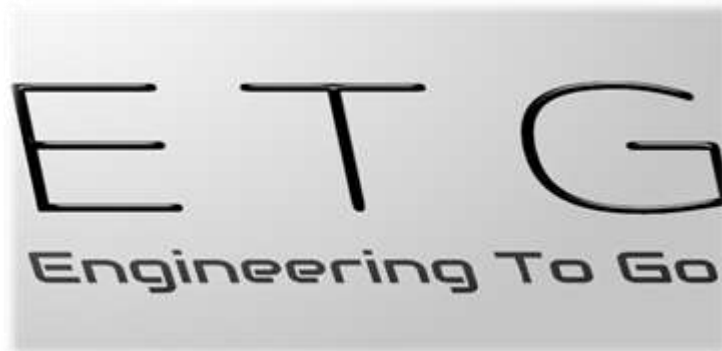


OPERATION MANUAL

EML4550C – Senior Design Spring 2016
TEAM 17 - “IMPROVED DOG GROOMING TOOL”



Sponsors - Bill Bilbow, Todd Hopwood

Team Advisor – Dr. Simone Hruda

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Team 17 Biography

Justin Proctor is the team leader of Team 17. He is also an active member of the student chapter of Society of Automotive Engineers, where he serves as the head of the Baja Racing rear suspension unit. In his spare time Justin enjoys working on white Mazda Miata as a project car.

Jordan Chupp is the Team Secretary for Team 17. He is in charge of making sure that all notes are taken and that all minutes from any meetings we conduct are recorded. Justin is into archery as he likes going out to shoot his crossbow

Dennis Pugh is the Treasurer for Team 17. He is the head of managing our accounts, how much we have spent and what we have to spend. He is also in charge of submitting and keeping record of receipts, invoices, and any purchase orders. Dennis is a member of the Florida A&M University's Track and Field team.

Roy Mason is Team 17's Web Designer and Editor. He is responsible for editing and creating the layout of Team 17's webpage, as well as formatting, editing, and finalizing all reports and presentations for submission and use. Roy Mason is an active member of the Florida State University chapter of the Society of Automotive Engineers, where he serves on the executive board as club treasurer. He is also a part of the Baja Racing brake design unit. Roy Mason enjoys pencil sketching, playing basketball, and studying the Bible.

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Team 17 would also like to give thanks to Dr. Nikhil Gupta as well as Dr. Shih, for their continued guidance, evaluation and constructive criticism. Dr. Gupta and Dr. Shih have helped motivate Team 17 to stay on task and to have good schedule management.

Team 17 would like to express in gratitude to its team sponsors, William Bilbow and Todd Hopwood. Team 17 is grateful for them for providing them with the opportunity to even embark on this project by being the first team to be a part of their engineering entrepreneurial incubating initiative. Team 17 would like to thank them for their support both financially and through the preliminary design and planning process.

A special thanks would like to giving from Team 17 to all those who participated in the consumer survey, with a major thanks to the Lori Williams at Paws and Claws for her willingness and openness to participate in the research and testing and trial phase.

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. Team 17 has successfully constructed a grooming brush prototype that looks to solve the issues encounter when grooming the brush. With this report Team 17 looks to provide th is about how it is to be operated, how to troubleshoot it and background on the parts and their specifications. The goal is

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 detangled and ordered using a process that is non-stressing for the groomer, and pleasant for the dog. The team has conducted analysis on how the tool operates and functions, as well as listed a step by step process to the safe operation of the tool.

2. Functional Analysis

The improved dog grooming tool, Figure 1, will function as an electrical dog brush that will implement preventative methods as the solution to the issue of mats developing within dog fur. This brush is designed to be applied to dogs with tangled or messy fur. The manner with which the brush will work, is that the user, whether dog owner, groomer, or care taker will hold the brush by the handle, keeping the hand a safe distance from the brush head, turn it on, and carefully apply brush to the unordered fur location. As the brush makes contact with the fur the bristles on the spinning brush head will straighten out the fur as they are driven the bristles in and out of the messy fur. The most effectively neatens the dog fur when it is initially applied to outer coat and gradually worked closer and closer to the skin.



Figure 1: Improved Dog Grooming Tool

2.1. Ergonomic Handle

The ergonomic handle as shown in Figure 2 is designed to serve to functions. The first is that the handle is to provide a means for the user to grip the brush and provide ease and comfort when maneuvering the brush around the dog or transporting around the workspace. The grooves in the handle provide a place for the fingers to fit into making for an ergonomic grip that reduces hand fatigue as well as the chance of the brush slipping out of the hand.



