Backwards Looking PLan

Situation

Last week, the team did a test run with the AEV on the track and created a concept screening matrix. Before the test run, the team assembled one of the AEV designs that was drawn. The test run was completed so that the performance of the AEV constructed could be evaluated. After the test run, data collected by the Arduino during the run was downloaded to be used with the Design Analysis Tool. Using the tool, two graphs were made that showed the relationship between power, time, and distance during the test run. This process was necessary in order to learn how to utilize the Design Analysis Tool for the remainder of the project.

After collecting data from the test run, the team created the concept screening matrix. The team chose different criteria that would be used to compare the different AEV design concepts. The various aspects of each design were rated, and as a result, the team was able to discover which designs would be more successful than the others. The purpose of this exercise was to become more familiar with techniques used in design decision making and to choose the best AEV design to be used.

Results and Analysis

In exercise one a test scenario was run for the Arduino Nano on a makeshift AEV. The motors were performing well and as expected, as the code was fully accomplished with little problems. Points to consider include when the motors were starting from rest and operating at low percentages. For example, in line 1 of scenario one's code [Scenario *1*] the propellers puttered before picking up to the wanted speed of 15%. The team learned that the propellers feedback is not instantaneous and should be taken into consideration for testing. In exercise two an AEV was constructed and code was created. The AEV ran the code to completion with no problems. Noticeably, when the brake command was utilized, the AEV would not break right away and would coast to a stop. But because of the wheels, current power, and weight the AEV did not coast more than a few inches. Nevertheless, it was concluded that the AEV commands may limit the success of our AEV without the proper use, such as the break command. A fix to make the AEV stop faster would be reversing the propellers. Also, the reflector sensors were added and tested to the model AEV[*Image* 1]. In exercise three the team presented their AEV concept designs. Jordan's[*Image 2*] was narrow at the top with the propellers thrusting out of the back sides to catch more air. His battery was located under the AEV because it was the heaviest object to provide stability. Joe's[*Image 3*] AEV was the same as Jordan's except the battery was located on the top side of the AEV. This design was rocky and very heavy in the rear. Tyler's[*Image 4*] design was aerodynamic because the wings with propellers jutted up at a 45 degree angle. It was deemed very stable for being condense but also unsafe. Nick's[*Image 5*] design also uses the 45 degreed angled wings that center the thrust of the AEV. But Nick's design was also very unstable. The team created an AEV[*Image 6*] based off of the best performance, mainly modeled off of Jordan's AEV for its superior stability and safety. In exercise four the team constructed the top AEV and ran a code in order to obtain a power vs time plot [*Image 7*] and a power vs distance plot [*Image 8*]. The power vs time plot shows how the AEV slowly built up to the 25% wanted for the first three seconds. Once the AEV reached the first percentage power, it did not have trouble staying. The power vs distance plot showed the AEV moving forward and as more power was used, but the point where the AEV was supposed to go backwards is not present because the AEV used the backwards thrust to stop and did not go backwards at all. In exercise five, screening and scoring charts were made. The AEV's were ranked by plus(+) and minus(-) in reference to the reference AEV in stability, safety, durability, maintenance, and minimal blockage in the concept screening chart[*Chart 1*]. It was decided that Joe's and Jordan's designs were the best for the low thrust and safety. Jordan's design was put ahead though for its stability. The concept scoring matrix [*Chart* 2] multiplied the group's decided weight by the rating to add up to an overall score. Jordan's AEV scored highest for the same reasons.

Takeaways

Things that can be taken away from the AEV are the common applications for mechanical machines such as motors, servos, sensors, and controllers. All of which are common in the engineering world so it will be useful to understand how they work and what they do. Also learning the coding language that allows us to control our AEV will be useful for understanding how to communicate with a computer or controller which could be. The engineering design process taught us how to rank and assess each design efficiently helped the group to come together with a unanimous decision on what design should be used, as well as allowing us to see where our best designs could be improved. Additionally working as a team our group is good at evenly splitting workloads and coming to common agreements about design decisions allows us to work efficiently without holdups.

<u>Forwards looking plan</u>

Situation

In the upcoming week concept screening and concept scoring charts will be made that includes descriptions of the pros and cons of each AEV. This will be completed outside of the classroom in order to allow for optimal time spent on Advanced R&D in lab. The top two AEV designs will be determined and updated with the intent of choosing one design to work on in the near future. The website will be updated with work done from lab exercise five, meeting notes, and deliverables in order to stay up to date and not fall behind on website updates.

