

CAT HAIR DEVOURER

DESIGN JOURNAL

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Design Project Title: Cat Hair “Terminator”

Design problem, or topic:

It's easy to find out which friends around us have pet cats, even if they never mentioned it to you--because the cat hair on the owner's clothes is not deceptive. Every cat owner will be troubled by cat hair. It not only stick to clothes and affect the appearance, but also hide in sofas and quilts and cause the disease of skin and respiratory tract. Therefore, every cat owner is eager for a cat hair solution.

Research question:

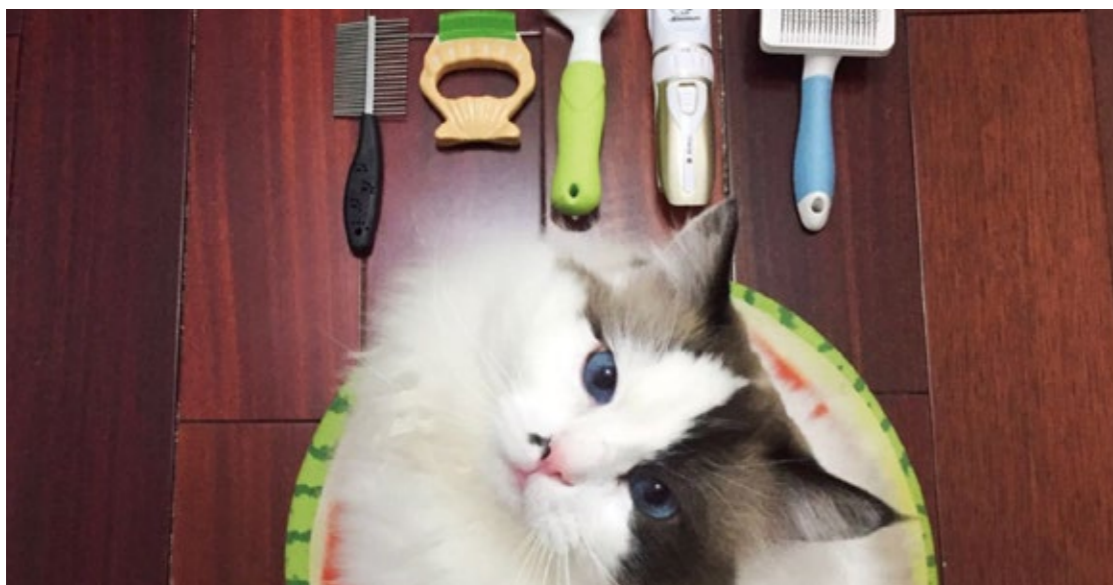
What did cat owners do to clean their fur?
Why are these methods not effective enough?

Design goal / intent:

I want to design a product to help families with cats solve the problem of flying cat hair. It could be an electric product. It has two key points. One is that I hope it can solve the problem of cat hair from the source, rather than remedy it after work; the other is that the cost of using it is not too high - no one has time to clean cat hair all the day! Of course, it's also important that it doesn't harm cats - you know, I'm also a cat owner.

Proposed design approach:

First of all, I will observe some cat families and record in detail why they are usually troubled by cat hair, how they are troubled and what struggles they have made to solve the problem of cat hair. I will also analyze why the results of these attempts are not satisfactory. Then, I will do some second-hand data research. It mainly studies the principle, cycle and some characteristics of cat hair loss. In addition, I will study and analyze the advantages and disadvantages of the existing cat hair treatment products (viscose, comb). After completing the above steps, I will design some interviews with cat owners. In the interview, I will learn more about the problems I got in the above research and my thinking. After getting the conclusion of the interview, I will design a following questionnaire to get some data information.

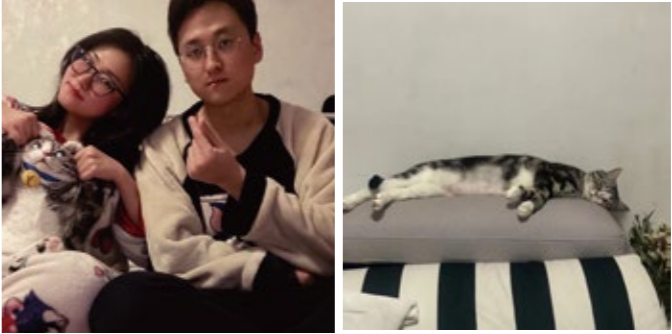


USER STORIES



Meng Xucong
White collar

Meng Xucong is a white collar worker who has a lovely cat. She loves her cat, but hates her cat hair. They always stick to her black It makes her look bad in meetings. She has a hard time getting rid of these hairs. Every piece of clothing has cat hair on it, even in the washing machine.



Fei & Mengmeng
Couple

Fei and Mengmeng are a young couple who have had a cute cat for 5 years. Their parents didn't prohibit them having a cat until Mengmeng got pregnant. Fei's mother asked them to give up the cat because she was worried about cat hair causing respiratory infections.



Zhonghai
Novice cat owner

Zhonghai has just had the first kitten, whom he has been looking forward to for a long time. But things didn't seem to go smoothly. With no breeding experience, his cats were not very close to him. He found it difficult to build up trust and he had difficulty to groom or bath it.

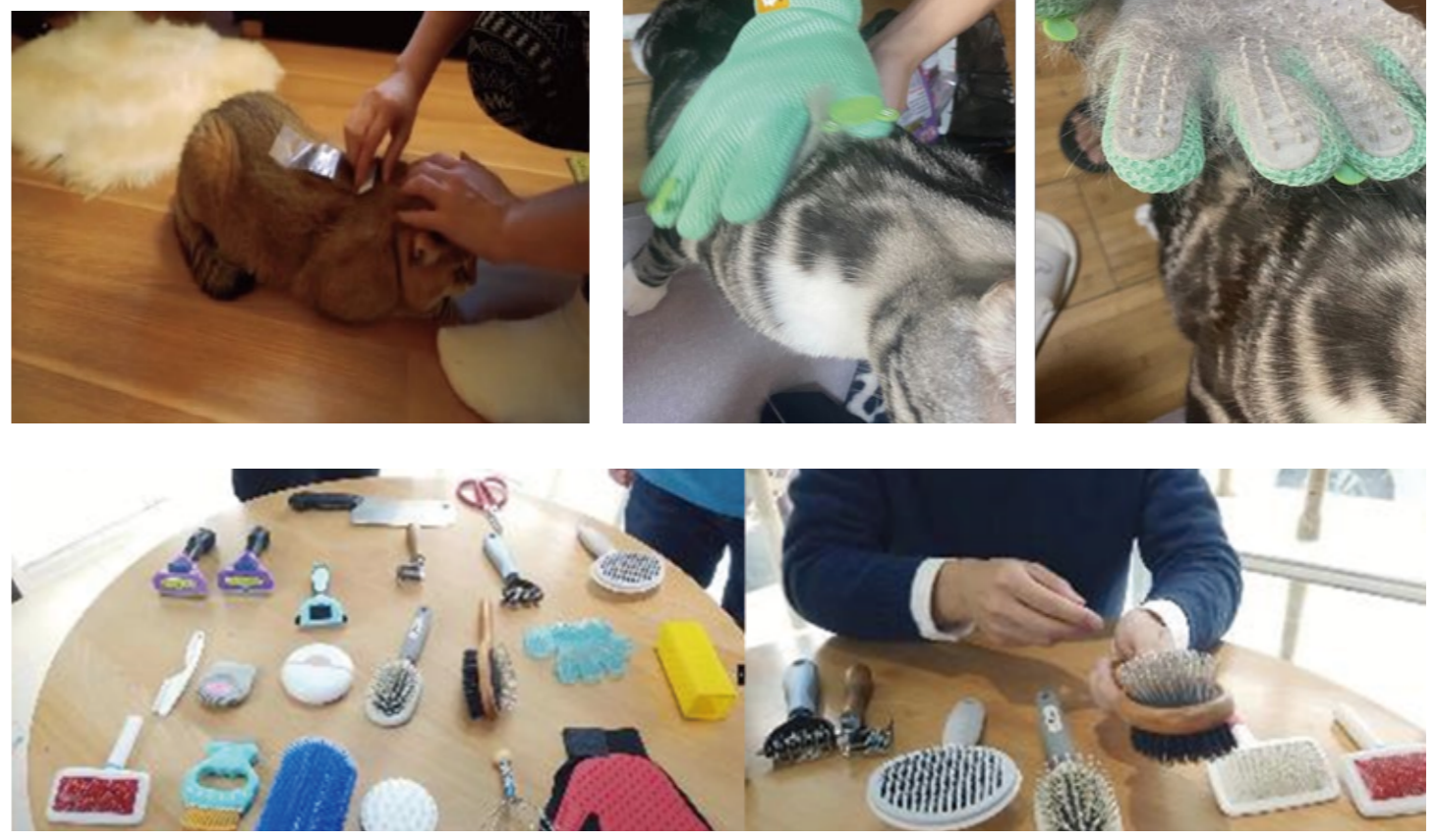


BEHAVIOR OBSERVATION & IN-DEPTH USER INTERVIEWS

As a cat keeper, I am also one of the users. I know that cat hair can be a nuisance to owners in many ways. But my personal habits and behaviors may be specific, so I contacted three cat owners of different ages and went to their homes for behavior observation and site exploration.



User Pain	User behavior
Hair sticking to clothes is ugly and hard to clean	Use sticky lint roller to remove lint from clothes and beds
Cat hair on sofas and beds affects skin and respiratory health	Grooming and bathing or even shaving their cats
Cats are resistant to daily grooming and don't trust their owners	Frequent laundry and mopping
Worry about their child's health	Giving up cat ownership (not the right choice)
Some guests may be allergic or disgusted by cat hair	Keep the cat locked up when guests come
Grooming a cat is a bad experience and very tiring. Cat hair floats in the air and can easily be inhaled into the lungs.	Let the cat lie on their laps to groom it. Grooming with multiple people
Cats can get hairball syndrome	



EXPERT CONSULTATION



I went to the vet and spoke to feline specialist Dr. Zhu. From him, I got some information about the physiological characteristics and behavioural habits of cats. I also made further observations on more cats in the vet.

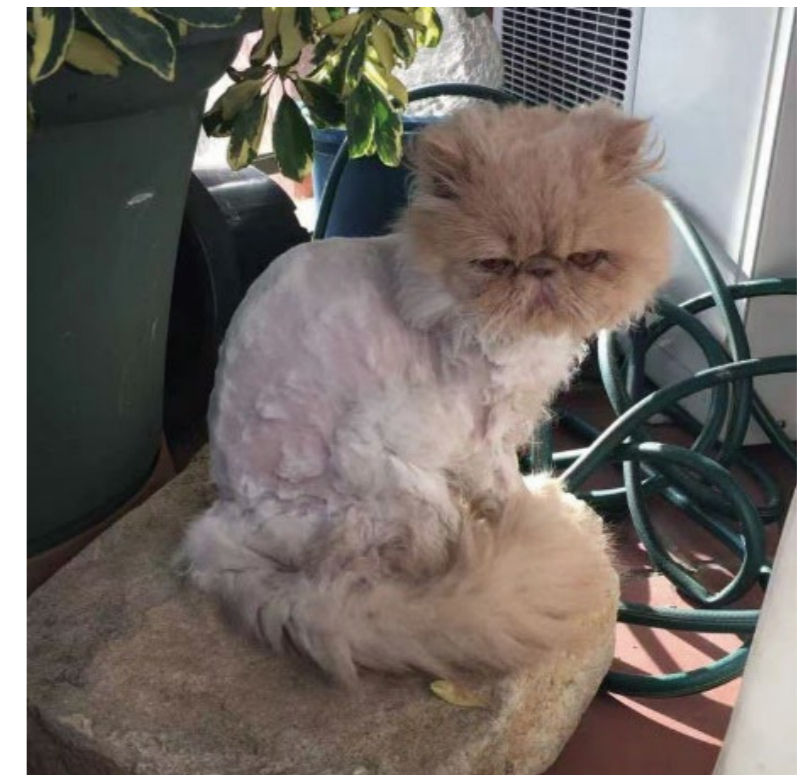
In addition, I watched many documentaries on cats and got more information about cats and their hair.



