To: Dr Janiszewska

From: Ian Claggett, Ed Doerring, Stuart Fanko (Group Jasper)

Subject: ENGR 1182.01

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Introduction:

After the full track run was completed it was once again necessary to review the EPROM data to find more modifications to make in order to make the AEV ever more power efficient. The code as well as the design of the AEV will be reviewed again to find any areas to improve. The biggest areas that were looked at would be areas of high power usage to see if it could be lowered, such as accelerating up inclines and braking the AEV. Finally the code will be reviewed to make it more efficient.

Performance Test 2; Code 1

```
reverse(4);
motorSpeed(1,32);
motorSpeed(2,32);
goToAbsolutePosition(-155);
brake(4);
reverse(4);
motorSpeed(1,38);
motorSpeed(2,38);
goFor(0.95);
brake(4);
goFor(2);
rotateServo(165);
goFor(6);
motorSpeed(1,20);
motorSpeed(2,20);
goToAbsolutePosition(0);
brake(4);
goToAbsolutePosition(250);
motorSpeed(1,15);
motorSpeed(2,15);
goToAbsolutePosition(320);
brake(4);
reverse(4);
motorSpeed(1,17);
motorSpeed(2,17);
```

```
goFor(1.5);
brake(4);
goFor(4);
motorSpeed(4,30);
goToRelativePosition(-68);
brake(4);
reverse(4);
motorSpeed(4,35);
goFor(2);
celerate(1,30,28,3);
celerate(2,30,29,3);
brake(4);
goToRelativePosition(-98);
brake(4);
reverse(4);
motorSpeed(4,28);
goToRelativePosition(-78);
brake(4);
reverse(4);
motorSpeed(4,55);
goFor(0.5);
brake(4);
goFor(4);
reverse(4);
motorSpeed(4,38);
goToRelativePosition(-226);
brake(4);
reverse(4);
motorSpeed(4,65);
goFor(0.65);
brake(4);
goFor(4);
reverse(4);
motorSpeed(4,43);
goToAbsolutePosition(-137);
brake(4);
reverse(4);
```

```
motorSpeed(4,47);
goFor(0.75);
brake(4);
goFor(2);
rotateServo(0.00);
goFor(3);
motorSpeed(1,25);
motorSpeed(2,25);
goToRelativePosition(49);
brake(4);
goToRelativePosition(84);
reverse(4);
motorSpeed(1,65);
motorSpeed(2,65);
goFor(0.6);
brake(4);
goFor(4);
reverse(4);
motorSpeed(1,27);
motorSpeed(2,27);
goToRelativePosition(150);
brake(4);
reverse(4);
motorSpeed(1,30);
motorSpeed(2,30);
goFor(1.3);
brake(4);
goFor(4);
```