Starting on lab week five, two Advanced R&D topics will be decided amongst the group. These will be decided through talking about which topics the group as a whole is the most interested in while keeping in mind the choices of the other committees. Tasks will be assigned to individual group members to allow for each group member to know his responsibilities. How tasks are assigned will be worked out in lab five, with the work being split up randomly or having two team members per topic. In order to stay on top of the Advanced R&D research and deliverables, the group will meet outside of lab to work. Committee meeting one will also be worked on outside of the classroom in order to be the most efficient and timely of completion.

Weekly Goals

Week 5 Goals:

- Choose two topics for Advanced R&D based off the Advanced R&D resource guide.
- Divide deliverables and tasks in each topic decided either by choice/randomly or by splitting up the topics into 1 for 2 team members. This will be decided in lab 5 and will be decided based on equally divvying up the workload and responsibilities. Refer to Advanced R&D resource
- Talk about Advanced R&D to clear up understandings for timelines, reports, deliverables, and overall tasks.
- Understand objectives for specific Advanced R&D topic according to Advanced R&D resource.
- Begin working on testing procedure and deliverables for assigned topic

Week 6 goals:

- Meet up on weekend to work on specific topic and deliverables.
- Update AEV, change design to reflect best results from testing, concept screening and concept scoring.
- Learn about and get updated on Committee Meeting 1
- Work on and fully complete Committee meeting 1
- Work on Advanced R&D topics

Weekly Schedule

- One topic of Advanced R&D will be started on Wednesday February 7th and finished by Wednesday February 21st. It will be completed by the team as a whole with the work split up equally. Roughly, this task should take up at east 6 hours all together of work.
- Committee Meeting 1 will be started on Wednesday February 7th and completed by Wednesday February 14th. The whole team will work on the project, most likely meeting up over the weekend to work on it together. This task should take up about 3 to 4 hours.
- Deliverables in Preliminary R&D were started 4 weeks ago, but will be finished by Wednesday February 14th in order to stay caught up. The whole team will work on it together and also update the website with the deliverables. This task should take about 2 hours to complete

Appendix

Meeting Notes

<u>Meeting 1</u>
Date: Wednesday, January 10th, 2018
Time: 3:55-5:15
Location: Hitchcock, 224
Attendees: Joe Malinak, Jordan Thrash, Nick Study, Tyler Szekely

Topics Discussed: What all the parts were, the objective of the lab, and an overall idea of what would have to be done to complete project such as coding and where to place parts. Decided Jordan would take kit home (lost in Rock, Paper, Scissors to Tyler).

- All group members contributed to deciphering the project.
- This was done so that all group members understood what was supposed to be accomplished by end of project.

Upcoming tasks: Understand the track of the AEV: Tyler
Start coding: Joe, Jordan
Design AEV body and configure: Nick

<u>Meeting 2</u>
Date: Wednesday, January 17th, 2018
Time: 3:55-5:15
Location: Hitchcock, 224
Attendees: Joe Malinak, Jordan Thrash, Nick Study, Tyler Szekely

Topics Discussed: Worked on lab 1, including testing code and seeing how the AEV worked. The team talked about how to fix problems with the code and troubleshooting. The team could not get on to lab 2 due to technical errors.

- Jordan and Nick worked on the code.
- Joe and Tyler worked on connecting the motors and propellers to the test body and discussed how the sensors would be attached and connected.

Upcoming tasks: Sketch a possible AEV design
Work on catching up in lab

<u>Meeting 3</u>
Date: Wednesday, January 24th, 2018
Time: 3:55-5:15
Location: Hitchcock, 224
Attendees: Joe Malinak, Jordan Thrash, Nick Study, Tyler Szekely

Topics Discussed: Our sketched out AEV designs were the main topic. It was decided that it would be best to have the battery on the bottom because it was the heaviest and only had one wire that needed to be attached. A basic AEV was constructed off of this model, including propellers and sensors attached. This week, lab 2 was completed, with the sensors attached fully and tested. Pictures were taken of the sensors attach for website deliverables.

