Dog Grooming tool

TEAM 17

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SPONSOR: ENGINEERING TO GO

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Background

Some dogs have fur that is prone to matting and tangling

Textures and characteristic of the coat vary by dog's size and breed

- Short and long hair
- Course and fine hair

Grooming issues

- Takes too long
- Tools not very ergonomic
- Unpleasant experience for dogs and groomers

Background Research

What makes a grooming tool successful?

- Safe for the pet and groomer
- Remove knots and tangles from hair
- Comfortable and easy for groomer to use

Various de-matting tools that currently exist

- Knot out – cuts fur
- FURminator – pulls mats
- Mat-Splitter – splits mats

No current tools brush through knots

- **Hypothesis:** A rotating brush could gently de-tangle hair from the top down

Mat-Splitter

Knot Out

FURminator

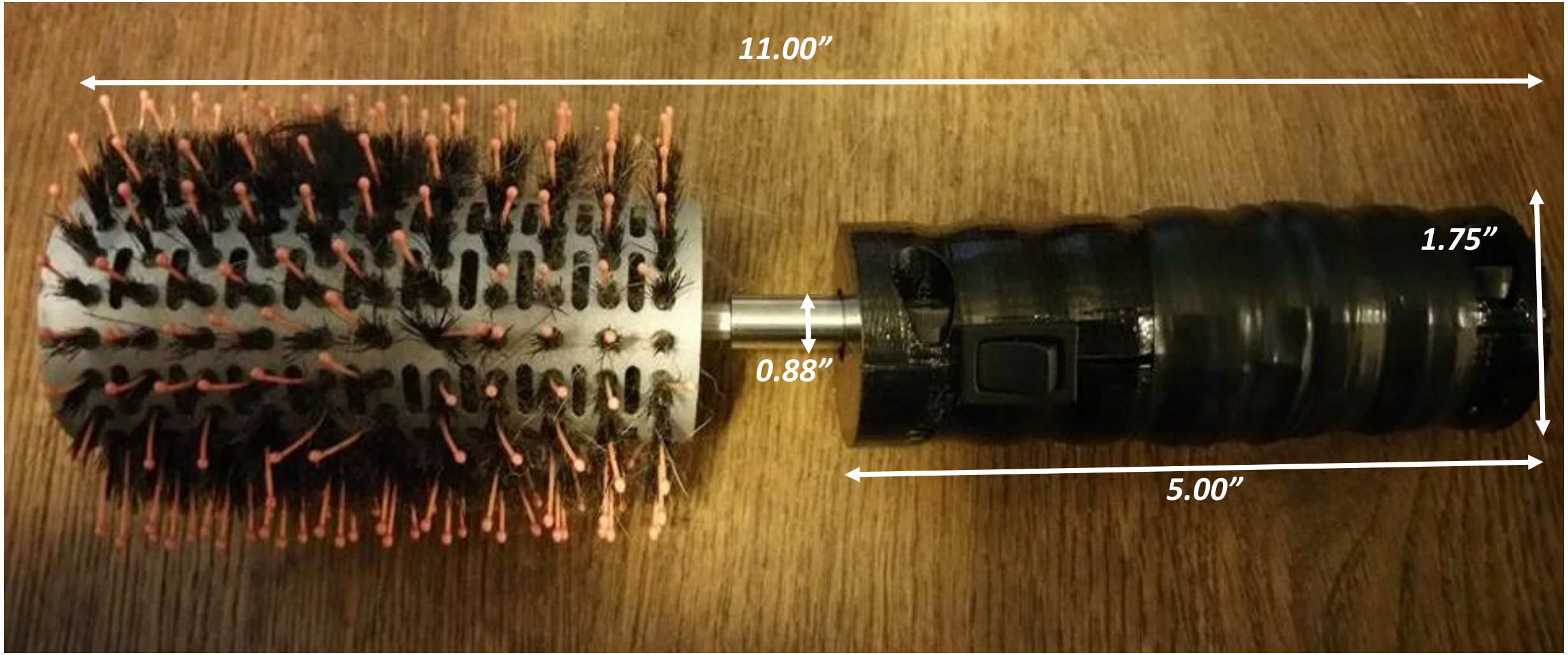
Need Statement

"**De-matting a dog's fur** can be an **unpleasant experience** for both the dog and the groomer, especially if the matting has advanced and is deep in the hair or fur. The de-matting process is considered to be **time consuming and painful**, for the groomer as well as the dog."