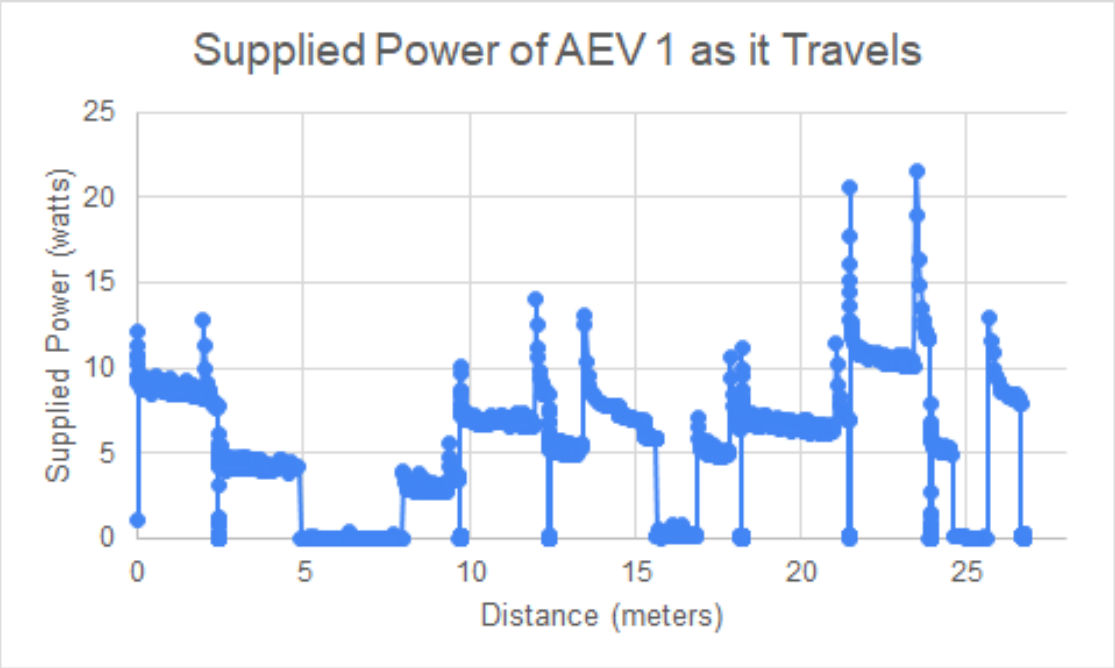

Figure 1: The power supplied into the AEV utilizing programming one as it completed its full track run

Performance Test 2; Code 2

```
  // Beginning of the program
reverse(4);
motorSpeed(4,38);

  // return to grand canyon, retrieve the cart
goToAbsolutePosition(-143);
brake(4);
reverse(4);
motorSpeed(4,40);
goFor(0.75);
brake(4);
goFor(2);
rotateServo(175);
goFor(6);

  // Go to waves
motorSpeed(4,30);
goToAbsolutePosition(-60);
brake(4);
```

```
goToAbsolutePosition(250);
motorSpeed(4,25);
goToAbsolutePosition(342);
brake(4);
reverse(4);
motorSpeed(4,60);
goFor(0.85);
brake(4);
goFor(4);

  //Go to Alaska
reverse(4);
motorSpeed(4,34);
goToRelativePosition(165);
brake(4);
goToRelativePosition(15);
reverse(4);
motorSpeed(4,55);
goFor(0.6);
brake(4);
goFor(4);

// Go to Canada
motorSpeed(4,30);
goToRelativePosition(-68);
brake(4);
reverse(4);
motorSpeed(4,35);
goFor(2);
celerate(1,30,28,3);
celerate(2,30,29,3);
brake(4);

//go To Rocky Mountain
goToRelativePosition(-98);
brake(4);
reverse(4);
```

```
motorSpeed(4,28);
goToRelativePosition(-78);
brake(4);
reverse(4);
motorSpeed(4,55);
goFor(0.5);
brake(4);
goFor(4);

//Hocking HIlls
reverse(4);
motorSpeed(4,38);
goToRelativePosition(-226);
brake(4);
reverse(4);
motorSpeed(4,65);
goFor(0.65);
brake(4);
goFor(4);

//Grand Canyon Dismount
reverse(4);
motorSpeed(4,43);
goToAbsolutePosition(-137);
brake(4);
reverse(4);
motorSpeed(4,47);
goFor(0.75);
brake(4);
goFor(2);
rotateServo(0.00);
goFor(3);

//Go to maintenance
motorSpeed(4,25);
goToRelativePosition(49);
brake(4);
```

```
goToRelativePosition(84);
reverse(4);
motorSpeed(4,65);
goFor(0.6);
brake(4);
goFor(4);
```