BBC documentary Wide side of cats



The Lion in Your Living Room



FURTHER ANALYSIS

Quantitative analysis of questionnaires

I distributed 200 questionnaires, which were answered by 200 cat owners, to confirm previous judgements with a larger sample of data. It mainly identified some of their feelings and situations.



Are you troubled by cat hair yes-100%



Has your cat ever been afraid or refused to communicate with you yes-68%



Is your cat afraid of bathing yes-73%



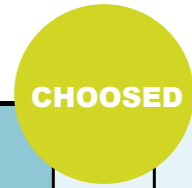
- nearly everyday
- 2-3 a week
- once a week
- 2-3 a month
- once few months

How often do you comb your cat

Key modality decisions

Combine the above research information to give the different hair treatments Scoring. The scale was used to combine the scores and to select grooming as the key method to solve the cat's hair problem

Requirement		User Importance (1-5)				
		bath	shave	groom	tape	
Remove floating hairs	Effect	4	5	5	4	2
	NO harm to cat's health	5	2	1	5	4
	Easy to operate	3	1	1	4	5
	Low economic costs	2	4	3	5	1
	Duration of effect	3	4	5	3	2
Total			53	52	72	51

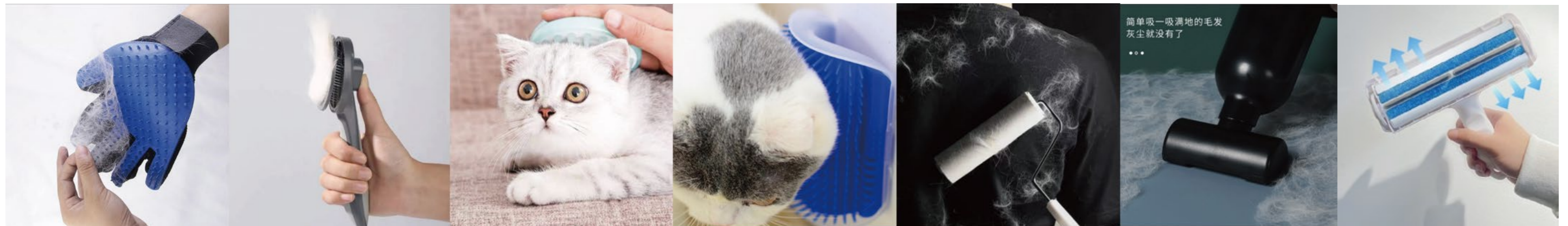
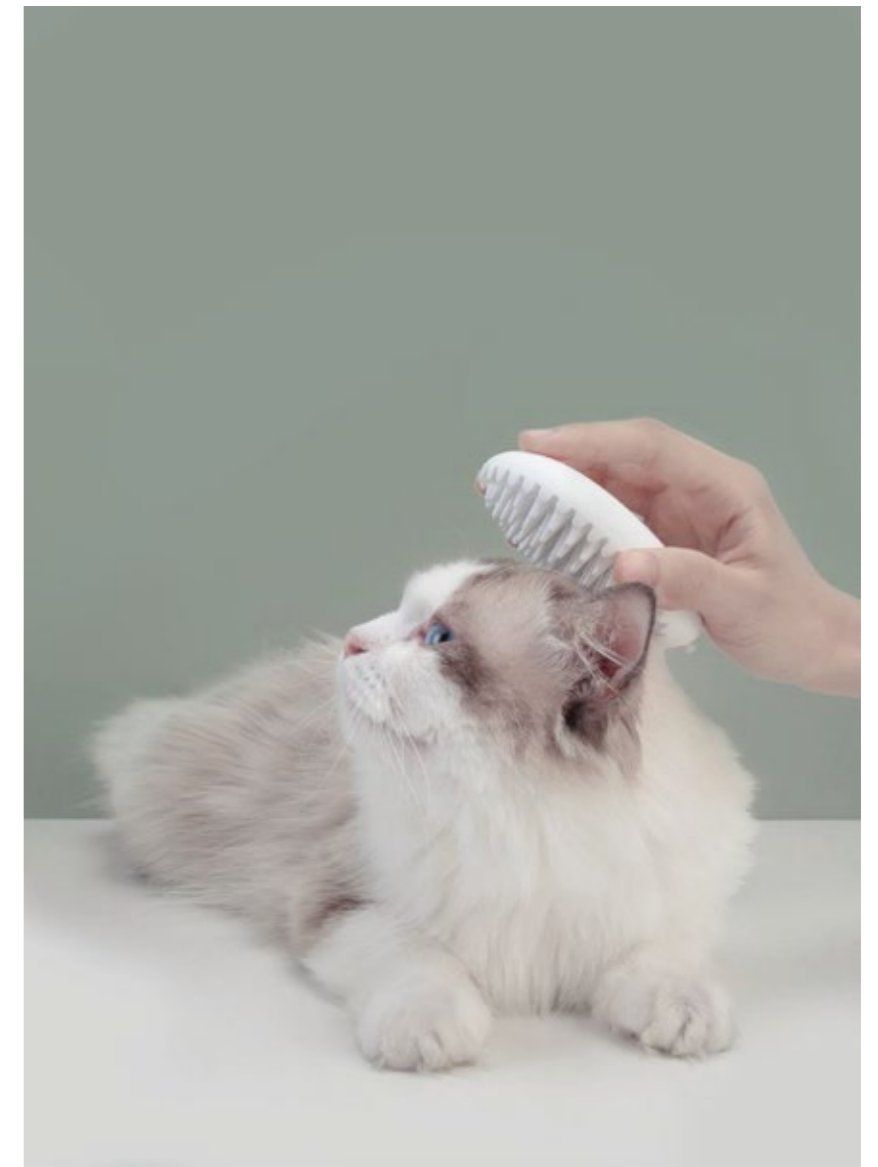


The most effective way to reduce a cat's fur loss is to brush it regularly. This will help you collect some of the dead fur on your cat before it falls. This means you'll have less cat fur in the air and furniture in your home, and you'll inhale less cat fur. It also significantly reduces the risk of hairball disease in cats.

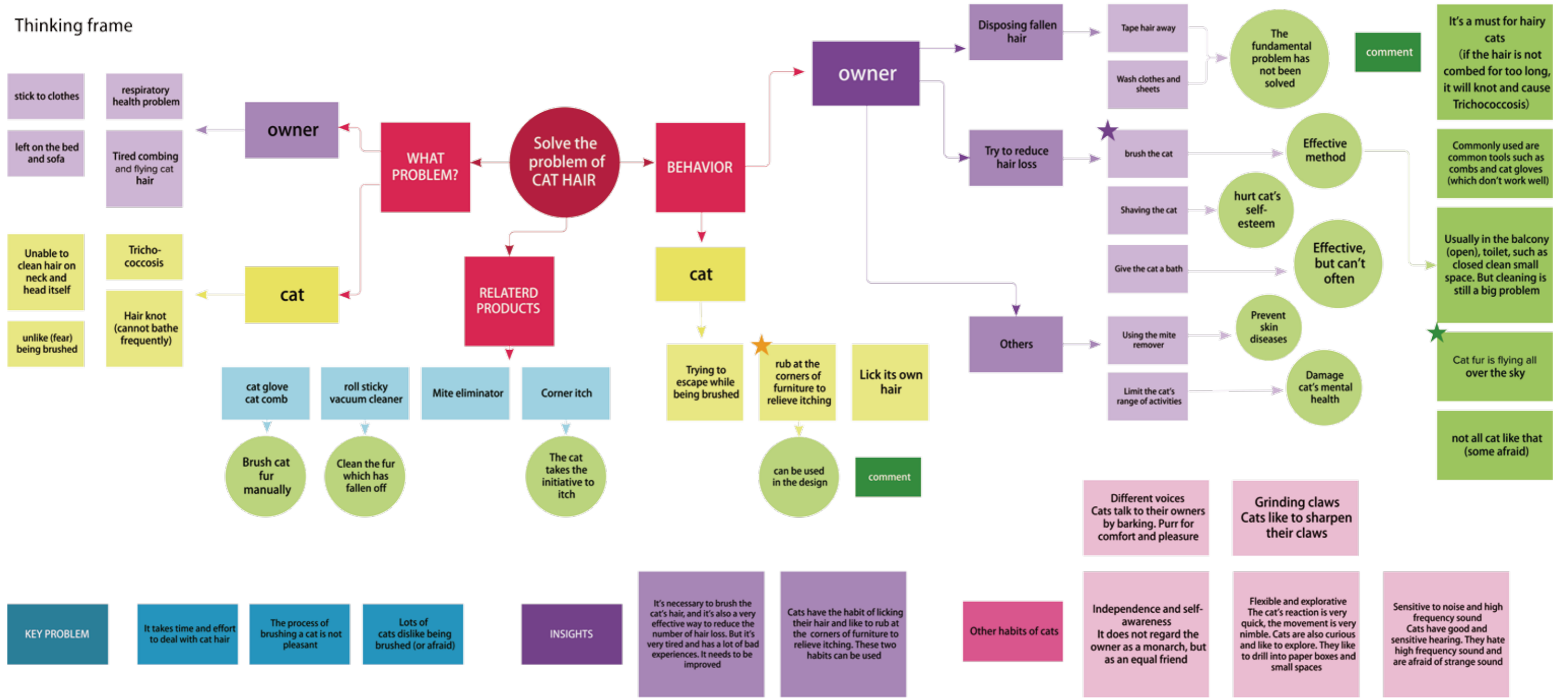
In addition to reducing fur loss, helping cats brush their fur also helps them maintain fur quality and prevent cat fur from knotting. Of course you can also bathe the cat to reduce fur loss. While this may help, make sure your cat takes a bath voluntarily, not mandatorily. Because if cats don't like to take a bath, it just puts more pressure on them, causing them to lose more fur.

