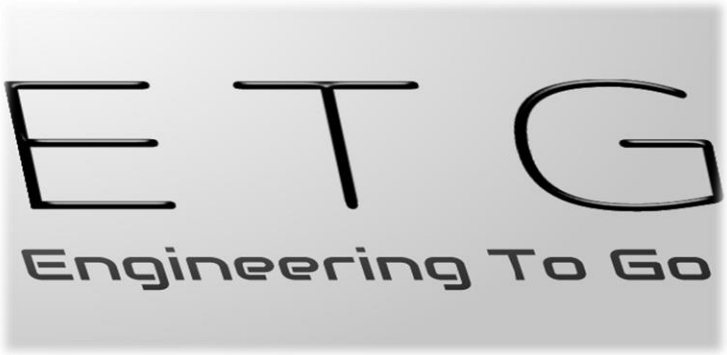
DELIVERABLE VI: PROJECT PLANNING/PRODUCT SPECIFICATIONS (RESTATED)

EML4552C – Senior Design Spring 2016

TEAM 17 - "IMPROVED DOG GROOMING TOOL"



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Acknowledgements

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Abstract

All dog coats, require consistent maintenance and upkeep to prevent painful matting, maintain cleanliness and preventing bad odors. The Improved Dog Grooming Tool project, is an engineering endeavor that looks to provide a solution to the problems dog owners and caretakers face when it comes to grooming their dogs. This project is sponsored by Todd Hopwood and William Bilbow, two professional engineering business owners. The current process of manually brushing hair and removing mats from dog fur is a time consuming, and strenuous task for caretaker and at times the dog. In-depth research was conducted to identify current tools used for grooming tools and the issues people deal with while using them. A plan to organize the order in which this project was to be carried out was formed. After which conceptual designs were created based on the voiced needs of the consumer and sponsor. The concept design and its components were selected based on design, budget, and performance constraints, which led to further studies in the form of failure mode analysis. Results from the initial testing have proven design concept feasibility, leading to future testing in the next phase of this project.

1. Introduction

Team 17 has been selected to provide a solution for the unpleasant grooming experiences of dogs and their caregivers, through the design and construction of a tool, which will allow a dog's coat hairs to be brushed and ordered using a process that is non-stressing for the groomer, and pleasant for the dog.

So far in the initially stages of this design project, Team 17 knows and understands that the current brushes that are being used to detangle and de-mat dog coats function inadequately to the expectations of their users. Team 17 also understands that while there is a market for their desired product, a detailed planning process, as well as a thorough research and prototyping phase, are essential for a successfully designed product that meets the objectives, and accomplishes the goal. Team 17 has implemented several methods as ways to appropriately plan for the project ahead. These methods include the construction of a Gantt chart, which provides the project's critical path methods, allowing the team to stay on top of the progress of current tasks and to prepare for upcoming ones. In the development of the design prototype there are a number of technical questions that must be both asked and answered that allow for the team to take the characteristics of which it is essential for the product to consist. The research phase helps provide answers to the design questions, which in turn provides the prototype design phase with the opportunity to be effective and resourcefully efficient

2. Project Definition

2.1. Background Research

After some rigorous researching there are many types of dog grooming tools that are on the market today. For example, there are double-sided dog brushes, which have different types of bristles on each side. There are also dog brushes, which utilize a vacuum pump that sucks up the hair as the groomer brushes the dog. Of all of these different types of dog grooming brushes the most popular type of dog hair detangle that is on the market today is called the FURminator, seen below in Figure 1, which is said to reduce shedding by up to 90%. This tool is widely popular by dog owners and groomers and has established a reputation of being the best solution to any dog coat hair issues

Figure 1: FURminator[1]

Figure 2: Mat-Splitter[2]

2.2. Needs Statement

For this project we have two sponsors, Todd Hopwood and William M. Bilbow. The problem presented to Team 17 is that dogs of all hair qualities, textures, and lengths, experience matting and tangling in their coats. This matting makes it tough to groom the dog when trying to complete small tasks, such as brushing a dog's hair. This problem is seen in many different types of dogs with different hair lengths.

"De-matting a dog's hair 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. To de-matt or de-tangle, it can be very time consuming and uncomfortable, if not painful."

2.3. Goal Statement and Objectives

"Design and develop a grooming tool that provides a less stress experience to the groomer and dog."

