Design of a Less Deafening Hair Dryer

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Presentation Overview

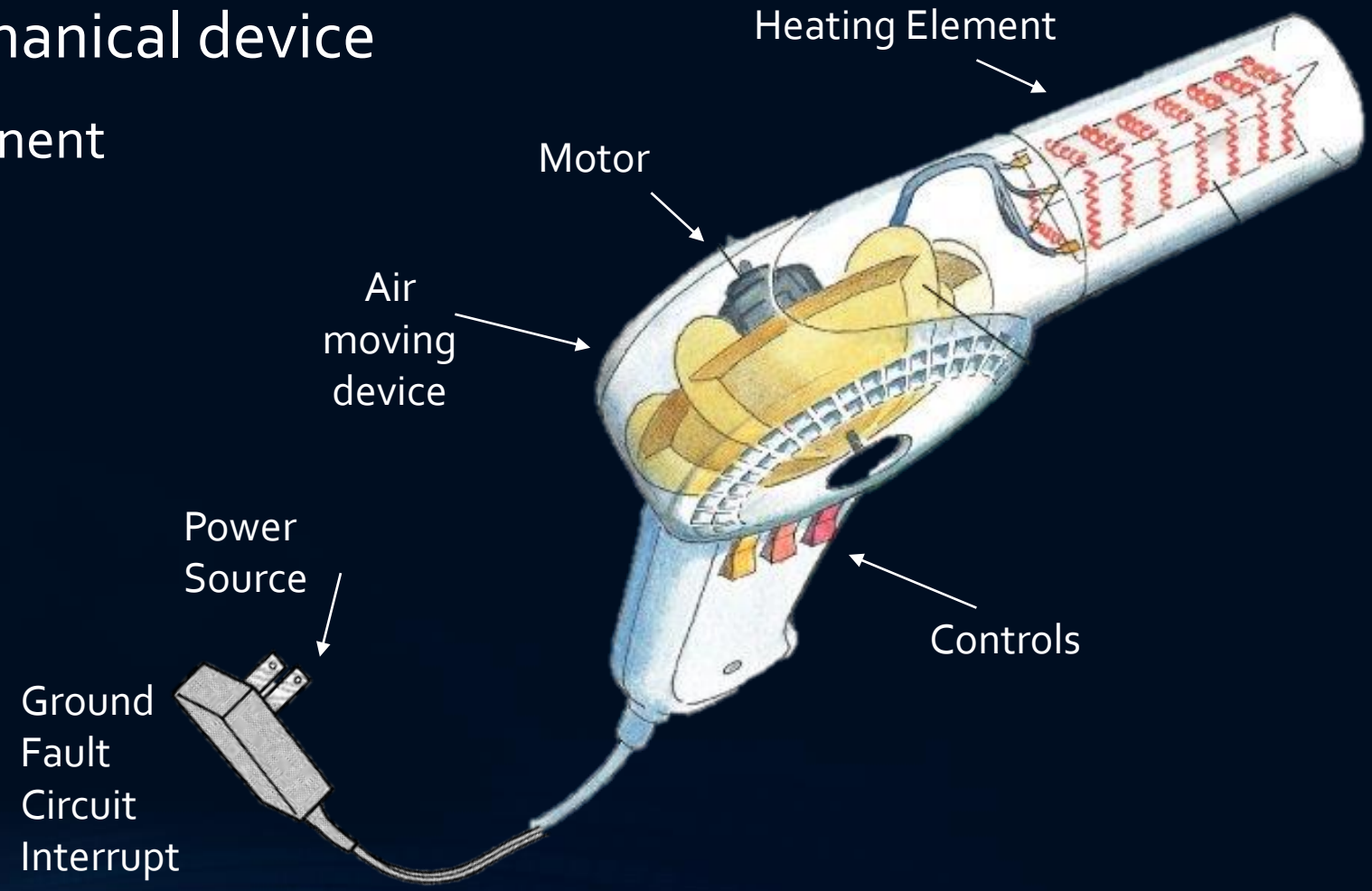
- Project Scope
- Hair Dryer Background
- Flow Path Options
- Current Design
  - Components
- Hair Dryer Effectiveness
- Measuring Sound Pressure
- ACC Innovation Challenge
- Gantt Chart
- References