- Joe, Tyler, and Nick worked on constructing the AEV
- Jordan provided the AEV design that was the most popular with the battery on the bottom
- Jordan and Nick worked on code for testing sensors

Upcoming tasks: Update meeting notes
Catch up on website deliverables
upload pictures of AEV sketches
upload pictures of sensors attached

<u>Meeting 4</u>
Date: Tuesday, January 30th, 2018
Time: 7:30-8:30
Location: Thompson Library
Attendees: Joe Malinak, Jordan Thrash, Nick Study, Tyler Szekely

Topics Discussed: Jordan uploaded code and pictures of sensors. Team meeting notes were updated. All members posted pictures of AEV concept sketches and wrote about them.

Upcoming tasks: Complete exercise 4 in class on Wed, Jan 31st.

<u>Meeting 5</u>
Date: Wednesday, January 31st, 2018
Time: 3:55-5:15
Location: Hitchcock, 224
Attendees: Joe Malinak, Jordan Thrash, Nick Study, Tyler Szekely

Topics Discussed:

- Run the AEV design to get the data for the power vs. time and power vs distance plots
- Upload the data to matlab
- Deliver these tasks to the website
- Discussed the importance level of each category in the success criteria.
- Decide the ratings for each of the designs and calculate the weighted and total score.

Upcoming tasks:

- build the AEV
- progress report

Code

Scenario 1

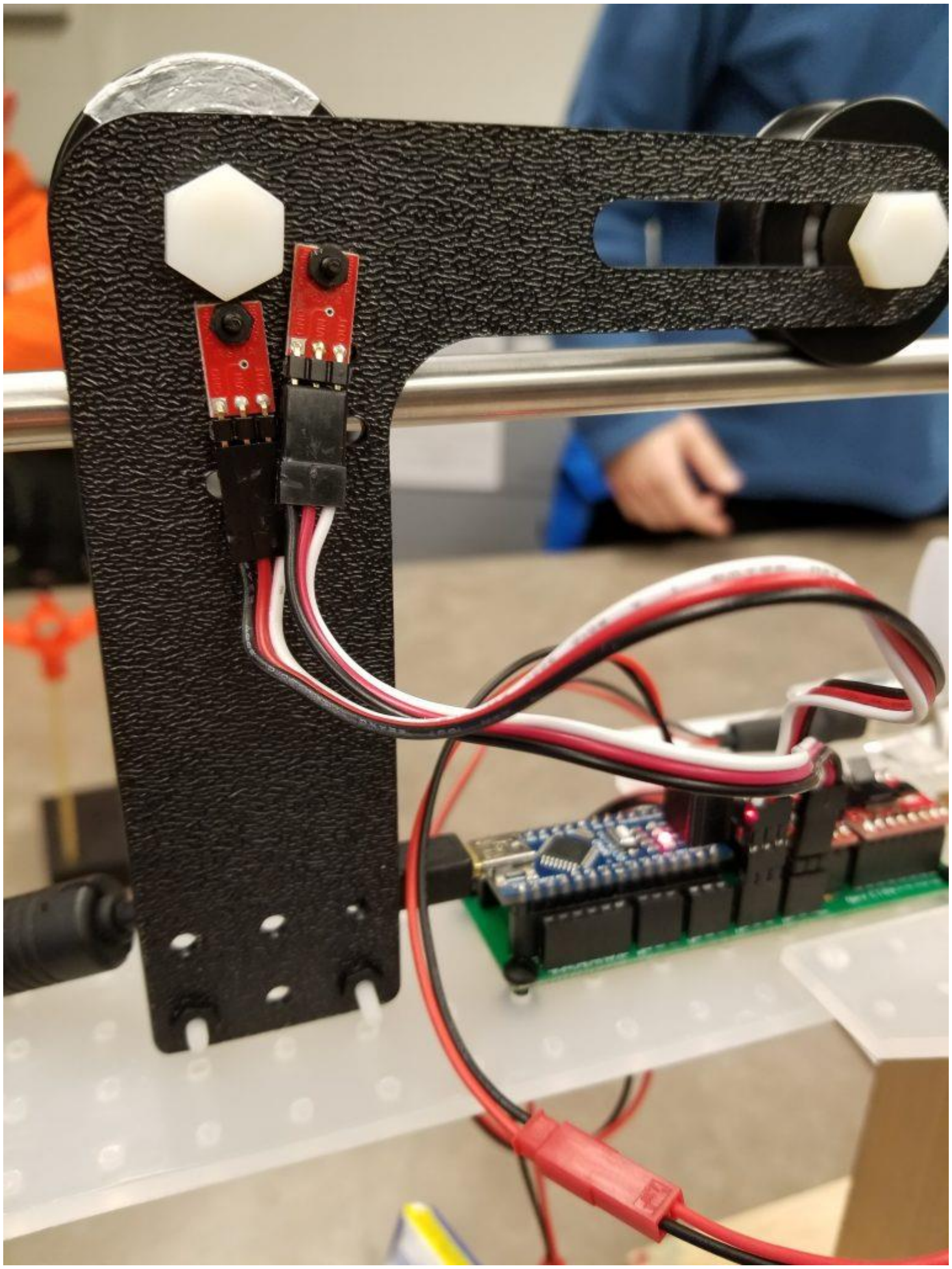
```
celerate(1,0,15,2.5); //Accelerate motor 1 from 0% to 15% in 2.5 seconds
goFor(1); //run motor at constant speed for 1 second
brake(1); //brake motor 1
celerate(2,0,27,4); //accelerate motor 2 from 0% to 27% in 4 seconds
goFor(2.7); //run motor 2 at constant speed for 2.7 seconds
celerate(2,27,15,1);//decelerate motor 2 from 27% to 15% in 1 second
brake(2);//brake motor 2
reverse(2);//reverse motor 2
celerate(4,0,31,2);//accelerate all motors from 0% to 31% in 2 seconds
motorSpeed(4,35);//set all motors to 35%
goFor(1);//run motors for 1 second
brake(2);//brake motor 2
goFor(3);//run for 3 seconds
brake(4);//brake all motors
reverse(1);//reverse motor 1
celerate(1,0,19,2);//accelerate motor 1 from 0% to 19% in 2 seconds
motorSpeed(2,35);//set motor 1 to 35%
goFor(2);//run motors for 2 seconds
motorSpeed(2,19);//set motor 2 to 19%
celerate(4,19,0,3);//accelerate all motors from 19% to 0% in 3 seconds
brake(4);//brake all motors
```

