Advanced Energy Vehicle Project

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Introduction

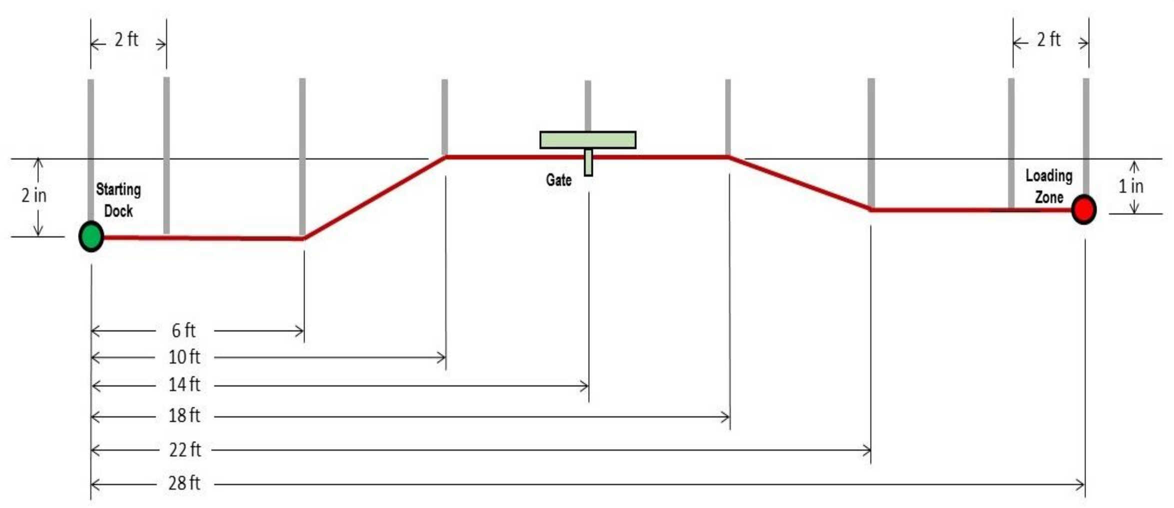

Figure 1.0 The Elevated AEV Test Track

- We are creating an autonomous, electric-powered vehicle
- The goal is to create the most energy and time efficient vehicle under the $500k budget
- This is our final product after various testing and development

Design Process

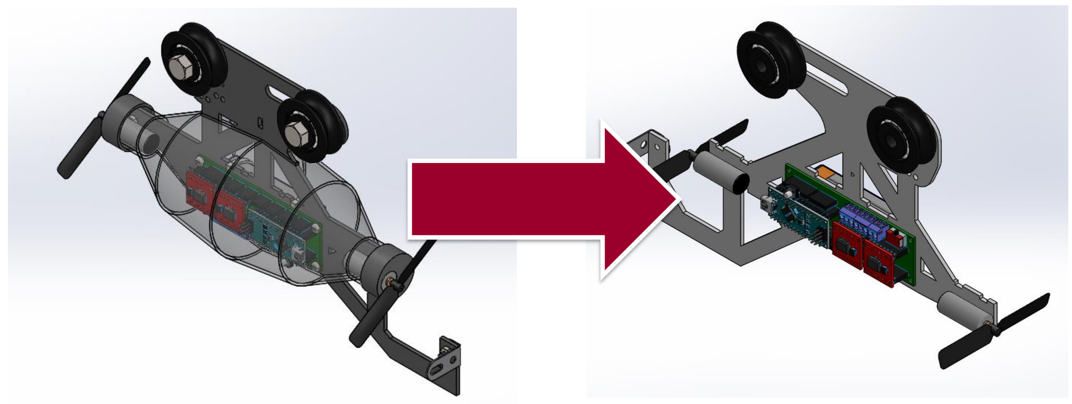

Figure 2.0 AEV with Shell   Figure 3.0 Current AEV

- The design of an unnecessary aerodynamic shell was dropped.

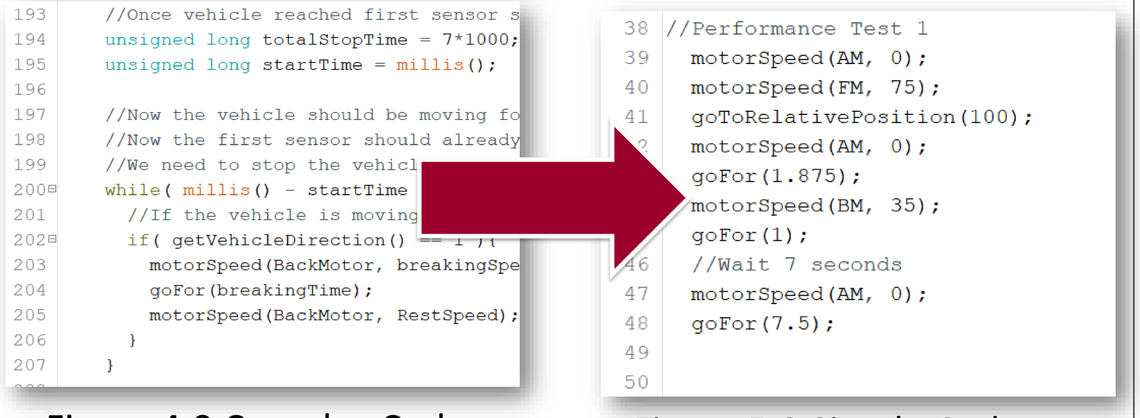

Figure 4.0 Complex Code   Figure 5.0 Simple Code

- Complex code was simplified to increase consistency.

