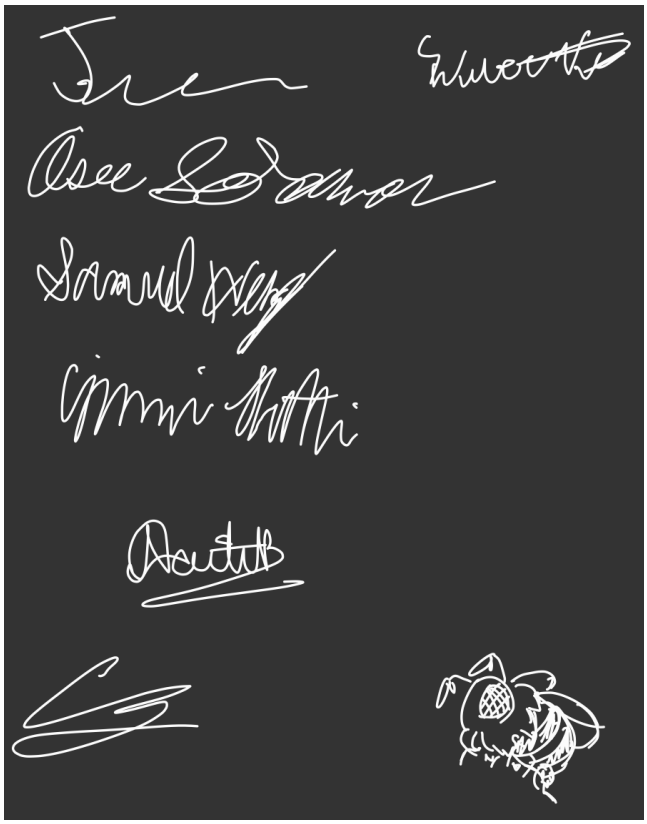
Crash Site Dummies Cover Sheet MS9

ENES 100- 0702

Milestone 9: 12/16/2021

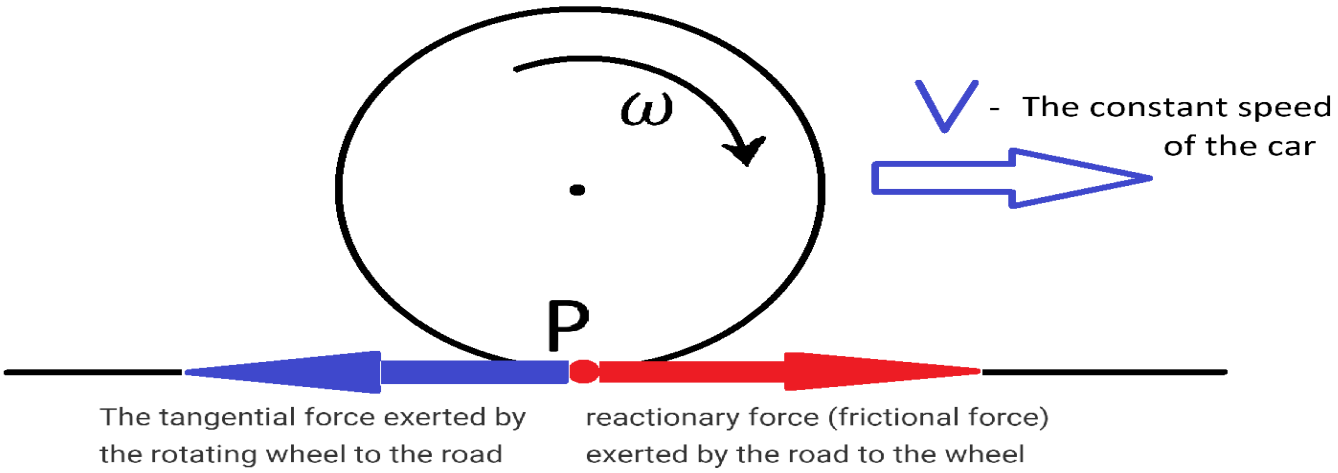
- Asa Solomon: Project management brief
- Giovanni Ratti: Modeling brief
- Sammy Hung: Teamwork brief
- Christina Zhang: Troubleshooting brief transcript
- Wilber Villeda: Engineering drawings, index
- Justin Nguyen: Prototyping brief
- Naitik Gupta: Electronics brief, Troubleshooting video



FINAL DESIGN BRIEFS

Design Brief 1: Modeling (Giovanni)

