# Individual Lab Report 9

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Team A / The Avengers

Teammates:  Tushar Agrawal & Pratik Chatrat

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## 1. Individual Progress

Over the past few weeks, I've (a) designed marker mounts, (b) designed obstacles for the SVE, and (c) worked towards implementing Odroid control of the NicaDrone Electro-Permanent Magnet (EPM). Progress was cut short by several challenges which I detail in the next section.

*a. Marker Mount Design*

Over the past few weeks, we've been using a custom AprilTag mounted on a piece of project board as a landing marker for the drone. The AprilTag works well, however the board we are using is too light weight and must be anchored to keep it from blowing away. This method has worked well for testing of marker identification, but poses a risk to the drone when landing. The drone can get caught or crash on any object raised above the AprilTag's surface.

The solution to this is to build a flat mount for the AprilTag that weighs enough not to be affected by the drone's propeller wash.

After discussing a few options with Tushar, I settled on a design based around a ½" of plywood. I will also drill holes in the sides for rope handles for ease of transport. This design will be cheap, easy to transport, and will be a stable platform for takeoff and landing.

*b. Obstacle Design*

Obstacles design and fabrication posed its own challenge which I'll cover in the *Challenges* section below.

The test requirements for the drone required that our project required the obstacles to be 1.5 x .5 m and 2 x 2 m. Upon further discussion as a team, we determined that two obstacles of 1.5 x .5 m would be more financially responsible in addition to raising the standards of the project as smaller objects are harder to detect.

The original design for the obstacles required that these profiles be elevated two stories in the air (approximately 6 meters). I planned to implement these using a scaffolding of ¾" PVC pipe. Tarp would cover the scaffolding to provide a surface for the Hokuyo Lidar to detect. This can be seen in *Figure 1* below.

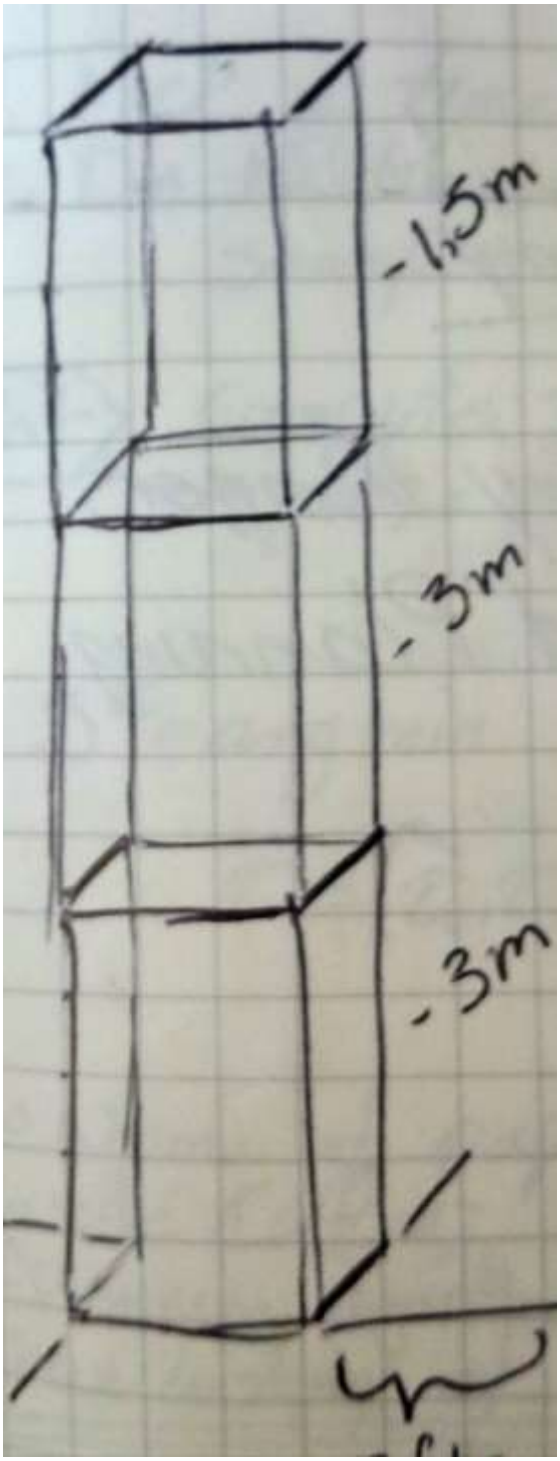


*Figure 1:* Original Obstacle Design 7.5 Meters in Height

However, upon inspection the ¾" PVC pipe was too thin to support the structure and would possibly buckle in the wind. 1-½" PVC would suffice but would also double the price. I purchased the required materials from Home Depot for $247.

Concerned about the price, I had a discussion with the team upon returning to the lab. I pointed out that the majority of the costs. We identified several misconceptions which I detail in the *Challenges* section. The materials have now been returned for a full refund.

The team settled on a second design that was significantly less costly. The second design which is shown in *Figure 2*.