Project Scope

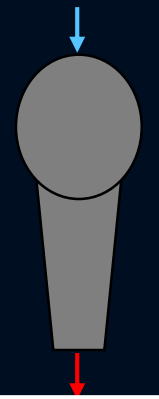
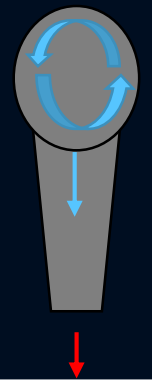
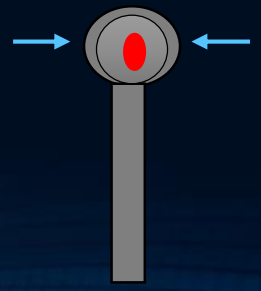
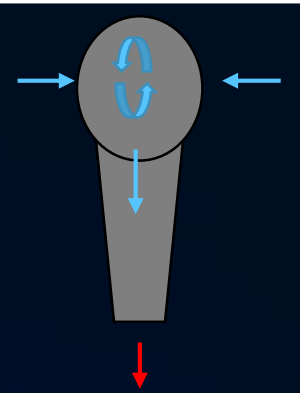
- The project is to create a hand-held hair dryer which produces a sound pressure level no higher than 70 decibels, yet still effectively dries a user's hair within a reasonable amount of time
- Milestones
  - 3-D Print centrifugal housing, fan blades, and outer casing
  - Ensure electrical components function properly
  - Qualify for *ACC Innovation Competition*

Hair Dryer Breakdown

- Simple electromechanical device
  - Air Moving Component
  - Motor
  - Heating element
  - Controls
  - Power Source
    - GFCI