The objectives of this project are:

- Design a hand held dog grooming tool for use by consumers, groomers, and dog rescues.
- Successfully untangle hair without harming animal
- Develop a hand-held rotary pet groomer that provides for a stress-free experience for both the dog (or other animal) and the groomer

2.4. Constraints

The constraints of this project are:

- The tool must be hand-held and ergonomically friendly
- The tool must have a low RPM to keep quiet
- The tool must be easy to clean and sterilize
- The battery should last 2 hours at 50% duty cycle
- The total weight must be at 1 pound or under

3. Project Planning

3.1. Methodology

Throughout the upcoming year, Team 17 plans to take this design project from its initial concept all the way to prototype and production phases. The design team plans to accomplish this by following a well-defined set of objectives and timetables as closely as possible, and adapting to any setbacks that may arise. The first steps in this process involve gaining an insight into the wants and needs of potential customers to determine if there is a market for our desired product, and what any potential risks are. Surveys will be performed on potential customers with questions

that will help the team understand what engineering characteristics to focus on when the design begins. By obtaining the 'voice of the consumer', the team will better understand what features and characteristics are important to potential buyers. A risk assessment and failure analysis will also be conducted in order to determine what road blocks may lie ahead for this project and if it is an endeavor with a large enough profit to make it worth pursuing. After determining what engineering characteristics will be included in the product and conducting the risk analysis, the design phase will begin as the team begins to draft the chosen concept based on the information found from consumers. The tentative goal is to have a final prototype by the end of the fall semester.

3.2. Work Breakdown Structure

To help meet the deadlines set by the project sponsor as well as the team, it is important to keep track of deadlines for project deliverables. By creating a work breakdown structure as well as a Gantt chart, it becomes much easier to see what deadlines are coming up and stay ahead of them. Figure 3 below shows a basic work breakdown structure that lists the tasks that are critical to the completion of the project, and the progressive step by step process with which they must be accomplished.

3.3. Gantt Chart and Critical Path

Figure 4, shown below, is the revised Gantt chart diagram for the design project. In the left matrix, the Gantt chart display a list schedule of all the tasks of the design process that are to be completed during the 2016 spring semester. These tasks are linked and interrelated with one another based on the completion times and the design hierarchy of tasks. Not included on the Gantt schedule but still carried out by Team 17 are between the team and the sponsors. The hierarchy of tasks displayed in the Gantt create the critical path method for the project. The critical path method provides a timeline for the tasks to be done, and shows what tasks are dependent and independent of completion of preceding tasks. This allows there to be no stoppage in working as the team will know which things can be done while other tasks are pending.