The speed we measured on our OTV was 20ft in 7.2 seconds. This is 0.85 m/sec (r=d/t), but the top speed is faster because the OTV has to accelerate before getting to the top speed. With a radius of 2.4 cm, this translates to an angular velocity of 338 rpm. This is very similar to the no-load speed given on the motor specification. The motor specs say the no-load speed is 350 rpm. As shown by the comparison of no-load speed to measured speed, the motors were not using much torque compared to their stall torque. The motors did not come with torque specifications, but we knew that there would be more than enough torque, especially while using 4 motors. Our estimate of the stall torque is about 1 N-m. The predicted torque that each motor would need to exert was about 0.02 N-m, which is only a small fraction of stall torque. This is why the measured angular velocity is almost the no-load speed. With our motors being so overpowered, they were predictable in terms of speed and were what we expected.

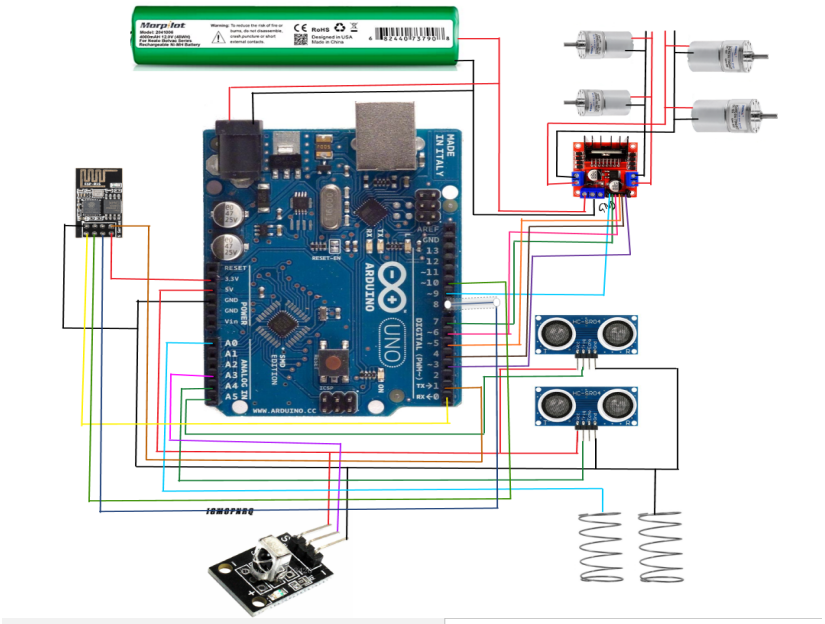


(Figure 1)

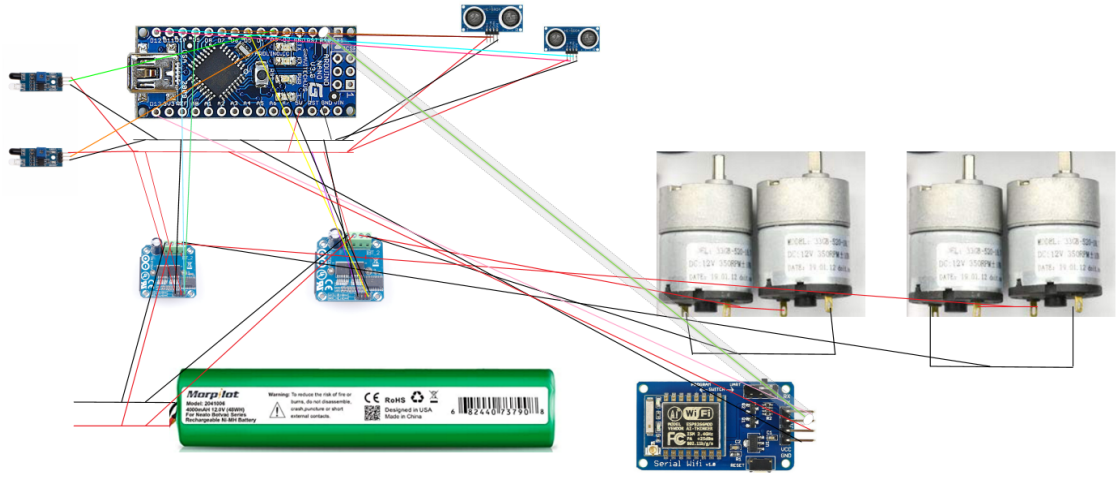
Calculations
V= 0.85 m/s
r= 2.4 cm
w= V/r
w= 338rpm
m= 2.1 kg
Frr= (.01)(2.1)
Frr= 0.021 kg