Figure 2: Ergonomic Handle

2.2. Brush Head

The brush head is the most important component of the improved dog grooming tool as its sole purpose is to flow through tangled or messy fur and smooth it out while rotating. Since dog fur can differ in both length and texture, several brush heads that vary in diameter and bristle design are used to accomplish the desired grooming function. Figure 3 shows the different brush heads being used. The bristles are designed to be inserted into the messy dog fur and pull through the tangles, realigning the fur and providing a neat look. The bristles of the brush are considered moderately soft as they are to deflect whenever they encounter the dog's skin or an advanced mat in the dog's fur. This function prevents the bristles from causing pain to the dog through brush burn on the skin or ripping out of fur.



Figure 3: Brush Head Designs

2.3. *Motor Shaft Adapter*

The motor shaft adapter was included in the design as a solution to the problem of the actual motor shaft tearing out of the motor as a result of excessive dynamic bending moment loads from the brush head. The motor shaft adapter, shown in Figure 4, fits onto the motor shaft on one end located within the brush handle, and provides an opening on the other end outside the brush handle for the brush head to attach too. The adapter without failure or fatigue takes on the bending loads that occur at the exit of the brush handle so that motor shaft will not have to.



Figure 4: Motor Shaft Adapter

2.4. *Reversible Switch*

The reversible switch, shown in Figure 5, that is used to for the brush functions in powering on and reversing the rotational direction of the DC motor. With a brush head that rotates in only one direction the improved grooming tool becomes limited to the user, as it does not account for ambidexterity and dynamic orientation when maneuvering about a dog. The reverse switch allows the user to control which direction the brush head rotates based on their dominant hand and what side of the dog they need to brush. The reversible switch also adds an element of safety should the brush head become wrapped up in long dog fur, as it allows the user to use the brush to unwrap itself from the dog fur.



Figure 5: Reversible Switch

3. Product Specifications

3.1. *Motor*

The selected motor for the dog brush needed to be a high torque low speed motor. The high torque was needed so that the motor would be able to withstand the expected tangential forces acting on the brush from the clusters of dog fur. The tangential forces from the brushing process would create a reacting torque on the motor shaft that if the motor torque was not high enough would result in the motor stalling and becoming useless. The low velocity was required because a slow spinning motor would allow the slow spinning brush head to work through strands of long fur without the fur wrapping on itself

and binding on the brush head. The dimension of the motor was of no concern as the brush handle in which the motor would fit would be designed around the motor selected. The various characteristics and dimensions of the motor are located in Table 1 and Figure 6 below.

Table 1: 12V DC Motor Specs

ATTRIBUTES	VALUES
<i>TORQUE</i>	2.655 in.-lbs.
<i>VOLTAGE</i>	12 V
<i>SPEED</i>	60 RPM
<i>TOTAL LENGTH</i>	2.68 in.
<i>SHAFT DIAMETER</i>	0.236 in.
<i>WEIGHT</i>	4.87 oz.

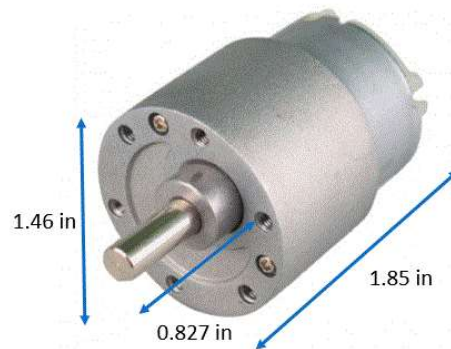


Figure 6: Hossen 12 V DC Gear Motor

3.2. *Brush Handle*

The dimensions of the brush head were determined based up the size of the motor's diameter. It was understood that the diameter of the handle had to be minimized to also accommodate the comfort of the user's grip. The grooves in the handle were placed to increase the comfort and overall ergonomics that could have been lost due to the diameter size. The length of the brush handle was chosen to be kept at a minimal, as it was thought to minimize the overall bulkiness of the handle to make it easier for the user to maneuver around the dog. Figure 7 shows an assembled drawing of the brush handle with the diameter of 0.175 in. and a length of 5 in.

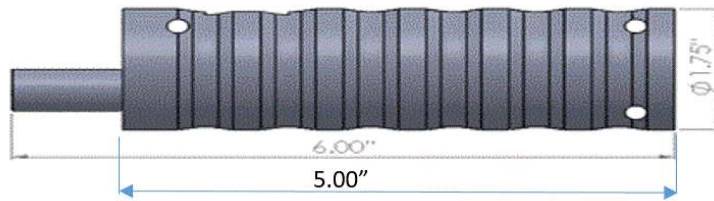


Figure 7: Brush Handle Drawing

3.3. Brush Head

The brush head that are used for this brush, shown in Figure 2 were chosen primarily based upon their diameters and lengths. The dimensions of each of the brush heads from Figure 2 are provided below in Table 2.

