Engineering Proposal:

Cat Washer

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Cats do not need to be bathed regularly, or even at all, as they groom themselves (Munkevics, 2020). However, neglecting this aspect of a cat's life will not only affect their hygiene but the owner's as well since the cat will spend much time around its owner. Bathing a cat is also important because, with the right soap, the chances of dandruff, fleas, and other skin parasites are much lower (Munkevics, 2020). Additionally, a bath will heavily affect how a cat smells and feels which impacts the owner's perception, reaction, and treatment of the cat and, therefore, the bath is not only for the cat but for the owner's gratification as well. However, since cats generally dislike water (unless it's for drinking), bathing them is a very difficult task. Our cat washer strives to balance two positions, bathing for cats or not bathing for them at all, by creating a space to wash cats that promotes hygiene and delivers an experience that is pleasurable (or not altogether, detestable) for the cat.

Similar but Ineffective Solutions

There have already been attempts to create a cat washer to solve the issue and capitalize on the need to wash cats. The first cat washer we observed locked the cat within a compartment and released soap and water on the cat. This, although a reliable way to clean the cat, was not cat-friendly and the reaction of the cat, jumping, screeching, and clawing, throughout the cycle illustrated that (Automated Cat Wash, 2009) The second cat washer also placed the cat within a compartment, but the water and soap rose to meet the cat this time. This process was more cat-friendly, as the cat's reaction was much milder than in the previous example, however, we found that the process was not reliable as the water and soap didn't rise to the cat's full height to allow

for better cleaning of all areas of the cat and there was no rinsing mechanism which means that the soap and water were dried on the cat which is an ineffective method of washing the cat (Auto Cat Washer, 2010). The machine accounts for these two defects in the previous versions to ensure both cat-friendliness and efficiency.

Process

All the components will be combined to make the machine a complete and functional product. The entire operation will be controlled by the software which will be programmed to run each process in the machine.

Figure 1: Washer example and specifications

There will be a button, however, as a mechanism to manually override the machine and provide some level of control during the washing process. There will also be a slider that ranges from 5 inches to 15 inches based on the cat's height. In the first cycle, the magnetic door will open to allow the cat into the machine then close. The tap will then fill up the machine to a certain height, based on the slider, with water and soap to clean the cat. Thereafter, the drain will open briefly to remove the liquid then close. In the second cycle, the tap once again fills up the machine, this time only with water to rinse the cat. The water heater is there to heat the water

from 100°F to 102°F, to provide a deeper cleaning while keeping the temperature of the water at a comfortable degree for the cat. Thereafter, the drain will again be opened, and the dryers will switch on to dry the cat. Finally, the magnetic door will open to release a clean and healthy cat into the welcoming arms of its owner.

The cat washer is estimated to be $42,466 (All Paws Pet Wash, 2018), the average expense of such a product and service, which includes all the components in the technical description for the invention as well as the costs for installation of the machine in a location. The dryers will be approximately $500, the drains are $1000, the heating system is $280, and the magnetic door is $300 (Abram, 2018). These are just a few sample expenses to give a sense of how much the machine will cost, so most of the costs will come from acquiring a unit and establishing the business. Another cost that needs to be addressed is the labor cost. We will require technicians and engineers to build the product and implement many of the components. We require mechanical engineers, electrical technicians, or a company that sources such workers, and service personnel to maintain the machine. This will inflate our costs beyond what it already is, and it should be expected that the costs of the product will be on the higher end of production. In total, it would cost $70,000 (All Paws Pet Wash, 2018).

Figure 2: Sample Startup Costs

Components

Water Heater

Water heaters use various thermodynamic chemical properties to heat the inflow of cold water. To heat the water, there is a liquid refrigerant inside the device itself that passes through an evaporator. This liquid refrigerant must have a low boiling temperature so that it easily evaporates. Once this liquid evaporates into a gas, it is compressed to further increase the temperature (decrease in gas volume increases pressure, which in turn increases temperature). This heated gas passes heat to the water inflow through thermal conduction. Once the water is heated, the gas is expanded and as a result, turns into a liquid again. At this point, the process will repeat. Another component of our water heater, one which we will add, will be a soap compartment. This will allow for an easy soap refill.