Design Brief 2: Electronics (Naitik)

Old circuit:



New Circuit:



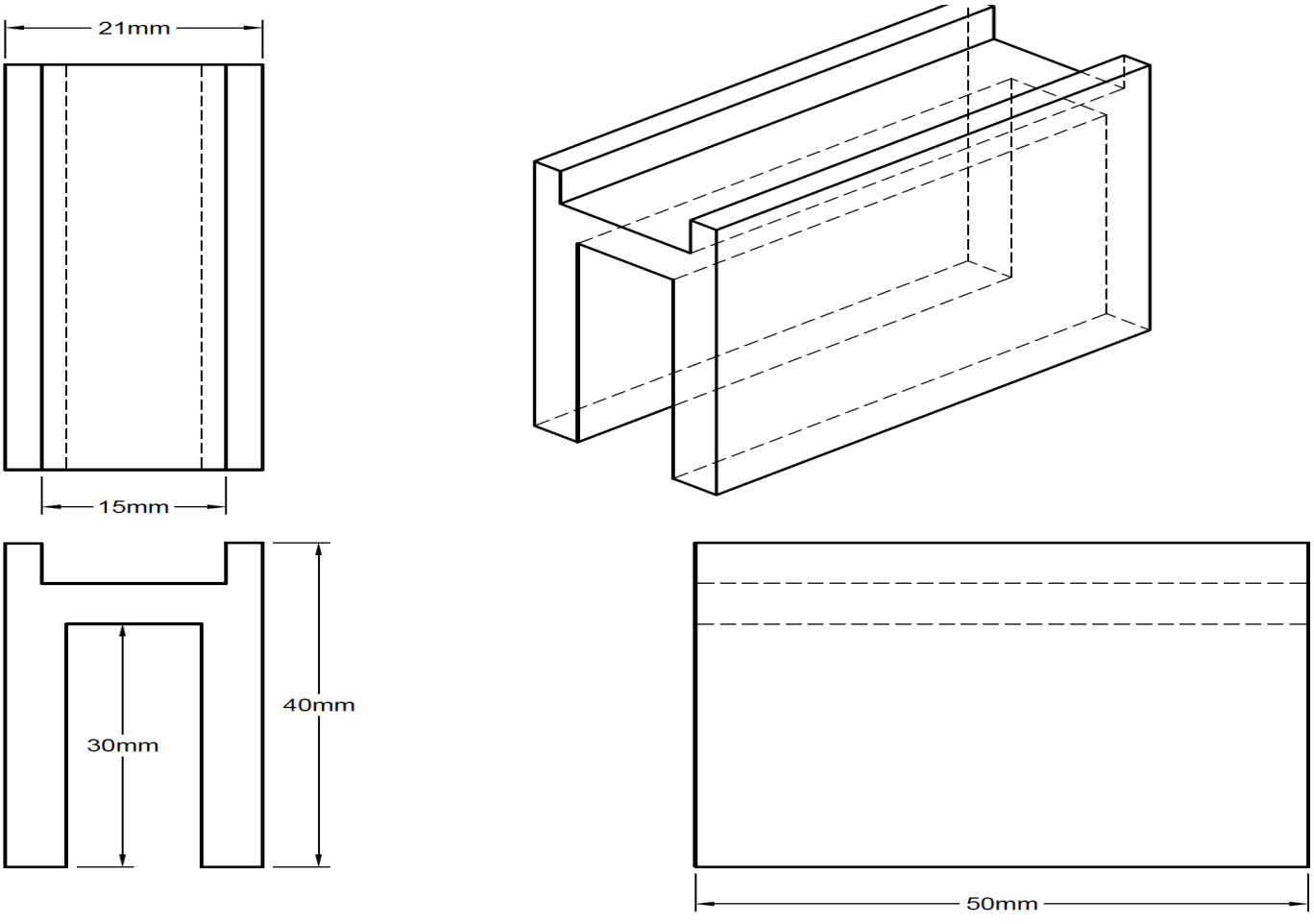
As we progressed, we realised that we needed additional sensors. We added the IR sensors that could detect the difference in colours of the side to detect the abnormality. We realised, we did not need the metal prongs anymore as the infrared sensors were giving a very accurate value for our results.

We also decided to swap our Arduino Uno for an Arduino Nano. This was done so the circuit could be more concise and fit a smaller footprint.