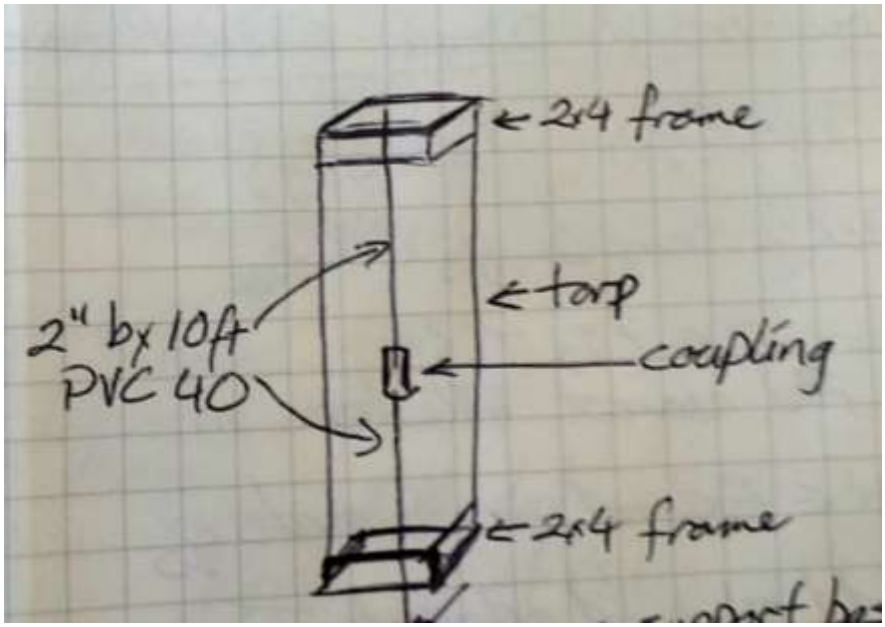


*Figure 2:* Updated Obstacle Design 6 Meters in Height

The new design is significantly cheaper and easier to transport. It uses two 2” PVC for a support shaft. Tarp mounted to a 2x4 wood frame provides the body of the obstacle. The body will be hoisted into place by rope like a flagpole.

*c. Odroid Control of NicaDrone EPM*

Due to an event which is also covered in the *Challenges* section, this goal for the PR was deprioritized. Work to be done for next PR.

**II. Challenges**

There were large issues this sprint dealing with a drone crash, the MakerBot, software incompatibility, and team miscommunication.

*a. The Crash*

The largest issue that the team faced was the crash of our drone. While recording video for the PR, our drone had a mishap and landed sideways. We speculate the crash was caused by the drone misinterpreting its height and dropping several meters. During its rapid descent, the drone hit a tree which knocked the drone sideways.

The drone impacted on its side which ripped the superstructure from the drone, removed a motor, bent the mount for a second motor, and destroyed the underbelly.

Our drone has now been rebuilt and is flying correctly despite several ad-hoc adaptions and a bent motor mount.

*b. MakerBot 3D Printing*

After the drone crash, we needed to reprint the underbelly which holds the NicaDrone EPM, LidarLite, and camera. However, both MakerBots were malfunctioning. It appeared that the filament wouldn't feed properly in either machine. Prints turned to spaghetti. Due to time constraints, I wasn't able to troubleshoot them as I have for the program in the past. According to Dr. Dolan, the 3D printers have been fixed and we will reattempt the print before next PR.

*c. Software Incompatibility*

In order to implement Odroid control of the NicaDrone EPM, we conducted research on the best method. It was identified that we will need to switch to the PX4 stack from the APM stack in order to access the channels required. This is different from the RF channel limitation of the RC Transmitter and is solely software based. It's important that the team understands the implications of this change before proceeding.

*d. Team Miscommunication*

Design and purchase of the obstacles was a significant time commitment that required balancing budget considerations, test requirements, and available materials. The high expense which prohibited the original design was caused by a misunderstanding of the requirements.

The drone currently scans at a height of 15m while looking for the obstacle. This is above the 7.5m originally communicated. The largest expense of the obstacles was its height. By going to a smaller cross section (1.5m x .5m instead of 2m x 2m), we were able to reduce the support structure of the obstacles. Additionally, I pushed that the drone be lowered in its search pattern allowing us to further reduce the obstacle to a height of 6m. This proposal was accepted. The team will acquire the required materials and build the obstacles before the next PR.

## III. Teamwork

Team A is now behind the revised schedule that we committed to at the beginning of the semester, but can easily recover the schedule. 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 continues to be the backbone of the team. He implemented autonomous landing and takeoff, and is helping me research how to implement Odroid control of the NicaDrone EPM.

*Pratik Chatrat*

Pratik has integrated the navigation stack into Odroid. Additionally, he has been a big help to Tushar in testing various subsystems.

## IV. Plans

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

1. *Reprint the Drone Underbelly*
2. *Control the NicaDrone EPM via the Odroid*
3. *Build the Obstacles*
4. *Complete Integration of the Software Subsystems*
5. *Work towards a Complete Dress Rehearsal*