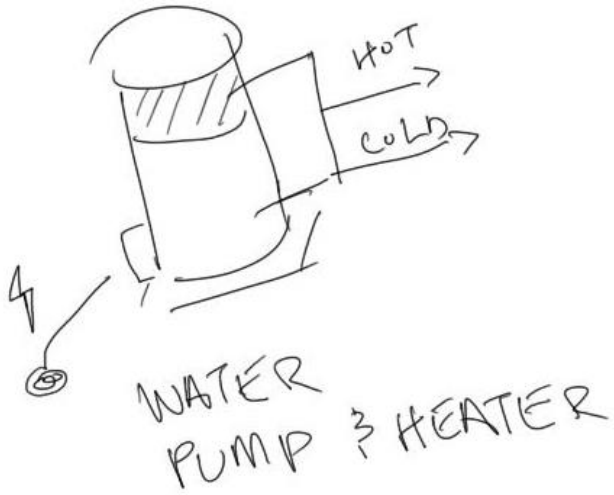

Figure 3: The way a heating system works

Push Button

The cat washer utilizes a metal push button, which is located on the top left corner of the water heater, to turn on the machine. The button is made of metal and plastic and has a circular shape. The button also has a diameter of 17.8 millimeters. When the button is pressed down then let go by the user, the machine is powered on, and the software is activated. When the button is held down for 3 seconds, the machine is powered off. Without the button, the cat washer's motherboard would be unable to run the software, leaving the user with a cat washer that doesn't wash their cat.

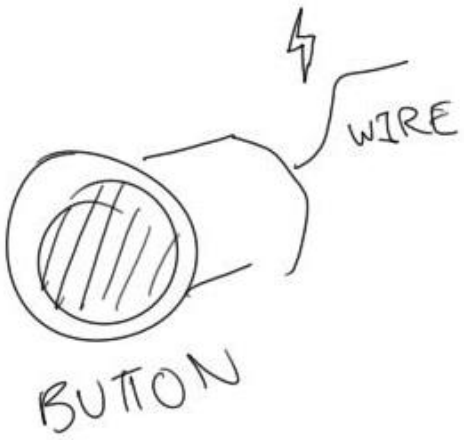

Figure 4: Visual of the metal pushbuttons

Plexiglass Walls

The exterior design of the cat washer will be made from acrylic glass. We have decided to go this route for a few reasons. When looking over past designs of automated cat washers, we noticed most of their exteriors were made of metal, with little glass. This is of course a stress inducer for cats, as with that design they will feel trapped. This feeling will be removed, or at

least remedied, with this new design. It will also allow the cat's owner to be more visually in touch with their cat while it's being showered.

The Acrylic glass was chosen because it is much more resistant than regular glass. This interior of the cat washer will be a very thermally dynamic system (rapidly changing temperatures), which glass doesn't fair well with. Even aside from temperature changes, acrylic glass is more resistant than regular glass.

The exterior design will feature gaps between the walls and the ceiling. This is because: since hot air rises, hot air will be able to leave the system more easily, keeping the inside warm and not hot, and this allows for fresh circulation of air into the cat washer itself. The exterior also features a metal frame that outlines the acrylic glass which reinforces the structure.