Final AEV Design

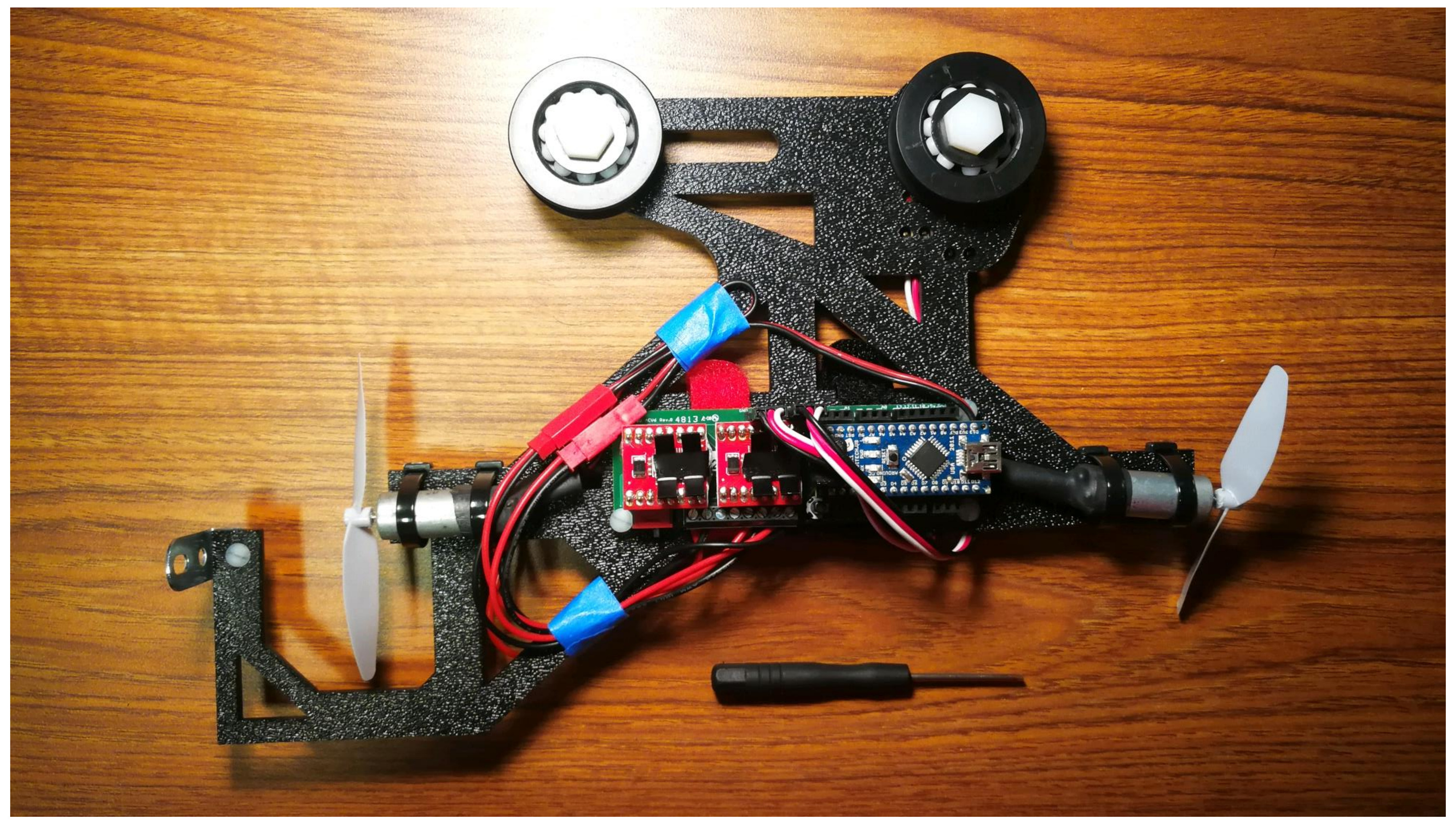

Figure 6.0 Team P Final AEV Model and Design

Core Features

1. Propeller Size and Positioning:

Figure 7.0 3-inch Propeller

- The 3in propeller was chosen over the 2in for it increases thrust exponentially