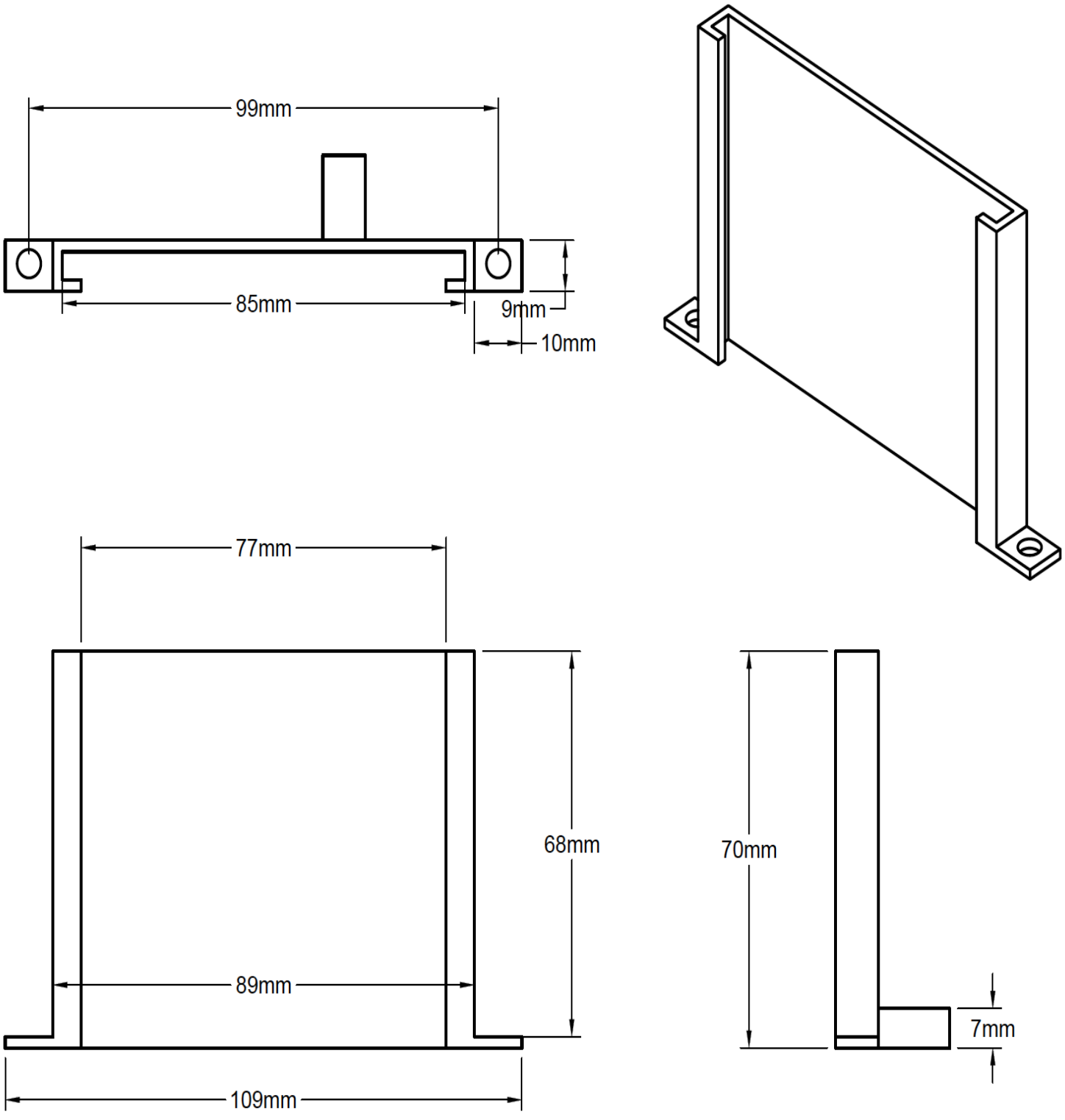
Finally, we decided to add another H-Bridge so reduce the high load on one H-bridge.

