Backwards Looking Summary

Situation:

In lab week 2 and 3, exercises 1, 2, and 4 were completed by Group A. In exercise 1, Group A learned the basics of programming the Arduino and checked the motors to see if they were functioning properly. Group A programmed a scenario, where the motors went forward, reverse, and both, using the basic Arduino function calls, such as celebrate, motorSpeed, goFor, brake, and reverse, to test out the motors. In exercise 2, Group A constructed a sample AEV design and performed a reflectance sensor test using the reflectanceSensorTest(); code. The reflectance sensor test was running the motors to have the AEV travel 12 feet. In exercise 4, the AEV that was built in exercise 2 was used to program a scenario on the tracks. Then the Arduino was plugged into one of the team member's laptops to record the Power vs Time and Power vs Distance data. Then the data was interpreted by the group to figure out what the data shown meant.

In lab week 4, exercises 3 and 5 were finished by Group A. In exercise 3, individual Group A members brainstormed ideas of how the AEV should be designed/constructed. Then a concept sketch was formed from brainstorming together and was drawn on graph paper. In exercise 5, two charts were made to compare a reference AEV to Group A's designs. One chart was a Concept Screening Matrix to how the designs fit the success criteria. The other chart was a Concept Scoring Matrix to score the designs and the one with the highest score will be designed.

Results & Analysis:

Throughout the course of the Preliminary Research and Development labs, the team could make observations on various aspects of the Advanced Energy Vehicle.

Many of the team's observations were made about the performance of the vehicle, as there were many moments when the vehicle would not move, even though there was the correct amount of power being given. This took place specifically in lab 4, where even though there was enough power sent to the vehicle, it still did not move. The team observed this with the small propellers, and found that changing those out for larger propellers made the AEV move. This change in propellers resulted in the AEV moving with lower power levels, making the team notice that the propellers would play a large factor in the efficiency of the vehicle.

Both graphs (see additional requirements) were recorded with the larger propellers. The first graph displays Energy vs. Distance, and the second graph displays Energy vs. Time. In the Energy vs. Time graph, the power speeds of the motors fluctuate. When the line goes up, the speed increases, and when the lines go down, the speed decreases. The Energy vs. Distance graph is a little different. The long straight vertical lines indicate when the AEV brakes or reverses, a bottom to top line signifying an increase in power as distance increases, with the opposite meaning the power decreases as the distance increases.

In lab 5, the team was given the chance to make more observations on the assorted designs which were created by each team member in lab 3 (see images below in additional

requirements). Throughout the lab, many team members were making observations on what they felt was good about each design, and what could be changed in future designs. This allowed the team to create a concept score, and eventually a concept screen including all the designs (see below). The team could do this by creating different criteria, assessing what the team thought was most important for the AEV design. This included, weight, stability, safety, and some others. The most important two to team A's AEV were the safety and weight (how heavy the AEV is) which were decided on when creating the weight for each criterion. Afterward, each design was scored based on the weights and rating for each design.

Both the concept score and screen let the team decide which designs to continue development with, and which ones to leave behind. In this case, it seems that design A and design D should be developed and tested, while the reference design, and design C should not be developed further.

Takeaways:

Over the course of the first few weeks of lab exercises, Group A made several insightful observations about the AEV performance. There were moments observed in testing in which the AEV would not move even with the recommended amount of power. It was observed that the smaller propellers did not generate enough force to successfully move the vehicle, so Group A decided to replace the smaller propellers with the larger set of propellers. This noticeably increased the functionality of the vehicle. This early observation made it clear to Group A that certain factors such as weight and stability would play a large role in the overall success of the project, and as such they were added to the concept scoring and screening list along with movement in both directions, safety, and maintenance. This list of criteria was discussed and agreed upon throughout the early development and testing stages.

After the process of concept scoring and concept screening, Group A was able to narrow down all of the design concepts to just two designs, design A and design D. These designs proved to be well rounded and efficient concepts, with higher marks in most categories than the reference AEV. Group A intends to move forward with developing and testing these designs. The positive mentality and synergy between members of Group A has proven to be a solid framework for an efficient team. Group A has been successful in delegating tasks between members based off of each member's individual strengths, and each member has completed their assigned work well and in a timely manner. This project has been promoting positive work ethics between not only team members, but also all members within each engineering firm. The importance and usage of meaningful communication between all people associated with this project has proven to be a vital tool in the success of the team.