Revised Goal Statement

Design and develop a grooming tool that provides both the user and dog with a pleasant, stress free, time efficient grooming experience

Updated Prototype Design



Prototype Components and Specifications

Handle Design

- Ergonomic handle, 3D printed for convenience, finger grooves

Motor

- 12V DC gear motor, runs at 60 RPM, has torque of 2.66 in-lbs.
- Dual bearings for lateral load placed on the motor shaft

Power Source

- Power is transferred through a small AC to DC wall adapter and a simple on/off switch

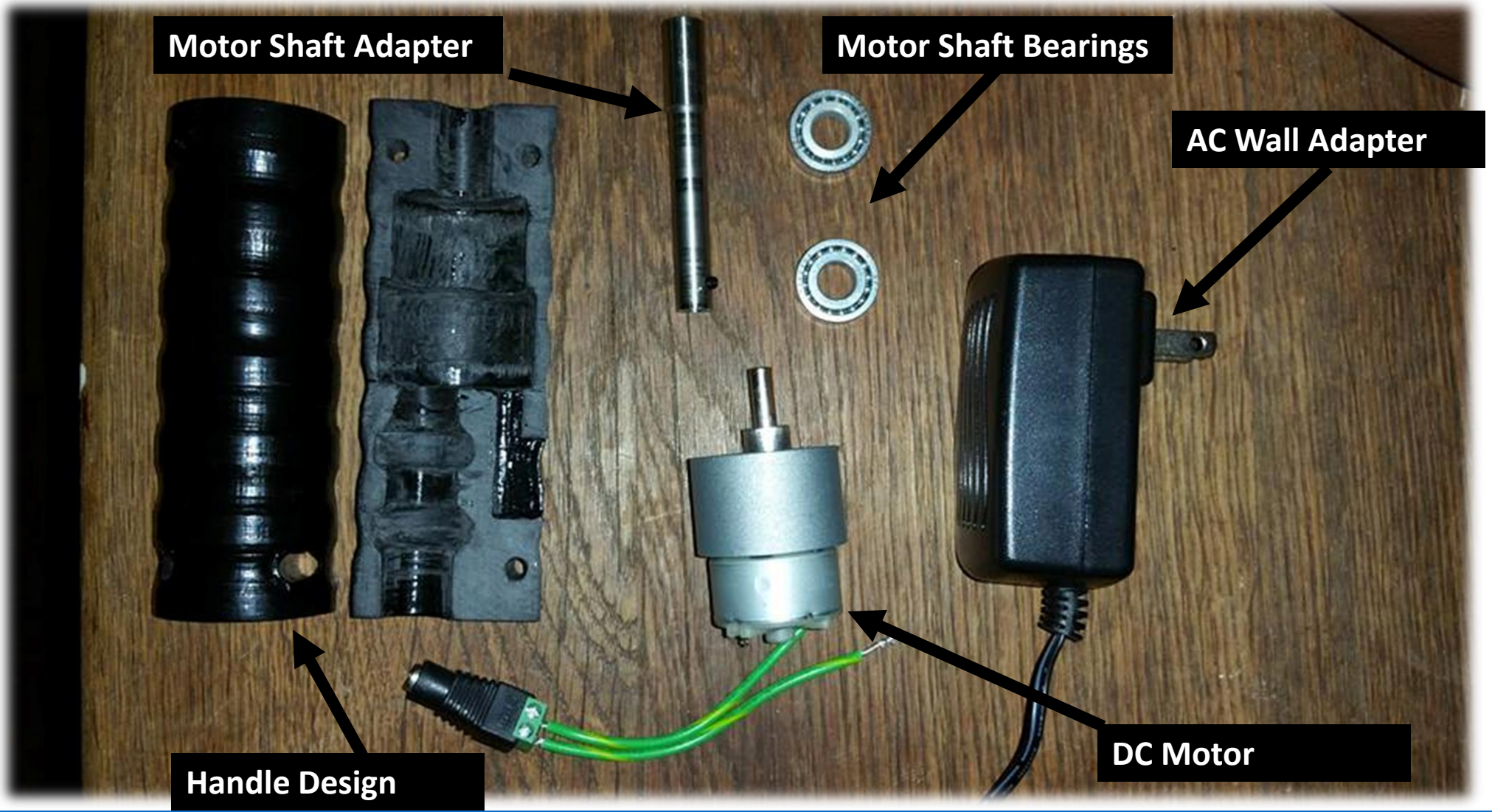
Brush Head and Bristles

- Taken from existing dog and human hair brushes

Overall Design

- More ergonomic, compact, and safe for the pet and groomer