RELATED PRODUCT COMPARISONS

	Name	Features	Benefits	Drawbacks
Cat hair comb	Cat gloves	Made in the shape of a glove, with combed teeth	can pet cats	poor effect
	Steel tooth comb	Comb made of hard plastic for grooming cats	high efficient	hurts cats easily
	Rubber tooth comb	Comb made of soft rubber for grooming cats	Cats are more comfortable	hard to clean
Other related products	Corner itch	A comb-like shape that can be attached to a corner for the cat to rub against	The cat takes the initiative to itch	only for neck
	Pet rollers	Tape rollers for fallen hair sticking	Easy to use	only can deal with fallen hair
	Pet vacuum cleaner	Handheld hoovers for fallen hair removal	Easy to use	only can deal with fallen hair



Thinking frame



PERSONA



CAT OWNER

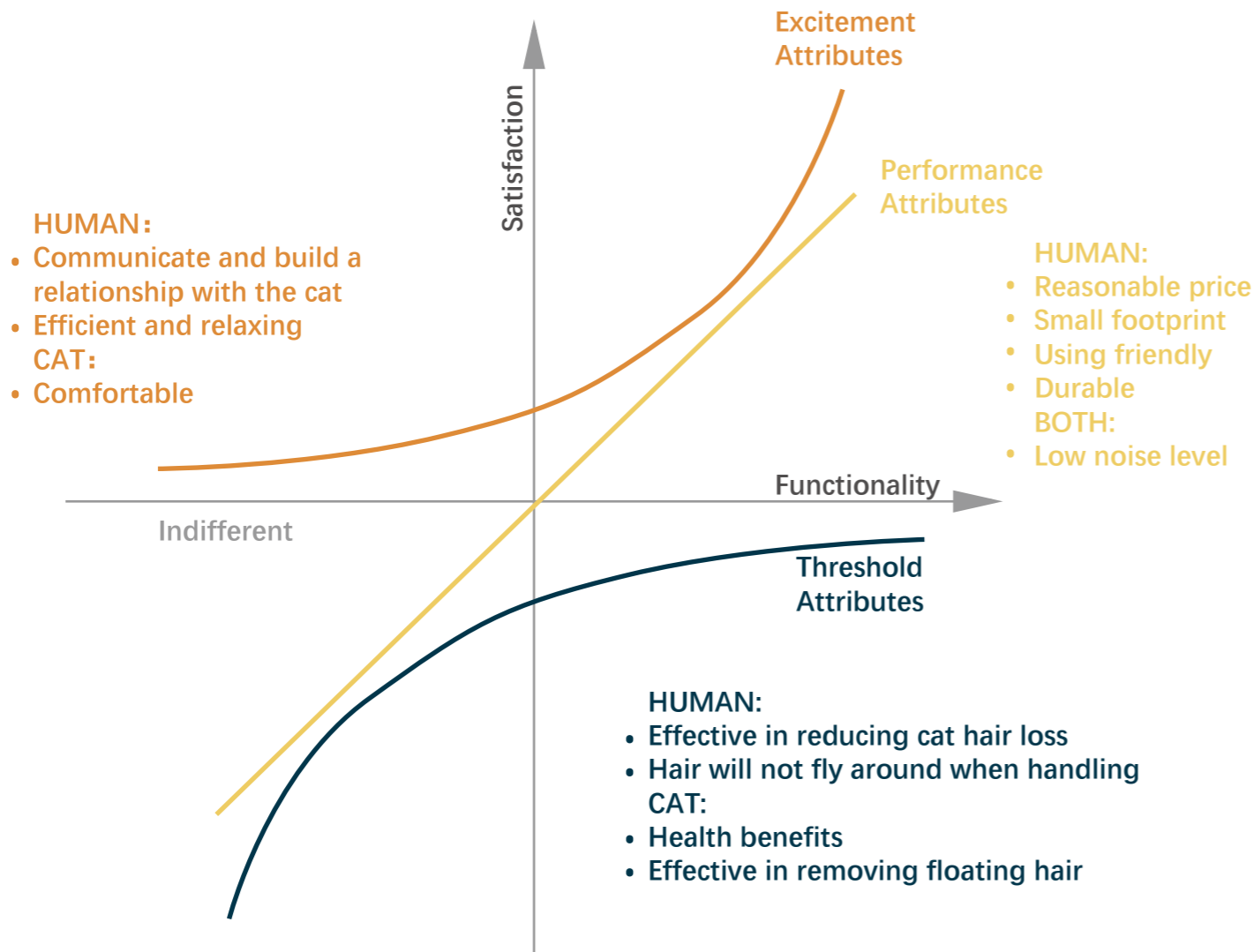
Troubled by cat fur problem
 Busy with work and housework
 It's a burden for them to brush cats



CAT

High vigilance, not easy to establish close relationship with people
 Feel fear and disgust when being brushed but need to be brushed

KANO MODEL



INSIGHTS & OPPORTUNITIES

Brushing the cat's hair is necessary which is also a very effective way to reduce the number of hair loss. But it's very tired and has a lot of bad experiences. It needs to be improved.

Cats have the habit of licking their hair and like to rub at the corners of furniture to relieve itching. These two habits can be used in design.

Cats are sensitive and self-conscious pets. Many owners are not close to cats. They need an opportunity for emotional communication



PRODUCT AIM

Cats lose too much hair	● ● ● ● ●	Solve
The process of grooming cats is not enjoyable enough	● ● ● ● ●	Greatly improve
Lack of communication between the owner and the cat	● ● ● ● ●	Improve a lot
Cats don't like being brushed or bathing	● ● ● ● ●	Improve
Guide and help cats to clean their hair on their own	○ ○ ○ ○ ○	Uncertain

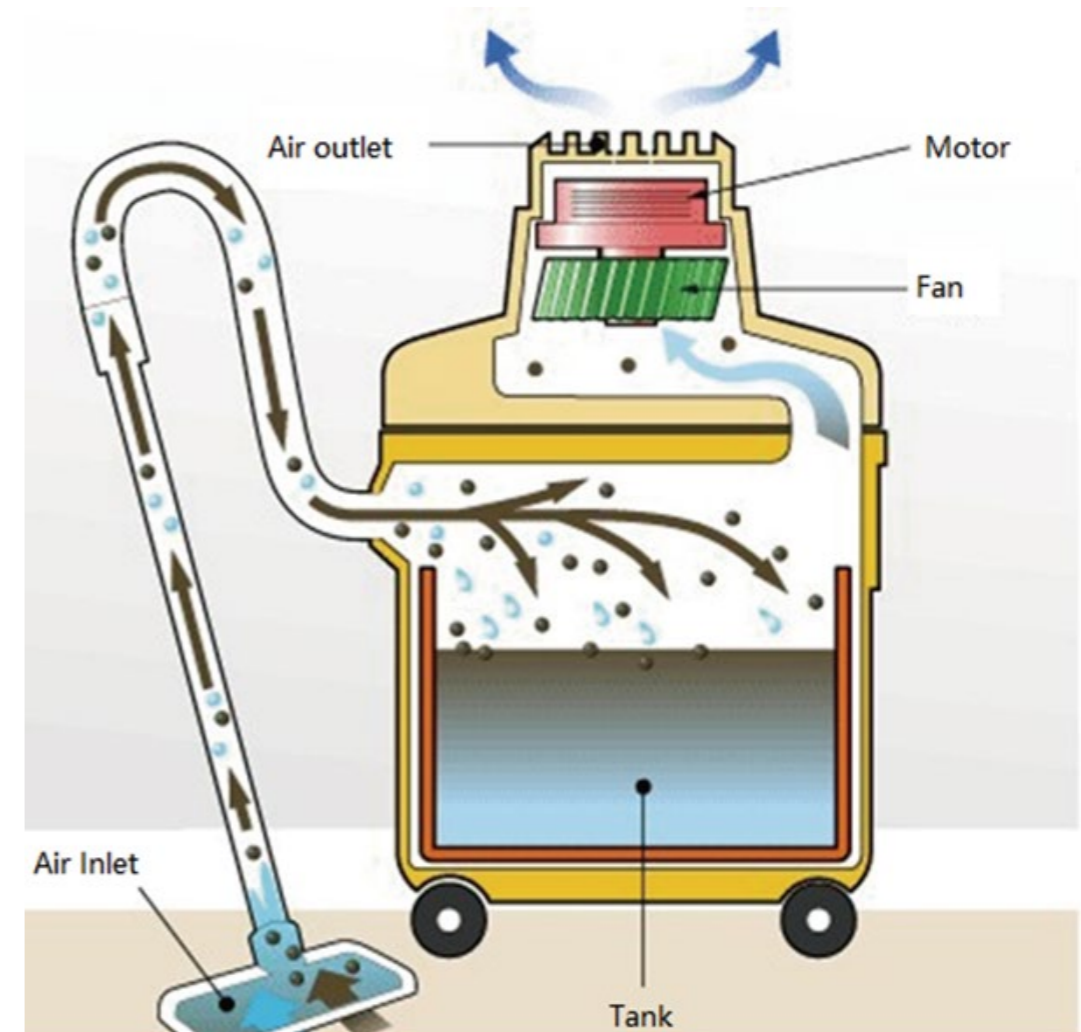
TECHNOLOGY PRINCIPLE

CHOOSSED

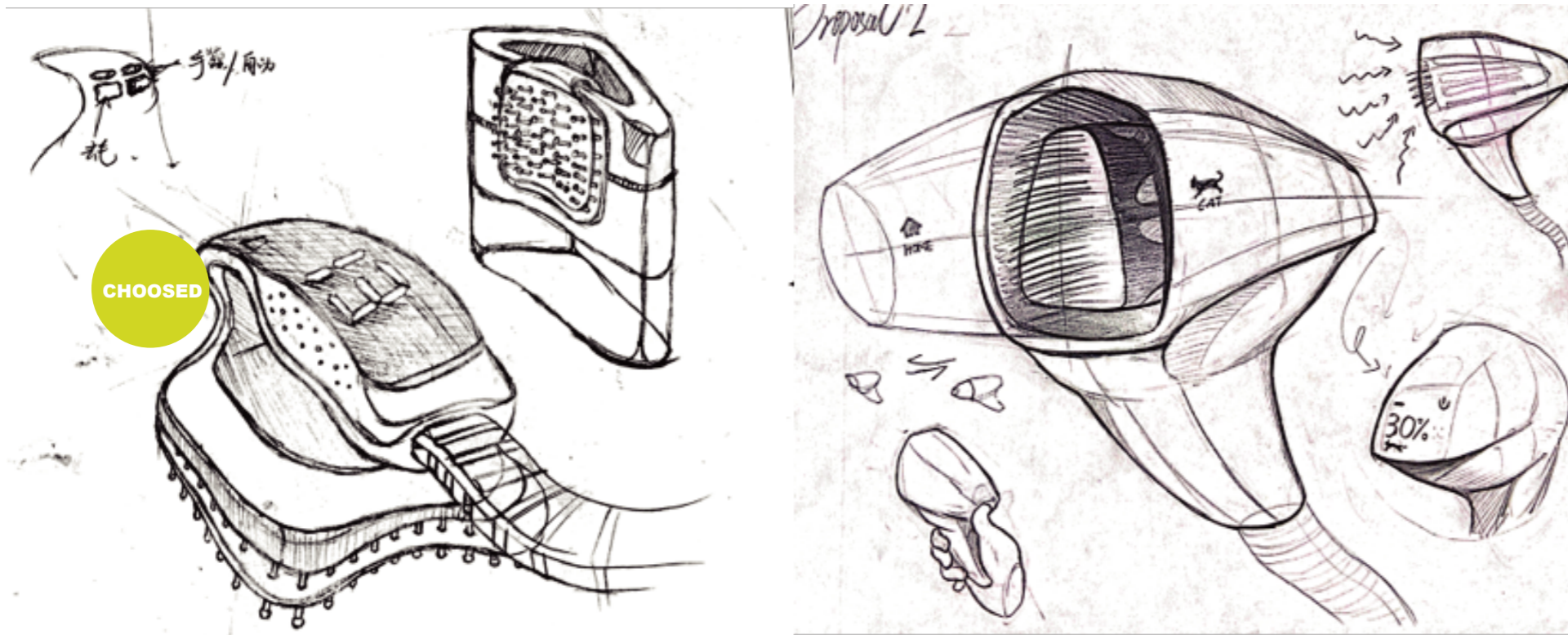
Requirement		User Importance (1-5)	suction	tape or sticky	wash by water
Avoid flying hairs when grooming	Effect	5	5	3	5
	Recyclability	3	4	4	2
	Easy to operate	4	5	5	3
	Low economic costs	4	4	1	2
Total			73	40	51

We have now settled on a comb-like structure to help remove floating hair and reduce daily hair loss in cat's life. However, how to alleviate the problem of cat flyaway during combing and how to promptly deal with the cat hair which does not get stuck in the teeth of the comb (i.e. the hair that will fly into the air) is still uncertain.

After reviewing the information, I found that there are three main ways to deal with the fallen hair: suction, flushing and sticking. Using user importance as a weighting factor, and taking into account the design context and usage scenario of the product, I scored each of these three methods. I scored each of the three methods and calculated the total score. In the end, I adopted suction as a way to prevent cat hair flying into the air.



WHAT IF...