Dynamic Thrust Equation
F = thrust (N), d = prop diam. (in.), RPM = prop rotations/min., pitch = prop pitch (in.), V_0 = propeller forward airspeed (m/s)

$$F = 4.392399x10^{-8} \cdot RPM \frac{d^{3.5}}{\sqrt{pitch}}\left(4.23333x10^{-4} \cdot RPM \cdot pitch - V_0\right)$$

Figure 7.1 Thrust Equation

2. Custom-made Support Arm:

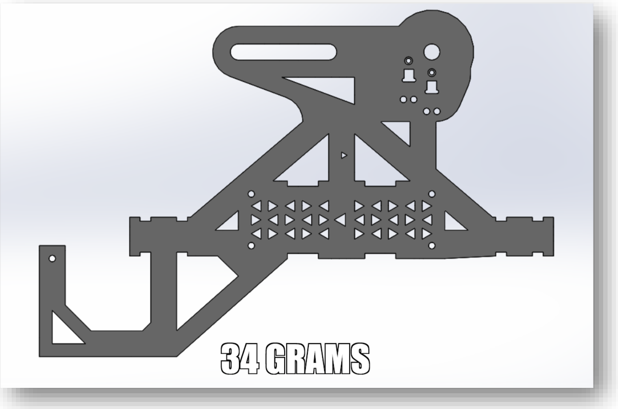

Figure 8.0 Central Support Arm

- Lightweight
- Two-direction Motor Support
- Provide Clearance for Propellers

3. Hybrid Braking System:

- A hybrid braking system incorporates a combination of coasting and power braking.
- This can be done by allowing the AEV to coast and then brake with the reverse motor.
- The hybrid braking approach increases accuracy and precision and also decreases the amount of power used.

4. Propelling Method:

- There are 3 possible propelling methods for our AEV, pulling, pushing, and hybrid.
- From our R&D tests, the pulling motor configuration was shown to be the most effective.
- The pulling propeller method can be used in both directions due to our design choices.

Result

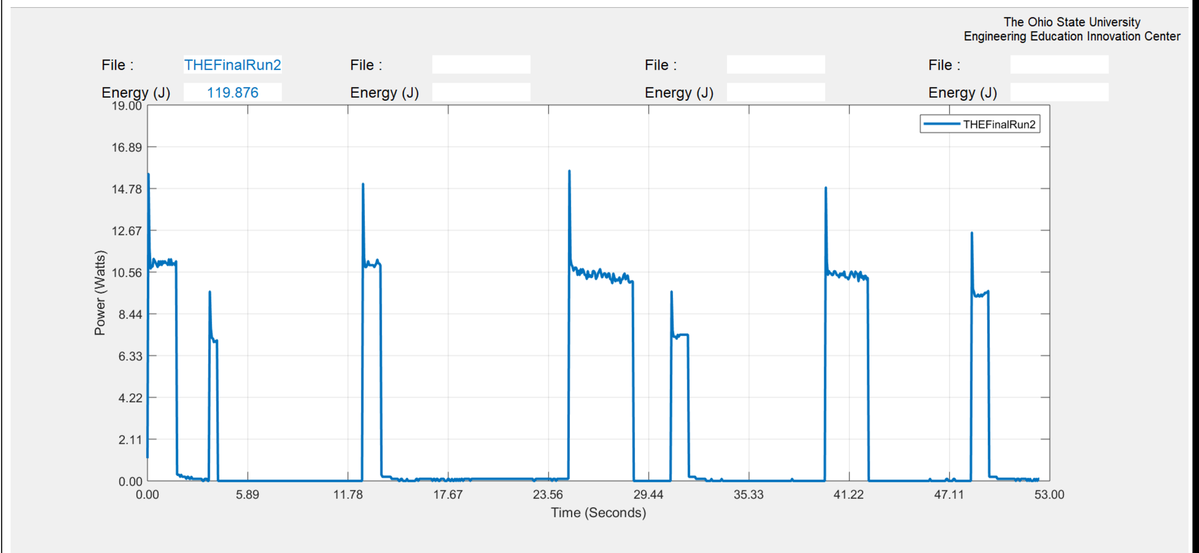

Figure 9.0 Final Performance Test Result (Best 1 of 3)

- Time Used: 50 s
- Energy Used: 119.8 J

Comparison to Class Average

- 51 seconds vs. 55 seconds
- 120.9 Joules vs. 224 Joules

- Capital Cost: $148,540
- Final Cost: $534,014.04

Table 10.0 Total Cost Analysis

	Best 2 of 3 Runs
Capital Costs	$ 148,540
Energy Costs	$ 185,450
Time Costs	$ 166,500
Accuracy Penalty	1.052631579
R&D Costs	$ -
Safety Violations	$ 15,000
TOTAL COST	**$ 534,014.04**

Conclusion

- A lightweight vehicle with a support arm was created for use and testing for energy efficiency
- The propellers were tested and found to be more efficient using a bigger size and a pulling method
- Hybrid braking was used for accuracy in Performance testing

ACKNOWLEDGEMENTS

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