- Total weight of brush assembly is ~15.3 oz. (0.96 lbs.), less than 1 lbs. constraint

Prototype Components



Testing Review

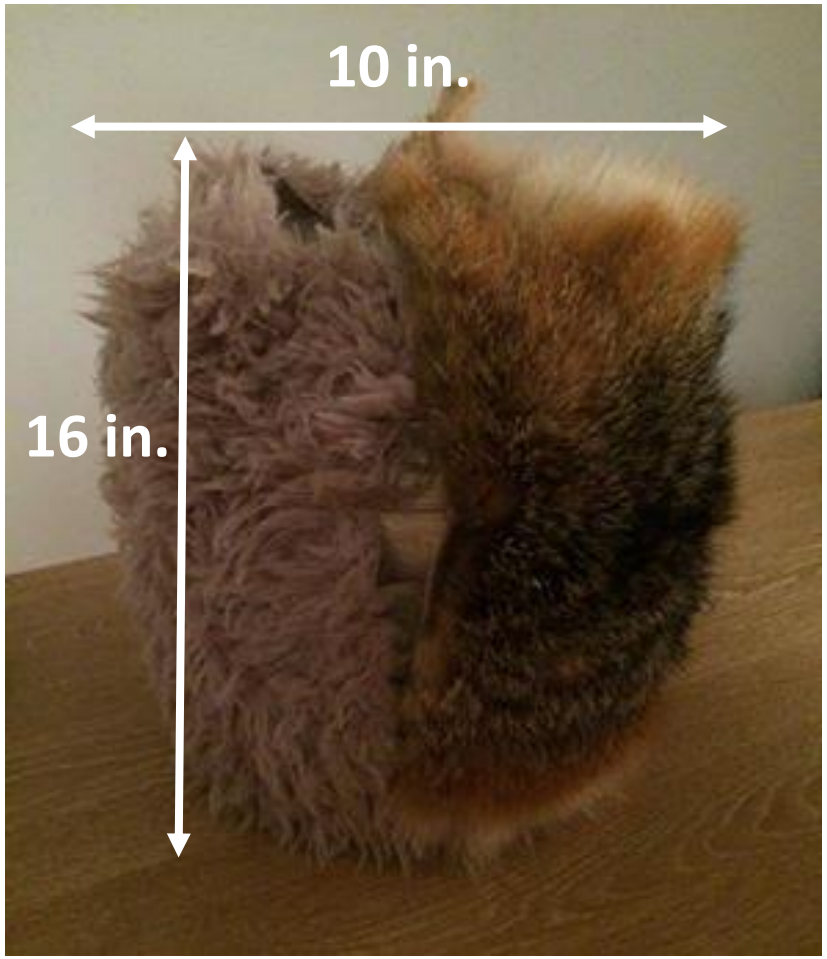
Table 1: Test Result Review

Test Conducted	Purpose	Results
Motor Stall Force	Calculate max applied tangential force where motor stalls	**22.5 lbs.**
Required Brushing Force	Determine the approx. force used to pull ordinary brush through fur	$\leq$ **1 lbs.**
Shaft Bending Moment	Calculate max applied bending force that shaft would encounter	**Static: 8.4 lbs.** **Dynamic: 25.7 lbs.**
Bristle Deflection	Determine how much each bristle would deflect when force applied	**Displacement = 0.183 in** **Angle = 15.6 deg.**
Bristle Design	Determine how well stiffer metal bristles handled fur	**Bristles tend to grab and pull hair without release**