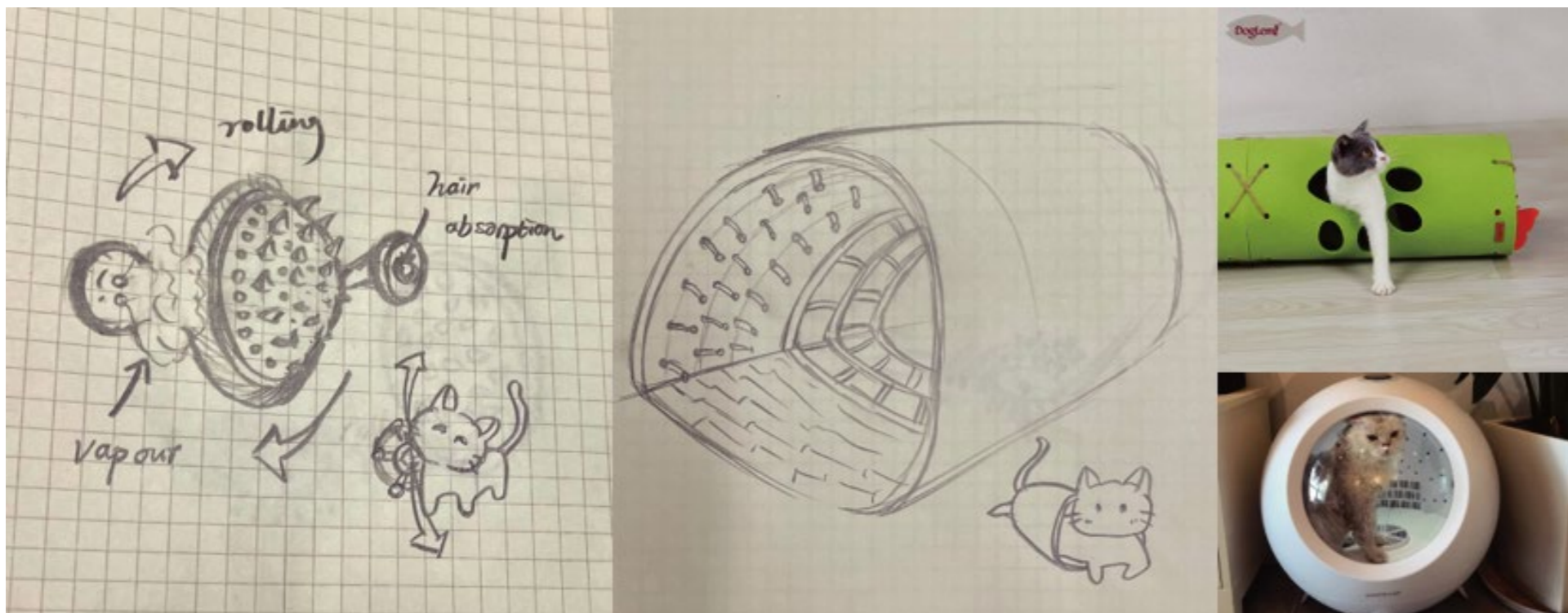


WHAT IF...

It's a cat's own entertainment space. It can also help clean the cat's fur, do cleaning, relax and entertainment

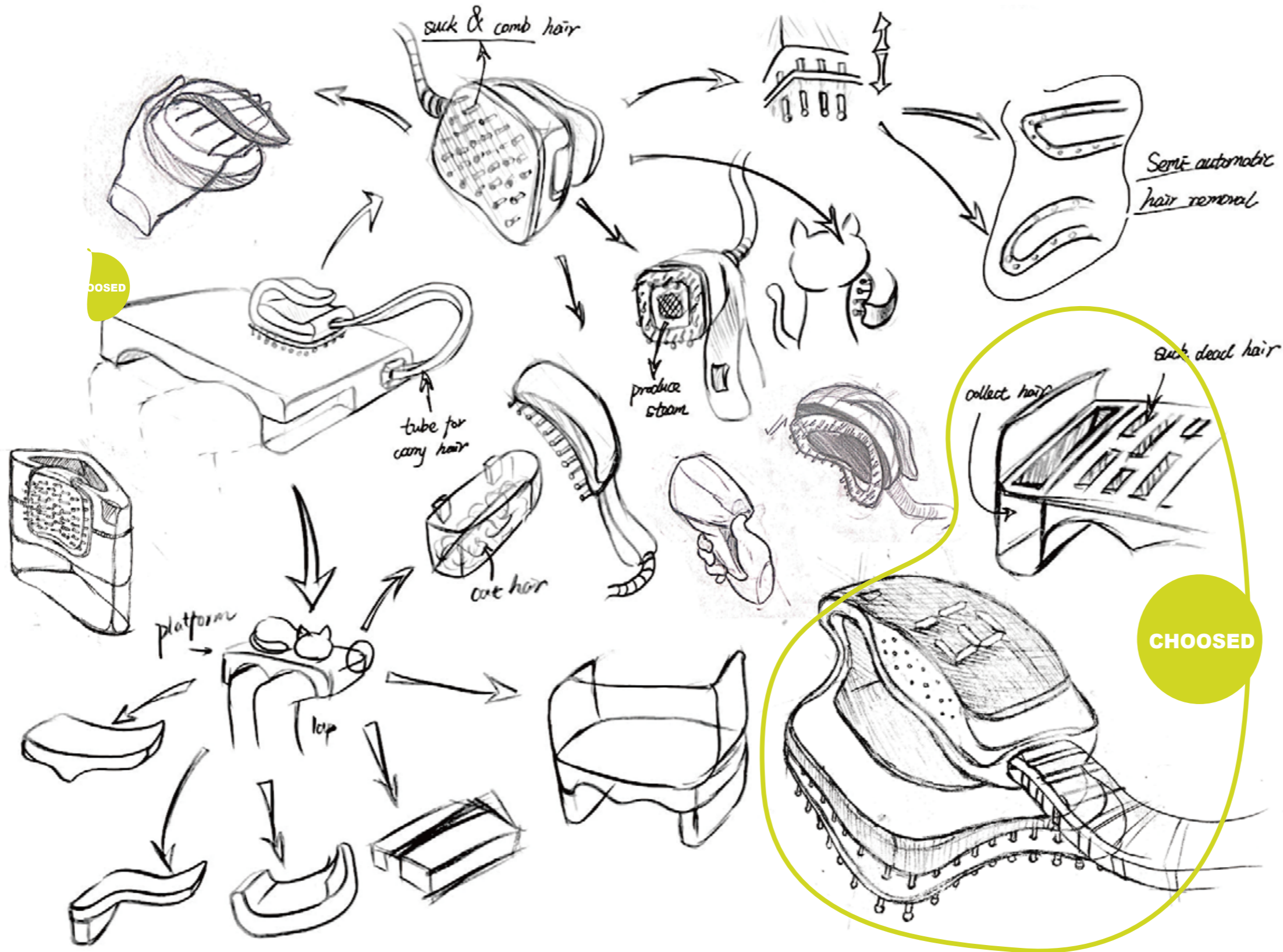
WHAT IF...

Cat hair comb with suction function and emotional communication. Maybe it's also a spa machine



advantage	disadvantage	User feedback
more interaction between owners and cats	Some cats may resist and run away	Feeling will improve a lot of experience, hope it can be more interesting and make cats like it more
Better cleaning effect	It needs manual operation and may be tiring	Hope to be able to deal with cat hair immediately, no longer cause pollution
Products may take up less space		
It won't cause the cat's fear, more independent	Cats may not be interested in the product, became useless	I'm worried that the cat won't cooperate, because it doesn't play with the cat that I bought
It can carry more functions, such as dry cleaning	It may take up more space/more expensive	If cats like it, it's a good product and they want to buy it
	It may be difficult to clean and repair	

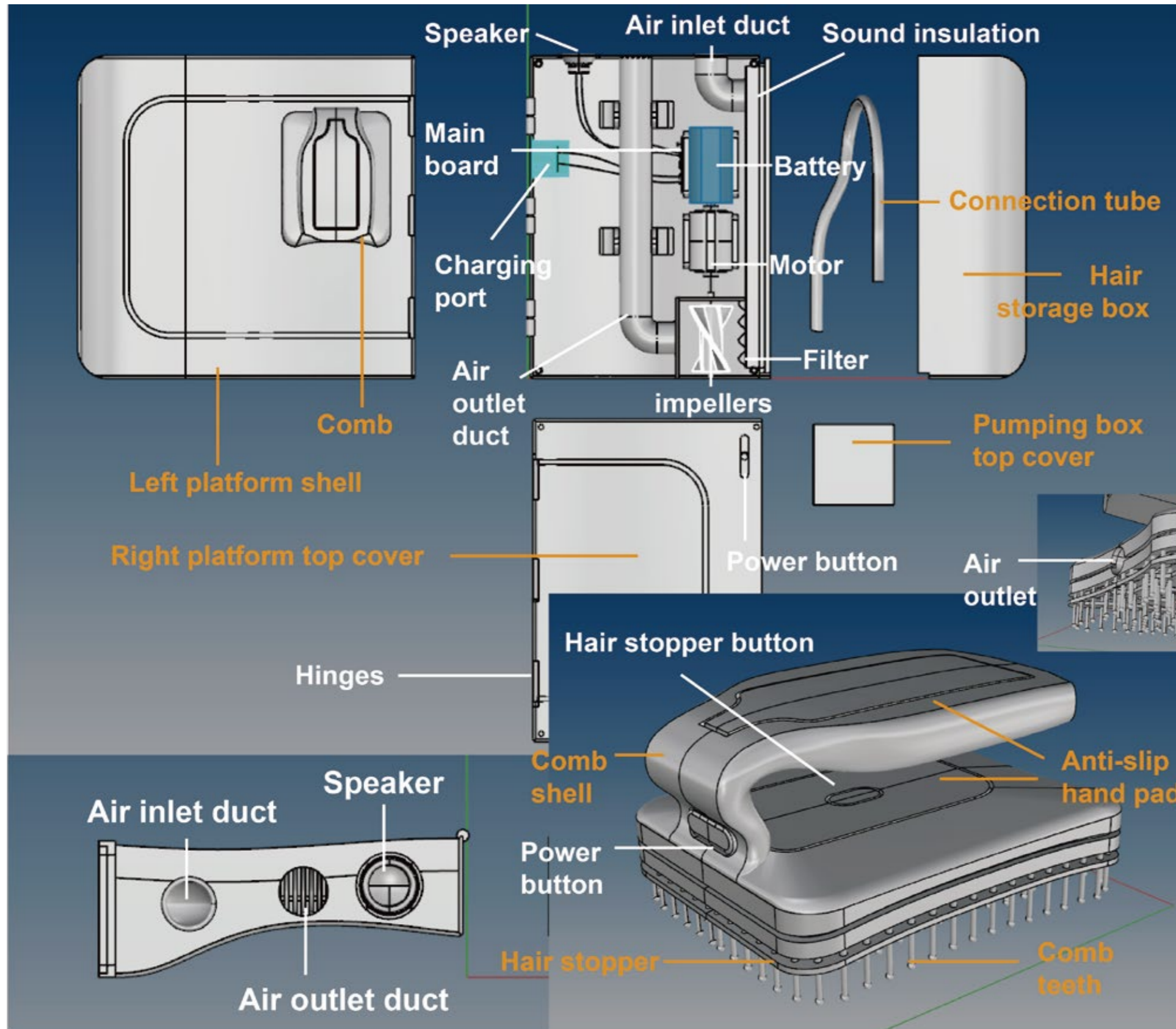
DESIGN CONCEPT



			CHOSED	
		User Importance (1-5)	comb	platform
Requirement				
The air intake should be	Effect	5	4	5
	Recyclability	3	4	2
	Easy to operate	2	2	3
	space occupied	4	4	2
Total			77	60

Based on the results of the previous research and design decisions, I carried out a series of designs. A solution was identified in which the product would consist of two main parts: an aspiratable cat hair comb and a mainframe with a matching cat hair comb. In the end, I chose the shape shown on the left as the shape of the comb. This is because the soap-like shape is easier for the hand to grip and less strenuous than the cylindrical handle. The design of the handle makes it easier to move the comb by hand and there is no worry of the comb falling out. For the design of the main unit, the final solution was a platform that could be placed on the person's lap. As this platform allows the cat to lie on it, it solves the problem of rubbing against the body when grooming and gives more value to the body of the main unit. We have also designed a stopper on the teeth of the comb to make it easier to remove any remaining hair from the teeth.

