



Oral Presentation

Team 9

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Aiden Deady



Benjamin Furman



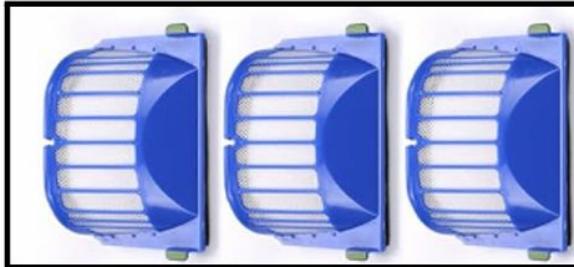
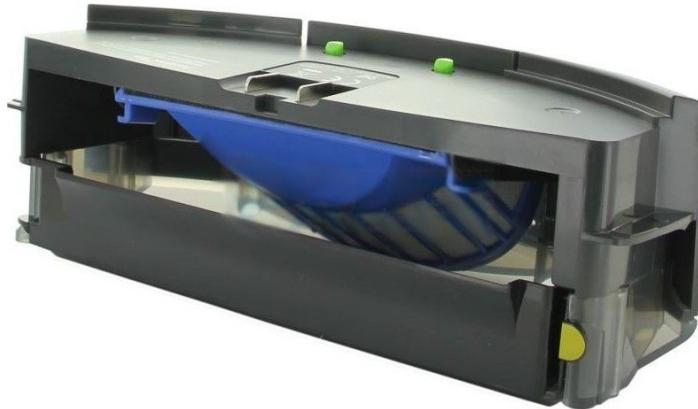
David Strom



Cassandra (Cassie) Zimmerman

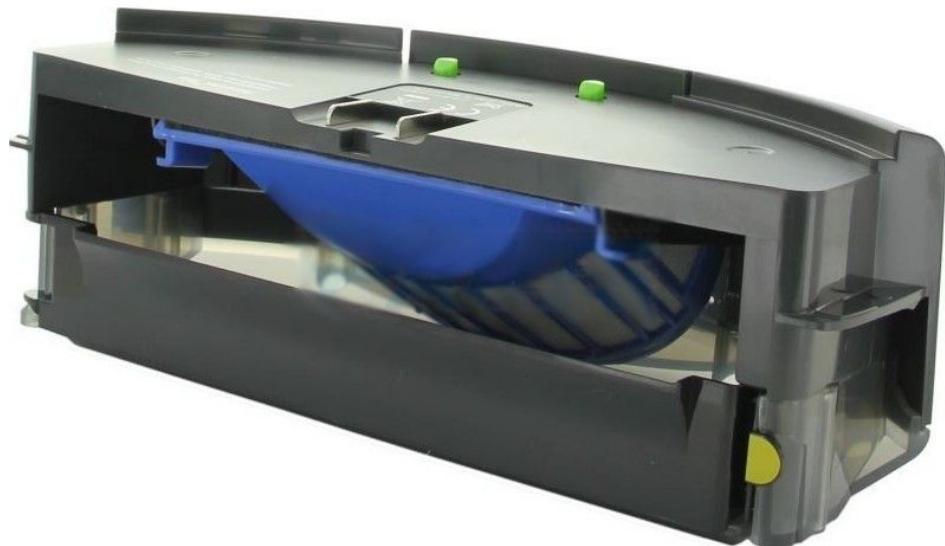
Aero-Vac Dust Bin

The AeroVac dust bin is designed to collect dust and debris.