Reflectance Sensors

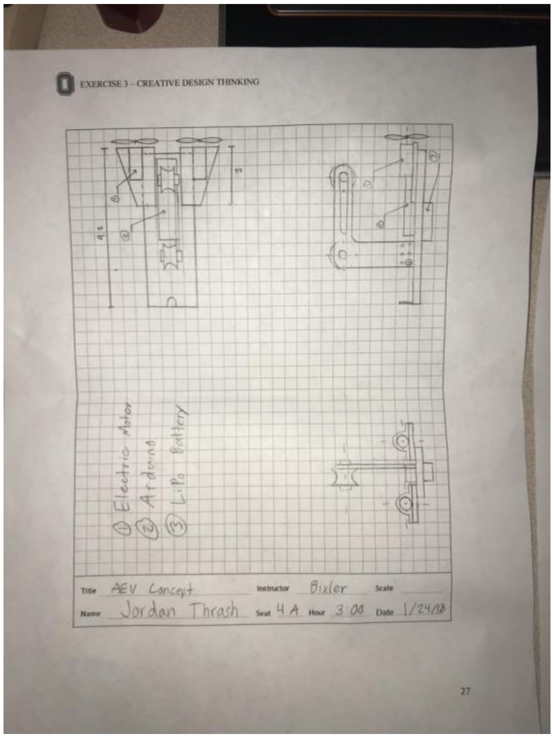
```
motorSpeed(4,25);
goFor(2);
motorSpeed(4,20);
goToAbsolutePosition(12);
reverse(4);
motorSpeed(4,30);
goFor(1.5);
brake(4);
```