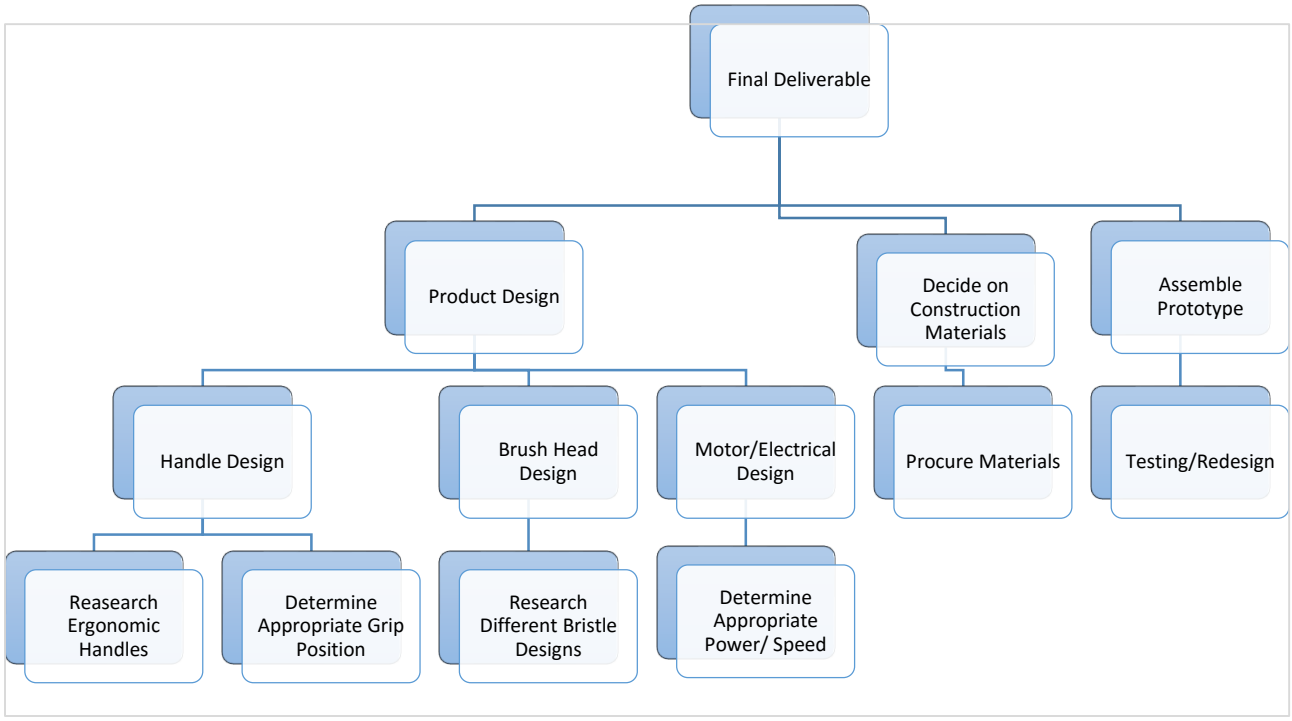

Figure 3: Work Breakdown Structure Diagram

Task Name	Durat	Start	Finish
Research Alternative Designs	**61 days**	**Mon 12/7/15**	**Mon 2/29/16**
Phase II (January - March)	***75 days***	***Mon 1/4/16***	***Fri 4/15/16***
Test and Analysis I	**24 days**	**Mon 1/4/16**	**Thu 2/4/16**
Test Motor Speed	10 days	Mon 1/4/16	Fri 1/15/16
Analyze Ergonomics	10 days	Mon 1/4/16	Fri 1/15/16
Test Power Source	10 days	Mon 1/4/16	Fri 1/15/16
Test Electrical Components	10 days	Mon 1/4/16	Fri 1/15/16
Test Tool Effectiveness	10 days	Mon 1/4/16	Fri 1/15/16
Test Tool Effeciency	14 days	Mon 1/4/16	Thu 1/21/16
Troubleshoot Issues	10 days	Fri 1/22/16	Thu 2/4/16
Voice of the Customer II	**11 days**	**Mon 1/18/16**	**Mon 2/1/16**
Redesign	**30 days**	**Fri 2/5/16**	**Thu 3/17/16**
FMEA	3 days	Fri 2/5/16	Tue 2/9/16
Design Approval	3 days	Wed 2/10/16	Fri 2/12/16
Build Prototype	10 days	Mon 2/15/16	Fri 2/26/16
Test and Analysis I	14 days	Mon 2/29/16	Thu 3/17/16
Field Trials	**21 days**	**Fri 3/18/16**	**Fri 4/15/16**
Voice of the Customer Report	**54 days**	**Tue 2/2/16**	**Fri 4/15/16**

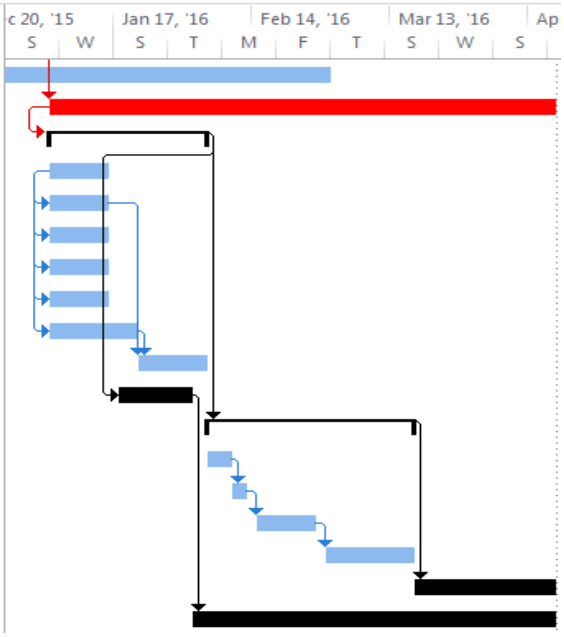

Figure 4: Phase II Project Gantt Chart: Spring Semester

3.4. Project Task List

Table 2: Phase II Project Task Table

Task	*Leader*
Managing Records and All Documentations	Jordan Chupp
Liaison for Sponsors	Justin Proctor
Manage Scheduling	Roy Mason
Cost Analysis of Materials and Components	Dennis Pugh
Liaison for Groomers	Roy Mason
Test Planning	Team 17
Research De-Matting Design Alternatives	Roy Mason Jordan Chupp
Procure Materials	Justin Proctor
Brush Assembly	Team 17
Brush Testing Materials	Dennis Pugh
Brush Handle Testing	Roy Mason
Brush Motor Testing	Jordan Chupp
Brush Head Attachment Testing	Justin Proctor
Prototype Re-Design	Team 17
Brush Field Trials	Team 17

Table 2 above shows the upcoming tasks for Team 17 and which team member or members will be taking the lead on them. In the first phase one of the Improved Dog Grooming Tool project, Team 17 worked on defining the voice of customer, leading to the need for the grooming tool as well as initial and detailed concept designs. Now as the project transitions into the second phase of this design project, the team has identified and delegated the lead of various tasks to each team member.