Testing Materials and Apparatus

Dead Red Fox Hide

Faux Llama Fur



Testing Apparatus Body

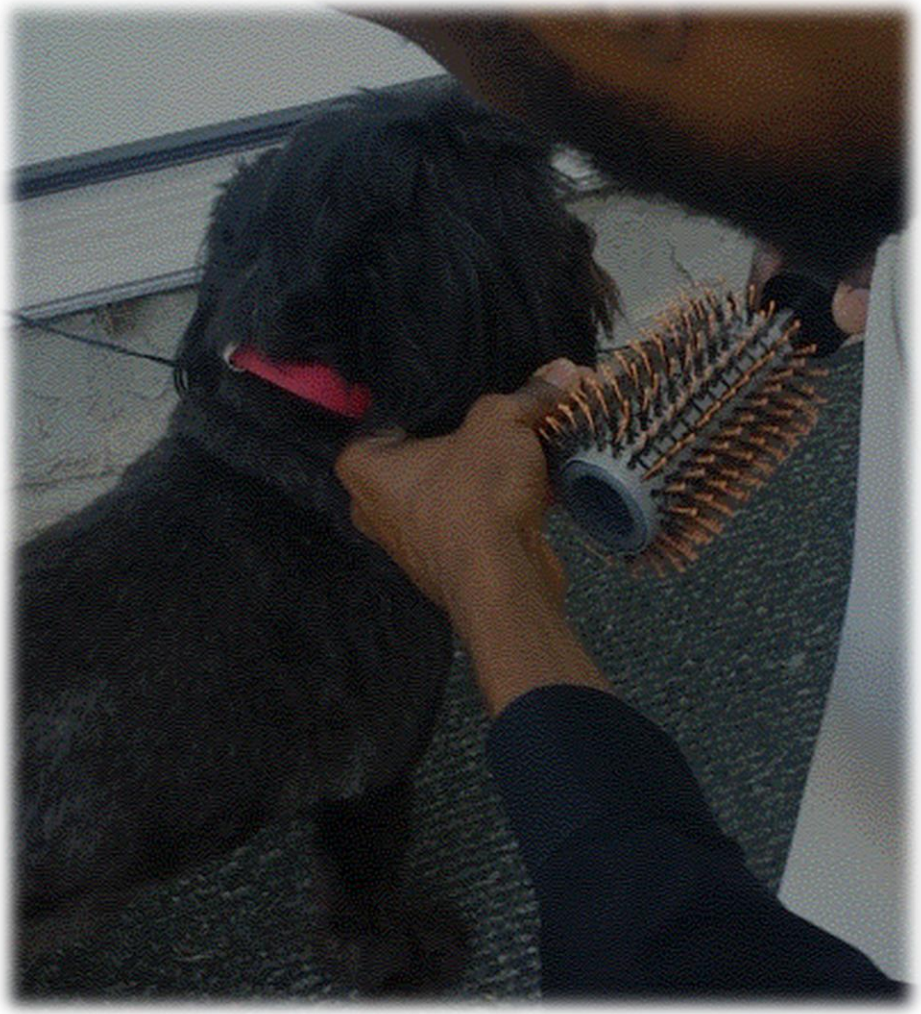
Testing and Analysis: Brush Head Bristles

Test Conducted

- Applied brush on disordered and mildly matted fur
- Applied rotary bush with different heads to various types of fur

Test Purpose:

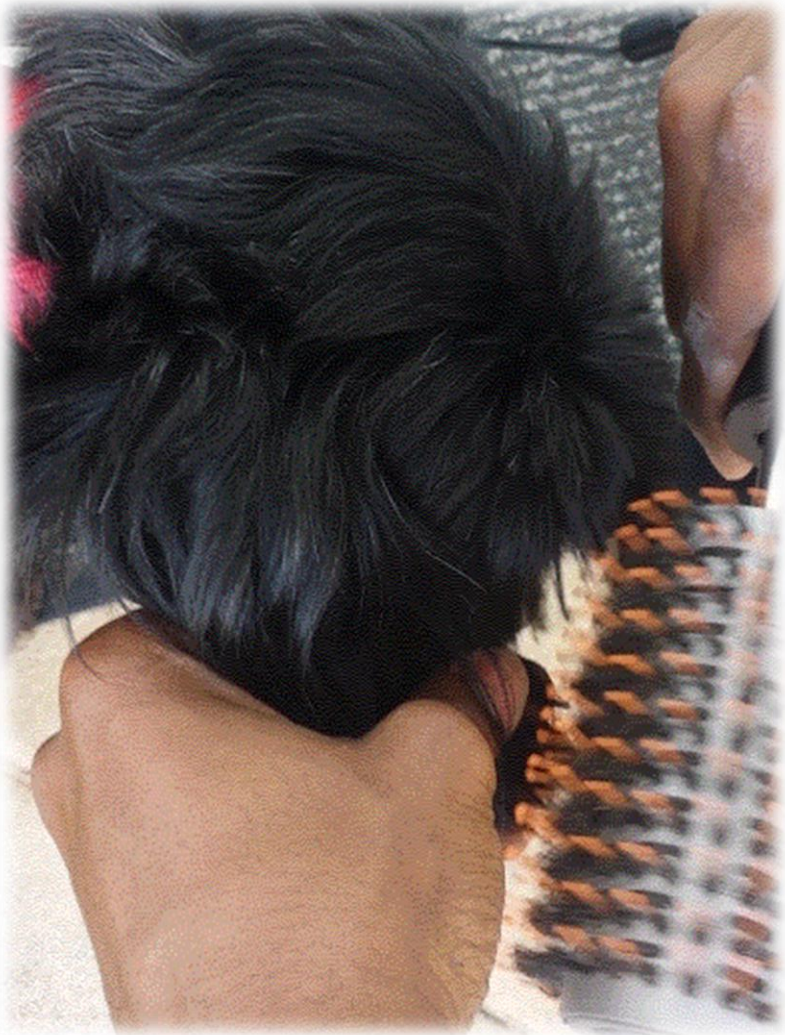
- Evaluate how well the select bristle design works
  - Is the fur neat?
  - Did the bristles snag on the fur?
  - Was excessive fur removed?



Testing of Brush Tool

Testing and Analysis: Brush Head Bristles

Gently Grasping Dog



Applying Brush to Ear

Removed Mat

Testing Results:

Brush Head Dimensions:

- Less than 1.7 inches diameter caused wrapping regardless of bristle shape

Bristle Material:

- Snagging reduced when Hog hair and plastic was used versus metal

Motor:

- High torque of the motor would not allow brush head to stop rotating if snagged

Fur:

- Disordered fur became neat and ordered after brush use
- Minimal hair was removed

Dog's Response:

- Noise of brush startled dog
- Dog had to become familiar with sound of the brush in order to cooperate

Testing Conclusions:

Brush Head Dimensions:

- $1.75\ in. \leq Diameter \leq 4in.$
- $3\ in. \leq Length \leq 6\ in.$

Bristle Material:

- Boar hair and plastic bristles will be used

Motor:

- Adding a clutch or torque regulator is the best option to combat high torques

Fur:

- Rotary brush functions effectively as a tool for simple brushing messy fur

Dog's Response:

- Noise of the brush is a factor for dogs in common situations

Boar Bristles

Miniature Clutch

Plastic Bristles

Updated Brush Head Design

Brush Head 1

Brush Head 2

Brush Head 3

Brush Head 4

Images not to scale

Brush Head Design

Table 2: Brush Head Dimensions

Brushes	1	2	3	4
Diameter (inches)	1.9	1.7	3.2	1.7
Length (inches)	5	4.8	4.2	4.5
Weight (ounces)	4.7	3.7	7.17	1.8