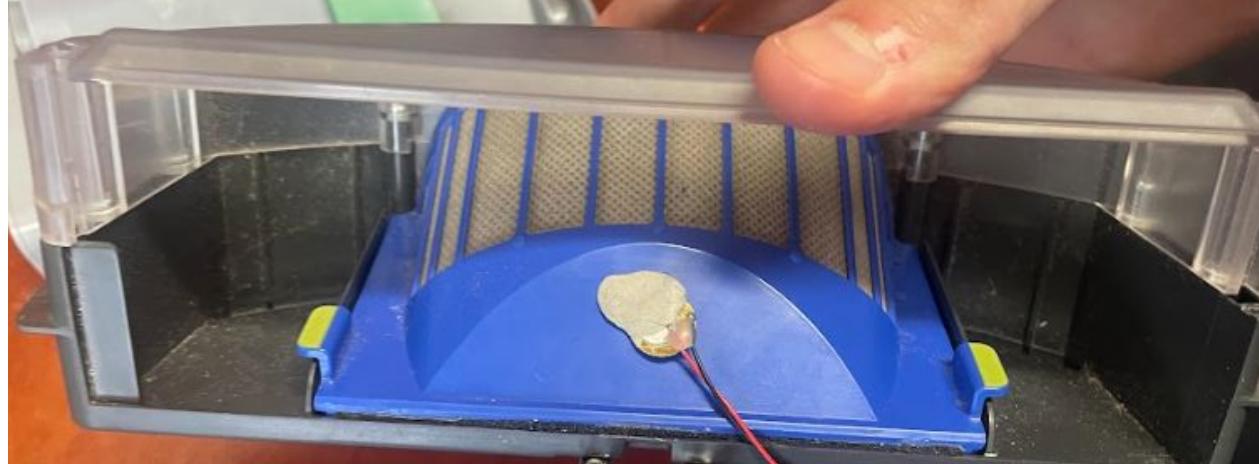
Problem

The Roomba 670 Aero-Vac Dust Bin Produces Too Much Noise



Problem Specifics

- Two methods were used in order to track the noise coming from the Aero-Vac dust bin
 - Sound Level Meter
 - Vibration Testing - Piezo Electric Oscilloscope



How Loud Is The Dust Bin?

- We found the dB of the dust bin from various places in the assembly

Assembly	Max (dB)	Min (dB)	Average (dB)
Full Assembly	77.4	74.5	76.4
Assembly w/ Filter Removed	79.1	64.1	77.7
Isolated Motor	83.3	76.5	79.1

- The assembly was found to be **76.4 dB**
 - This value was used as our baseline dB value

Methods - Preliminary Research

- Using Databases
 - Knovel
 - Scopus
 - Compendex
 - Google Scholar
- Conflicting Information on Fan Blade Count
- Filters seem to work the best

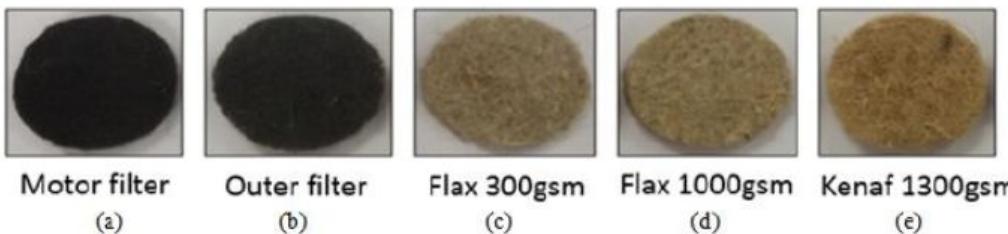


Fig. 16. Installing a vacuum cleaner for noise reduction experiments: without AMM (left) and with AMM (right).

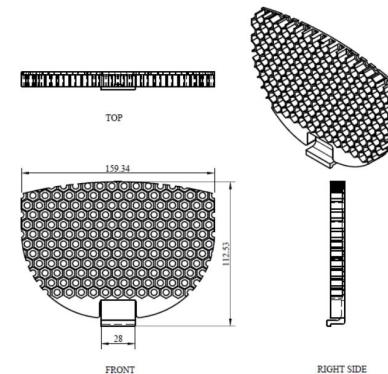
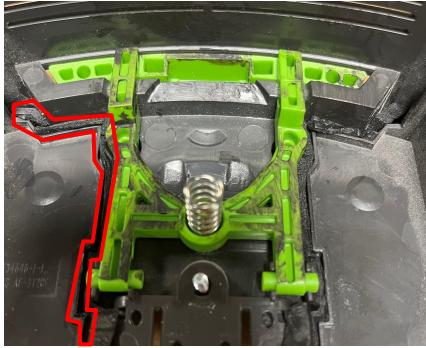
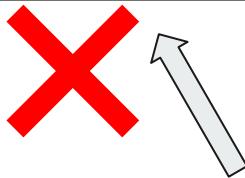


Fig. 4 - Drawing of the proposed honeycomb liner noise filter

Methods - Mind Map



Dampening Spray

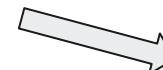
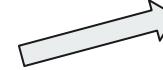


Foam Insulation



Reduce Noise
Emission of Aerovac
Dust Bin

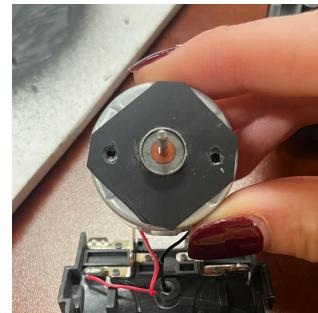
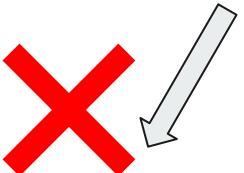
PLA With Less Fins