Table 2: Brush Head Dimensions

BRUSHES	1	2	3	4
DIAMETER (INCHES)	1.9	1.7	3.2	1.7
LENGTH (INCHES)	5.0	4.8	4.2	4.5
WEIGHT (OUNCES)	4.7	3.7	7.17	1.8

4. Product Assembly

Table 3: Brush Bill of Materials

ITEM NO.	DESCRIPTION	QUANTITY
1	60 RPM DC Motor	1
2	Motor Shaft Adapter	1
3	Motor Shaft Bearing	2
4	½ Grooved Handle	1
5	½ Grooved Handle Counterbored	1
6	Reversible Power Switch	1
7	¼-20 Cap Screw	3
8	Brush Head	1

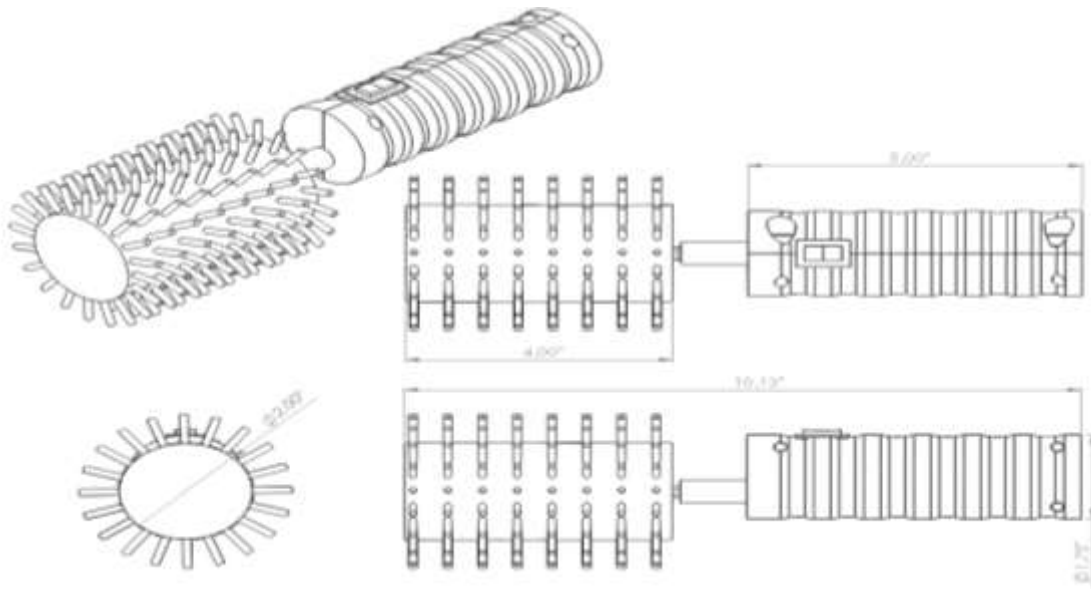


Figure 8: Brush Full Assembly

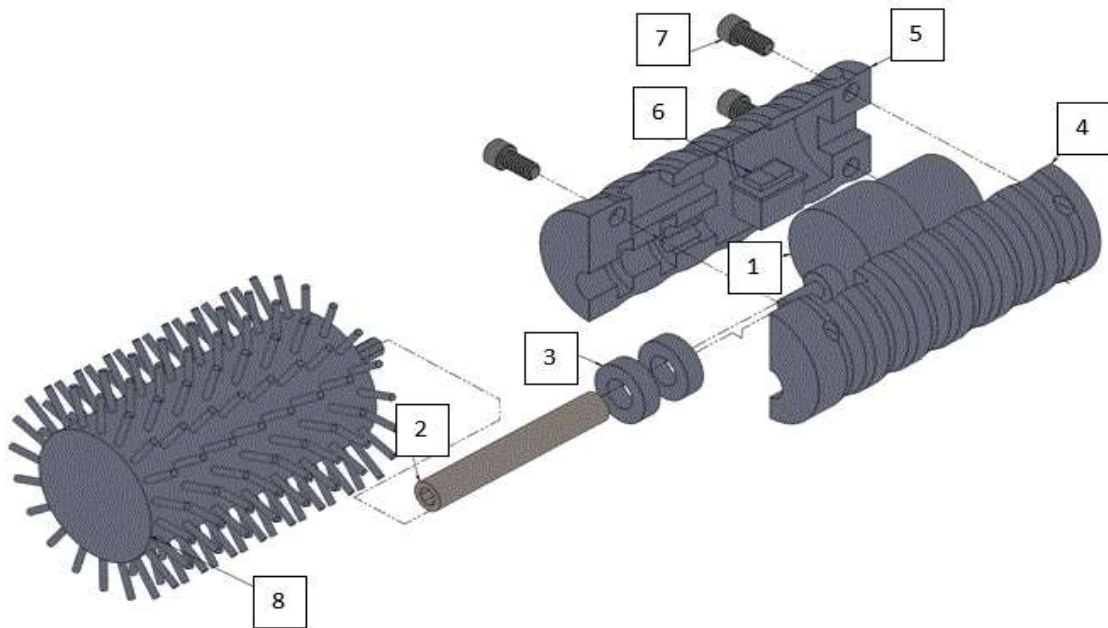


Figure 9: Brush Full Assembly Exploded View

5. Operation Instructions

5.1. *Pre-Operation*

Prior to operation of the device, ensure that all components are properly assembled and are in proper functioning order. Check that all screws and bolts are securely fastened and all stationary components are not able to move. Likewise, make sure that all components intended to move are in fact moving in the way they should be. Check for any cracks, breaks, or flaws in the device that could result in catastrophic failure once the device is powered on. Inspect the power supply and cable to ensure that it is in proper working order and there is no damage to its components. Check that the brush head shaft is firmly seated in the motor shaft. Once all components have been inspected, it is then possible to power on the device and begin operation.

5.2. *Operation the Brush*

1. Read and follow all pre-operation instruction before powering on the device.
2. Confirm that power switch is in the off position and power supply is unplugged.
3. Locate desired brush head attachment based upon dog hair type and length.
4. Attach the brush head to handle assembly by firmly inserting the brush head shaft into motor shaft until it is secure.
5. Locate power supply and check cable for any possible damage.
6. Plug male end of power supply cable into the female connector on bottom of brush assembly.
7. Plug power supply into a 120 volt household outlet until secure.
8. Turn power switch to on position and confirm that brush head turns freely and does not bind.
9. Slowly groom dog taking care to not let hair tangle or wrap around brush.

6. Troubleshooting

Potential problems that may arise when operating this tool are displayed in Table ##. These problems may arise due to overuse or misuse. Overuse may occur when the lifetime of individual components are met such as the motor and adapter. Other components like the shaft or handle can deteriorate over time from wear and tear. When not operating the tool correctly the components might fail sooner than expected. If these problems arise, trying one or more of the solutions

provided in the table should resolve the issue. If after trying all solutions, please call the company's customer service phone number to resolve any issue.

Table 4: Troubleshooting Solutions

Problem	Reason	Solution
Brush head is not rotating	Brush head is wrapped up into hair	Reverse directions to unwrap brush head