Design Brief 3: Engineering Drawings (Wilber)

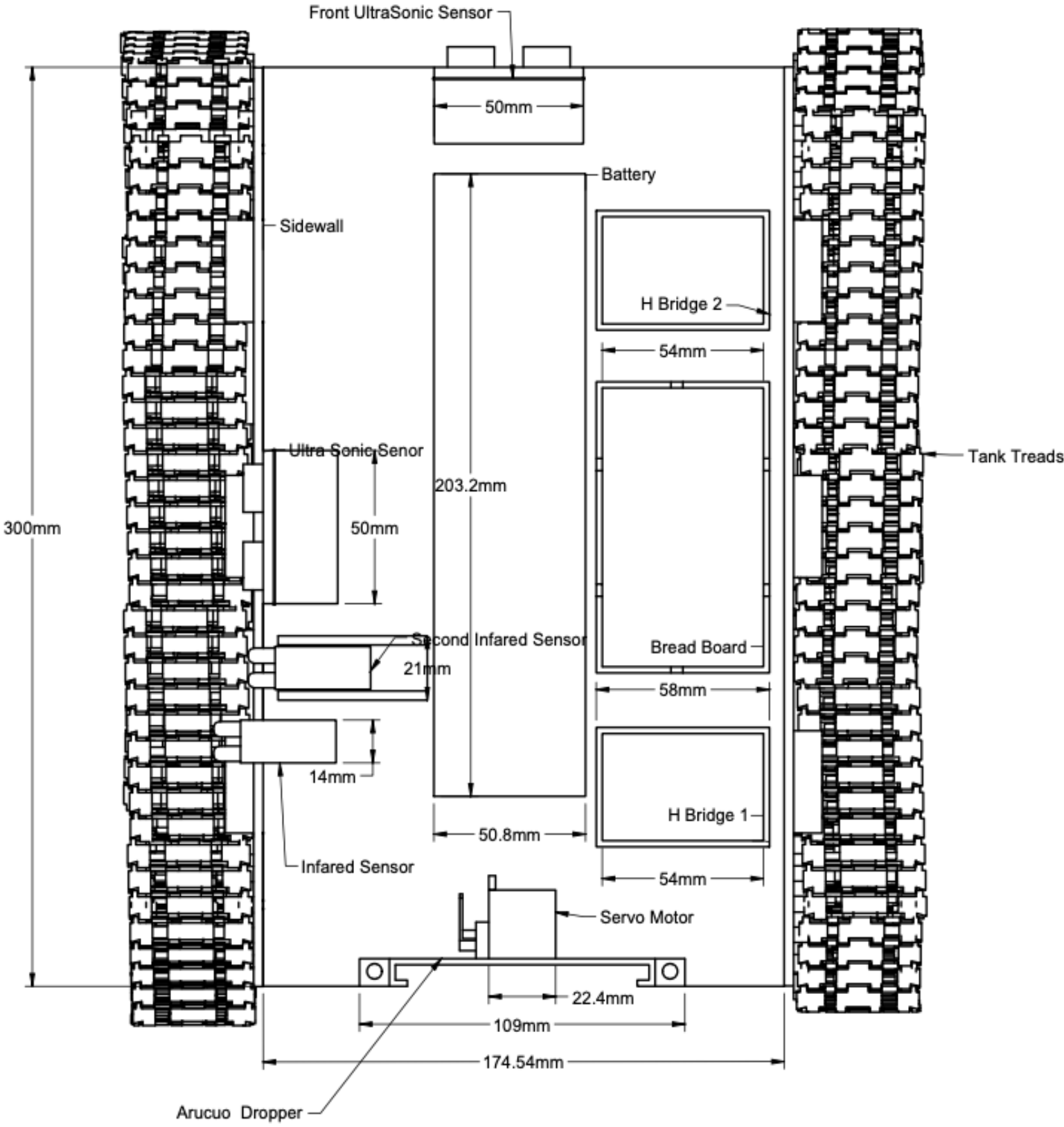
The final engineering drawing has many distinct differences from our first anticipatory drawings that were presented within the brief of MS3. The main differences can be spotted in the addition and removal of many sensors and components. Some examples of these can be how the cameras were ultimately removed, the addition of not one, but two H-brides, the addition of an IR sensor, the Aruco marker holder, the servo, the different placement of the battery, and of course all of the stands and mounts that needed to be created to maintain these said components. Below are the drawings of The Top-View OTV labeled with dimensions of the components, accompanied by a 4 side view engineering drawing, then there is a drawing with labeled dimensions of the IR sensor that we had made and 3D printed within the lab as our first non-commercial off the shelf component, and then the mount for the aruco dropper mount as our second non-commercial off the shelf component.