Future Work: Test Plans

Table 3: Test Plans

Components	Test	Purpose
New Brush Heads	Use constant diameter brush heads on different length and textured furs	Determine effective range for brush head diameter for specific length fur
Bristle Design	Use bristles made of stainless steel and plastic to brush fur	Select best material to use for bristles, and determine desired deflection
Brushing Effectiveness	Use the prototype tool and manual dog brush to various brush fur	Compare the two and determine the more effective and time efficient
De-Matting Effectiveness	Operate brush on fur with various degrees of matting	Determine how effective the rotating brush head is at removing mats from fur

Upcoming Design Adjustments

Brush Head

- Metal bristles were found to be to lower deflection, so plastic and hog hair bristles will be further tested

Motor

- Implementation of motor torque regulator (clutch)
- Ability to control amount of torque output from prototype

Switch

- Incorporate switch to allow motor to reverse revolution direction
- Allow tool to be used with either hand

Future Work: Testing and Field Trials

- Visit with groomers and owners to complete testing plan
- Use results from test to finalize prototype design and function
- Distribute to selected groomers and dog owners for trials
- Gather feedback on performance from trials
  - Likes and Dislikes
  - Areas for improvements

Future Work: Current Goals

- Have a finalized working prototype that can functions as a dog brush
- Compete and WIN Engineering Shark Tank Competition
- Conclude whether current design will work as effective de-matting tool
- Build multiple grooming tool prototypes for sponsor
- Complete prototype and have product ready so that sponsor's marketing phase can begin
  - Business Model
  - Market Analysis
  - Commercialization

Future Work: Prototype Finalizations

Challenges:

- Price of miniature clutch too expensive ($100/ea.)
- Creating adequate mats and tangles in fox fur and faux fur
- Addition of reversible switch requires re-printing handle
  - Costly unable to meet prototype goal

Possible Solutions:

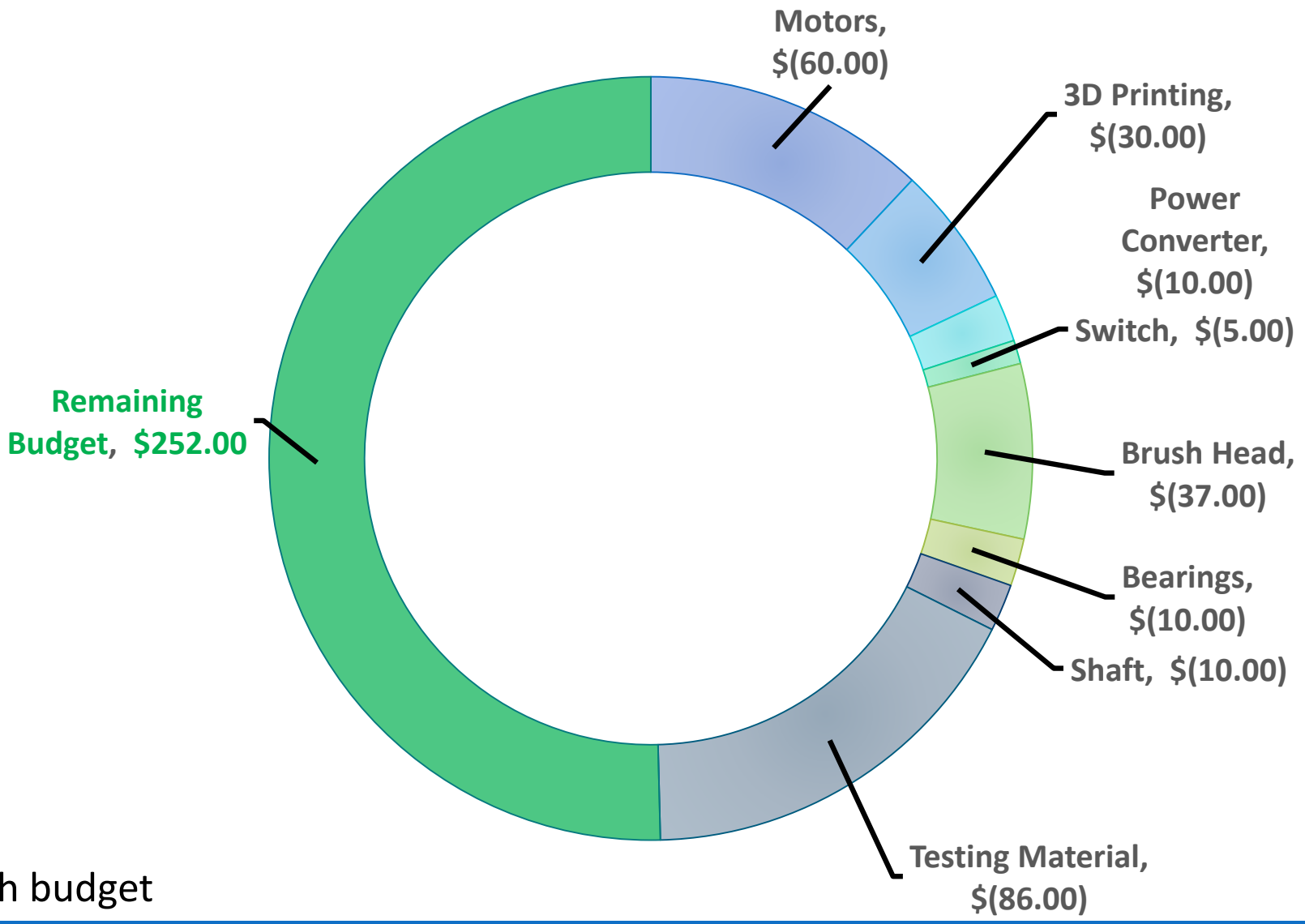
- Add reversible switch
  - Allows tangled brush to unwrap itself
- Use matted dog fur from owners and groomers to test de-matting abilities
- Consider decreasing the number of prototypes to be made
- Request increase in budget funding