	Brush head shaft is loose and spinning inside brush	Replace brush head
Electric brush is not powering on	Brush tool power adapter is not properly inserted into wall outlet	Check power outlet, ensure adapter is correctly plugged in
	Switch is malfunctioning	Return to manufacturer to have switch replaced
	Electrical short/ Wire fraying/ Adapter malfunctioning	Replace adapter
Brush Handle Fracture	Manufacturing Error	Replace handle immediately due to safety concerns with housed electrical internal components
	User Error	
Water or fluid leaks inside brush housing	Crack / Fracture in brush handle	See Fracture Problem
	Handle is not securely fastened together	Tighten screws
		Check for holes and fill with rubber or sealant
Bristles falling out of brush head	Wear and tear	No replacing of bristles can be done. If several bristles come off then a new brush head is required
	User error	
	Manufacturing error	

7. Regular Maintenance

Some regular maintenance will keep the tool lasting for a long time. Routine things an operator should do is clean the tool after each use to prohibit the spread of diseases if using the tool on multiple animals. If using the tool on one animal each time, cleaning the tool will still be a good idea after each use. To clean the handle, dip it into bleach water and rinse thoroughly. To clean the brush head, pull off any hair on the head and then dip into bleach water and rinse with clean water. All internal components should remain dry during this process due to proper sealing. The tool must be unplugged and remain off during the cleaning. No other parts need to be cleaned.

If water leaks through the handle then unscrew the two pieces that make up the handle and dry each component. Reattach the handle after the internal parts are dry and you may test the tool to see if it still works. If not, please call the customer service phone number. If the tool works then try and fix the leak issue with a troubleshooting solution.

The brush heads are detachable so that different sizes may be used when necessary. If the bristles begin to fall off due to being worn down then you will need to replace the entire brush head. If the shaft on the brush head becomes loose then you will need to replace the whole brush head. The brush heads are designed to last for a few years depending on the daily usage. If troubleshooting does not work when the tool is not turning on then you will need to order a new handle.

8. 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.

Team 17 has provided the operation instructions for the improved dog grooming brush. By following these instructions and adhering to the list problems and troubleshoot solutions. Team 17 ensures the user with a safe and satisfactory experience

9. References

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[2] https://www.petedge.com/zpetedgemain/catalog/productDetail.jsf?wecappid=PEDM_WEBSHOP_TR&itemKey=005056A633791ED2B5864B5340D1CFB3

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