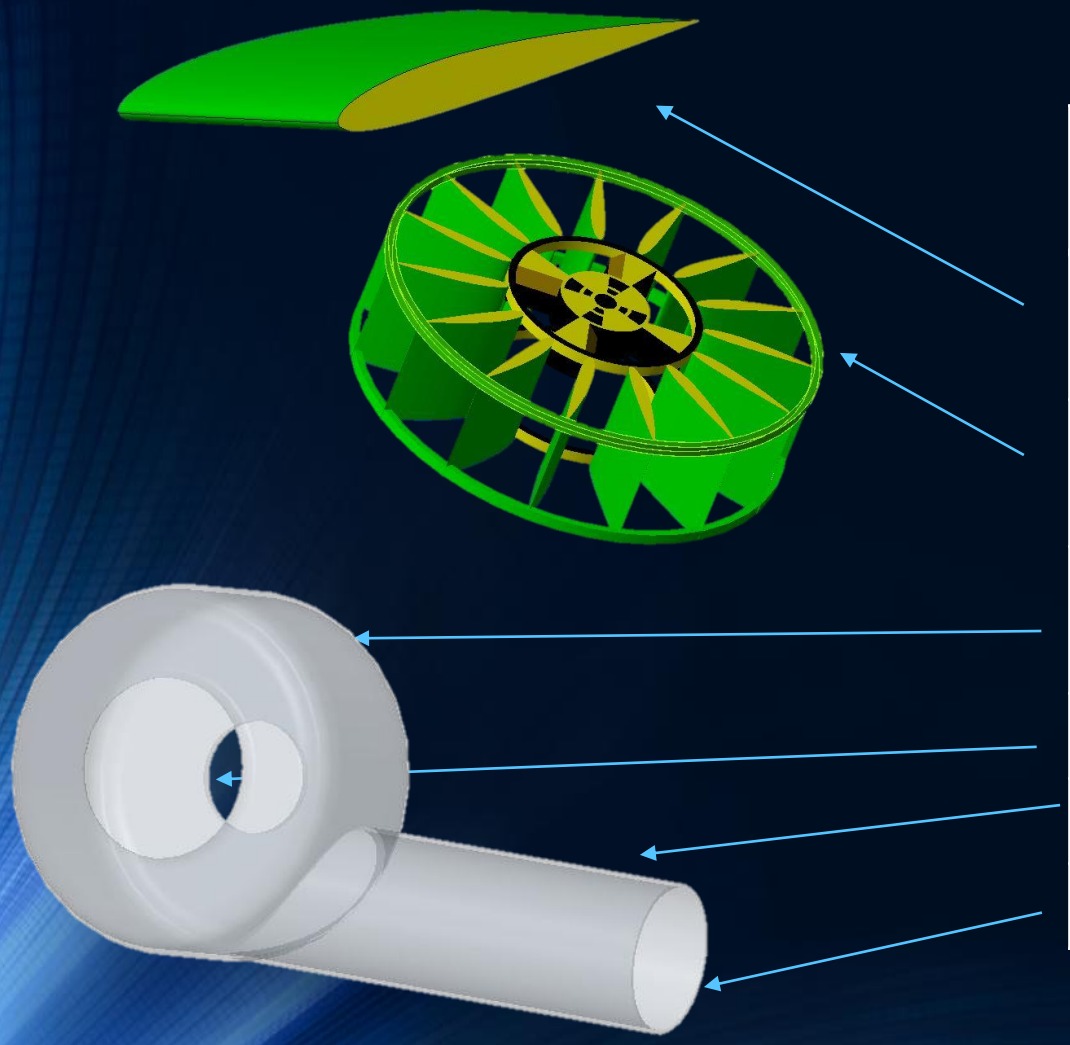


Flow Path Options

	Side View	*Front Nozzle View*	*Overhead View*
Option 1: Axial Fan			
★ Option 2: Horizontal Centrifugal			
Option 3: Vertical Centrifugal			

- Less air-obstructions
- Easier wiring setup
- Stable motor position
- Intake directed away from user's ear