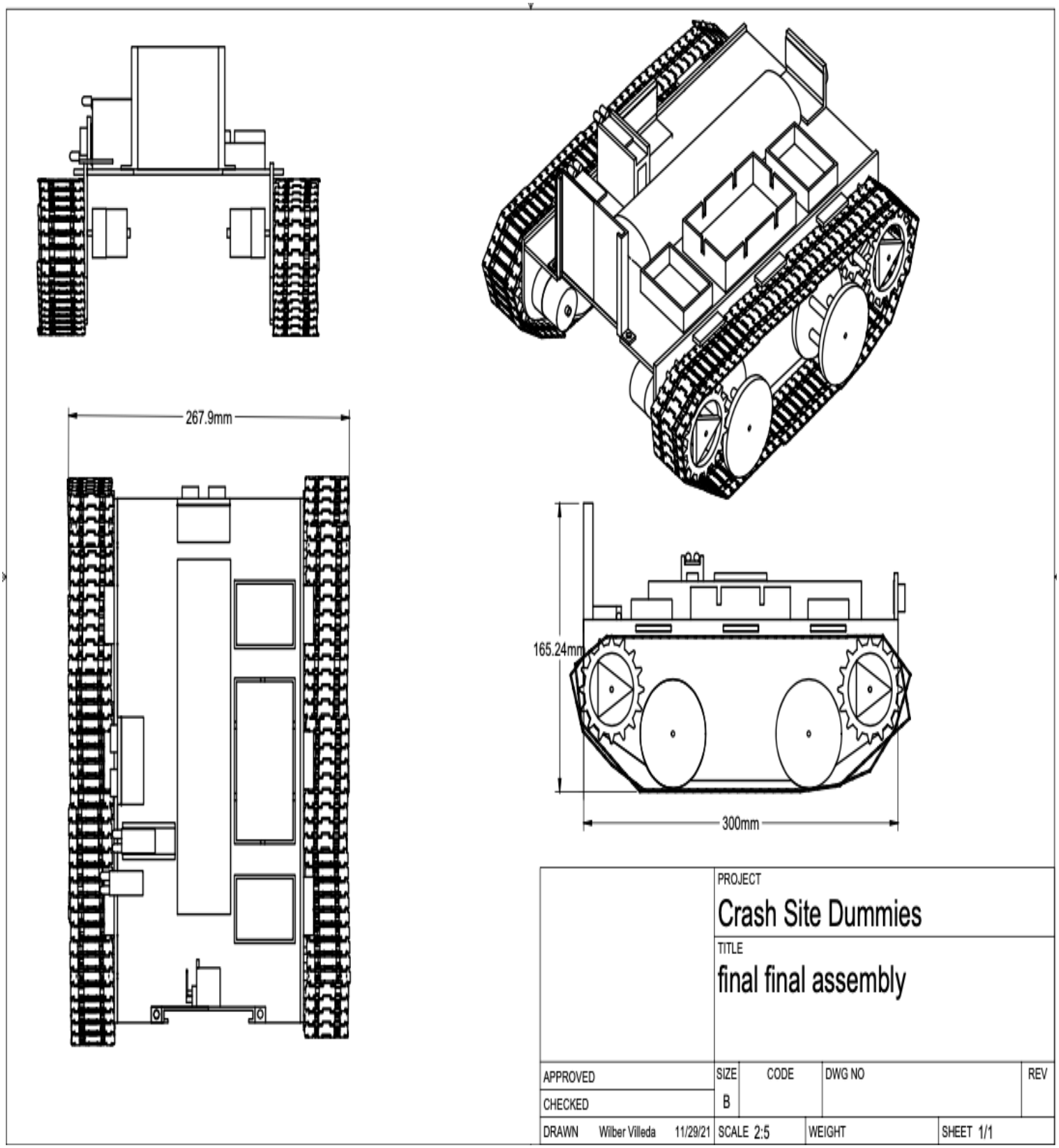
(Figure 2)



(Figure 3)


Front UltraSonic Sensor
50mm
Battery
Sidewall
H Bridge 2
54mm
Ultra Sonic Senor
Tank Treads
300mm
203.2mm
50mm
Second Infared Sensor
Bread Board
21mm
58mm
14mm
H Bridge 1
50.8mm
Infared Sensor
54mm
Servo Motor
22.4mm
109mm
174.54mm
Arucuo Dropper

(Figure 4)