Forwards Looking Plan

Situation:

The upcoming week(s) for the AEV Project include: advanced research and development, preparing for committee meeting 1, completing the grant proposal, and gathering all necessary materials for the completion of the final AEV concept design. Through the completion of these tasks within weeks 5 – 7, a better understanding of the AEV as a whole will be learned by the students.

The tasks are necessary to the AEV project because they will introduce students to topics like: Motor Configuration, Track Variance, and Energy Analysis, which are topics not common to student's everyday research in academia. It will be interesting to discover how these factors, and many more, will influence the different AEV designs. The tasks will be completed in and outside of class as well as brain storing in a group message for the team. Weeks 5 – 7 are crucial for the overall completion of the AEV Project, and by completing these weekly goals, Group A will be successful in determining the ideal AEV concept design.

Weekly Goals:

Goals for the Week Include:

1. Build Final Team Concept Sketch
2. Test Final Team Concept Sketch
3. Use AEV Analysis Tool to compare AEV models

The Final Build for the Concept Sketch will be completed by the entire team during class time, as well as the testing for the design, too. Group A has planned to have members test it along the overhead track in Hitchcock 224 with someone at the end of the track to catch it once the code is finished. It will be tested with the code given in the previous labs, and then begin to brainstorm ideas for the final respective code. The group will then use the AEV analysis tool to compare the results of the AEV design to previous designs and previous runs of the Arduino code.

Weekly Schedule:

Tasks to complete for Week 5:

1. Complete Project Screening by first class Week 6
2. Complete Project Scoring by first class Week 6
3. Finalize AEV Concept Design due by the end of aR&D
4. Prepare for Committee Meeting 1 due Feb 13
5. Progress Report 1 due Feb 6

Each of the four tasks to be completed this week will be headed by a different member of the group. Anna will be in charge of finalizing the AEV concept design and uploading all the concept sketches to our website. She will have help from Elle, making sure that everything gets done in the right format and helping to organize all of the deliverables. This task will be

completed by Lab Week 05. The Project Screening will be completed by both Phil and Michael. They will assist each other by having two sets of eyes carefully examining each concept design in order to properly compare it to the original provided AEV design. Michael and Phil will also share the task of completing the Project Scoring. It is crucial to have two people to complete this task in order to assign proper weights to each screened category and to score them appropriately. Both of these tasks, project screening and project scoring, will be completed by Lab Week 06. Elle will have the task of preparing for Committee Meeting 1, and the Progress Report 1. It is her job to make sure that all of the pieces of the report are fully completed, and that the group is prepared for the committee meeting and has their final AEV concept design ready. The Progress report will be completed by Lab Week 06 and the preparation for the committee meeting will be ready by Lab Week 07.

Appendix

Appendix A: Team Meeting Notes:

Team Meeting Notes
Week: 1
Location: Hitchcock 224
Time: 8:00 AM
Attendees: Elle Marquez, Phillip Da Silva, Michael Gregg, Anna Cutno

Meeting Objective:
The objective of this meeting is to begin the initial research and brainstorming for the AEV project. Also, members met each other for the first time so they were able to introduce themselves.

Previous Meeting Topics:
This was the first group meeting.

Topics Discussed:
1. AEV Project initial ideas – how to build, and basic research of parts that came I AEV box
2. Initial Brainstorming
    a. Disney monorail design?
    b. Possibly use the servo for breaking and rotating

Upcoming tasks:
Assigned to all of team -
1. Research
2. Update website
3. More brainstorming for possible design ideas

Timeline:
Complete initial R&D and Lab 1 and 2 by 1/16/18

Decisions made by the group:
Team Roles Decided:
Michael Gregg – Team Leader
Elle Marquez – Note Taker
Anna Cutno – Time Keeper
Phillip Da Silva – Researcher

Reflection on previous assignment:
This was the first group meeting and first assignment.

