DESIGN OF A QUIETER HAIR DRYER

TEAM 6

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ABSTRACT

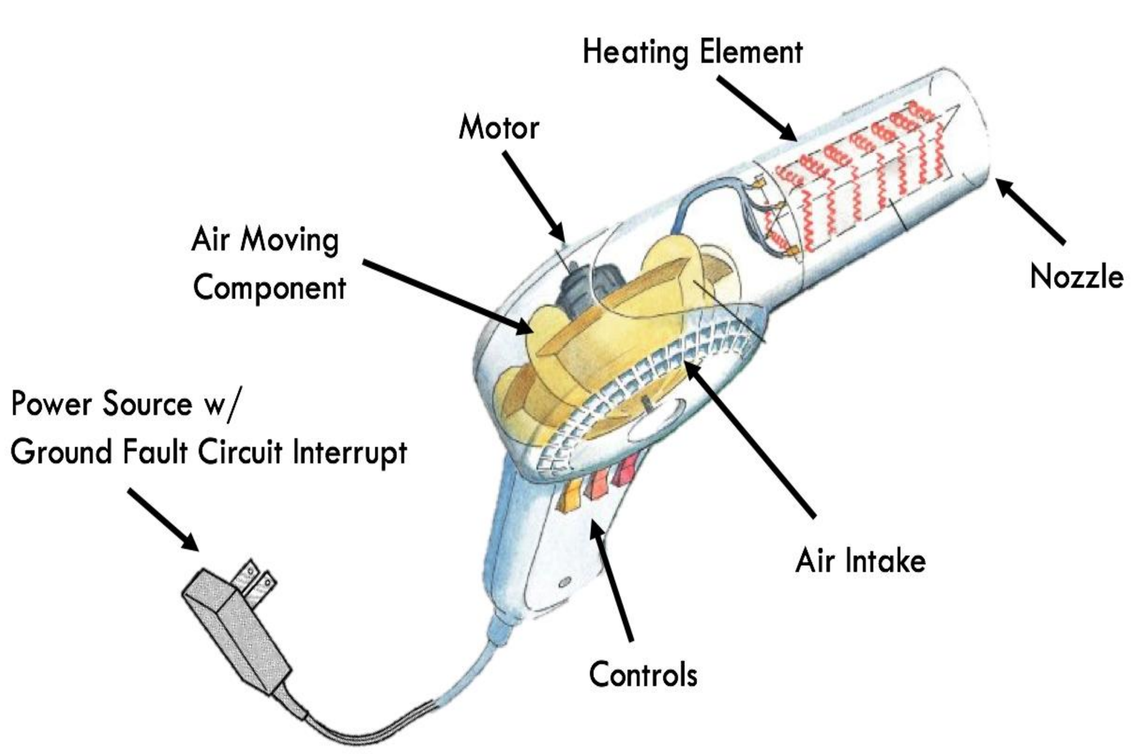
The primary goal of this project is to **design a quieter hairdryer**. Due to limitations on the knowledge of electrical components, the **project goal changed** to making measureable and repeatable improvements the noise output of a hair dryer. After reverse engineering many hairdryers, the *Whisper Light* was determined to be optimal for modifications that could be subsequently tested. It has a removable centrifugal type fan, and was relatively quiet with a measured sound output of **73 dB(A)**. The modifications to its design include empirical changes to the fan, improved baffle design and a chevron nozzle, which were all created by 3D printing.

WHAT IS THE PROBLEM?

Hairdryers are TOO Loud!

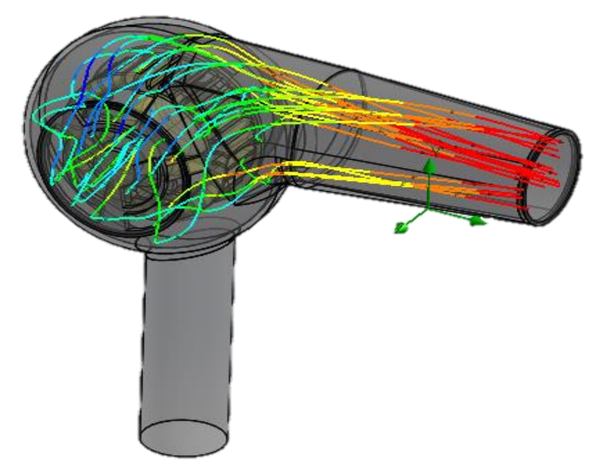
Hairdryers can be **very loud** and can cause noise disturbances in peaceful areas such as *salons*, *pet grooming shops*, and our very own *households bathrooms*. The average hairdryer operates at **85db**, which is right on the cusp of noise induced hearing loss!