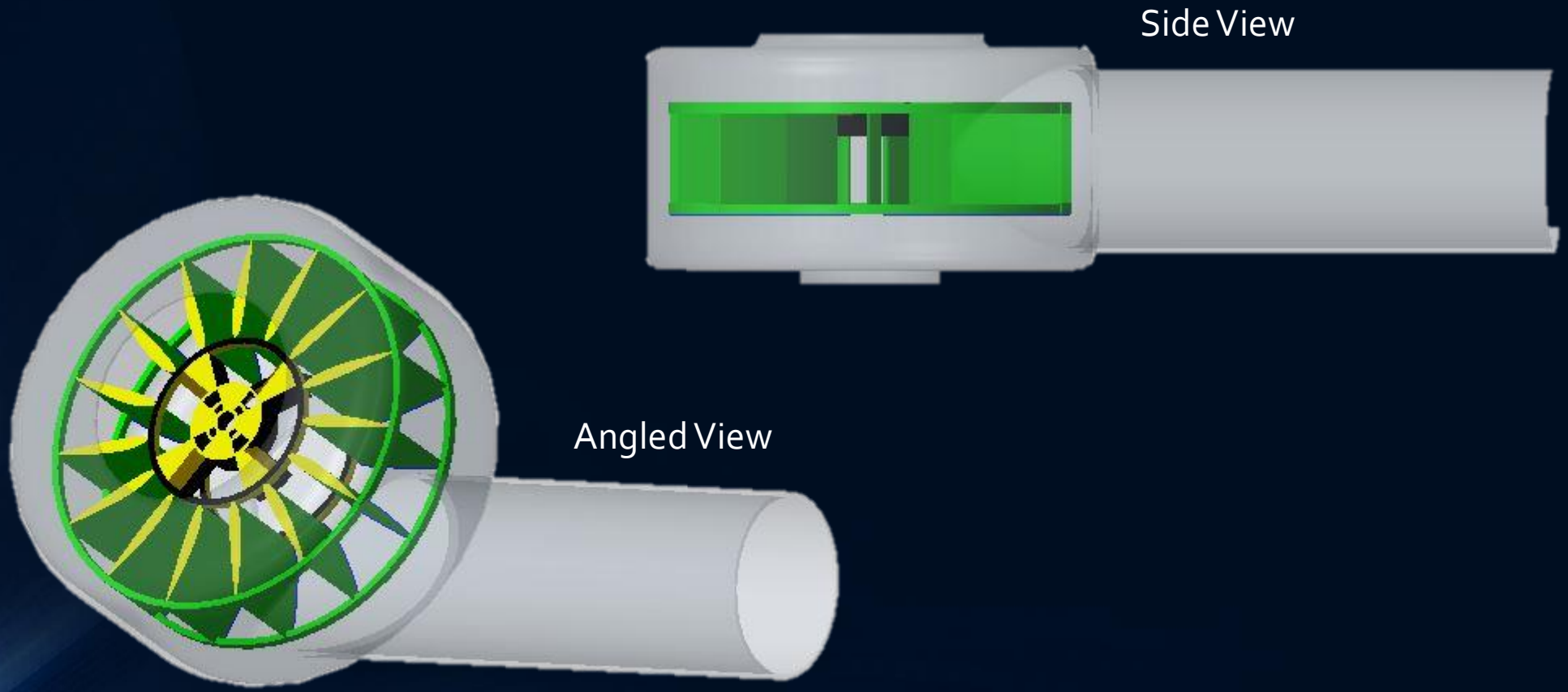
Current Design



Dimensions

Part	Length (in)	Width (in)	Height (in)	Diameter (in)
Airfoil Fan Blade	1.000	0.079	1.000	n/a
Fan Assembly	n/a	n/a	1.000	3.625
Centrifugal Housing	n/a	n/a	2.250	4.125
Inlet	n/a	n/a	n/a	2.000
Nozzle	5.560	n/a	n/a	1.700
Nozzle Exit	n/a	n/a	n/a	1.600

Assembled View of Primary Components



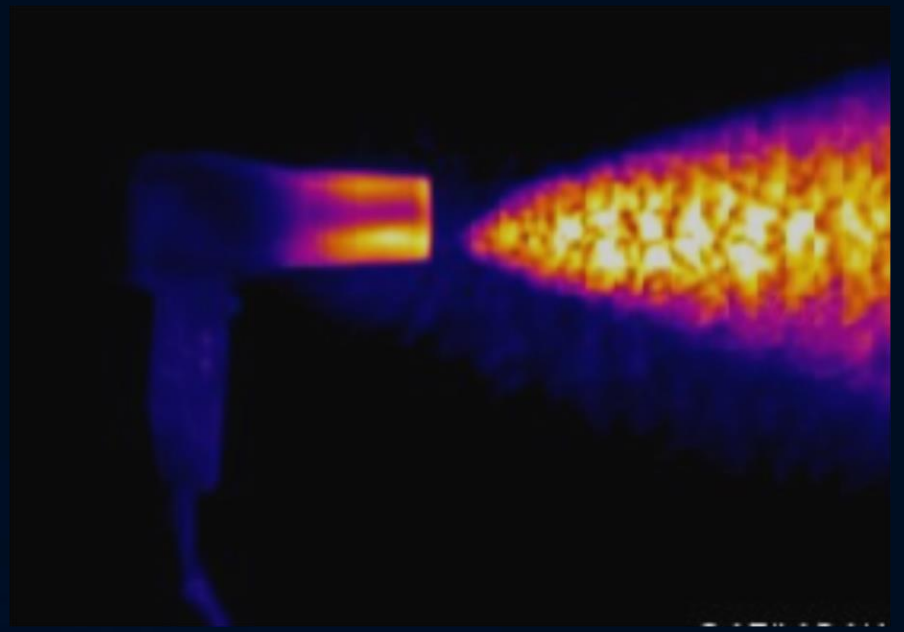
Secondary Components

Parts	Quantity	Currently Own
Brushed DC Motor	1	Yes (re-use)
Motor Mount	1	Yes (re-use)
Mounting Screws	7 (min)	Yes (re-use)
Heating Element	1	Yes (re-use)
Electrical Wiring	multiple	Yes (re-use)
Switches	3	Yes (re-use)
Outer Body Casing	1 (2 half pieces)	No