Team Meeting Notes
Week: 4
Location: Hitchcock 224
Time: 9:35 AM
Attendees: Elle Marquez, Phillip Da Silva, Michael Gregg, Anna Cutno

Meeting Objective:

The objective of this meeting was to brainstorm ideas and designs for the final AEV design. Members also scored the AEV designs based on a list of criteria through concept screening and concept scoring.

Previous Meeting Topics:

The objective of the previous meeting was to begin the initial research and brainstorming for the AEV project. Also, members met each other for the first time so they were able to introduce themselves.

Topics Discussed:

1. Possible Design Ideas – combinations of pieces and placement on AEV
    a. T-shape/X-shape
2. Lab 3 and Lab 5 Progress Report Questions
    a. Individual concept sketches, orthographic view

Upcoming tasks:

Anna – Website Deliverables Lab 3 & Lab 5
Phillip – Put data from concept screening and scoring into excel document
Michael – Continue working on Progress Report Questions
Elle – Continue working on Progress Report Questions

Assigned to Entire Team -

4. Research
5. Update website
6. Email Anna Concept Sketch

Timeline:

Complete Lab 03 and Lab 05 website deliverables and progress report by 2/6/18

Decisions made by the group:

Main AEV design decided upon, minor tweaks still able to be made.

Reflection on previous assignment:

Many AEV concept sketches were brainstormed and the multiple sketches helped us to narrow down which one to use.

Appendix B: Arduino Code:

ReflectanceSensorTest

```
reflectanceSensorTest();
```

ExternalSensorsOutside

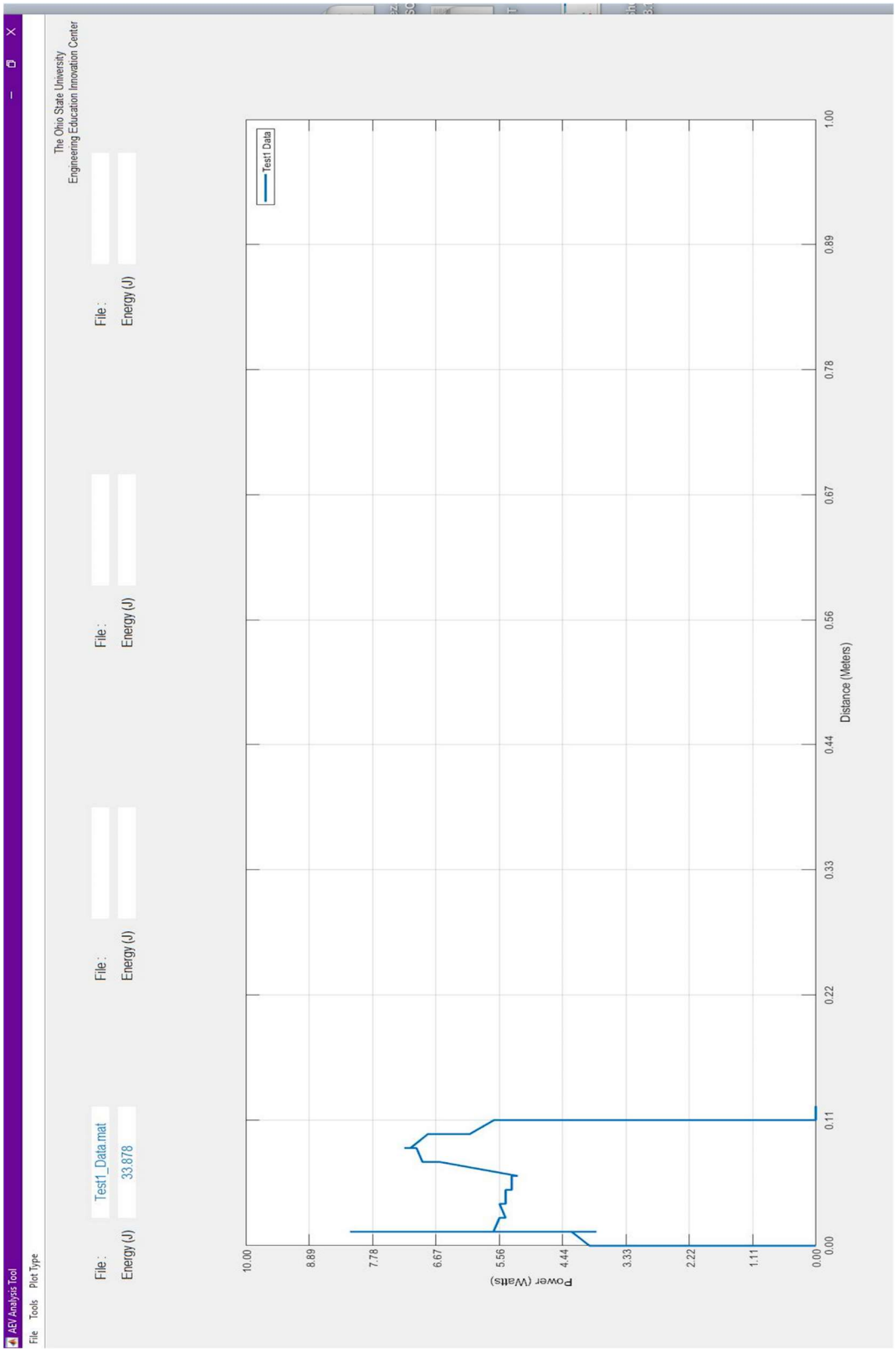
```
  motorSpeed(4,35);
  goFor(2);
  motorSpeed(4,35);
  goToAbsolutePosition(295);
  reverse(4);
  motorSpeed(4,35);
  goFor(1.5);
  brake(4);
```