Straight Track Test

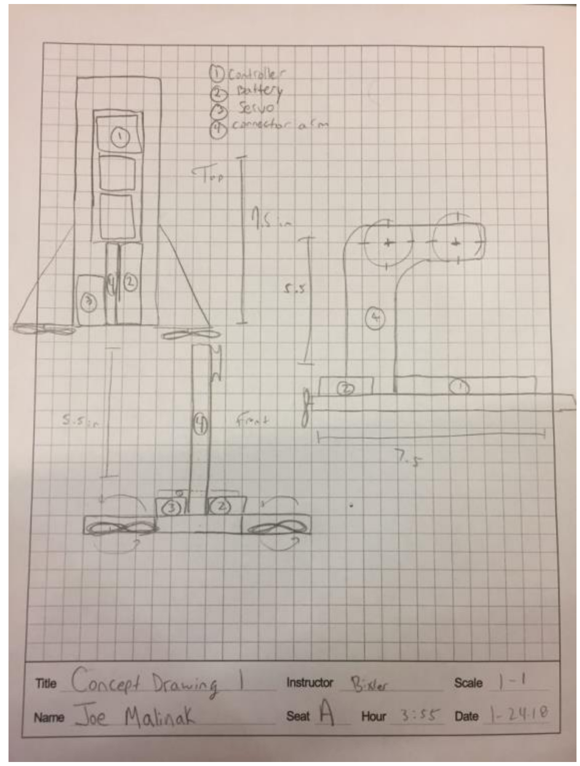
```
celerate(4,0,25,3);
motorSpeed(4,25);
goFor(1);
motorSpeed(4,20);
goFor(2);
reverse(4);
motorSpeed(4,25);
goFor(2);
brake(4);
```



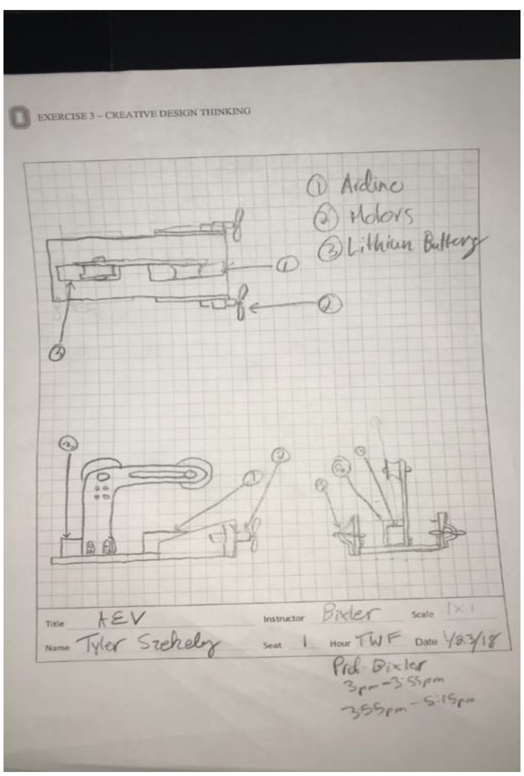
[Image 1] Reflectance Sensors attached to AEV