Rubber Dampering



Blade Angle



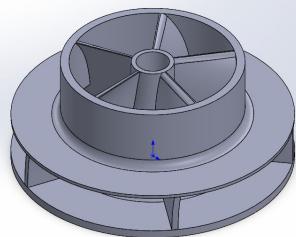
Our Plan

Design Fan Blades With Differing Blade Amounts (PLA)

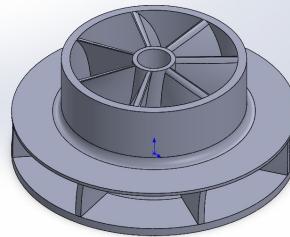
Incorporate Rubber Around the Housing For Dampening Effect

Incorporate Foam Around the Motor Housing

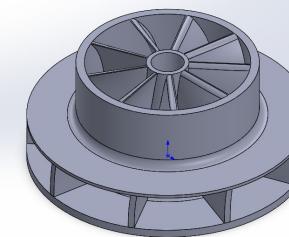
1. Redesigning Fan Blades



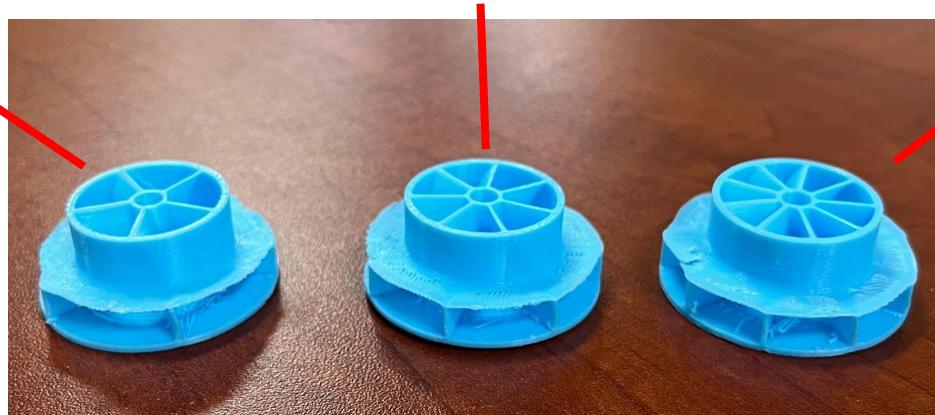
PLA Replica (5 blades)



PLA Replica



PLA Replica (9 blades)



1. Testing Modified Fan Blades

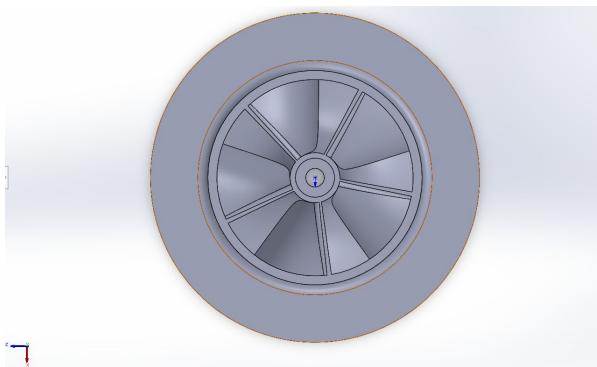
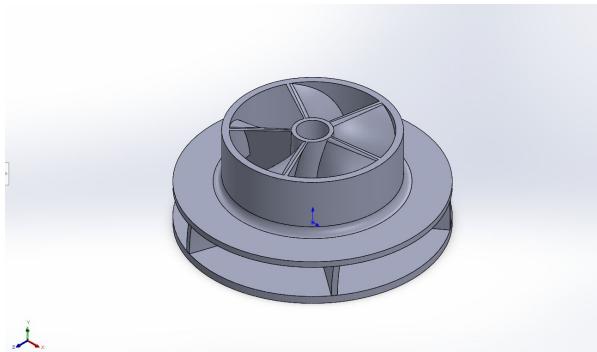
Assembly	Max (dB)	Min (dB)	Average (dB)
Full Assembly	77.4	74.5	76.4
Full Assembly PLA Replica	76.4	59.1	75.1
Full Assembly PLA 9 Blades	74.9	72.2	74.0
Full Assembly PLA 5 Blades	75.0	63.8	73.5