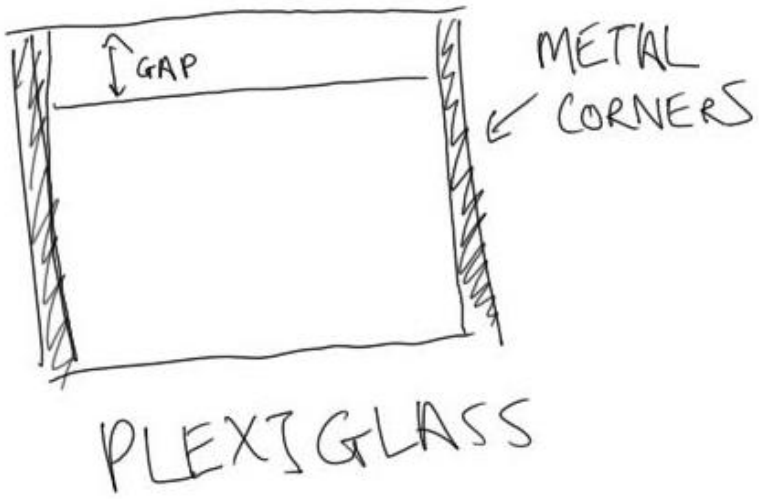

Figure 5: Visual of the cat washer walls

Magnetic Door

The door is located on the opposite wall of the tap. The door allows the user to put the cat in or out of the machine. The doorway utilizes a mini electric magnetic lock system and rubber gasket around the doorway to create a tight seal. The magnetic lock works thanks to the attractive force of magnetism. The magnet that is attached to the door has a different pole than the magnetic attached to the doorway. When two different poles are near each other, they are attracted and thus attach (Rutledge, 2011). The software of the machine turns the magnetics on, and off which allows the door to open. The doorway is also in possession of the slider. The slider informs the software what the height of the cat is, in a range of 5 inches to 15 inches. Without the magnetic doorway, there would be no way for the cat to get into the machine and no way for the machine to close tightly.

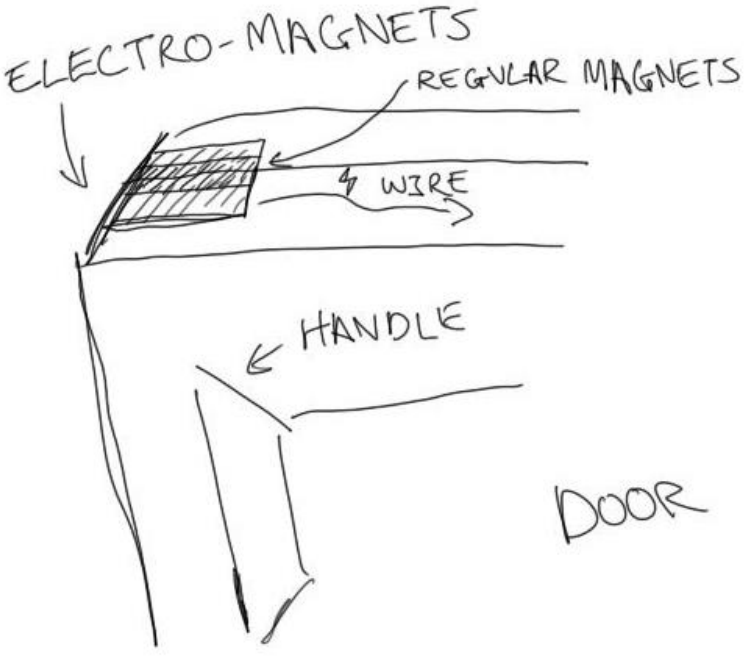

Figure 5: Mini electric magnetic lock system

Waterfall Tap

The cat washer utilizes a wall-mounted waterfall tap, which is located inside the cat washer on the opposite wall of the magnetic door. The tap is made from ceramic, which is the same material as the floor of the cat washer. The tap is connected to the water heater through a drain hose. Liquid flows from the water heater to the tap and into the cat washer. The tap then releases the liquid in two cycles. In the first cycle, a combination of water and soap is released to the cat's neck level. In the second cycle, only water is released to the cat's neck level. The cycles are meant to wash the cat with soap and rinse the soap out of the cat. Without the tap, water wouldn't enter the machine and thus the cat would not get washed.