267.9mm
165.24mm
300mm
PROJECT
Crash Site Dummies
TITLE
final final assembly
APPROVED
CHECKED
DRAWN Wilber Villeda 11/29/21
SIZE
B
CODE
DWG NO
REV
SCALE 2:5
WEIGHT
SHEET 1/1

(Figure 5)

Design Brief 4: Prototyping (Justin)

The part of our OTV that was most integrated throughout the lifespan of our OTV was the mission sensors. At the beginning of our design process, the main way we were planning to sense the abnormality was to use a camera along with a ruler attached to the front of it. The camera was meant to incrementally take pictures while we drove around our mission site until it detected a shift in color/shininess. In the beginning, we also planned to use the ultrasonic sensors to sense the distance between our OTV to obstacles and use the ultrasonic to measure the length of the abnormality, since it could be coded to start measuring when the abnormality is sensed. We soon realized that the camera would not be a plausible idea because our main coder, Christina, told us the Arduino would not be capable of handling a camera and processing the images to recognize a difference in color or texture. Our next idea for the sensing of the abnormality included using metallic prongs to touch the object, then when the prongs touched the metallic shiny plates on the crash site object it would receive an electric current.

Then, if the metal prong touched the abnormality, which is a black plastic material, the prongs would not receive an electrical current therefore the Arduino would have a quantity to use to differentiate the abnormality from the regular panels on the crash site. We decided not to go with this because we realized how dangerous it would be to run an electric current through two prongs and then through the Arduino to read. Throughout the many stages of our innovation of the devices to scan and analyze the crash site object, we used lots of paper drawings and sketches, which is much like rapid or throwaway prototyping. We went through the stages of prototyping quickly to figure out the best device possible that could accurately tell the difference between the abnormality's black plastic material in contrast to the normal crash site metal plating. Along with the accuracy in detecting a difference between the two crash site materials, a lot of the innovation and prototyping was the result of being realistic in what we wanted to make and not overcomplicating our ideas for the sake of being fancy or different.

Eventually, for our final design that was constructed, we decided on using infrared sensors to detect the abnormality versus the normal crash site plating. The infrared sensor was something that was easily integrated into our system since it was made by Arduino, it is very

accurate in being able to tell the difference between the metal plating and the black plastic. This is because it shines a laser on the object and records the reflected quantity back as an albedo value, so there are very distinct values of the metallic plating and the black plastic. Both of these factors are factors that made us decide on the infrared sensor, overall they are very realistic options for us to use. We also decided on keeping the ultrasonics since they work very well with the whole system and are fairly simple to use.

Design Brief 5: Troubleshooting (Video Transcript: Christina; Video Portion: Naitik)
Video Link:
https://drive.google.com/file/d/1S_xejck7EEdAvqfXrduQV0JODKotn2uJ/view?usp=sharing

Beta transcript *: (This was the skit idea for our video portion for troubleshooting we chose)

So, using an Arduino Nano is fun, I'll admit it. It's like a cute little baby compared to the Arduino Uno. But, the thing about babies is that: babies are extremely whiny. And they'll cry.

What do you mean it's not uploading the code?

It means it's not uploading the code!

By crying, they demand things.

What do you mean we need to download a driver?

We should've just used the Uno, at least we didn't have to download anything for that.

Very specific things.

Okay so google told me the normal driver doesn't work, so we need to download a different one from a Chinese website.

It looks like it would give me a virus.

Just download it.

Sometimes, they cry again after getting what they wanted.

It's not uploading again.

AGAIN??

And it's mentally degrading for everyone in a 5m radius.

IT WAS RUNNING FINE FOR A WEEK!!!

I can't do this again. Please for the love of god just tell me it's a fluke.

enters Hey guys, what's up?

And the thing with crying is that you can never tell what it's about.

I don't get it, I uninstalled and re-downloaded the driver several times and made sure I was using the right port. *sigh* made any progress?

Even with assumed experts helping you.

(TAs) No.

But eventually, you'll figure out what happened. You find that something you've done has upset it, and remedy that problem.

Hey, wasn't the main wiring difference we made when it stopped working that we connected wires to the 0 and 1 digital pins?

I don't know anymore.

removes 0 and 1 and finds it uploads and cheers, extended

Even though the trials and tribulations, the Nano is still something you have to rely on and learn through experience, and eventually, it will work out in the end… Until it doesn't.

It's not uploading again.

FFFF

Then it's time to throw out the whole baby and get a new one.