Found that less blades is quieter than the regular design by **2.9dB**

PLA was quieter as a whole

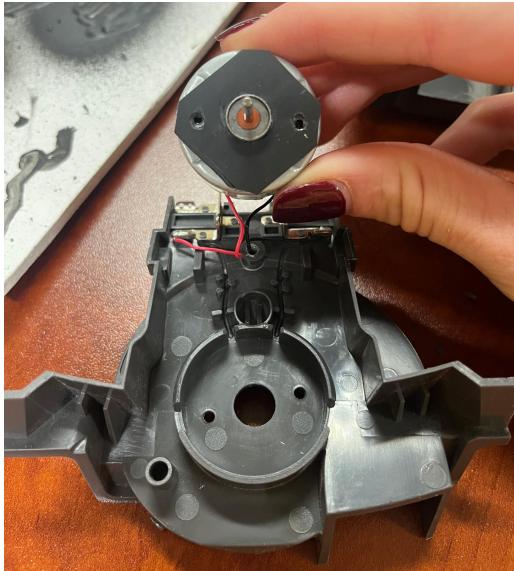
Note: Now that 5 blades is the quietest, we used this as we kept evolving our solution

1. Redesigning Fan Blades (Shallow Angle)

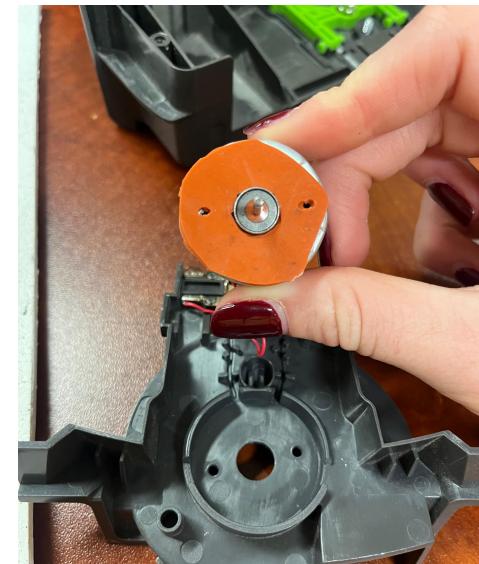


2. Adding Rubber

We then chose to add rubber around where the motor sits in the housing



Option 1: Thick Rubber



Option 2: Thin Rubber

2. Rubber Findings

Assembly	Max (dB)	Min (dB)	Average (dB)
Full Assembly	77.4	74.5	76.4
Full Assembly 5 Blades	75.0	63.8	73.5
Full Assembly PLA 5 Blades w/ Thick Rubber Attached to Motor	73.0	70.3	72.4
Full Assembly PLA 5 Blades w/ Thin Rubber	77.1	75.1	76.1

Adding thick rubber further decreased the noise by 1.1dB, for a total of a **4.0 dB** decrease

Note: Now that 5 blades with thick rubber is the quietest, we used this as we kept evolving our solution

3. Adding Foam

Assembly	Max (dB)	Min (dB)	Average (dB)
Full Assembly	77.4	74.5	76.4
Full Assembly 5 Blades	75.0	63.8	73.5
Full Assembly PLA 5 Blades w/ Thick Rubber Attached to Motor	73.0	70.3	72.4
Full Assembly PLA 5 Blades w/ Thick Rubber & Foam	72.9	70.8	71.5



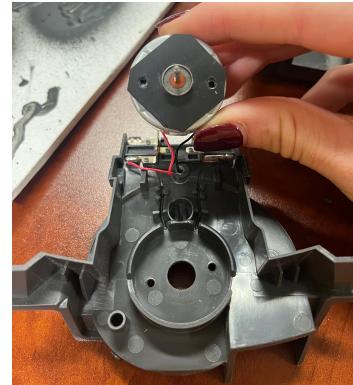
Adding foam further decreased the noise by 0.9 dB, for a new total **4.9 dB** decrease



Final Solution

Assembly	Max (dB)	Min (dB)	Average (dB)
Full Assembly	77.4	74.5	76.4
Final New Design	72.9	70.8	71.5

Final Reduction Of Noise = 4.9dB



Conclusion/Future Considerations

- There is room for improvement with iRobot's Roomba design when it comes to the vacuum portion, and noise level / air flow optimization
- Final design meets requirements
 - Is cost effective and repeatable
- Further considerations include:
 - Testing the amount of airflow coming out of the fan with different blade designs

Questions?