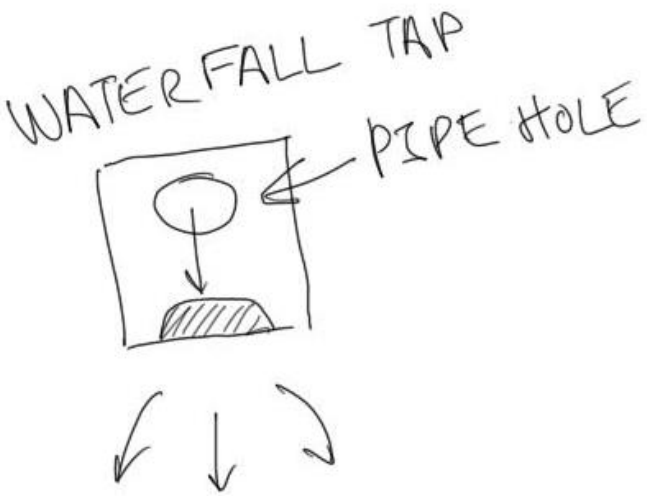

Figure 6: Waterfall tap

Dryers

The dryer is a vital part and the last process that the machine will run before switching off. The dryer will be located within the machine and will be connected to the entire machine

through software that automates the launch after all other processes have been run. The dryer will resemble the wall-mounted dryers used for hand drying but the process and components of all types of dryers are similar so this paper will draw from different types of dryers.

The dryers will be composed of several components: cover, base plate, fan wheel, fan scroll, motor, sensor, heating elements, nozzle, (Mediclinics, n.d.). Cover: Provides housing for the dryer (Khan, n.d.). Base plate: metal forming on the back of the dryers that will include holes for wall mounting (Mediclinics, n.d.). Fan wheel: a centrifugal fan that has a cylindrical shape and many small blades on the impeller (Dan, 2018). Fan scroll: The housing of the fan wheel. Directs the flow of air within the dryer. Motor: The part of the machine that allows the dryer to run through electricity or internal combustion (Khan, n.d.). Sensor: electronic detection by infrared beams (Mediclinics, n.d.). Heating elements: Made of nichrome wire which is a resistor that turns electric energy to heat energy (Khan, n.d.). Nozzle: the opening that the air comes out of, it will be able to turn 360º. The dryers will surround the machine on all 4 sides and will be very close to the top. The components of the dryers all work together in the dryer to push out hot air and dry the cat. As drying is the last function of the machine, the sensors in the dryers will be activated when all other processes in the machine stop as determined by the program.

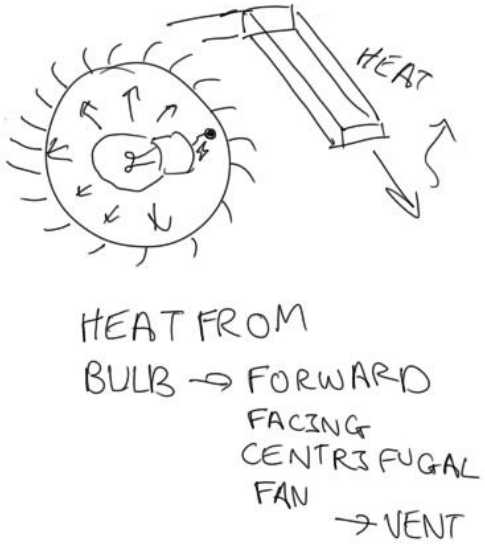

Figure 7: Dryer's component and mechanism

Drain

Drains are used to remove wastewater into the sewers or wastewater systems (Zurn, n.d.). There will be a drain in the room where the machine is to remove the water that is used to wash the cat. Since the process of washing the cat will require a significant number of gallons used, the drains will need to be built to withstand it, and therefore will require the following specifications: the ability to meet the demands of 5 gallons per minute (GPM) of wastewater which can handle the water released by bath faucets (Zurn, n.d.). A 3" wide stainless-steel grate mainly for hygienic applications will be used for the machine which ensures sanitation and will be able to handle the volume of water released (Swiftdrain, n.d.). This specification in the drain, i.e., the 3" stainless steel, also accounts for the material that the bottom of the machine will be made of, metal, and the size of the machine which will be medium-sized which will make it easy to incorporate into the machine.