PrgmBasics

```
  celerate(1,0,15,2.5); //accelerate motor 1 from 0 - 15 % in 2.5 seconds
  goFor(1); // move at 15% for  second
  brake(1); // brake motor 1
  celerate(2,0,27,4); //accelerate motor 2
  goFor(2.7); //go for 2.7 seconds
  celerate(2,27,15,1); //decelrate motor 2
  brake(2); //brake motor 2
  reverse(2); //reverse motor 2
  celerate(4,0,31,2); //accelerat both motors
  motorSpeed(4,35);
  goFor(1);
  brake(2);
  goFor(3);
  brake(4);
  goFor(1);
  reverse(1);
  celerate(1,0,19,2);
  motorSpeed(2,35);
  goFor(2);
  motorSpeed(1,19);
  goFor(2);
  celerate(4,19,0,3);
  brake(4);
```

Additional Requirements:

Energy vs. Distance


AEV Analysis Tool
File Tools Plot Type
The Ohio State University
Engineering Education Innovation Center
File : Test1_Data.mat
Energy (J) 33.878
File :
Energy (J)
File :
Energy (J)
File :
Energy (J)
Test1 Data
Power (Watts)
Distance (Meters)
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6.67
5.56
4.44
3.33
2.22
1.11
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0.00
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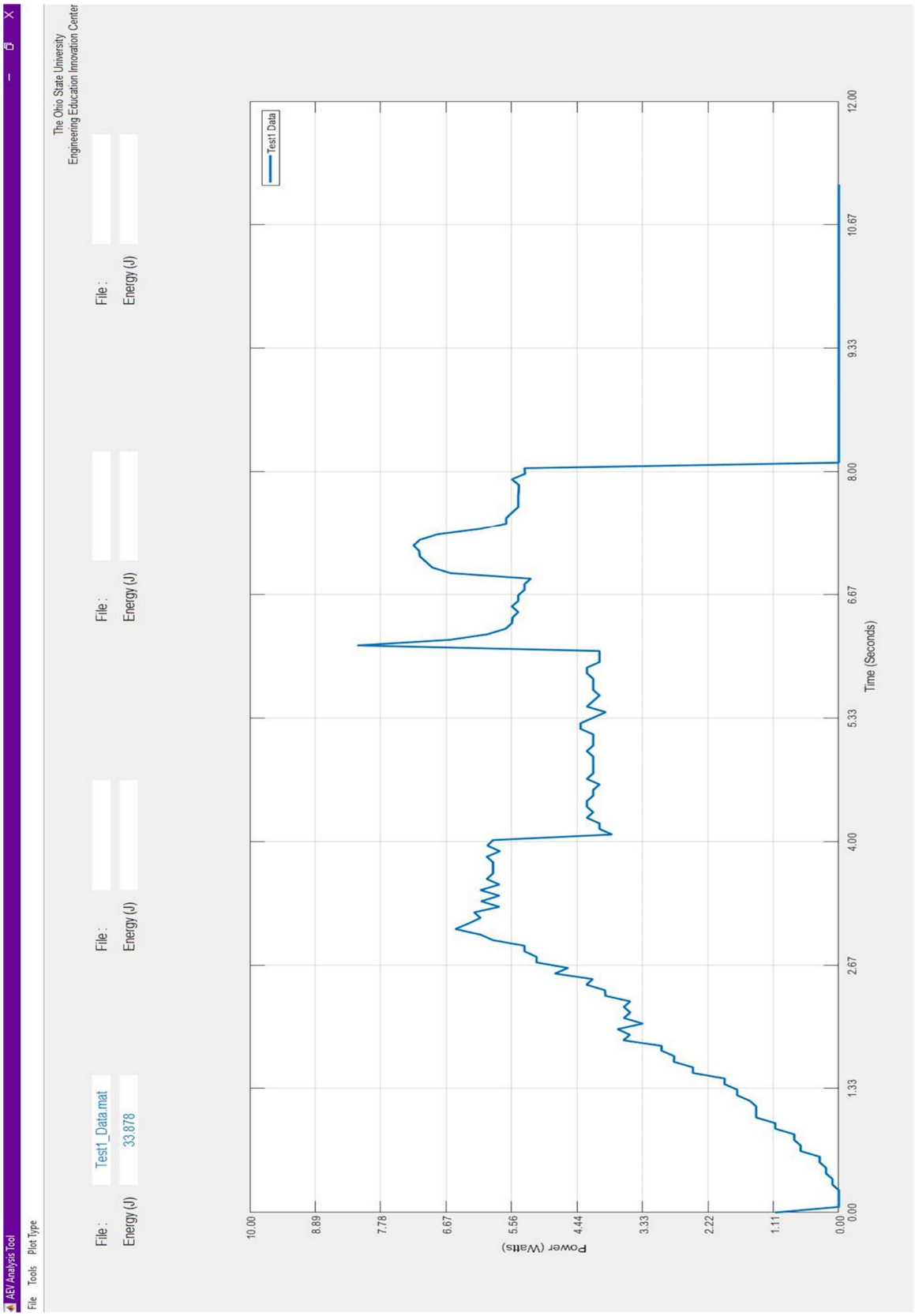
0.22
0.33
0.44
0.56
0.67
0.78
0.89
1.00

Energy vs. Time



Success Criteria	Reference	Design A	Design B (Mike's)	Design C (Phil's)	Design D (Anna's)	Design E (Elle's)
Weight	0	+	-	+	0	0
Stability	0	+	0	+	+	+
Movement in both directions	0	+	+	+	0	+
Safety	0	-	+	-	+	-
Maintenance	0	+	-	+	+	0
Sum +'s	0	4	2	4	3	2
Sum 0's	5	0	1	0	2	2
Sum -'s	0	1	2	1	0	1
Net Score	0	4	0	3	3	1
Continue?	Revise	Yes	Revise	Yes	Yes	No

Figure: Object Screening

Success Criteria	Weight	Reference		Design A (Team Design)		Design C (Phil's)		Design D (Anna's)	
		Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Weight	20%	3	0.6	2	0.4	2	0.4	3	0.6
Stability	25%	2	0.5	4	1	2	0.5	3	0.75
Movement in both directions	25%	1	0.25	3	0.75	3	0.75	1	0.25
Safety	20%	3	0.6	2	0.4	2	0.4	4	0.8
Maintenance	10%	2	0.2	3	0.3	3	0.3	3	0.3
Total Score			2.15		2.85		2.35		2.7
Continue?		No		Develop		No		Develop	

Figure: Concept Score