Current Budget

Total Budget Allocated
- $500.00*

Amount Spent
- $248.00

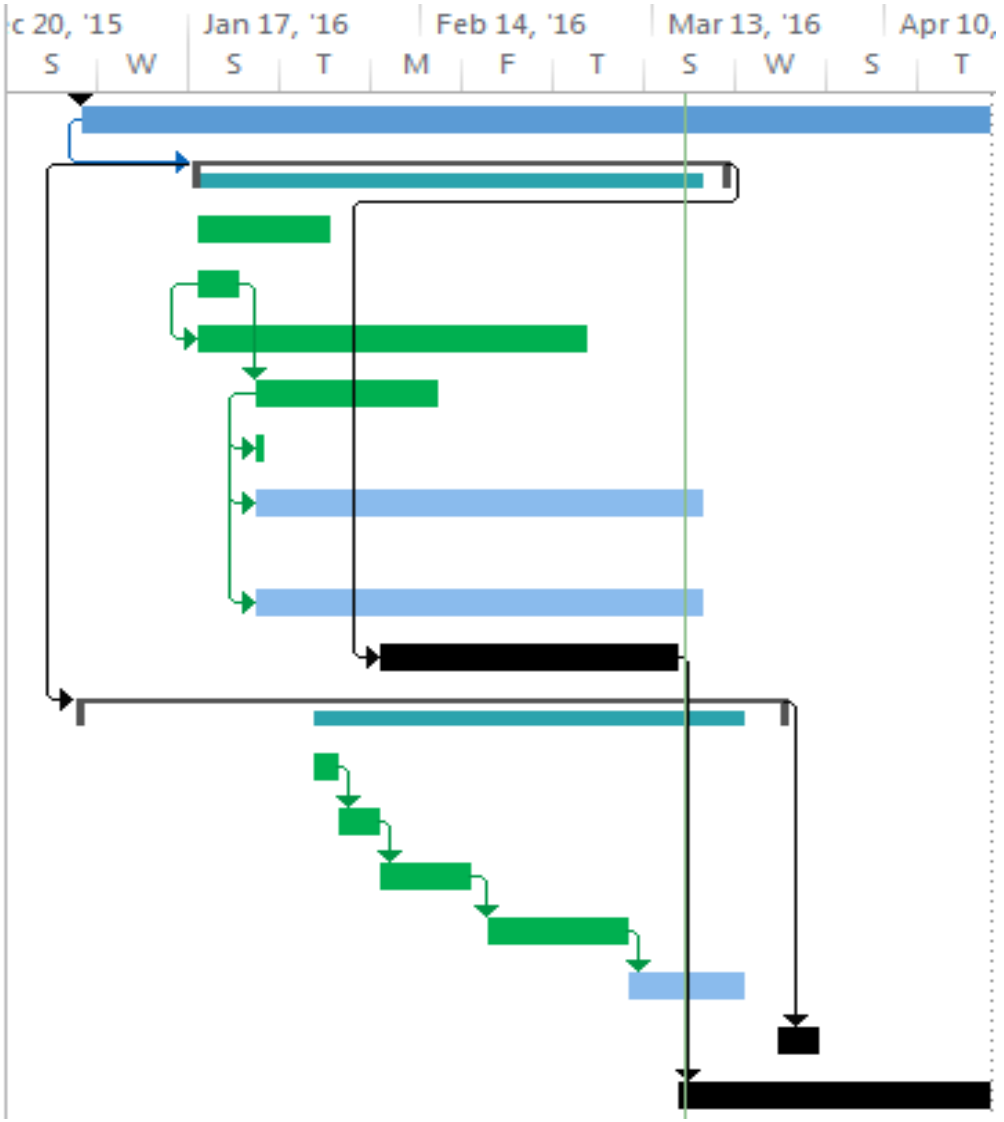
Remaining Amount
- $252.00



*Sponsor has expressed flexibility with budget

Updated Gantt Chart: Phase II

	Task Name	Duration	Start	Finish
30	***Phase II (January - April)***	***80 days***	***Mon 1/4/16***	***Fri 4/22/16***
31	**Test and Analysis**	**46 days**	**Mon 1/18/16**	**Mon 3/21/16**
32	Analyze Ergonomics	12 days	Mon 1/18/16	Tue 2/2/16
33	Test Planning	5 days	Mon 1/18/16	Fri 1/22/16
34	Procure Test Materials	35 days	Mon 1/18/16	Fri 3/4/16
35	Test Motor Stall Force	16 days	Mon 1/25/16	Mon 2/15/16
36	Test Power Source	1 day	Mon 1/25/16	Mon 1/25/16
37	Test Optimal Brush Head Diameter	40 days	Mon 1/25/16	Fri 3/18/16
38	Test Bristle Design	40 days	Mon 1/25/16	Fri 3/18/16
39	**Voice of the Customer II**	**26 days**	**Tue 2/9/16**	**Tue 3/15/16**
40	**Redesign**	**61 days**	**Mon 1/4/16**	**Mon 3/28/16**
41	Review FMEA	3 days	Mon 2/1/16	Wed 2/3/16
42	Design Approval	3 days	Thu 2/4/16	Mon 2/8/16
43	Fabricate Redesigned Parts	9 days	Tue 2/9/16	Fri 2/19/16
44	Rebuild Prototype	13 days	Mon 2/22/16	Wed 3/9/16
45	Test and Analysis II	10 days	Thu 3/10/16	Wed 3/23/16
46	**Field Trials**	**5 days**	**Mon 3/28/16**	**Fri 4/1/16**
47	**Voice of the Customer III**	**28 days**	**Wed 3/16/16**	**Fri 4/22/16**



Conclusion

- Redesign Phase continues
- Product component testing will continue
- Brush head diameter and length range determined
- Optimal bristle design material chosen
- Prototype’s function as a de-matting tool to be determined
- Testing results and data to be reported and used to improve product
- Practical solution for over torqueing motor to be sought out

Questions?