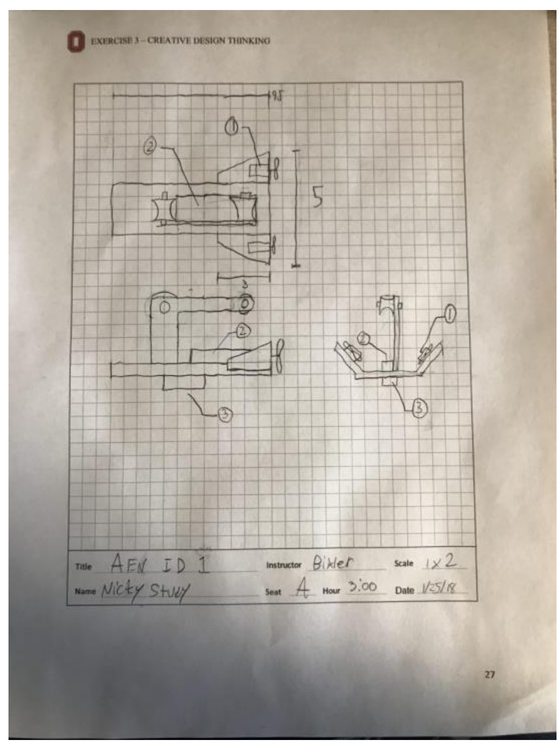
[*Image 2*] Jordan's AEV Concept Sketch



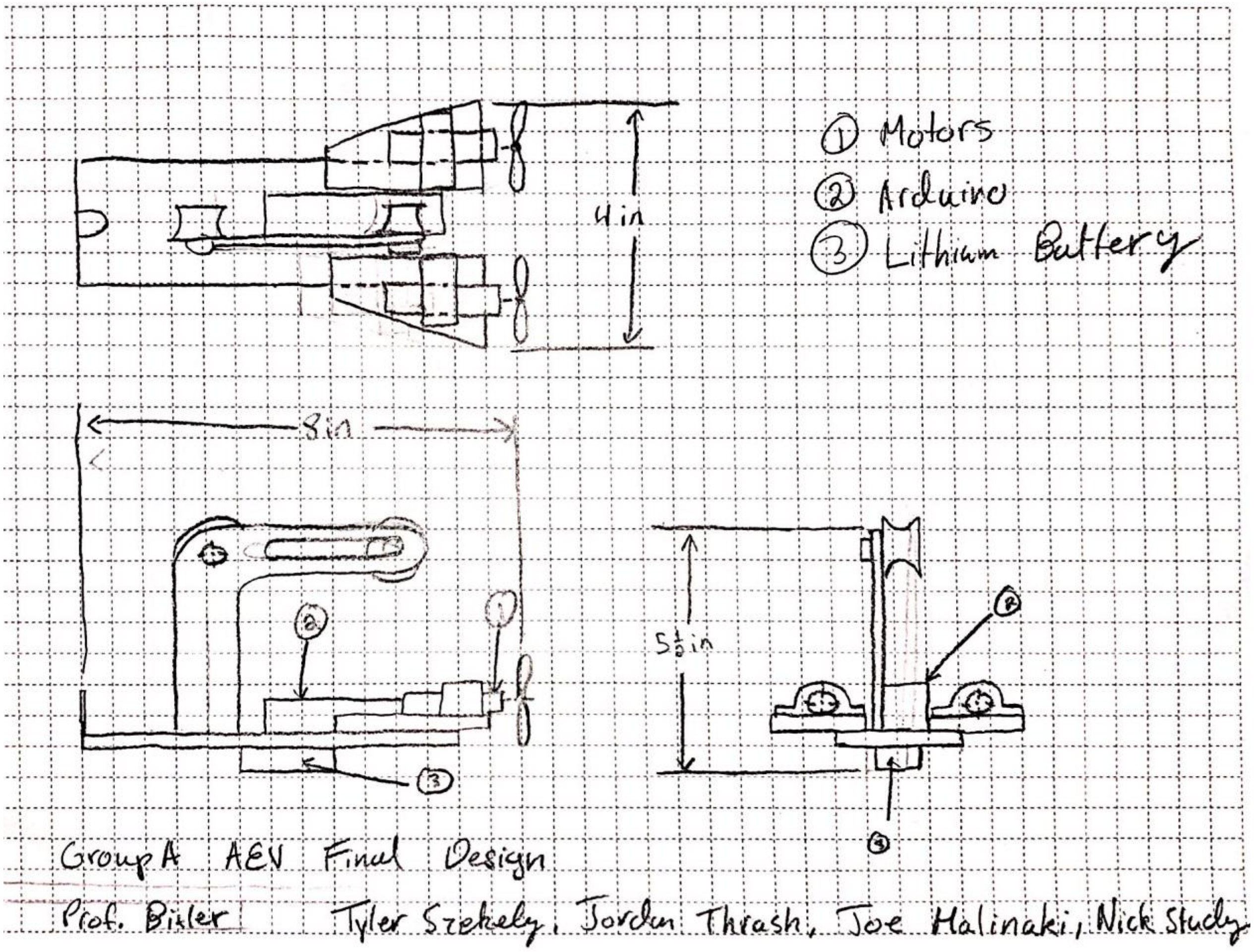
[*Image 3*] Joe's AEV Concept Sketch



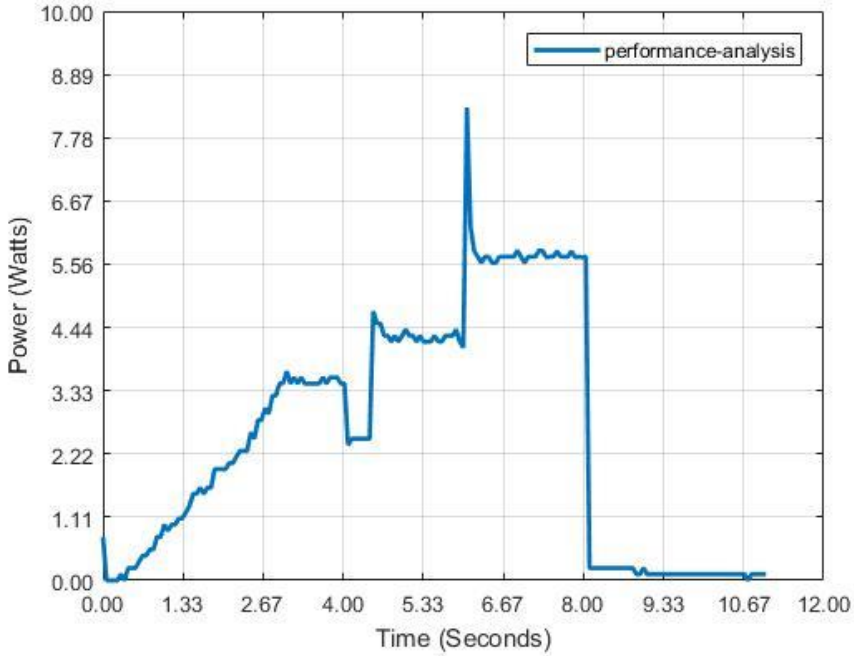
[*Image 4*] Tyler's AEV Concept Sketch



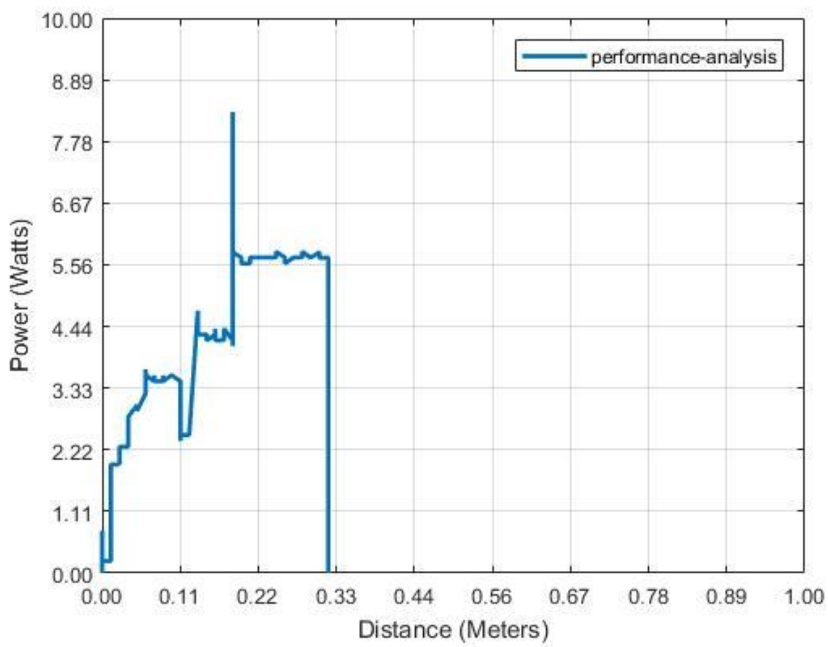
[*Image 5*] Nicky's AEV Concept Sketch



[*Image 6*] Developed AEV Concept Sketch by Group A



[*Image 7*] Plot of Power vs Time for “Straight Track Test” Code



[*Image 8*] Plot of Power vs Distance for “Straight Track Test” Code

Success Criteria	Refernce	Joe's Design	Tyler's Design	Jordan's Design	Nick's Design
Stability	0	0	(-)	(+)	(-)
Minimal Blockage	0	0	(-)	(-)	0
Maintenance	0	(-)	(+)	0	(+)
Durability	0	0	0	0	0
Safety	0	(+)	0	(+)	0
Sum +	0	1	1	2	1
Sum 0	5	3	2	2	3
Sum -	0	1	2	1	1
Net Score	0	0	-1	1	0
Continue?	combine	revise	no	yes	revise

[*Chart 1*] Concept Screening Chart

		Reference		Joe's Design		Tyler's Design		Jordan's Design		Nick's Design	
Success Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Stability	25%	3	0.75	3	0.75	2	0.5	4	1	2	0.5
Minimal Blockage	10%	3	0.3	3	0.3	2	0.2	2	0.2	3	0.3
Maintence	15%	3	0.45	2	0.3	4	0.6	3	0.45	4	0.6
Durability	20%	3	0.6	3	0.6	3	0.6	3	0.6	3	0.6
Safety	30%	3	0.9	4	1.2	3	0.9	4	1.2	3	0.9
Total Score			3		3.15		2.8		3.45		2.9
Continue?			No		Develop		No		Develop		No

[*Chart 2*] Concept Scoring Chart