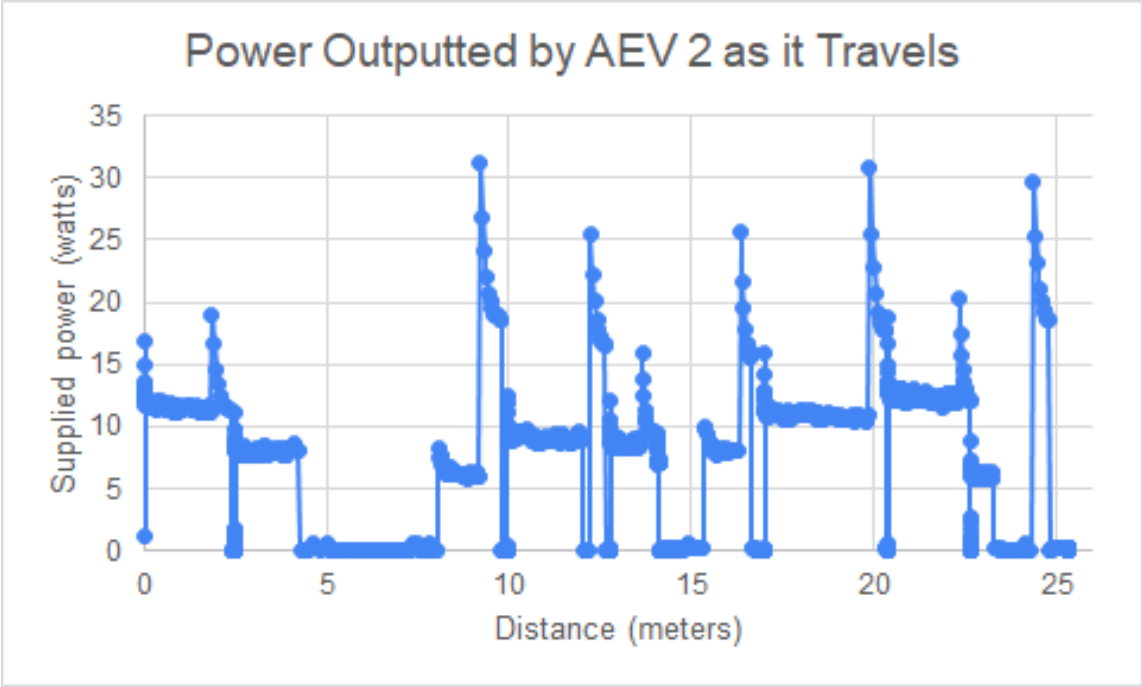

Figure 2: The power supplied into the AEV utilizing programming two as it completed its full track run

Programming Strategy:

For the programming, there were several alterations made in the code to prepare the AEV for the full track run with a cart attached. One of these big changes being the implementation of stronger and shorter brake functions. The programming was altered so that instead of the several seconds at low motor speed, the AEV would instead have the motors run at a higher motor speed for less time. This was done not only to increase the accuracy of the AEV stops, but as well as help with the energy efficiency of the vehicle. Having the vehicle stop sooner and quicker could help reallocate the power more efficiently and create a more energy efficient vehicle. Another change implemented into the code was longer periods of time which the AEV would utilize its gravity to propel the vehicle further on incline hills. This was performed since the vehicle not only saved energy by reducing redundant motor thrust on declines, but as well as eliminated the opportunity for the AEV to dismount itself from the track during the run. The vehicle itself saw several issues on speed on the curve which caused one of the wheels on the hook to dismount itself from the track. With a reduced speed, this conflict can be eliminated completely.

Finally, one of the biggest changes made to the code was the implementation of higher motor speeds and thrust to carry a new weighted cart for the AEV track. Due to the last cart falling out of commission, the new cart had several different variables and weight differences which caused issues with power output and speed of the AEV. The carts weight produced issues going down hill at fast speeds, causing the AEV to drift further and dismount itself on corners. This problem was swiftly eliminated with even stronger brakes and adjustments made to the distances of the program. The cart itself had different weight balances as well, which required the AEV to watch its speed so as to not cause the cart to dislodge itself by losing its balance. The resulting data created a much larger power requirement for the AEV to complete its run, as seen in figure 3 below. However, alongside further fine-tuning and adjustments, the code can create a much stronger and energy efficient model for the new cart. This can be achieved efficiently with the new structure and organization of the coding, one the more minute and quality-of-life improvements made into the program.