STANDARD COMPONENTS OF A HAIRDRYER



HAIR DRYER MODEL TO IMPROVE

Bio-Ionic Whisper Light

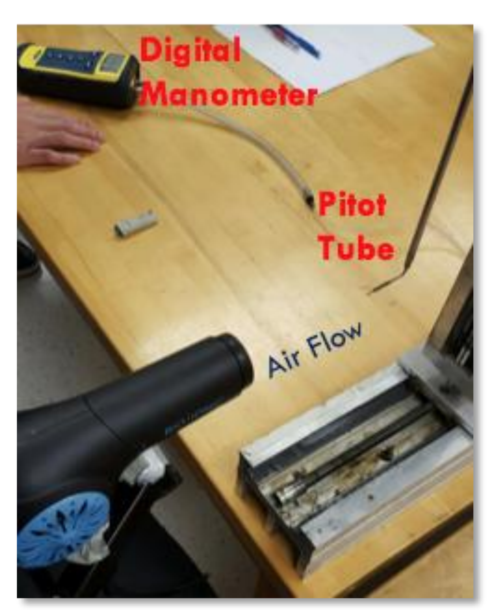


EXPERIMENTAL SETUP

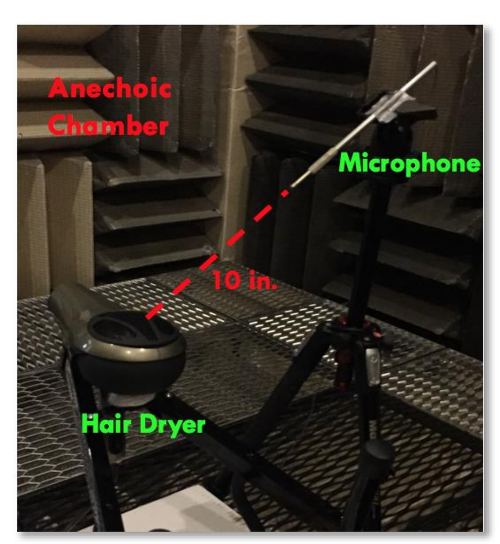
Experiments were setup to determine key factors in evaluating the baseline hairdryer and the effectiveness of the modifications to the hair dryer. These factors are ***noise***, ***volume flow rate***, and ***temperature of exiting-air***

Temperature:
- 6" away from surface
- **Infrared thermometer** to measure temperature

