Group R

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Progress Report Three

At this time, the team of engineers has successfully completed the preliminary and advanced research and development stage. This means that the team has researched the AEV and its specific properties in depth, and that it was now time to apply that research to the performance tests. The performance tests were meant to prepare the team for the final task by requiring the AEV to accomplish portions of it in sequential order. This meant that naturally, the tests became more difficult as time went by.

The first performance test called for the AEV to travel along the track, trigger the first sensor at the gate (but not the second), stop for seven seconds, and finally proceed through the gate. This performance test took many attempts of trial and error to create. Most of this was do to the inconsistency of coasting and power braking. The AEV would complete several runs on the track using the same battery, every time losing more and more voltage. This meant that the code would need to be adjusted every few minutes to compensate for the lack of power. And because a new battery was used at the start of every class period, the trial and error process had to be restarted every day. Despite these complications, the team finally completed the test by using commands dependent on time to get up the incline of the track and then power brake to stop at the gate using Code 1 (see attchached). Shown below in Figure 1 is the model used to complete the first performance test one.

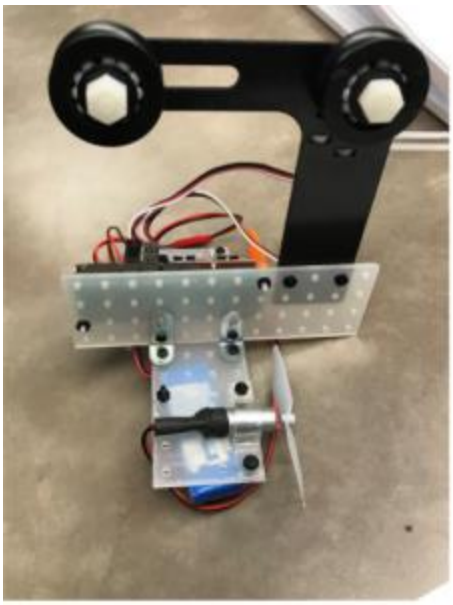


Figure 1: Model used in Performance 1

The second performance test required the AEV to repeat performance test one, as well as attach to the caboose at the end of the track, and then finally move backwards out of the "loading zone." For this test, the team changed the method in which the vehicle traveled in the sense that the code was now reliant on distance rather than time. The model of the AEV was changed as well. The Arduino board was now attached underneath the main body and holds the battery in place (Figure 2). The adjustment was made to accommodate for the requirement that the magnet must be at least 2 inches away from the Arduino. It was much needed, seeing that the magnet is an essential element to the test. Even after few trials, using the reflective sensors proved to be more consistent than using power percentages and time alone. The first command in the code had to AEV travel up the incline based on a certain number of marks (one mark is equivalent to .4875 inches). The second command made the AEV power brake based on a motor percentage and time. Marks could not be used for the power braking because that would cause the vehicle to travel backwards. After these were executed, the vehicle would gently coast a few inches into the range of the sensor. Though the commands were written independent of time, the battery still caused variations in the code. As the battery became weaker, the time interval between the

forward command and the reverse command (which are meant to happen immediately after one another) increased. This often caused the AEV to brake too late, travel too far forward, and trigger the second sensor, resulting in error. However, by the end of the third day of testing, the team completed the test using Code 2 (see attached).