Parts	Quantity	Currently Own
Casing Screws	multiple	No
Sound Absorption Foam	unknown	No
Motor-to-Fan Press Fitted Fastener	1	No
Inlet/Exit Grill Covers	2	No

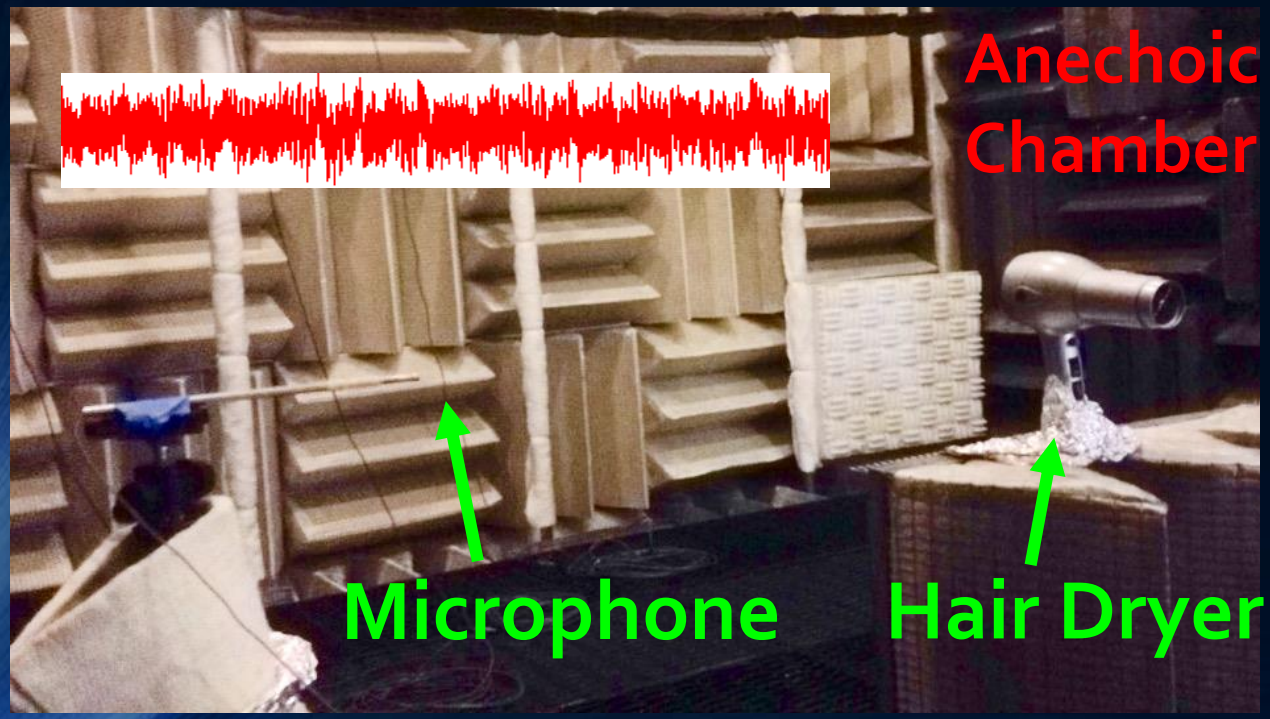
Quantify Hair Dryer Effectiveness

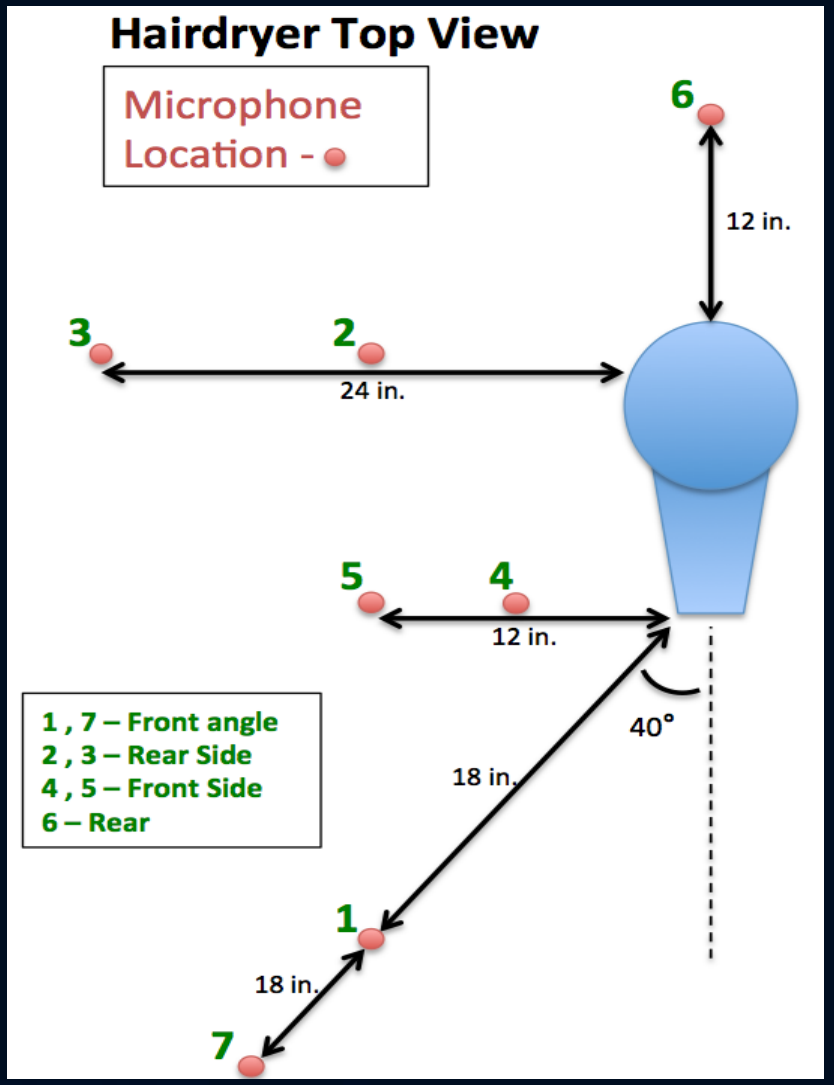
- A project goal is to not decrease the effectiveness of Hair Dryer
- Benchmark prototype against competitor designs
- Determine rate of heat produced
- Velocity or volume flow rate
  - Pitot tube or an Air flow meter
- Temperature at distance of use
  - Thermocouple or Thermometer



Measuring Sound Pressure

- Benchmark to noise output of competitors
- Determine sound based on frequency
- Calculate motor rpm