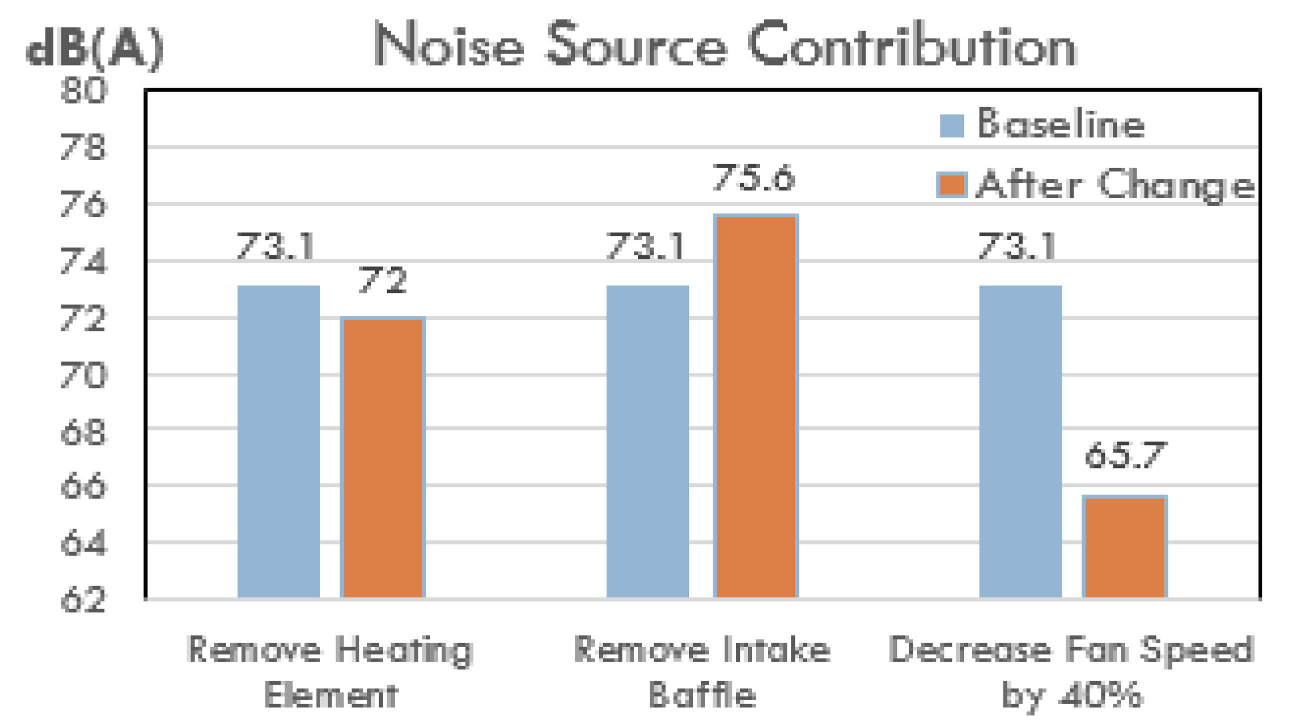
Volume Flow Rate:
- **Digital Manometer** & **Pitot tube** connected to a **mechanical traverse**, which measured **pressure** and **velocity** to obtain **volume flow rate**



Noise:
- Performed in **Anechoic Chamber**, using a ¼" **Free Field Microphone** to record **noise signal** produced at various locations radially around hairdryer

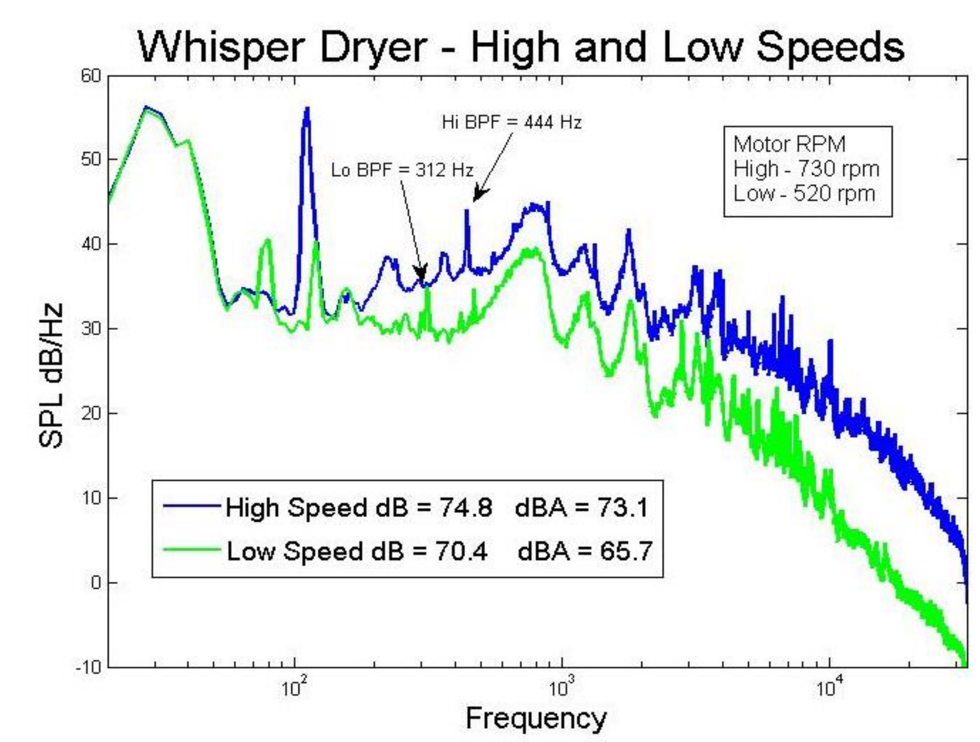


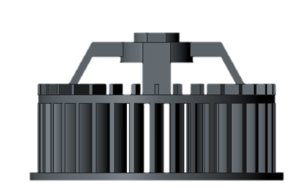
NOISE CONTRIBUTIONS



Fan speed is the *largest contributor* to noise, and improvements to the *fan-blade system will* allow for *speed reductions* leading to *reduced noise*.