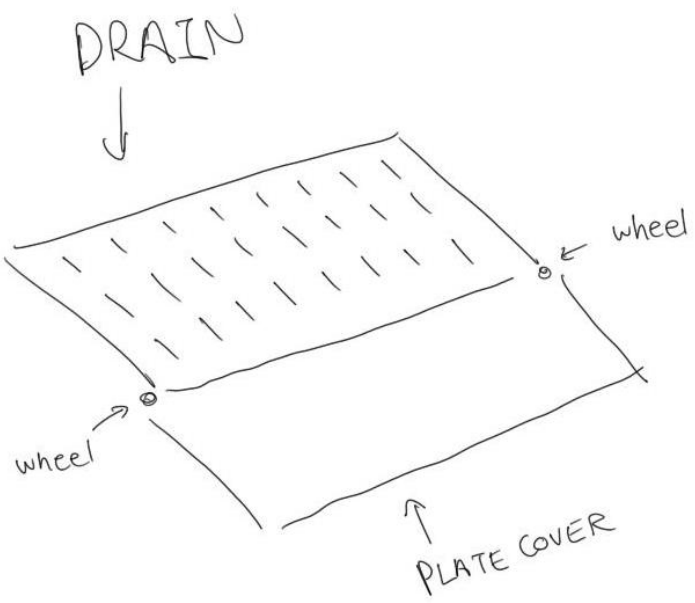

Figure 8: Stainless steel grate

A softer and more colorful material will be used to cover the drain to make it more comfortable, and aesthetically pleasing, following our pledge to make this machine cat friendly. The cover will be attached to drain through wheels. The wheels allow the drain to open and close between cycles. The wheels are controlled by the software of the cat washer.

Software (Motherboard)

The software is how the cat washer is connected. Here, the thermometer within the water heater is placed to make sure the water does not exceed the limit of 100°F to 102°F (Alcorn, n.d.) to make sure the water is not scalding hot for the cat. Additionally, the machine askes for the cat's height to make sure that the water level never exceeds a specific limit. Aside from those two safety measures, there are two main functions of the motherboard. The first is controlling the

water input and output. The second is turning the dryer on and off. The motherboard creates a spot where all these functions can reach one point in the machine to communicate the data received to the software. The software will then communicate back to the physical parts of the cat washer to respond. For example, a temperature exceeding 102°F will cause the machine to reduce the heat of the water to reach that range of 100°F to 102°F. The software will use image recognition to determine when the water level reaches its limit, and when to initiate the drain. When the entire process is done, a signal will be sent to initiate the dryers and dry off the cat.

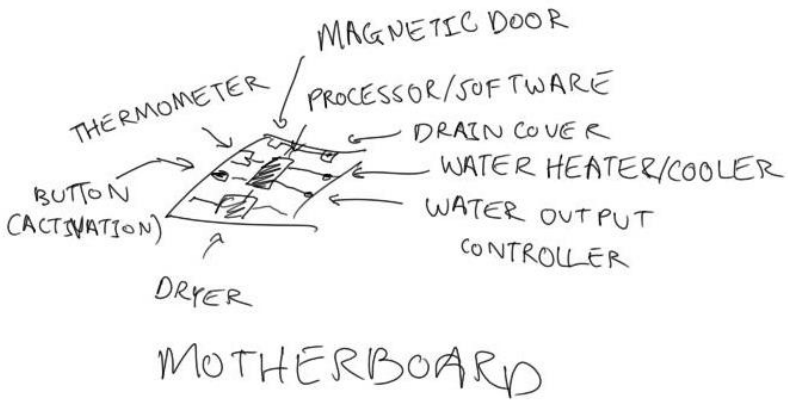

Figure 9: Visualization of motherboard

Conclusion

Washing cats has always remained a difficult issue for cat owners, especially for newer owners. As technology is being introduced in various parts of our daily lives, a cat-friendly cat washing machine has great potential to improve the lives of many cat owners. We look forward to how a near fully automated cat washer can improve the lives of many, and how its design can be further improved. Furthermore, we hope that this machine can make it easier for cat owners to

keep their cats clean. The main purpose of our cat washer is to create a machine that can be both fully automated as well as cat friendly, without compromising the comfort of the cat.

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