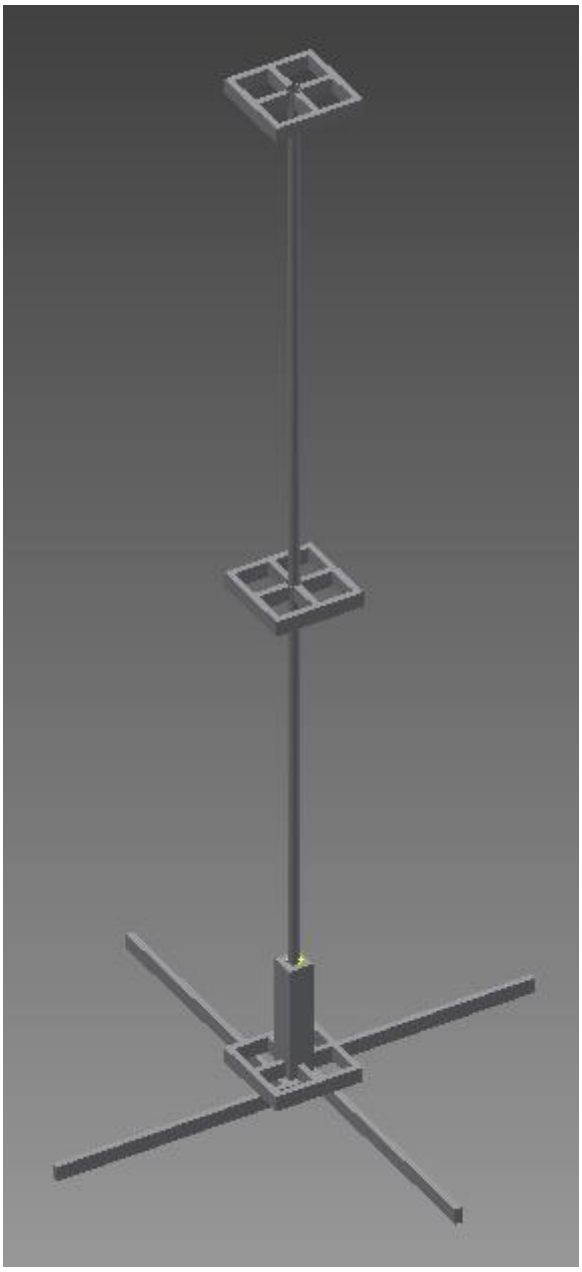

Figure 2: CAD Model of the Obstacle Design

Fabrication of the final design took two days. We identified several improvements during the build that were incorporated into the final design. The hardest part of the build was the wooden frames for the tarp. Braces extend from all four sides to buttress the pole and prevent movement. Finding the right tolerance took some patience (covered in the *Challenges* section). Final price of the obstacles was $169.47 and a partial assembly is shown in *Figure 3*.

Figure 3: Partially-Assembled Obstacle

b. Keeping the "Aerial" in Unmanned Aerial Vehicle

The worst crash of our project happened just before the last PR and significant effort was made to recover from that crash. This sprint, we actually used the original, damaged underbelly by cinching it to the battery for support.

The team experienced three crashes this sprint. Despite the repairs being quick, a large number of the spare parts were used, which validated our risk management

strategy. We were successful in restoring flight to the vehicle, which performed its tests after some additional tweaks by Tushar.

II. Challenges

There several issues this sprint dealing with drone crashes, the MakerBot, and obstacle fabrication.

a. Crashes as Fact-of-Life

The largest issue that the team faced was the crash of our drone. Several times. While recording tests, our drone experienced varied mishaps which resulted in collisions with concrete. While less damaging than the crash prior to last PR, these were more spectacular. I will defer to Tushar for an analysis on why each one happened. In total, three crashes occurred which damaged numerous propellers, legs, and support structure.

Each crash required use of the spare parts that Team A has been hoarding. We are running on borrowed time. The 3DR X-8+ is no longer manufactured. As such, spares effectively evaporated overnight from online vendors. I believe we can finish the program on the supplies we've managed to acquire. However, basing future MRSD projects on this model is unwise.

b. MakerBot 3D Printing

After the drone crash, we needed to reprint the underbelly which holds the NicaDrone EPM, LidarLite, and camera. However, the MakerBots were malfunctioning. It appeared that the filament wouldn't feed properly in either extruder on any machine. I made Dr. Dolan aware of the continued issues. On Tuesday, we got confirmation of a successful print from another team. However, we will be investigating alternate fabrication methods as the project continues.

c. Obstacle Fabrication

The 2x4 framing studs, while cheap, are neither square nor straight. Fitting the braces was a manual process requiring several visits to the wood shop. However, we noticed another issue once we fitted the braces and ran the brace up the "flag pole:" the frame was crooked and we couldn't straighten it with the tools we had. The solution is shown in *Figure 4:*