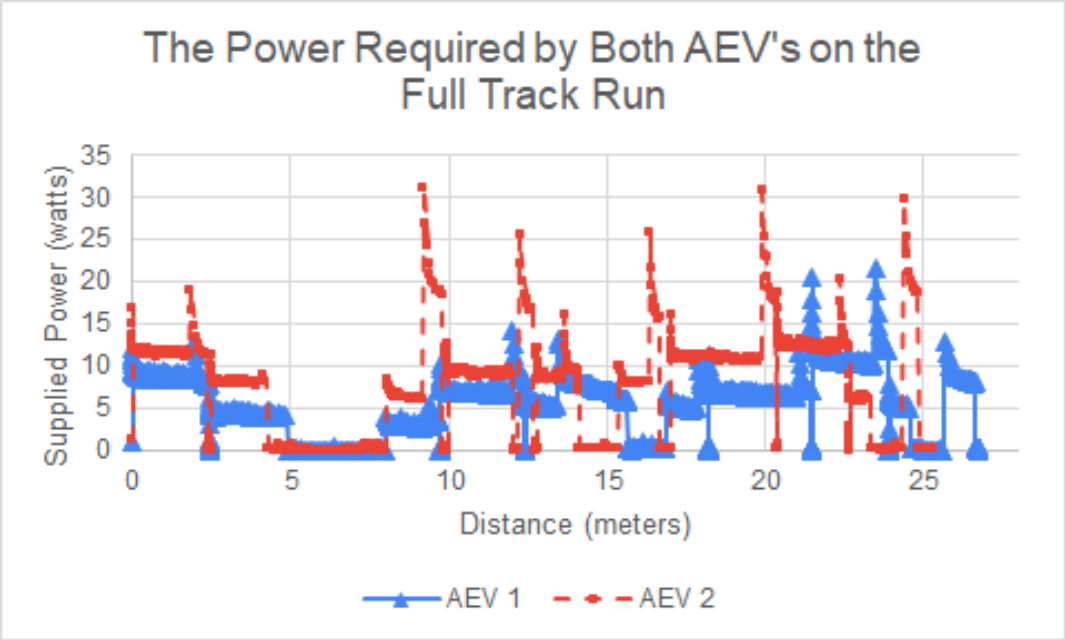

Figure 3: A comparison graph of the power supplied to both AEV's as it traveled the distance along the full track run.