Testing Setup

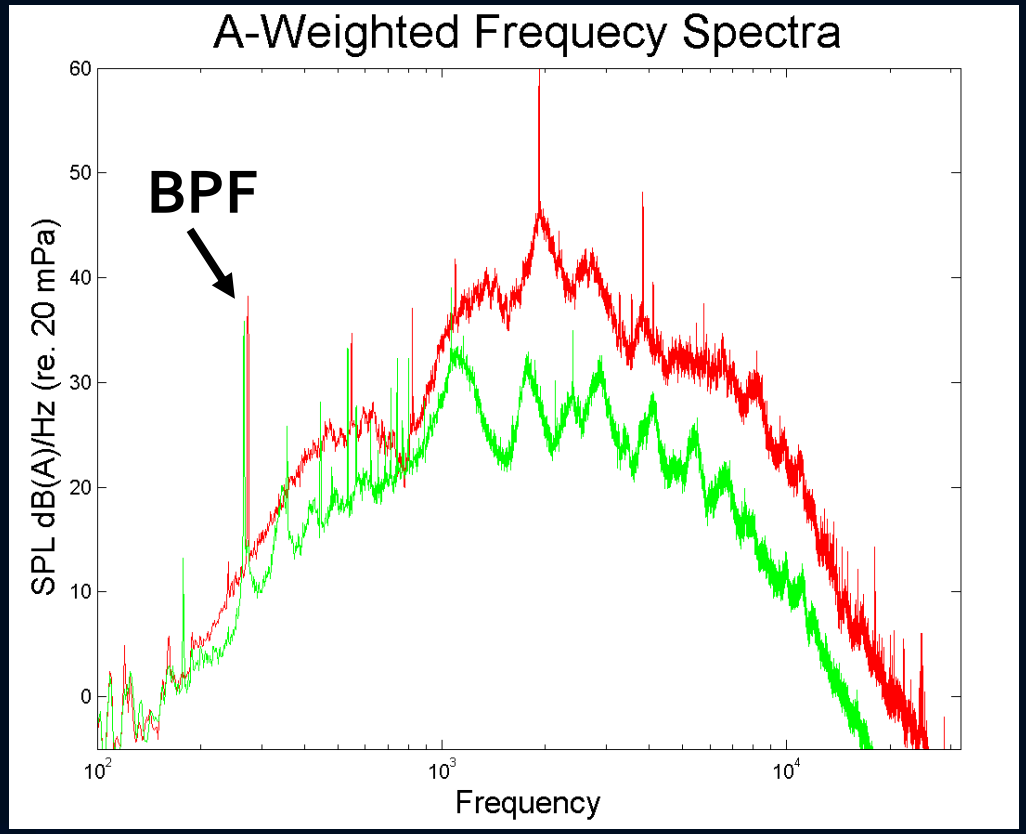
Measuring Sound Pressure

Revlon 1875 – Axial Fan

- **Fan RPM ≈ 2350**
- **SPL at 1 = 76 dB(A)**

Centrix Q-Zone – Centrifugal Fan

- **Fan RPM ≈ 530**