Managing all project documentations refers to the notes, ideas and plans shared and discussed at all meetings, as well as purchase receipts for components and project materials. This responsibility will be taken on by the team secretary, Jordan Chupp. The team leader Justin Proctor will continue to serve as the team liaison to project sponsors, scheduling meetings and updating them with progress, decisions made and any difficulties encountered. Roy Mason will be managing the scheduling, making sure that the team remains on track with the fulfillment of goals and objectives and that all deadlines are met in a timely fashion. Cost analysis of materials and prototype parts and components will be led by Dennis Pugh. Roy Mason will continue to act as the groomer liaison for Team 17, which will require contacting and visiting specific groomers that have expressed interest in the improved grooming tool, and updating them on progress and gathering valued input and design suggestions. Test planning is necessary because it allows the team to determine which aspects of the grooming tool prototype will need to tested as well as how the tests will be conducted. The test planning and actual testing process has been divided up to respective team members. Dennis Pugh is in charge of purchasing the various testing materials such as wigs and other materials to be used to simulate dog fur. Roy Mason is heading the testing

and design of the dog brush handle exterior and testing that it meets ergonomic requirements and customer comfort. Justin Proctor will be the head of the testing and design of the brush head attachment as well as the internal electrical components. Finally Jordan Chupp is in charge of the torque and angular velocity testing that each motor must undergo to determine if other internal components need to be included in the design to increase motor output or decrease it. The project sponsors chose to widen the scope of the project and saw it fit to focus on the rotational brushing tool. The method in creating a better way to de-matting a dog still has to be determined through detailed research which will be led by Roy Mason. As the team leader Justin Proctor will be in charge of acquiring all purchased components for the fabrication of the dog grooming brush. Once the all the parts have been delivered and fabricated, Team 17 will assembly each prototype and proceed to carry out each test chosen during the test planning phase. After receive conclusive results from each test, the team will edit and redesign the prototype to be finalized and dispersed for field trials near the end of phase two.

3.5 Risk Assessment

A risk assessment is essential because it provides team members with an awareness of the possible risks that lay ahead with the project so that the team never finds itself without a solution to a risen issue. The risk assessment conducted by Team 17 takes into account possible risks of the project as well as possible risks of the product that will be produced. For each listed risk within the risk assessment Team 17 also collaborated to come to a consensual contingency plan to address it. Below in Table 3 is provided a project risk assessment tabulating each foreseen risk along with its contingency option beside it. A detailed risk assessment that will be developed along with the detailed decision matrix, will be used to address the risk associated with the selection of each possible brush tool components, as well as any other design decisions that are made.

Table 3: Project Risk Assessment

Risks	Contingency Plan
Allocated budget is not sufficient for prototype fabrication	Narrow project scope and perform cost analysis
Materials are not delivered on time	Order parts and materials early or in a timelier manner
Deadlines for things such as machining need to be extended	Stick to Gantt Chart schedule and look for other areas to make up the time later
Failure to develop functioning prototype	Have multiple concepts ready for prototyping and fabrication
Bristles harm pet when tool is operated	Design brush safety bumper to keep bristles from getting too close to dog's skin
Team members get electrocuted during assembly	Wear personal protective equipment such as gloves

Operator gets harmed from tool	Design an ergonomic handle and test to see any complications
Bristle head spins at a dangerous speed	Use low speed motor and test brush at multiple speed until desired speed is reached

4. Product Specifications

4.1. Design Specifications

In order to design a tool that will met the specified goals, various specifications are required. Table 4 below lists the design specifications, but they are broken down here with descriptions starting with the overall design. The whole tool must be lightweight, which will require it to be one pound or less. Obviously the design will need to be appealing in order to get customers to buy the product when it hits the market. The design of the tool itself can be broken down into three major components which are the handle, the internal electronics such as the motor, and the rotary head.

Starting with the handle, it must be hand held and ergonomic, meaning the device must be comfortable to the customer's hand and not much force be needed to operate the device. The idea is to take away as much stress as possible and by providing a customer friendly tool, much stress will be levitated.

Moving to the inside of the tool, the battery will need to have a 2 hour duty with an 8 hour standby. Along with these specifications, the battery must be designed to be replaced quickly. The more stressful it is to replace a battery the less likely someone is to buy the product. Also, the power must have 120V AC charging capacity. These specifications are early on and are subject to change if needed.

Finally, there are some rotary head specifications. These include removable, single speed, bi-directional, low speed, small diameter, and bristles. The removable idea is key, because if one head is ruined, instead of replacing the whole tool, one could just replace the head. Also, taking the head off the tool provides a much easier availability to clean the head. The device must be single speed so that a careful low speed near 60 revolutions per second would not harm the animal. The bi-directional does not mean go both directions in this case, it refers to the head being able to be put on in the opposite direction so that no matter which hand is dominant the customer has the same experience. Lastly, the head specifications include being around 1.5 inches in diameter, as to not be too bulky, and to have bristles of some kind that are not corrosive and easily breakable. These bristles are not required to be of a certain material. Many different types will be thought of and the type that is most successful when dealing with efficiency and harmless to the animal will be chosen.