Design Brief 6: Teamwork (Sammy)

Throughout the project, the way we made decisions changed quite a bit. Initially, we tried to address every problem altogether as a team. When deciding on the initial plans for the vehicle we would all meet together as a team to discuss. Upon the beginning of the school year, we had weekly meetings at STAMP where we organized things such as all of the shared documents as well as ideas for MS1. While scheduling these meetings we aimed to have as many members present as possible typically having around 6 to 7 members present. However, as the semester went on it became apparent that not everyone could make these meetings in person, so we slowly transitioned to holding virtual meetings instead. Throughout all of this, we were still attempting to make all decisions together as a team. This was ineffective and impractical as most of the time conflicting schedules slowed or even halted our team's progress.

With MS1 approaching we assigned everyone a role as well as subgroups where each group was assigned tasks. It was at that point that our decision-making approach started to shift towards more individualized decision-making. Whenever we found a problem we would decide which subgroup was best suited to develop a solution. This expedited the decision-making process as it meant only a select number of people needed to work on developing a solution for the problem. This also helped us generate more effective solutions as the people who were approaching the task were better prepared in that area of expertise. For example, once we started working on the construction of the vehicle in preparation for MS5, I was working with Asa and Justin during office hours to get the vehicle built. We weren't sure how we were going to securely mount the sidewalls to the chassis, but we were able to expedite the decision-making process as only the three of us had to decide on the best solution. Initially, we had planned on using wooden triangular mounts that had been laser cut from spare plywood, however, there wasn't enough surface area on the sides of the triangles to stick to the sheets of plywood. We instead opted to buy metal brackets to secure the sidewall and chassis together.

In the final stretch of the project, we began to fully shift our approach to decision-making. With time of the essence, we began to start addressing problems individually as they arose while then getting input from others about the proposed solution. By this point, each member had certain areas where they were more comfortable and experienced. While attempting

to develop a new mechanism to drop our aruco marker at its target since we could no longer use an electromagnet, I developed a holder with a latch that would be used to drop the marker into place. While developing the CAD for the 3D printed part, I asked other members of the group including Asa and Justin what they thought and once I had the approval I printed the part.

Looking back, the most effective approach to our decision-making was when the decisions were made by the sub-teams or individuals working in that area for the vehicle. This approach best utilized the expertise and skills each member had as well as expediting the decision-making process.

Design Brief 7: Project Management (Asa)

During the beginning of the semester, the team was garnering focus and accommodation for the first Milestone. I, Asa Solomon, was put into the position of Team Leader. There had been some issues of teammates speaking over their fellow group members, so I tried to organize everyone and give everyone an equal chance to speak their opinions of the potential Over Terrain Vehicle and mission objectives. I as the team leader struggled to motivate everyone efficiently and properly. It seemed that each team member cared more about their other courses' work than the work of ENES100. The day to present milestone 1 came and we barely were able to complete the presentation with a passing grade. I believe the biggest reason being was that no one had taken ownership of the team's project and it showed. I felt that this was all my fault and I had failed my team. I thought to myself that a team is only as good as its leader and that I must not have been the correct leader for this team. I communicated with the team and told them that there would be a newly designated Team Leader and that I chose Naitik Gupta to be the successor because I believed he had a better vision for the Over Terrain Vehicle as a whole. I would then take over Naitik's position as Team Manager.

When I became the Team Manager, I took a step back and had Naitik try to organize the team for the upcoming milestone 2 presentations and milestone 3 reports. Unfortunately, I saw that the team was not responding well to Naitik's communication skills. I also quickly came to the realization that Naitik was not focused on actively organizing the team. He was more focused on the technical aspects of the over terrain vehicle. This is a fine area to focus on, but it does not allow for the organization of teamwork for the overall completion of the milestones at hand.

I had to make an unpleasant decision. I had to unofficially take back the focus of the team so that we could all work together on the milestone 2 presentations and the milestone 3 report. I also realized that I could not be “friendly” anymore and thought like I was coming out of this class with new friends. I had to become more of an authoritarian leader. I had to command this team’s attention. So, during the next meeting for the milestone 2 presentations, I detailed which individual groups would be working on which tasks and when those tasks were due. I also communicated with them about a meeting I had with Professor Lloyd where she said we are all failing this course and that she has threatened to break up the team if we do not do well on milestone 2. This, finally, gave the team the attention that this course deserved. We then presented Milestone 2 successfully.

What I have learned from my experience during this course from the Project Management standpoint is that it is important to remove oneself just ever slightly from a friendship approach to allow for commanding respect from the team.

Appendix