ENGINEERING TECHNOLOGY



The product consists of an suction comb, a connection tube and a lying platform.

The air suction comb consists of a handle, comb shell, hair stopper and hair stopper control button, comb teeth, air outlet, anti-slip hand pad, infrared transmitter and power button.

The lying platform consists of, housing, sound insulation, air inlet duct, hair storage box, filter, motor, impeller and air guide wheel, air outlet duct, box for storage duct, connecting hinge, speaker, infrared receiver, main board, charging port, suction opening battery and power button.

The button on the comb controls the suction function on and off, long press to turn on, release to stop.

The switch on the platform has three stops, off, weak suction and strong suction. The commands conveyed by the button on the comb are transmitted via an infrared transmitter to an infrared receiver on the platform, which controls the motor via the main board.

The core technology of this product is the use of air flow to suck out cat hair from the air stream. The key technology that needs to be addressed is how to reduce the impact of the motor noise on the cat.

CORE TECHNOLOGY



Cats are very sensitive and alert animals, they have good hearing and are sensitive to sound. Therefore, noise can also have a significant impact on cats. The key technical issue to be addressed in product design is that of noise. Ways need to be found to reduce the decibels and frequency of the noise. Avoiding cats resisting the use of the products we design, or even products that directly harm their health.

The human hearing range is between 20 Hz and 20,000 Hz, while the cat's hearing is between 60 and 65,000 Hz and is most sensitive to high frequency sounds. Cats can hear sounds at a minimum of 18 decibels, which is equivalent to the sound of a human's bare foot on the floor.

Cats do have their own favourite sounds. As cats have a different perceptual system and can hear different frequencies of sound than humans, to make a piece of music sound good to a cat, you need to start over with a suitable beat and pitch.

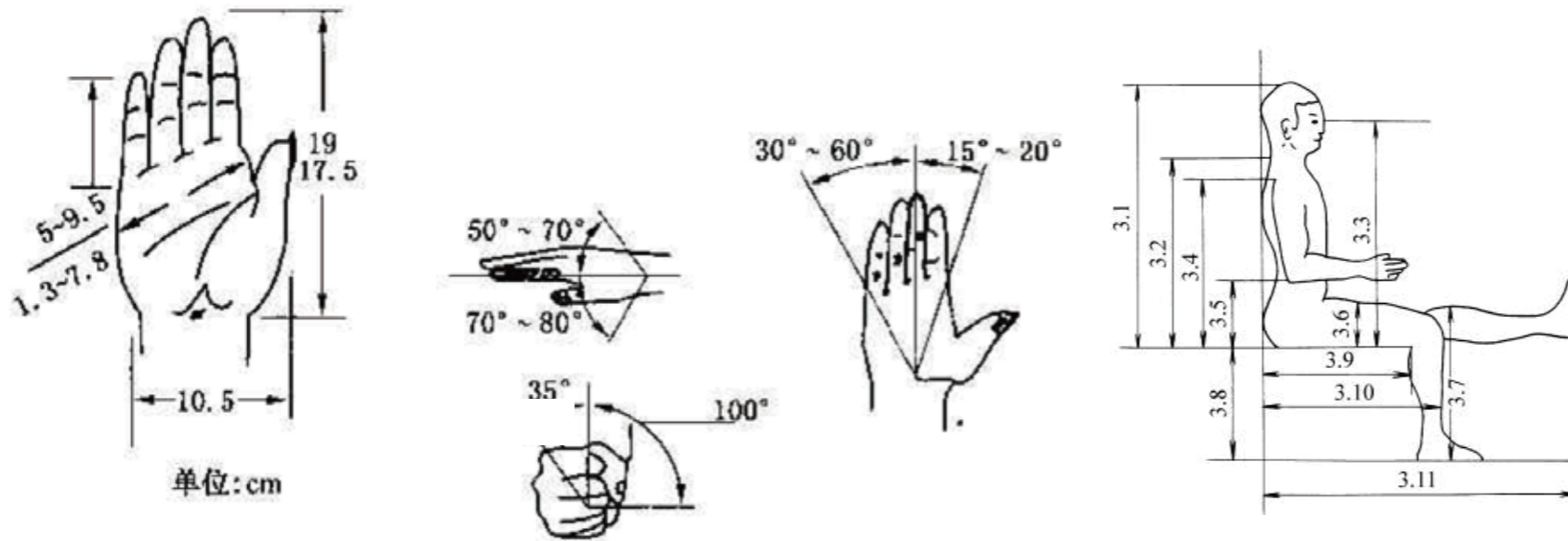
The National Symphony Orchestra's soloist (David Teie) collaborated with animal scientists to create Music for Cats, music that calms cats. A researcher gave each cat a stress test based on its behaviour and body posture, as well as the cat's reactions. The researchers found that cats were more relaxed and less stressed during the test when music customised for felines was played compared to classical and non-music.

Not only is this music specifically for cats beneficial to their health, but it also has certain healing and therapeutic properties that can reassure owners and can calm their cats.

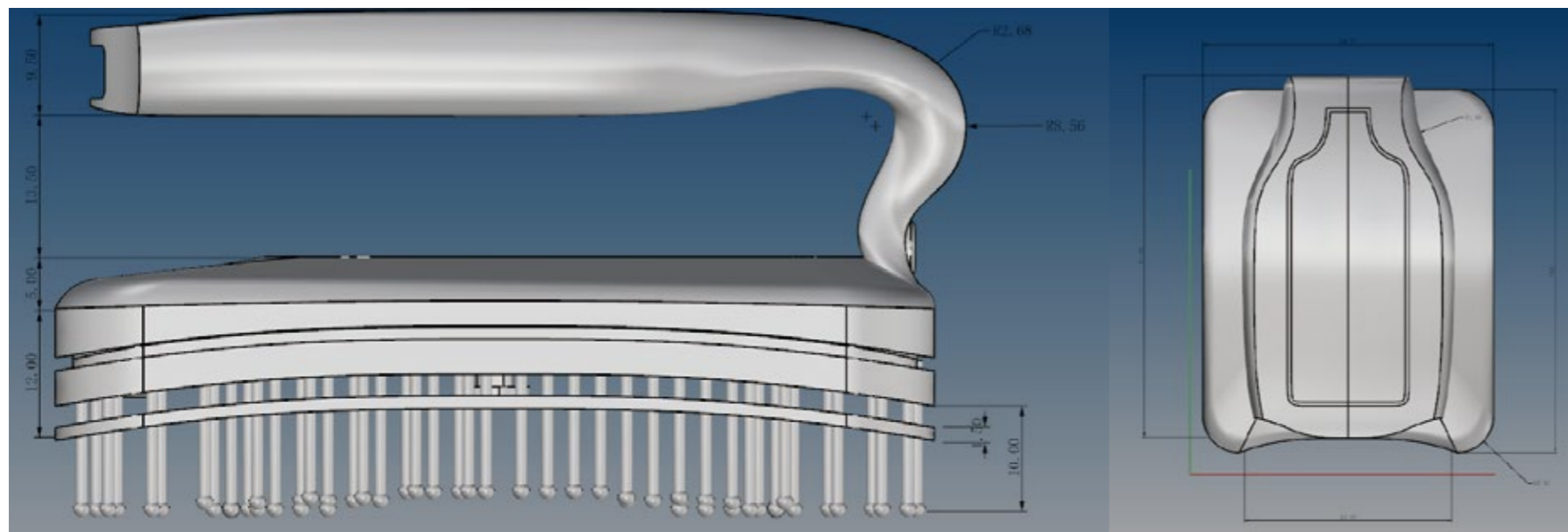
The playing of music will also be used to help cats relax in the product I have designed. In addition, I use engineering techniques in my designs to reduce the decibels of noise. Noise reduction using soundproofing devices. Please see the technical report for more details here.

Experimental pictures

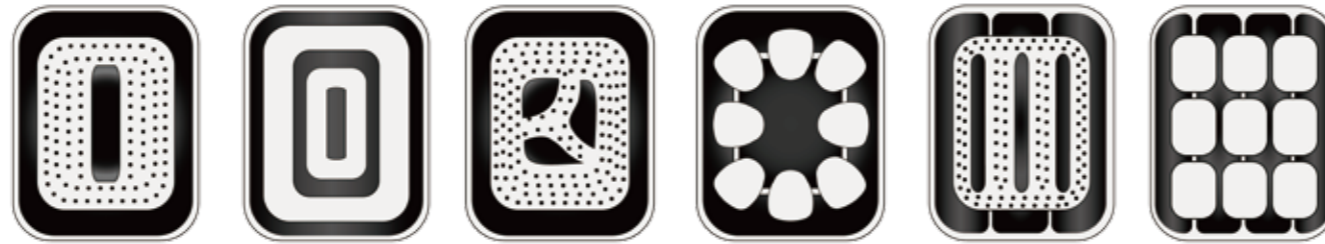
DIMENSIONAL DESIGN



The design principles for grip products were combined with a review of designs related to the human hand and sitting posture. The basic dimensions of the product were determined as follows. Based on the dimensions I have designed, I have made a prototype and carried out hand grip tests. Based on the feedback from the test, I then adjusted the final product dimensions. In addition, I tested the one-touch de-shedding function of the hair stopper with the prototype I and the results were satisfactory.

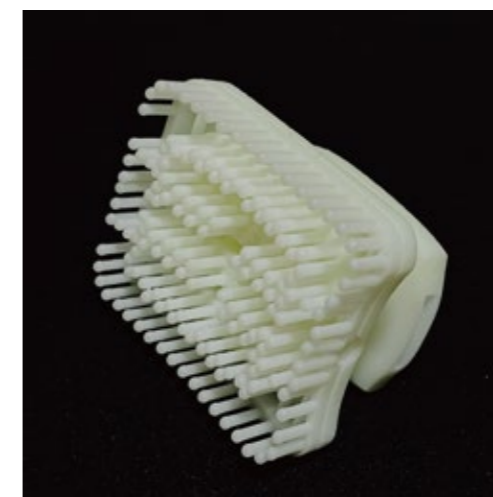
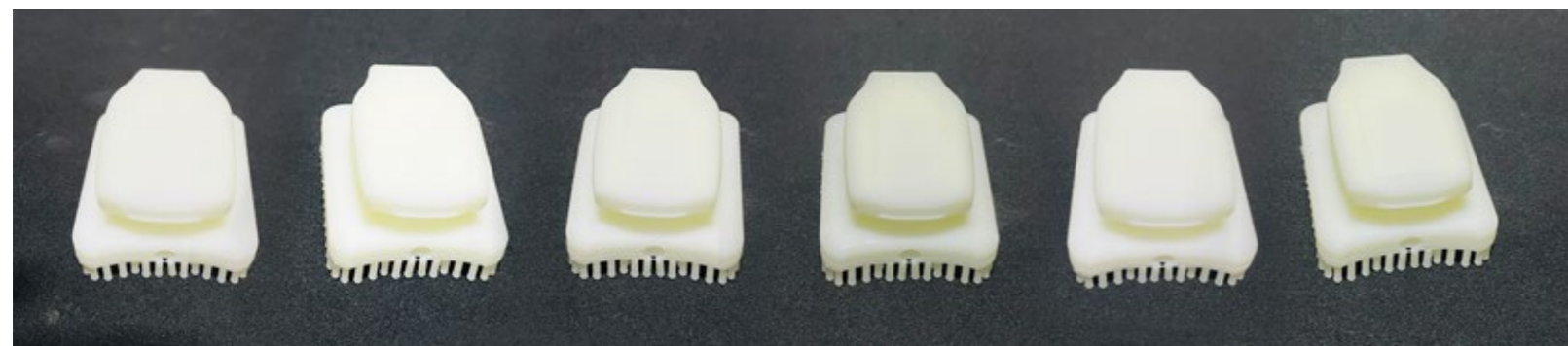