- **SPL at 1 = 64 dB(A)**



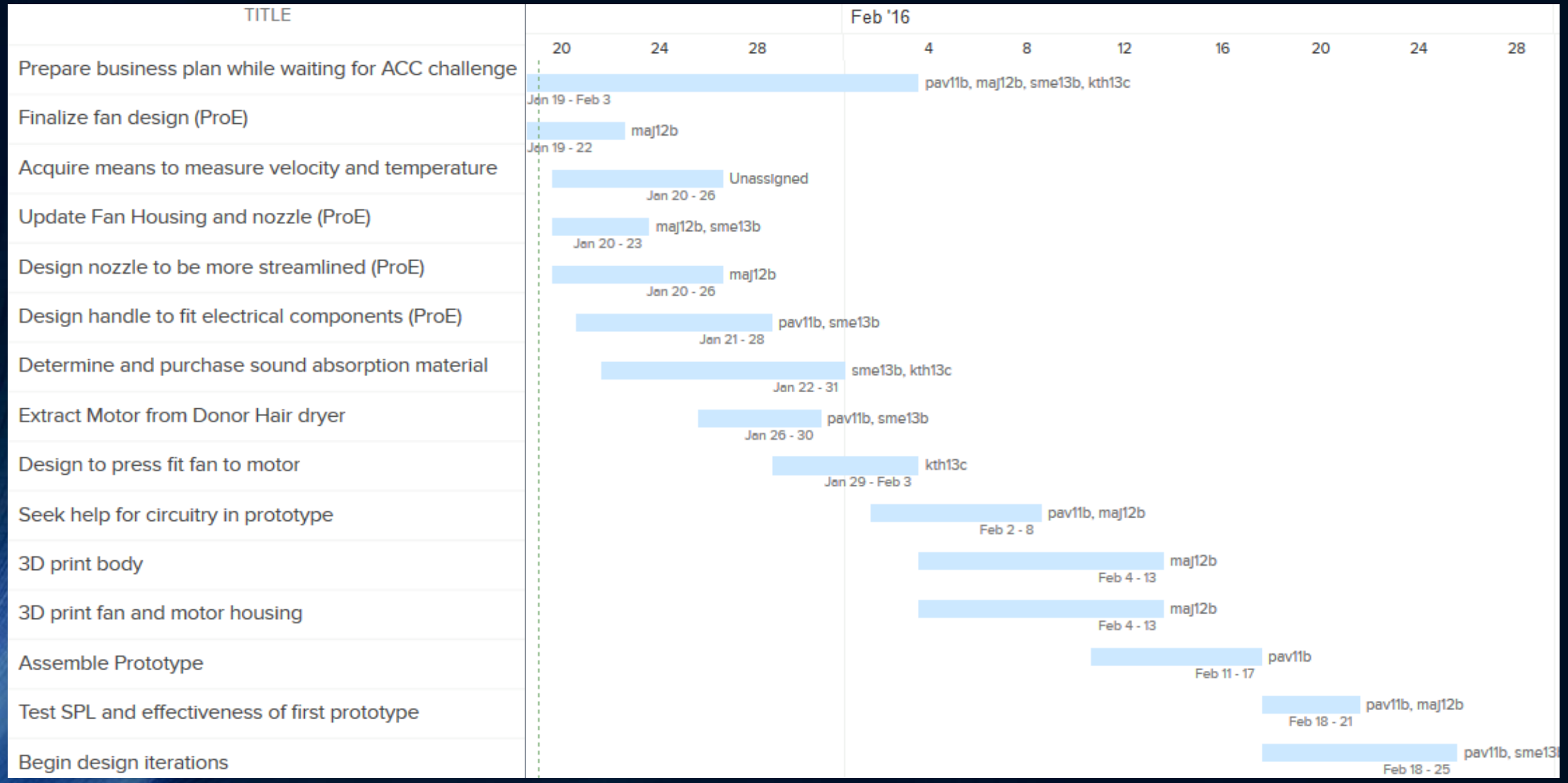
- Low speed setting of fan is roughly 70% of high setting
- Blade pass frequency magnitude comes from blades passing nearby stationary components