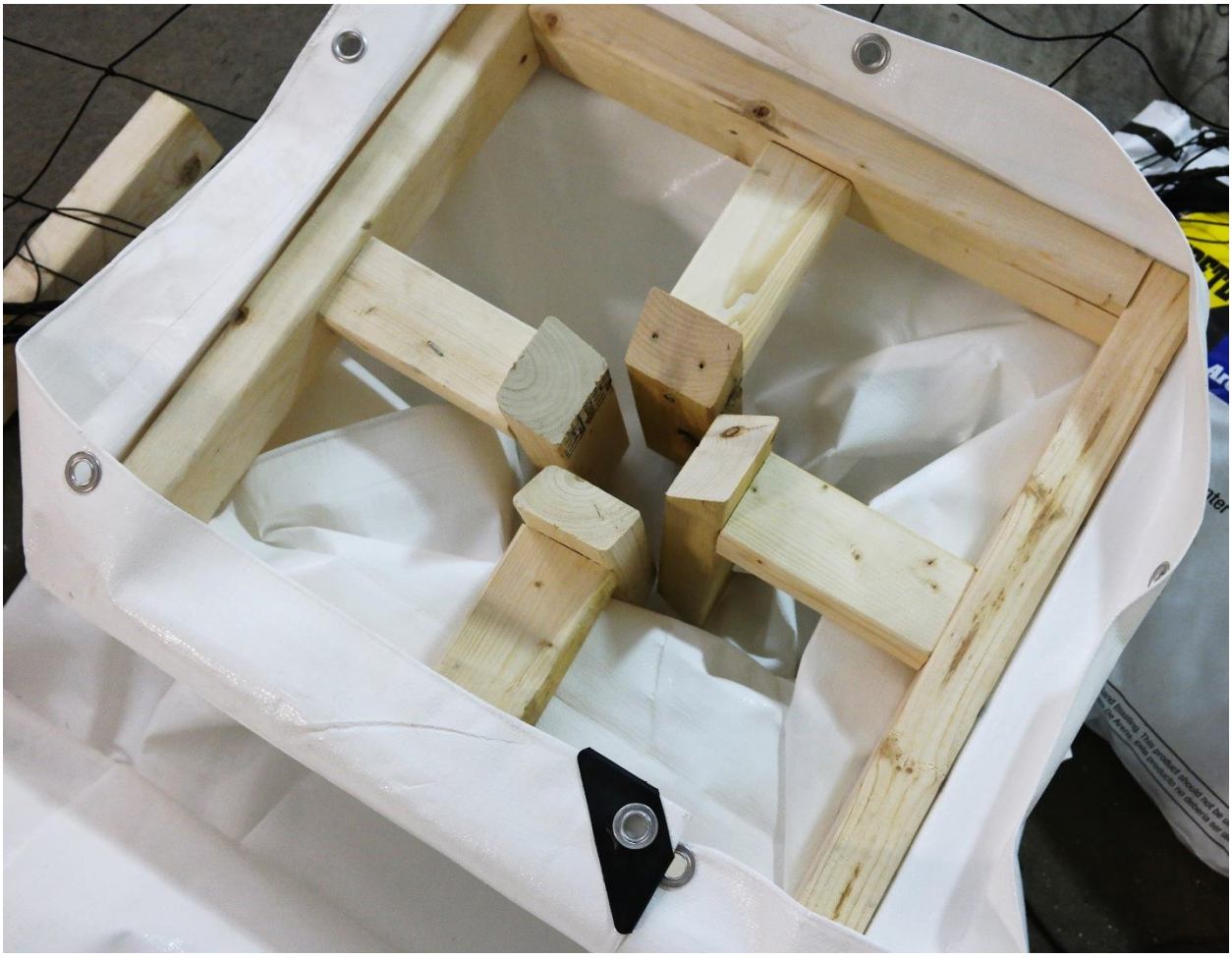

Figure 4: Improved braces

The additional braces allow of the frame to remain perpendicular to the pole. This method is only used on the highest of the three frames which permits the other two to remain level. Additionally, the inner supports were cut at 45° to allow them to slide over the coupler between the upper and lower PVC pipe.

III. Teamwork

Team A has recovered on the revised schedule that we committed to at the beginning of the semester. This sprint, each team member took on different components of the task. This allowed the team to build their individual skillsets while expediting the work.

Tushar Agrawal

Tushar pull more than his share towards the team's goal. This PR, he continued integration of the navigation stack with the rest of the code. Tushar relentlessly tests his code on the live drone and mentors Pratik on software development.

Pratik Chatrat

Pratik integrated his stack with Tushar's code. Additionally, he assisted in testing and obstacle fabrication. His training in Machine Shop transferred easily to the Wood Shop where he assisted me in assembling the obstacles.

IV. Plans

Before the next PR, the team has 3 main goals:

1. *Secure the Stadium for Testing (Sean)*
2. *Complete Integration of the Navigation Stack (Tushar/Pratik)*
3. *Complete a Full Dress Rehearsal (All hands on deck)*