4.2. Performance Specifications

When designing this dog-grooming brush there are many performance specs that have to be taken into account. The performance specifications will define the desired functionality of the product when being used. With the understanding that dog groomers, dog rescue workers, and personal dog owners will be using this product, it is essential that the performance of this dog-grooming brush meet the needs and expectations of every consumer.

Table 4: Design Specifications

Item	Specification
User Friendly	Hand-held, contoured handle, 50/50 weight distribution
Power Source	1. Battery, 2 hr duty, 8 hr standby, with quick replacement 2. 120V AC Charging Capacity
Weight (max)	1 lb
Rotary head	• Removable / replaceable • Single speed • Bi-directional • 40-100 rpm (Final speed determined experimentally) • Diameter: ~1.5” • Detangling elements/bristles: Stainless spring steel or similar (not subject to breakage, corrosion or harm to pet

Some of the main performance specifications that this product must meet are that it must be able to detangle and de-mat any type texture or length of dog. From talking with many dog groomers, rescuers and dog owners, it is very apparent that detangling a dog’s matted hair is very frustrating. It is said that using a conventional dog grooming brush is very time consuming, which is why we are creating a rotary style grooming tool. The brush must be electric powered device that does the de-matting and detangling work for the user. The brush must reduce the time it takes to de-matt a dogs coat significantly enough to make the use of Team 17’s product worthwhile to customers.

Dog groomers and owners claim that using a conventional dog grooming tools create a lot of stress on the hands and arms of the groomer. The electric functioning of the brush must perform in a manner that reduces the wear and tear on the user, and eliminates the stress that dogs experience when the groomed manually. Team 17 has to make the tool more ergonomic to appeal

to the comfort of the person using the brush. By creating an enjoyable experience with a simple task of grooming for the dog and its groomer, Team 17 can build brand trust and healthy consumer producer relationship.

The brush design must perform as quietly as possible, and output enough work to be effective in its grooming task while not harming any dog during the process.

4.3. House of Quality

Figure 5 shown on page 10 is the House of Quality for Team 17. This diagram was constructed based on results from surveys and questionnaires that were conducted in order to define the voice of the customer. The house of quality was used to form relationships between the desires of the target market and engineering characteristics of the dog grooming tool. The engineering characteristics are grouped under the categories of the tool's mechanical performance, technical specifications, and the user friendliness. All the categories except for the user friendliness are quantitative categories, which require the application of mathematical calculations and engineering principles. The user friendliness is a qualitative measurement and will be in direct relation to the voice of the customer. The roof matrix interrelates the engineering characteristics with each other define those that have strong, medium, and weak correlations. Finally the customer importance ranks the customer requirements on a 1-5 scale, with 5 being most important and 1 being the least. The planning matrix is similar to the customer importance as it likewise ranks the importance of the same customer requirements for team 17 and the designs of the leading competing devices.

4.4 Concept Design One

Since the initial goal of this project was to make a simple, hand held product, design one focuses on these qualities and attempts to be a product that will appeal to multiple audiences. This as seen in Figure 6, below, this design is as simple as possible while meeting all of the project constraints set by the group and sponsors. It has a very simple handle with a motor driven brush head.

Design one, or the hairbrush style, is designed to be familiar looking to the general public. This familiarity should help when introducing the product to potential customers. Not only is the handle oriented to make use very natural, the steel wire bristles used in the brush head should be able to easily pull matts out of thick hair, with nothing more than normal brushing movements.

While design one is designed to very simple to use, it does have some drawbacks. The number one concern, as with any project, is safety. For this product to be sold commercially, safety must be a major design factor. To ensure no harm will come to the animal being groomed, it may be necessary to install guarding or bumpers around the brush head. There is also a chance for longer hair to become tangled around the barrel of the brush. This can be prevented by keeping the barrel sufficiently large so that even the longest of hair cannot fully wrap around it.

Design one also has drawbacks in terms of ergonomics. Although the brush was designed to be simple to operate, it does lack some key features that would make it easier to use for some users.

Most notably, it lacks ambidexterity. Due to the rotation of the brush head, it would not be possible for left handed users to use the brush as comfortably. In order to solve this, the motor would need to have the ability to run in the reverse direction. While this is not a terribly complicated feature to add, it still requires more weight and planning to include. Table 5, below, includes a list of the pros and cons for this design.