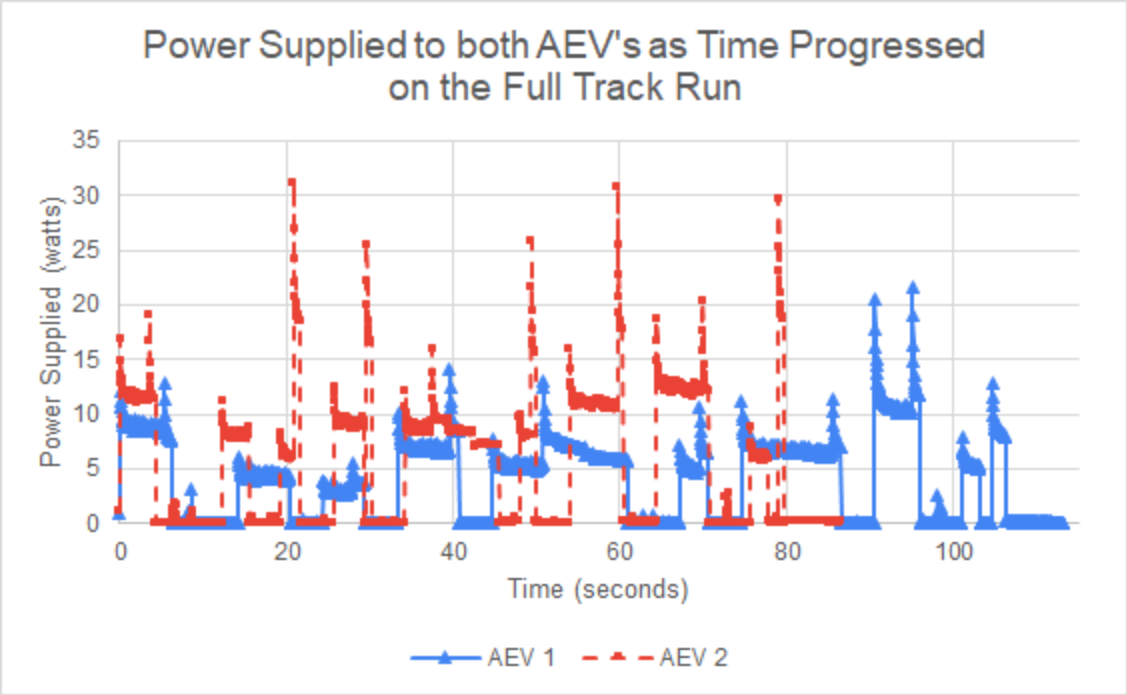

Figure 4: A comparison graph of the power supplied to both AEV's as time progressed alongside the full track run

Discussion:

After the final testing, the data was once again reviewed to find where optimizations could be made. It was found that the highest levels of power usage were going up the inclines on the track as well as for breaking the AEV. The highest power usage spike was on the Canada stop. This was the biggest spike because it is on an incline and the motors have to be running at a high level to keep the AEV in place.

It was found that a few steps need to be made to make the AEV even more power efficient. One of the biggest problem areas found was braking. It uses too much power as the motors are at a low setting. To make it more efficient a higher motor speed over a much shorter time should be used. It will both stop the AEV sooner and have a smaller effect on the power usage of the AEV. Better power usage on the slopes could also be calculated. A few of the slopes were traversed at much too high a speed using more power then needed as well as requiring more power to brake the craft to cancel out the high speeds. A better power setting on the motor might result in a more power efficient run for the AEV.

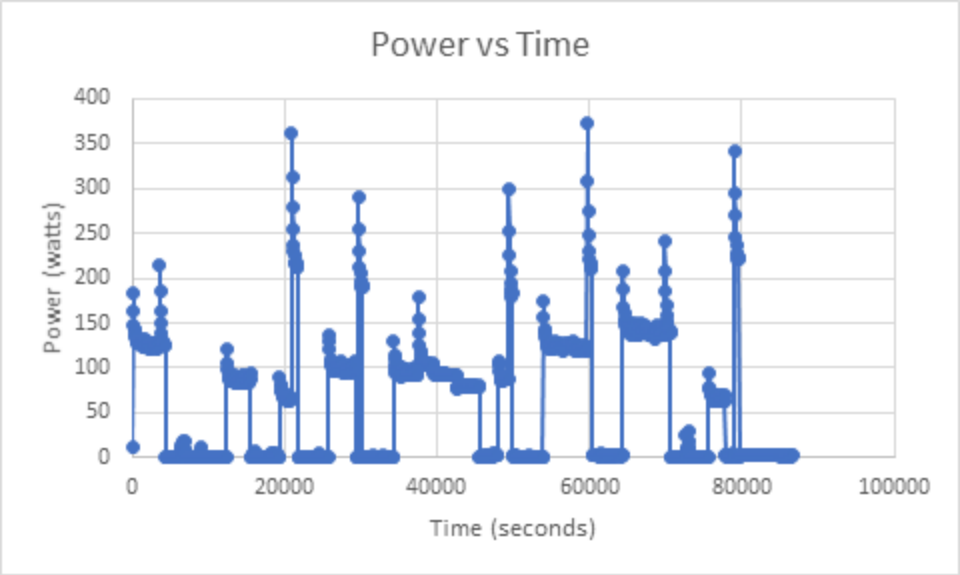

Figure 5: Power vs time chart for the power required for the AEV to complete its full track run as time progressed forward.

Conclusion:

After completing the full run of the AEV track the EPROM data was once again reviewed to find any further improvements to be made to the code. After a review it was found that the AEV run could be modified to make it more energy efficient on the hills as well as for braking. The code was slso found to be inefficient and was thus revisited to be made more exact. After the changes the AEV will be subject to more testing to ensure it is at its most efficient for the final run.

Lab 9: Performance Test 3 Progress Report		
Report		40
	Arduino code, graph and table from Performance Test 2 with grade	30
Writing Total		
	Spelling/Grammar Language Usage	20
Total		90

Instructor signature _____

Work division for this summary

Student Name:	Description of work
_____	_____
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