DESIGN OF THE SUCTION OPENING AND COMB TOOTH ARRANGEMENT



Combing efficiency	5	4	5	3	5	2
Amount of hair stuck in the teeth	3	4	3	5	4	4
Stability	5	2	5	1	4	2
Cat feedback	2	5	3	3	4	2

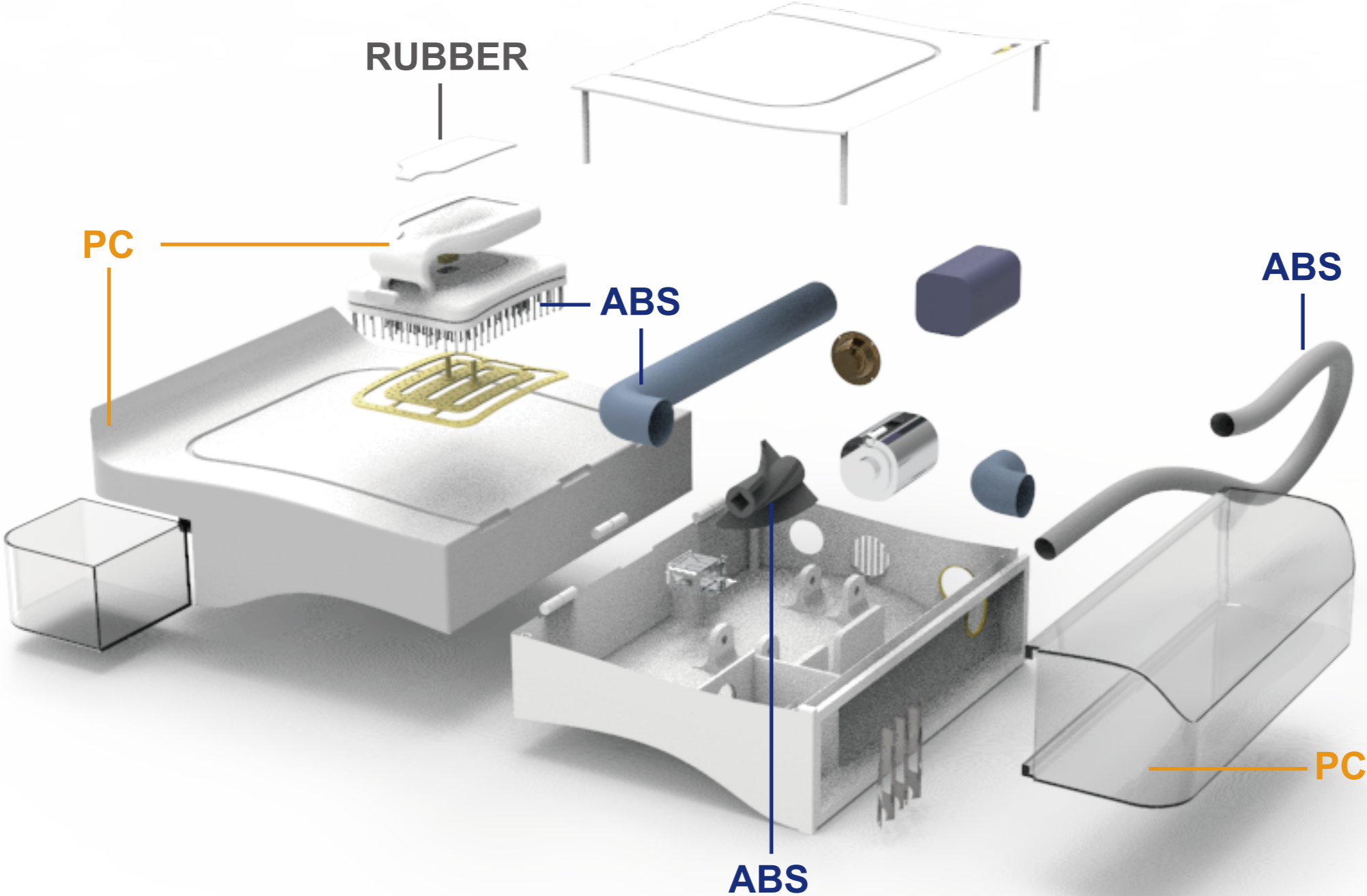
Next comes the ergonomic design that serves the function, in this section I designed several different comb-vent layouts. In the picture, white indicates the comb teeth and black the air outlet. I 3D printed these options and connected a medium suction Hoover for testing. The aim was to determine which arrangement gave the best results. The results obtained were rated (1-5) according to combing efficiency, the amount of hair stuck on the teeth, stability and the cat's reaction. In the end, option number 5 was chosen as the final comb tooth arrangement.



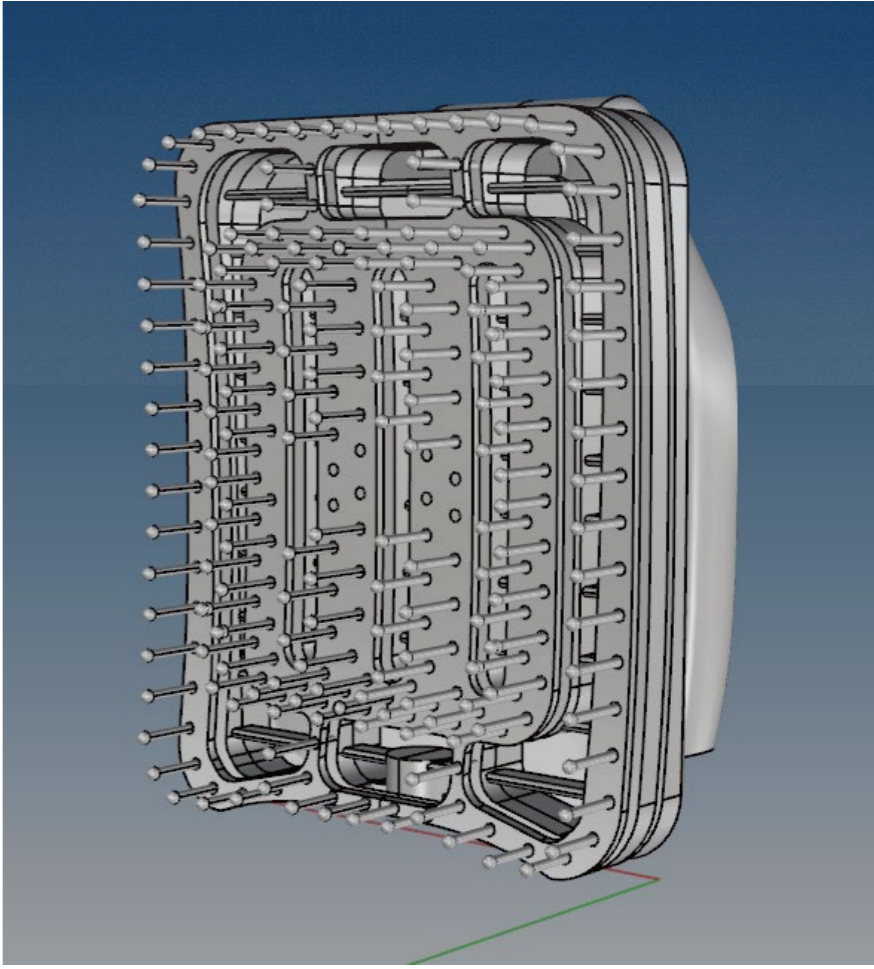
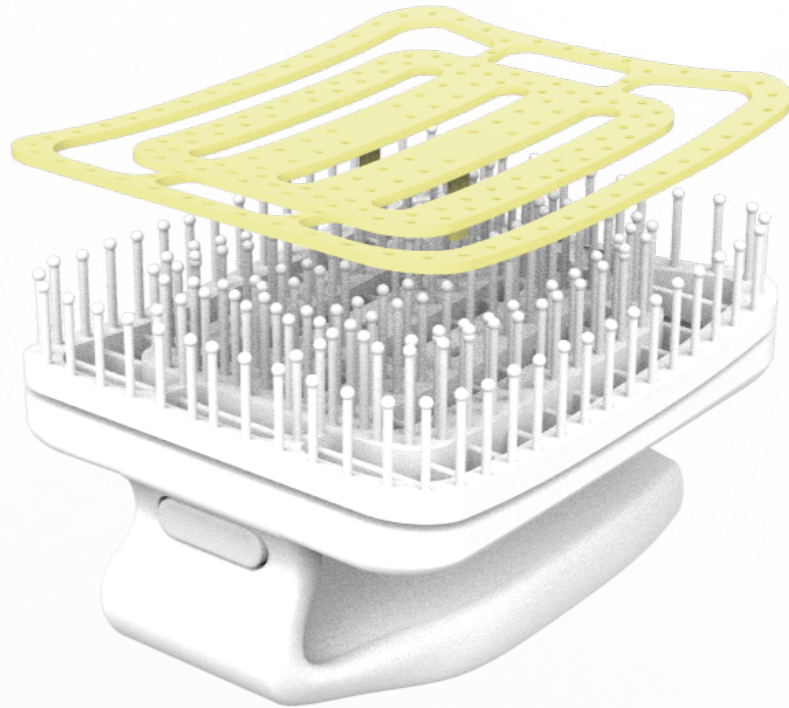
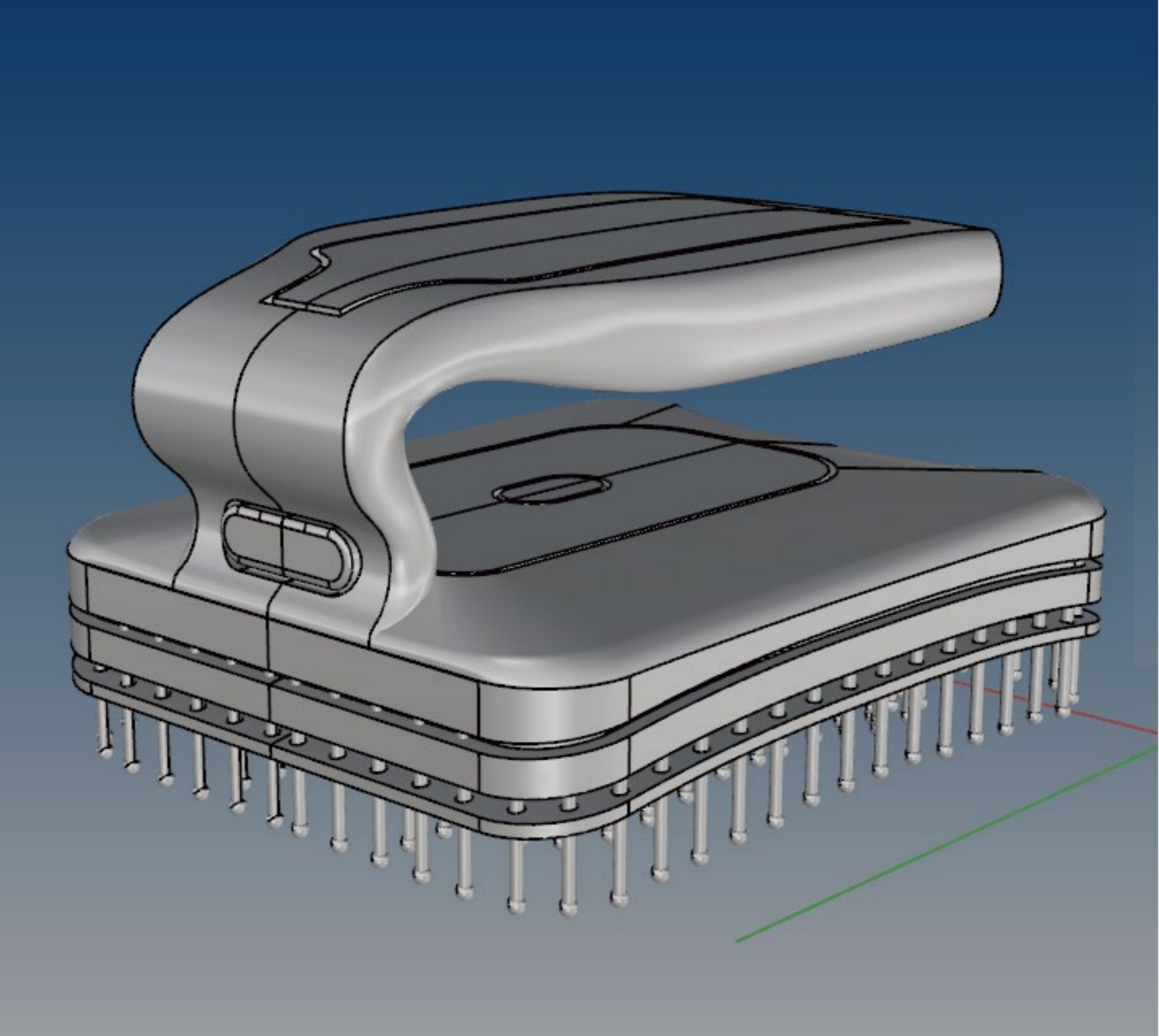
MATERIALS AND COMPONENTS