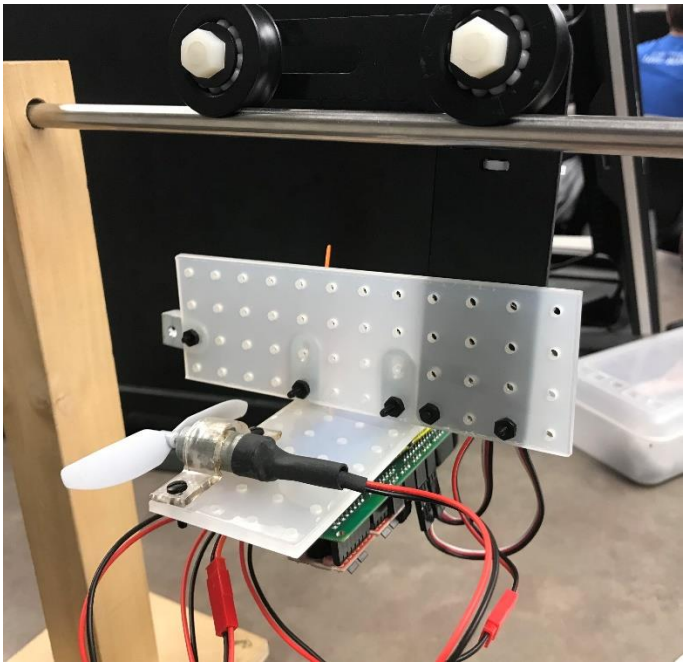


Figure 2: Model used in performance test two

Based on these performance tests alone, it can be concluded that power braking is a very temperamental method of braking due to the loss of power in the battery after each run. Because of this, the team had attempted to create a model that utilized the servo as a manual brake. However, the servo was never used because it was difficult to mount the it to the AEV in such a way that it would not drag along the track (preventing the vehicle from moving). To properly attach the servo, it would need a custom designed part, and the team decided it was too late to submit a request for a part. This meant that the AEV would need to use coasting and power braking in its final design. To best work with this method, the battery needs to replace often to keep a consistent amount of power running through the vehicle. And because using the reflective

sensors produced more consistent distances, the team will continue to use those command in the programs.

In the upcoming weeks, the team will use the lab time to improve the efficiency of the AEV in aspects of time and energy. Because all of the results from the performance tests were gathered using observations and qualitative data, the team will be shifting their focus to obtaining quantitative results from the tests to improve their solution. The whole project has a budget of 500,000 dollars. The AEV itself will already demand a large portion of these funds. The energy and time it takes for the AEV to run the course will use the rest of the budget. Trial tests will continue to be ran to find the best method to reduce the energy being used in the AEV. The Data Analysis Tool in MATlab will calculate the energy stored in the Arduino. The information will be used to further calculate to see if there is enough money in the budget to use. Next, the AEV will be timed through the whole course. Time is a very crucial budget constraint. Therefore, calculations will then be done for the use of time.

The main goals proceeding is to have a complete AEV that runs down the track and passes all the requirements on the track efficiently. This includes stopping at the gate, connecting to the load, stopping in the loading zone, and stopping at the gate on the way back. Writing code for these actions is not the hard portion. Creating code that makes the AEV run efficiently is the hardest part. Trials need to be ran and processed to find the most efficient code for the AEV. Another goal for the group is to meet outside of lab hours to conduct research. That way lab time will only be used for testing the AEV. The main task in the upcoming month is to create an AEV that will perform the task autonomously in its entirety. One member of the group will oversee writing the code while testing is being ran. Another team member will need to track the time it requires for the AEV to run from start to finish. A team mate will need to use the data analysis tool after each run to collect the data from the Arduino. Then once downloaded, the team mate will retrieve the energy analysis. The last team mate will be imputing the latest information into the cost equation. This will be performed for each run. After lab is over, as a group the information will be analyzed. One member will fill out the team meeting minutes while the other team members discuss what the next step will be moving forward. A meeting will be held at least once

a week or more until the end of the semester. These meetings will be held to analyze the data and make decisions outside of lab time so that no time is wasted. The main goal of the upcoming meeting will be creating and rehearsing the final oral presentation that is to take place during the last week of the semester.