FAN ANALYSIS AND MODIFICATIONS





- Created **frequency spectrum** of measured noise to determine characteristics and sources of the sound
- Large contribution from **blade passage frequency (BPF)** and its harmonics.

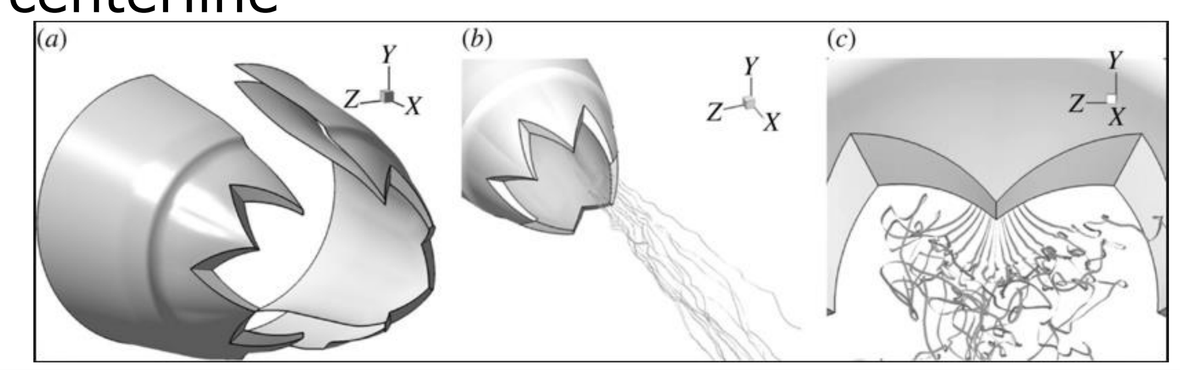
$$BPF = \frac{(Motor\ RPM) * (\#of\ Blades\ on\ fan\ )}{60}$$

Modifications to Reduce Sound:
- Reduce the number of fan blades
- Increase surface area of blades
- Saw-tooth serrations on trailing edges
- Reduce the fan's diameter

Used selective laser sintering (SLS) method of 3D printing to print replica of fan and 29 blade design.

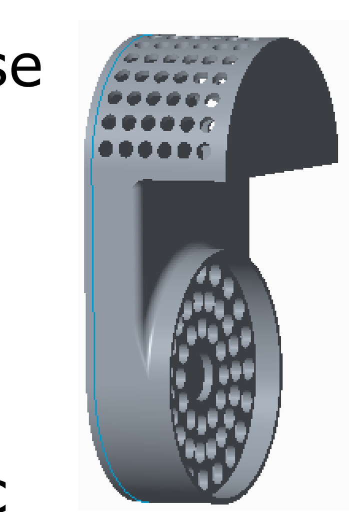
OUTTAKE CHEVRON

- **Induces early mixing** of escaping air
- Creates large scale vorticities much earlier
- **Reduces noise** in the 50 ° to 70 ° range from the centerline



INTAKE REDIRECTION BAFFLES

- **Redirecting** the Intake noise upwards
- Reduces sound by allowing less fan noise to escape
- Causes slight performance reduction
- **3D printed** with ABS plastic



CONCLUSION

Once determined that the fan system was the target for design improvements, we determined 3D printing was the best means to prototype. Testing the 3D printed fan designs in the hair dryer resulted in significant vibrations where noise followed. This inhibits the possibility to accurately test the new fan design. Our team is currently looking into methods to balance the fans. The intake redirection baffles work quite well and show an apparent reduction in the noise upon attachment. There is a slight reduction in performance, as that is the trade off with baffles.