In the choice of materials, the main components of the product are plastic. Of these, ABS plastic was chosen because the comb teeth, impellers and air tubes may generate a certain amount of heat, are inherently thinner and require greater strength. The shells of the comb and the lying platform are made of PC plastic, which is lighter, easier to work with and more environmentally friendly. The hair storage box needs to be made transparent for easy viewing, so PC plastic is also used. The hands non-slip pads are made of rubber.

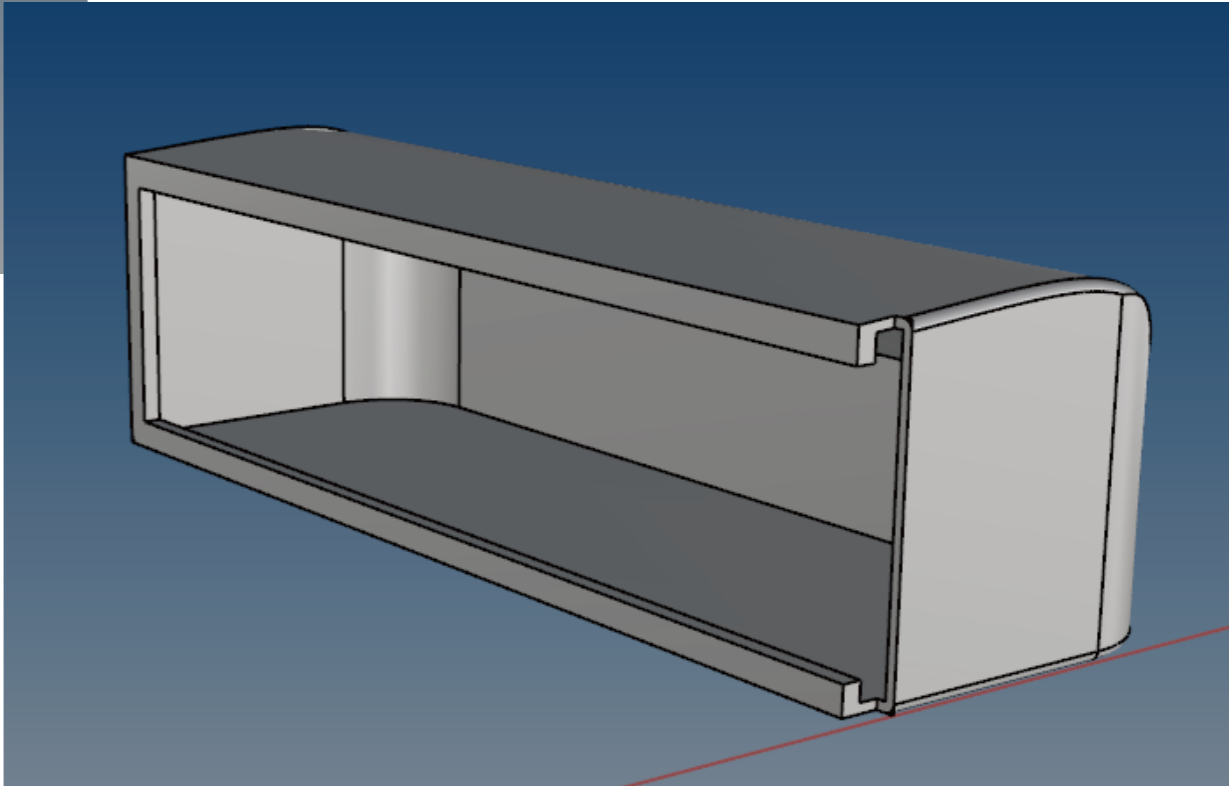
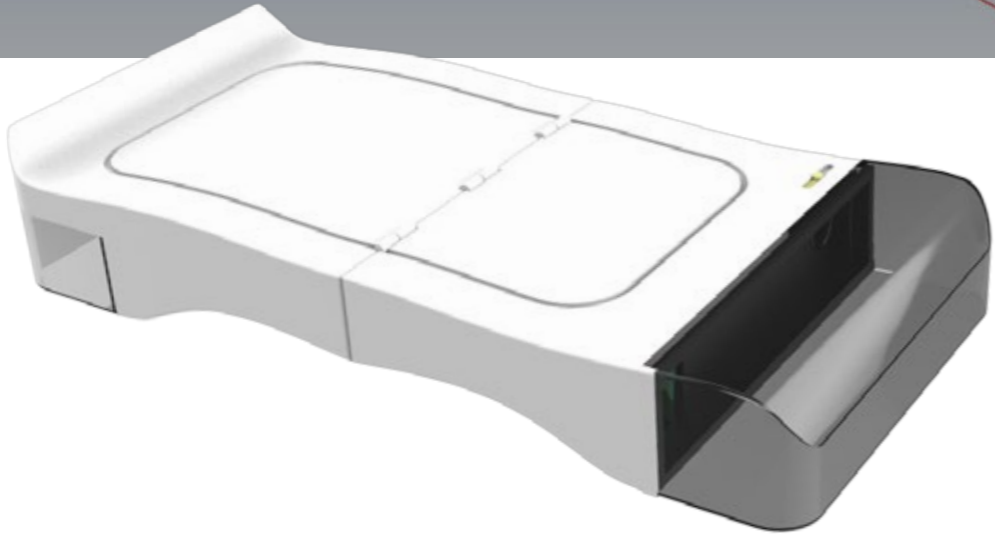
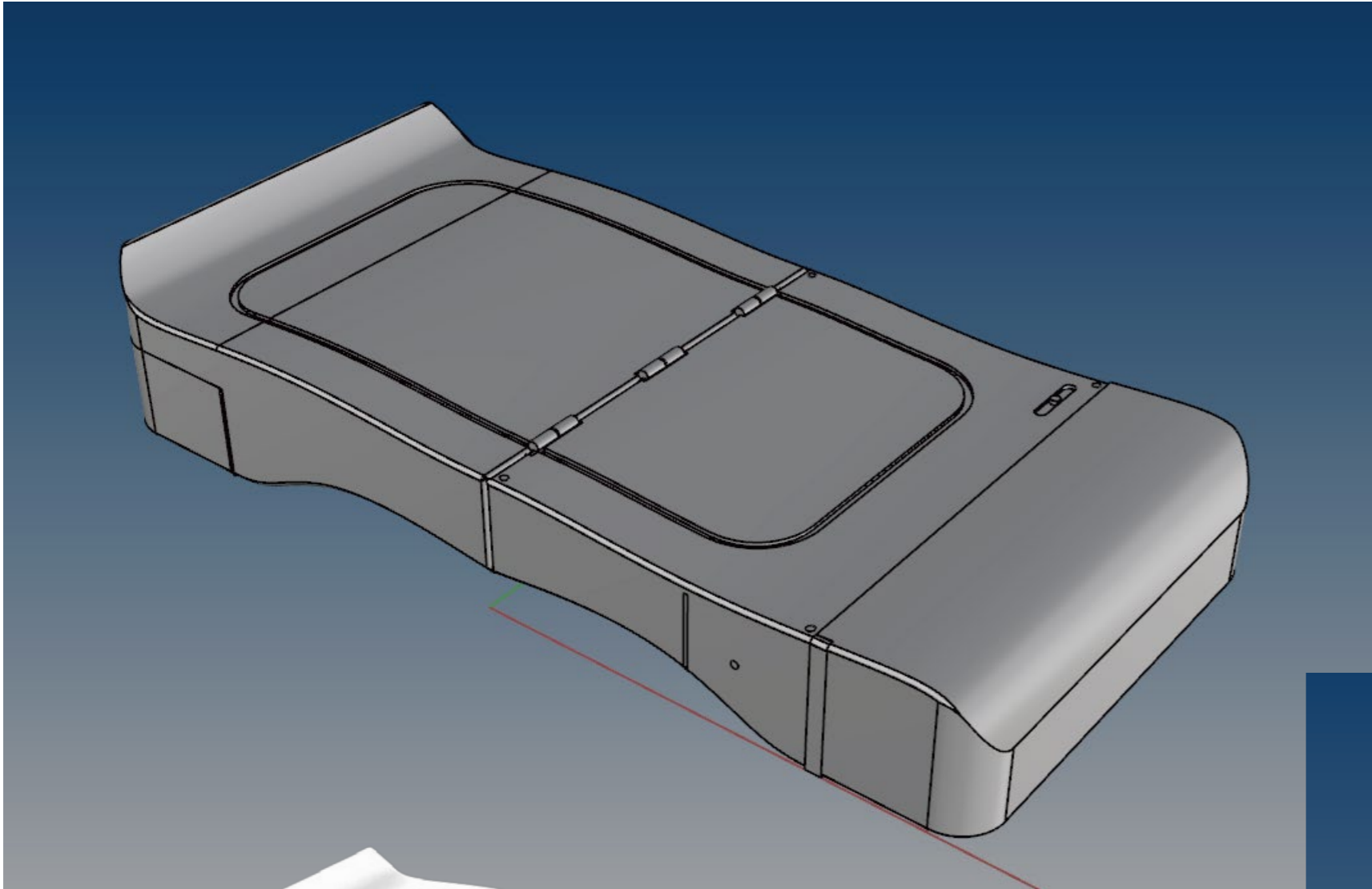
Parts	Materials	Manufacturing Process
Comb shell	PC	Injection molding
Platform shell	PC	Injection molding
Comb teeth	ABS	Injection molding
Hair storage box	PC	Injection molding
Connection tube	ABS	Extrusion moulding
Filter	ABS	Injection molding
Anti-slip pad of comb	Rubber	Plasticizing