Appendix

Figures

Figure 1- Model used in performance test one

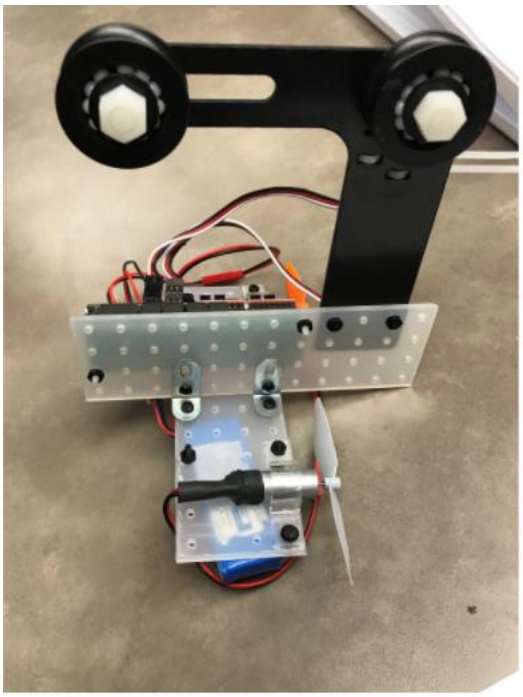
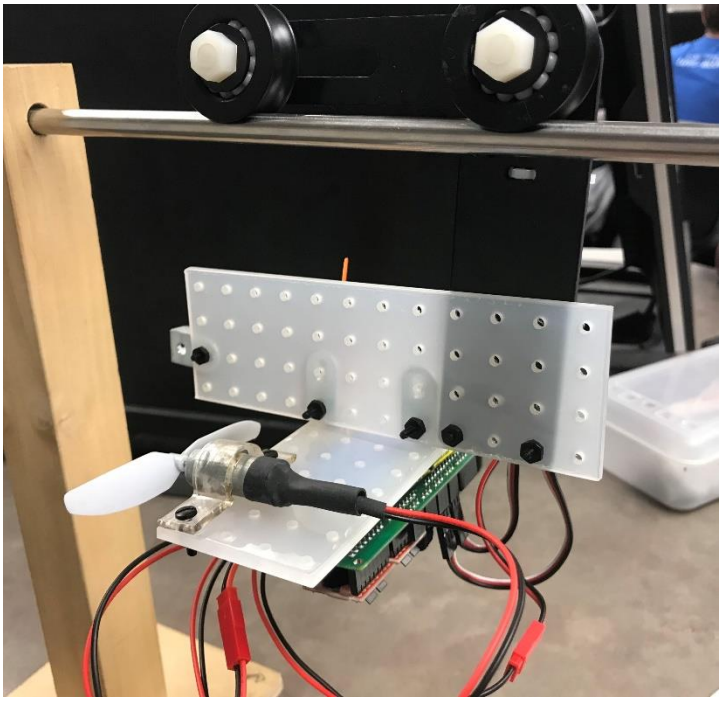


Figure 2- Model used in performance test two



Codes

Code 1- Program used to complete performance test 2

```
//reverse both motors
reverse(4);

//Accelerate both motors to 40% in 3 seconds
celerate(4,0,40,3);

//keep going for one second
motorSpeed(4,40);
goFor(1.75);

//brake both motors
brake(4);

//reverse
reverse(4);
celerate(4,0,60,1.25);
motorSpeed(4,60);
goFor(1.0);

//brake at the gate
brake(4);
goFor(9);

//accelerate
reverse(4);
celerate(4,0,60,2);
```

Code 2- Program used to complete performance test two

```
go to 20 marks
motorSpeed(4,40);
goToRelativePosition(-210);

//brake
brake(4);

reverse(4);
celerate(4,0,30,2);
motorSpeed(4,30);
goFor(.65);
```

```
brake(4);
goFor(7);

reverse(4);
motorSpeed(4,45);
goToRelativePosition(-110);
brake(4);
goFor(12);
reverse(4);
motorSpeed(4,50);
goFor(2);
brake(4);
```

Team Meeting Notes

Group R Meeting 08

Date/ Time/ Location
4/5/18

5:30 pm

Smith Lab

Attendees: Jacob Bell, Anna Goodge, Maycee Hurd, Chris Lipnicky
Agenda:

- Determine what the goals are for the upcoming weeks
- Finish progress report three
- Discuss what needs adjusted on the AEV for final performance test
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Summary
The team decided that the main goal for the week was completing performance test 3. It was decided that one official run should be made before Thursday. It was determined that Anna would manage the code for the AEV and organize it, Maycee would continue to work on the website and put together the progress report, Jake would create the cost spreadsheets, and Chris would record the team meeting notes. The team will communicate about the final presentation slideshow.

Upcoming Tasks

- Final presentation draft
- Final performance test
- Oral presentation
- CDR

Schedule

Week of Sun. April 8th

Goals: The main goal of this week is to successfully complete the third and final performance test.

Monday:

- Before lab, turn in the oral presentation draft
- During lab, finalize the code for the performance test and complete several successful runs

Tuesday

- During lab, run at least one official test
- Hold team meeting
    - Discuss who will present which part of the final presentation
    - Assign parts for revising the CDR draft

Thursday

- Have the final performance test complete

Week of Sun. April 15th

Goals: The goal of this week is to present the final solution

Monday:

- Have the oral presentation well-rehearsed, ready present during any of the days available
- Hold team meeting
    - Discuss what still needs accomplished on the website and CDR to keep all of the writing clean and consistent

Tuesday:

- Have website complete and ready to turn in (making minor adjustments throughout the week)

Thursday:

- Have CDR almost to completion, only making revisions

Friday:

- Turn in CDR and final website