(+) – Positive Correlation
(-) – Negative Correlation

◊ - Strong Interrelationship
□ - Medium Interrelationship
○ - Weak Interrelationship

Rankings are on a scale of 5 to 1 with 5 being the most important

Direction of Improvement		↑	↓	↑				↓	↑		↓		↑	↓			
Engineering Characteristics / Customer Requirements	Customer Importance	Mechanical Performance				Technical Specifications						User Friendliness			Planning Matrix		
		No. of Brush Head Blades	Brush Head Angular Velocity	Brush Head Output Torque	No. of Brush Head Motors	Brush Head Materials	Brush Electric Power Source	Total Brush Size	Multi-Sized Brush Heads	Meets Safety Standards	Weight	Brush Handle Materials	Ergonomic Handle	Brush Noise	Team 17 Product	Furminator	Mat Splitter
Affordable Price	5	◊			◊	◊	□		□		○	◊			4	2	1
Comfortable Grip	5							○			○	◊	◊		5	2	1
Simple to Use	3	○					◊		□				◊		4	4	2
Minimal Effort to Use	4	◊	○	◊			□	□	◊		◊		○		5	2	2
Non-Stressful for Dog	5		◊	◊		◊				◊	○			□	4	2	4
Works with Various Hair Types	3	○		□		○			◊						4	3	2
Disposes of Hair	1	○	□					◊							2	1	1
Longer Handle	1							◊			◊	○	◊		1	1	1
Durable	2	□				◊	○	○			□	◊			4	5	4
Removes Mats from Dogs	5	◊	□	◊		□			○						5	3	3

Figure 5: House of Quality

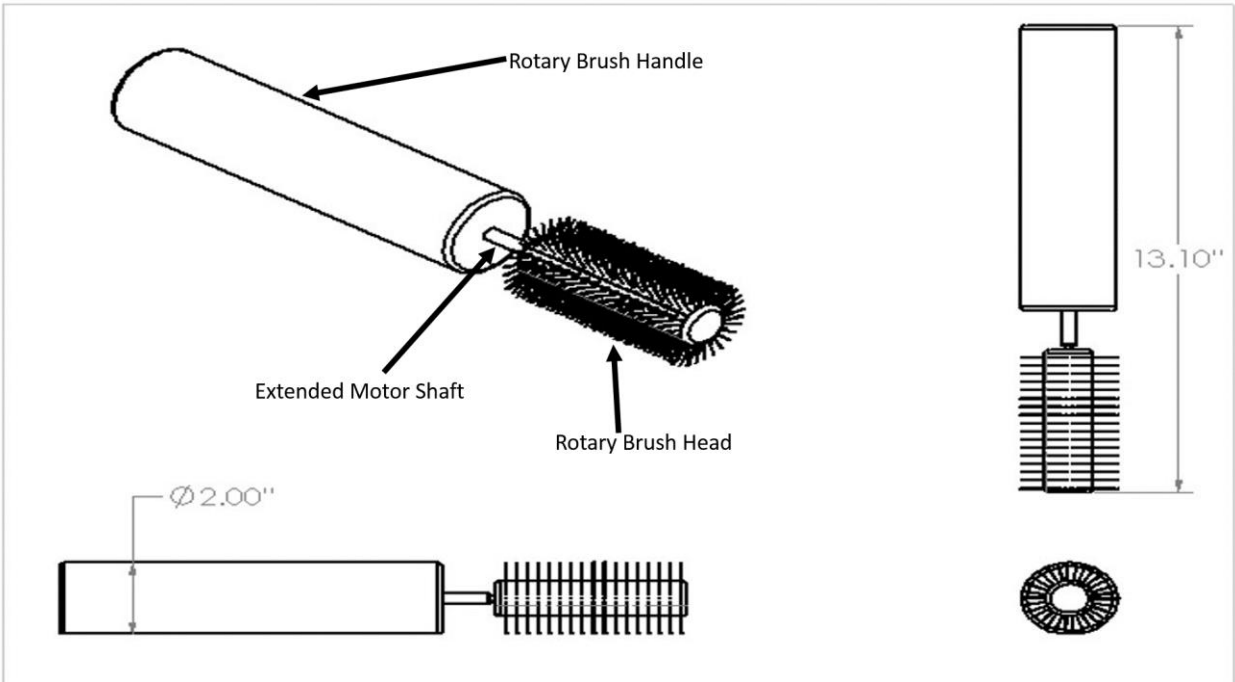

Figure 6: Concept Design One

Table 5: Pros and Cons of Concept Design One

Pros	Cons
Simple Handle Design	Lacks Ambidexterity
Low Cost to Manufacture	Requires Motor Reverser
Easily Swap Brush Heads	Difficulty Assembling Wire Brush Head