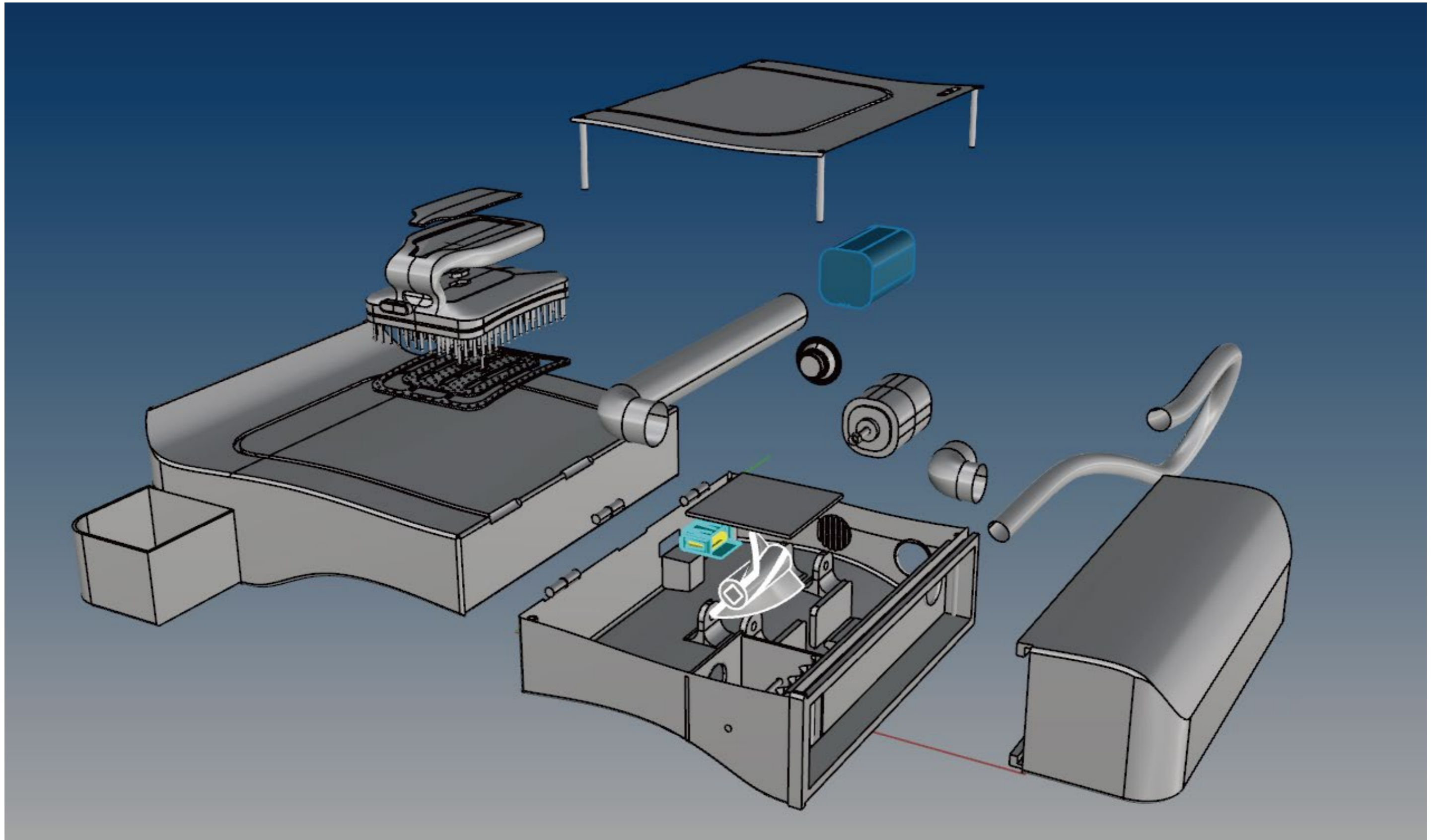
FINAL DESIGN



FINAL DESIGN

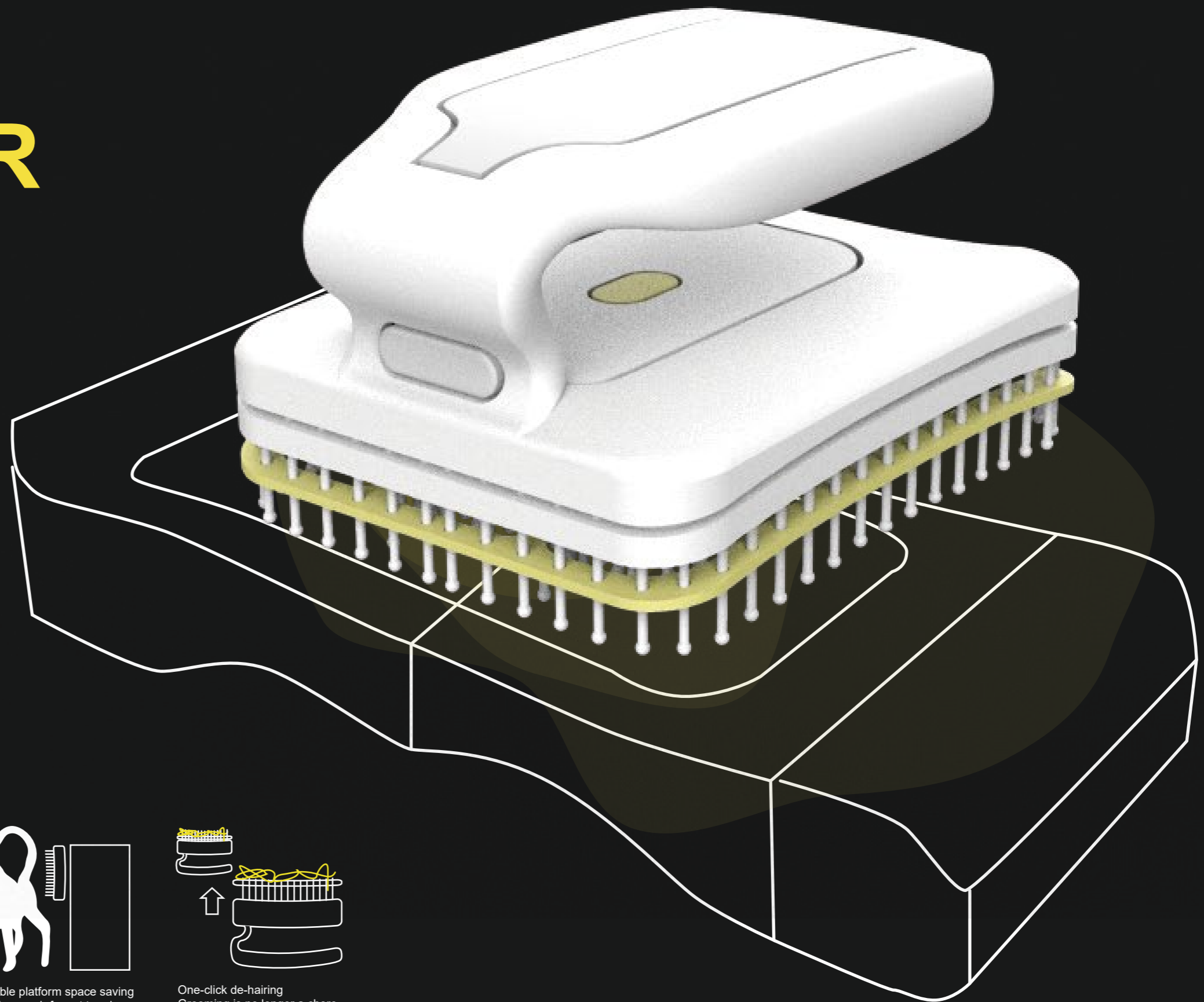


FINAL DESIGN

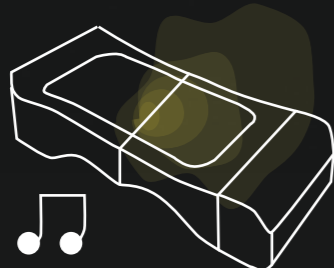


CAT HAIR DEVOURER

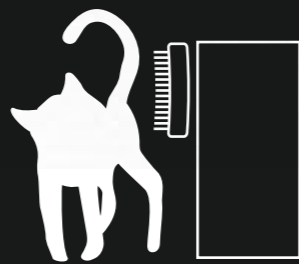
KEEPING A CAT ALWAYS BE AN ENJOYABLE THING



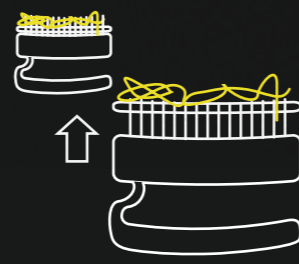
Grooming cats with the suction comb on your lap



Physical noise reduction
Exclusive music mental relaxation



Foldable platform space saving
Hanging comb for cat to rub



One-click de-hairing
Grooming is no longer a chore

ANSWERS OF THREE KEY QUESTIONS

How will the user get the cat to want to be groomed ?

I have designed a special arrangement of the comb teeth to give the cat the feeling of being massaged. While grooming, the product plays music intended for cats to make them more relaxed. The lying platform also enhances the cat's comfort.

How will your product build the relationship between owner and cat ?

Cats, like people, can be affectionate through physical contact. Grooming is a really good opportunity to do this. My test also proves that once cats discover that being groomed is not so scary, they will love listening to the music and enjoying the massage they get from their owner. It could say that by solving the problem of the cat's resistance to grooming, there is a natural chance for the relationship building.

How is your product different from those on the market ?

There are many of them on the market, but they can be divided into two main categories. One is the wide variety of cat combs; the other is products for disposing of shed cat hair. None of them focus on and work to optimise the whole grooming process and solve the comprehensive problems in the process. Cat combs are not designed to allow cats to lie down and comb without the emotional care of the cat, which can also lead to cat hair flying around. The hair stickers and hoovers, on the other hand, are treatments that treat the symptoms but not the root cause.

REFERENCE

- [1] Noreña, A., Gourévitch, B., Aizawa, N. et al. Spectrally enhanced acoustic environment disrupts frequency representation in cat auditory cortex. *Nat Neurosci* 9, 932–939 (2006).
- [2] Charles T. Snowdon, David Teie, Megan Savage. Cats prefer species-appropriate music. Department of Psychology, University of Wisconsin, Madison, WI, USA, School of Music, University of Maryland, College Park, MD, USA. 19 February 2015.
- [3] Hampton A, Ford A, Cox RE 3rd, Liu CC, Koh R. Effects of music on behavior and physiological stress response of domestic cats in a veterinary clinic. *J Feline Med Surg.* 2020 Feb;22(2):122-128. doi: 10.1177/1098612X19828131. Epub 2019 Feb 12. PMID: 30744475.
- [4] BBC documentary, *Wide side of cats*
- [5] BBC documentary, *The Lion in Your Living Room*
- [6] W. Nebel and G. Schumacher "Object-Oriented Hardware Modeling - Where to Apply and what are the objects?" *Proc. of the Euro-Dac 1996 with Euro-VHDL 96* 1996.
- [7] W. Fang et al., "Low-frequency noise study of Ge p-MOSFETs with HfO₂/Al₂O₃/GeO_x gate stack," 2015 International Conference on Noise and Fluctuations (ICNF), 2015, pp. 1-4, doi: 10.1109/ICNF.2015.7288550.
- [8] R. Zhang P.-C. Huang J.-C. Lin N. Taoka M. Takenaka and S. Takagi "High-mobility Ge p- and n-MOSFETs with 0.7-nm EOT using HfO₂/Al₂O₃/GeO_x/Ge gate stacks fabricated by plasma postoxidation" *IEEE Trans. Electron Dev.* vol. 60 no. 3 pp. 927-934 Mar. 2013.
- [9] C. H. Lee T. Nishimura K. Nagashio K. Kita and A. Toriumi "High-electron-mobility Ge/GeO₂ n-MOSFETs with two-step oxidation" *IEEE Trans. Electron Dev.* vol. 58 no. 5 pp. 1295-1301 May 2011.