The Little AEV that Could

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Design Process

Four designs were originally created:
1. Tiana's Design
2. The Airplane
3. The Mystic Macaw
4. Coaxial Contra-Rotating Propellers

Design's 3 and 4 were combined to create "The Bullet":

Figure 1: "The Bullet" Original AEV Design

Issues:
- Heavy
- Unbalanced
- Hard to maintain
- Insecure motors

Advantages:
- Aerodynamic
- Aesthetics
- Holds down wires

Figure 2: Second AEV Design

Issues:
- Wires insecure
- Not aerodynamic

Advantages:
- Secure Motors
- Balanced
- Easy to Maintain
- Lightweight

Final Design

The final design includes the following features:
- Coaxial contra-rotating propellers
- Standoffs for the propellers to hang below the AEV
- Battery holder located on top of base
- Cushioned magnet connection
- Arm centered for balance
- Wires secured with Zip-ties
- Magnet connector moves with friction to cushion load connection
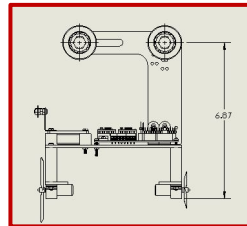- Propellers secured with extra pieces

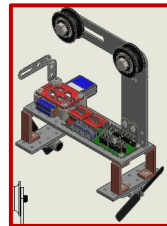**Figure 3: Front view of Final Design**

Figure 4: Isometric view of Final Design

Figure 5: Final Design on Track Photoshopped with Team

Final Materials Cost

Material Cost: $238,800

The AEV preformed less than expected due to time constraints and inconsistencies in the AEV's code. It used considerably more time and energy than expected and the code could have been improved to make the AEV more consistent.

Average Run Time: 79.75 seconds

Average Run Energy: 469.65 joules

Component	Amount	Unit Price	Total Price	Budget Unit Cost
Arduino	1	$100.00	$100.00	$100,000.00
Electric Motors	2	$9.99	$19.98	$9,990.00
Count Sensor	2	$2.00	$4.00	$2,000.00
Count Sensor Connector	2	$2.00	$4.00	$2,000.00
1"x3" Rectangle	2	$1.00	$2.00	$1,000.00
2"x6" Rectangle	1	$2.00	$2.00	$2,000.00
Battery Risers	4	$2.00	$8.00	$2,000.00
Motor Clamps	2	$0.59	$1.18	$590.00
L-Shape Arm	1	$3.00	$3.00	$3,000.00
Wheels	2	$7.50	$15.00	$7,500.00
Large Wheel Nut	2	$1.00	$2.00	$1,000.00
Large Wheel Bolt	2	$1.00	$2.00	$1,000.00
Battery Supports	1	$1.00	$1.00	$1,000.00
Battery Risers	2	$1.00	$2.00	$1,000.00
Propellers	2	$0.45	$0.90	$450.00
Angle Brackets	4	$0.84	$3.36	$840.00
Bulk Screws and Nuts	1	$2.88	$2.88	$2,880.00
Custom Shell	1	$65.50	$65.50	$65,500.00
		Total	$238.80	$238,800.00

Figure 7: Material Cost Spreadsheet [1]

CITATIONS

[1] Ohio State Fundamentals of Engineering Program, "AEV Student Kit Checklist" [Course Documentation]. Available: carmen.osu.edu for ENGR1182. [Accessed Jan. 29, 2019 - Present]

Advanced R&D

Advanced R&D 1: Battery
- Small changes in voltage do not affect speed

Advanced R&D 2: Propellers
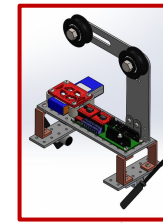- Contra-rotating propeller configuration chosen (see Figure 6, below and left)

Figure 6: Chosen Configuration

Advanced R&D 3: Wheel Position
- Wheel position is uncorrelated with position the AEV travels
- Revealed inconsistency of Reflectance Sensors

Performance Test 1 & 2

Results:
- propeller broke
- shell was too heavy
- the AEV was not consistent
- AEV was unbalanced
- added magnet connector

Takeaways:
- remove the shell
- secure the wires
- code revolved around distance and braking then going minimum speed to pick up load