4.5 Concept Design Two

The second concept design that Team 17 developed incorporates the familiar style that is commonly seen in a 2" paint brush. The design consists of an ergonomically shaped handle that will be designed to contour to finger placement as shown in Figure 7. Concept design two's handle will require that the user hold the handle in a vertical orientation shown below in Figure 7 versus the horizontal hand placement that concept design one requires in Figure 6. Based on research of grooming techniques it is understood that a vertical brushing motion will cause muscle fatigue more quickly than the horizontal motion. However, due to the fact that the brush will be motorized, the energy normally exerted by the user during repetitive brush strokes will be unnecessary. The brush head design concept was initially set to be cylindrical, having 8 inches in length and 4 inches in diameter. The design goal behind the 8 inch long brush head was that a longer brush head would cover as much dog hair surface as possible in order to limit the amount of time it takes to groom the dog. As far as the mechanical features of the brush tool in its entirety, they will be determined

and chosen after further component and motor research and analysis are conducted. Table 6 below indicates the initial pros and cons that are associated with concept design two. One benefits that concept design two provides is the ergonomic handle. The fact that there does not need to be a reversible motor for the brush head to rotate for the use of left handed and right handed users is desired. Another benefit is the fact that this concept is designed to keep all motors and electronics in the handle, allowing the brush head to be as simple in design as possible, making it cheap to replace and interchange. Drawbacks of this design are that the open spinning brush head could pose a danger to users who are ignorant or careless, and that it is currently unknown as to whether this design will be the best option in housing all essential components.

Table 6: Pros and Cons of Concept Design Two

Pros	Cons
Ergonomic Handle Design	Could be complex to fabricate
Provides for ambidexterity	Open spinning could be hazardous
Easily Swap Brush Heads	Unknown whether all necessary components can be housed

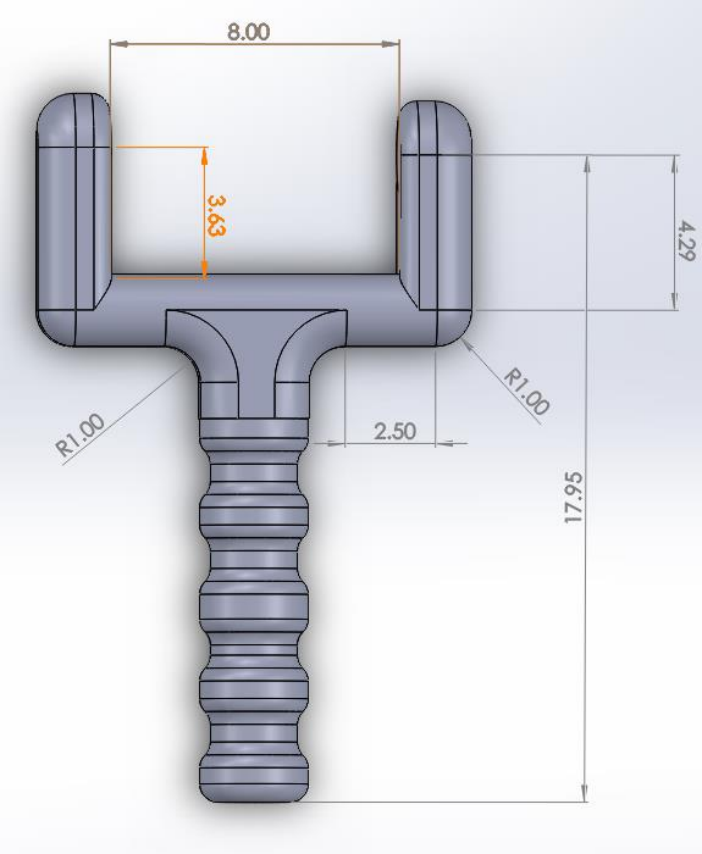

Figure 7: Concept Design Two Brush Handle: Front View

4.6 Concept Design Selection

When it came time to choose the final concept design, a great effort was made to make an unbiased decision and choose the best design criteria available. By creating decision matrices for the various components up for selection, it was possible to rank the choices based on a number of different criteria. Doing this allowed the team to determine the best options and create the best prototype possible.

4.6.1 Motor and Power Selection

The first section to be decided upon was the motor and power source that would be used to turn the brush head. Knowing these components would allow the handle to be designed, to ensure there would be adequate space to house all of the necessary equipment. Referring back to the original project constraints, the team knew that the motor would have to spin at a relatively low rpm and the power source would need to last at least two hours. Keeping these constraints in mind, the selection of motors was focused to ones whose speed would be between one and two revolutions per second. Since battery longevity was a key constraint, 110V AC current was considered due to the removal of the battery pack. This would not only extend run time, weight would also be saved. Three motor and power options were considered for the final concept: AC powered motor, DC battery powered motor, and AC converted to DC power to do away with a battery pack. Table 7, below, shows the results of the decision matrix.

After analyzing the motor decision matrix and tabulating the results, it was found that the ideal choice for the prototype would be a DC motor power by converted AC power. The decision factors used in this matrix were power, user safety, reliability, cost, weight, and pet safety. The winning selection received high marks in the safety, cost, and weight categories, beating out the battery powered DC motor by six points. By doing away with the heavy and expensive battery pack, the winning selection was able to beat out the other two options.