$$Blade\ Pass\ Frequency = \frac{(RPM\ of\ Motor) * (\#\ of\ Blades)}{60}$$

2016 ACC Innovation Challenge

- Competition amongst ACC schools for the best innovation
- Each school sends one representative idea to Georgia Tech in April
- Judging is based off of 3 minute pitches of idea and business model
- Notified after February 1st if our team is selected to continue in FSU
- Eligibility
  - Original creators and inventors of the prototype/idea
  - Open to FSU students
  - Must be able to produce a functioning prototype by April 2016
- Cash prizes for top teams at Georgia Tech

Gantt Chart


TITLE
Feb '16
20
24
28
4
8
12
16
20
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28
Prepare business plan while waiting for ACC challenge
pav11b, maj12b, sme13b, kth13c
Jan 19 - Feb 3
Finalize fan design (ProE)
maj12b
Jan 19 - 22
Acquire means to measure velocity and temperature
Unassigned
Jan 20 - 26
Update Fan Housing and nozzle (ProE)
maj12b, sme13b
Jan 20 - 23
Design nozzle to be more streamlined (ProE)
maj12b
Jan 20 - 26
Design handle to fit electrical components (ProE)
pav11b, sme13b
Jan 21 - 28
Determine and purchase sound absorption material
sme13b, kth13c
Jan 22 - 31
Extract Motor from Donor Hair dryer
pav11b, sme13b
Jan 26 - 30
Design to press fit fan to motor
kth13c
Jan 29 - Feb 3
Seek help for circuitry in prototype
pav11b, maj12b
Feb 2 - 8
3D print body
maj12b
Feb 4 - 13
3D print fan and motor housing
maj12b
Feb 4 - 13
Assemble Prototype
pav11b
Feb 11 - 17
Test SPL and effectiveness of first prototype
pav11b, maj12b
Feb 18 - 21
Begin design iterations
pav11b, sme13
Feb 18 - 25

References

- http://hebergement.u-psud.fr/projetsdephysiquestatistique/m1/projet_jt.html
- http://www.brd-nonoise.com/RequestDetails.aspx
- http://www.mne.psu.edu/lamancusa/me458/11_fan.pdf
- https://en.wikibooks.org/wiki/Acoustics/Noise_from_Cooling_Fans
- http://www.sengpielaudio.com/calculator-dba-spl.htm
- http://alumni.media.mit.edu/~dlanman/courses/decibel_meter.pdf

Questions?