Table 7: Motor/ Power Decision Matrix

Decision Factors	Column1	Choice 1	Choice 2	Choice 3	Scores	Column2	Column3
Criteria	Weight (1-5)	AC Motor	DC Motor	Battery Powered DC	AC Motor	DC Motor	Battery Powered DC
Power	3	5	4	3	15	12	9
User Safety	5	3	4	5	15	20	25
Reliabilty	3	5	4	3	15	12	9
Cost	4	3	4	3	12	16	12
Weight	3	4	5	3	12	15	9
Pet Safety	5	3	4	5	15	20	25
				Total Scores	84	95	89

4.6.2 Handle Material Selection

The second decision matrix created aided in determining the best material for the handle. While there are countless material options from which brush heads can be manufactured, project goals stated that the handle must be ergonomic and comfortable for the user. Not only does weight play a large role in this decision, the material must also be pleasant to hold for long periods of time. The team also determine that the handle material should be somewhat slip resistant since many grooming tools are used on wet animals. The final options were narrowed down to three options. Choice one was aluminum, which was chosen because of its strength, fairly light weight, and ease of machinability. The second choice was ABS plastic. ABS has a high strength to weight ratio and can also be 3D printed quite cheaply. The last option chosen for the decision matrix was HDPE plastic, which is the most common plastic used in manufacturing. Table five shows the handle decision matrix and criteria the chosen material was based upon.

As can be seen from the decision matrix in Table 8, the material best suited for the prototype handle is ABS plastic. This material scored high in manufacturability, user safety, and cost. ABS will be the ideal material for prototyping the design because it can be 3D printed quite cheaply and can handle all of the stresses and abuse the brush will encounter.

Table 8: Handle Material Decision Matrix

Decision Factors	Column1	Choice 1	Choice 2	Choice 3	Scores	Column2	Column3
Criteria	Weight (1-5)	Aluminum	ABS Plastic	HDPE Plastic	Aluminum	ABS Plastic	HDPE Plastic
User Comfort	4	3	4	4	12	16	16
User Safety	5	3	4	4	15	20	20
Strength	3	5	3	4	15	9	12
Cost	4	3	4	4	12	16	16
Manufacturability	4	4	5	4	16	20	16
Weight	3	3	5	4	9	15	12
				Total Scores	79	96	92

4.6.3 Bristle Decision Matrix

The last prototype design criteria to be decided upon was the bristle design. Once again, three final options were used in the decision matrix. These options included metal wire bristles, plastic bristles, and metal blade style bristles. Ranking criteria included safety, comfort and performance. The decision matrix for the bristle selection can be seen in Table 9. In Table 9, the winning bristle design was the metal wire type. This option excelled in the reliability, manufacturability, and user safety categories. This style of bristles will be make out of 0.01”

stainless steel wire for added reliability and reduced corrosion. Although the metal bristles were the overall winner, the plastic bristles were a close second. Plastic may still be another bristle to test if the metal bristles do not perform as expected.

Table 9: Brush Head Bristle Decision Matrix

Decision Factors	Column1	Choice 1	Choice 2	Choice 3	Scores	Column2	Column3
Criteria	Weight (1-5)	Metal Wire Bristles	Plastic Bristles	Metal Blades	Metal Wire Bristles	Plastic Bristles	Metal Blades
User Comfort	3	3	4	1	9	12	3
Pet Safety	5	4	5	1	20	25	5
User Safety	5	5	5	1	25	25	5
Pet Comfort	5	3	4	2	15	20	10
Reliability	3	5	2	2	15	6	6
Dematting Performance	4	4	3	5	16	12	20
Cost	4	4	4	3	16	16	12
Manufacturability	3	4	3	1	12	9	3
				Total Scores	128	125	64

5. Conclusion

Grooming a severely matted animal can be a long, stressful, and tiring process. This goal of this project is to make the grooming process much more enjoyable for both the pet and groomer. The team plans to examine the current methods used for grooming in order to develop an ideal product for future use. The team will use the resources of shadowing current groomers to learn the techniques used and issues encountered to continue the product design from an informed position

Team 17 understands that a strong planning stage sets the strong foundation for the rest of the design process. By developing a clear and concise schedule and delegating tasks to which each team member will be held accountable, Team 17 is putting itself in position to accomplish the goals and meet the needs and desires of the customers and sponsors.

Team17 has also learned and concluded from the current work done. That extensive testing and redesign must be done in order to create a working product that accomplishes the project goals and objectives. The team also knows that understanding methods and techniques used to brush and de-mat dogs is very necessary, because it allows the team to acknowledge what issues the groomers and dog owners face and how they can be addressed.

6. References

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