



Project II

# Redesign of beard trimmers for self-haircut at home

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# 1. Introduction

## a. Introduction

Beard trimmers are very popular among men. Trimmer kits also allow men to cater to most of their facial hair grooming needs from trimming, shaving of the beard to nose hair & ear hair trimming. Similar, albeit more powerful trimmers can be used for haircuts too. But men usually go to hair cutting salon for the haircut. The reason for this is the shape of the trimmers and the clippers that are available currently doesn't allow for them to be used around the head with equal control. The accessibility and visibility are reduced when we are cutting hair from the back of the head on our own. The proposed design will try to solve these issues by introducing relevant features to the current trimmers/ trimmer kits.

## b. Objective

To redesign beard trimmer / trimmer kits to allow for a user to have a hair-cut on their own.

## c. Rationale

After personally experiencing the issues with current trimmers when they are used for haircut, I decided to explore this product and look for design opportunities. On further observations I found that the battery-operated beard trimmers and hair

clippers work on same technology and beard trimmers can be easily used for having basic haircut.

## 2. Secondary Research

### a. Understanding Hair Removal Techniques

Hair removal can be classified in two broad techniques:

#### 1. Epilation

Epilation is removal of the entire hair strand from the skin. Waxing, Threading, Plucking are some of the examples of epilation techniques.

#### 2. Depilation

When the hair above the skin are cut leaving the root of the hair intact, it is called Depilation. Examples of Depilation are shaving and trimming.

When it comes to facial hair grooming, depilation is most commonly used, while epilation is used for setting eyebrow borders.

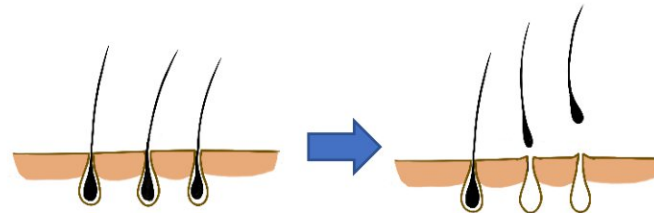


Figure 1 Epilation

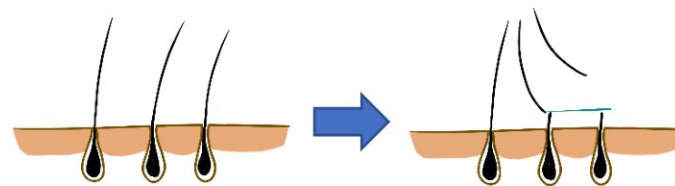


Figure 2 Depilation

## b. Understanding the techniques used for Depilation

Hair trimmers and hair removers can be classified into 2 basic categories

- Electric hair removers
- Mechanical hair removers

Scissors and combs are particularly useful when cutting longer hair.

This also requires higher level of skill from the operator compared to trimmers or shavers. Razors can be used to give close shave but require frequent change of blades. Electric products on the other hand require less skill from the operator and are also less time-consuming



Figure 3: Types of trimmers

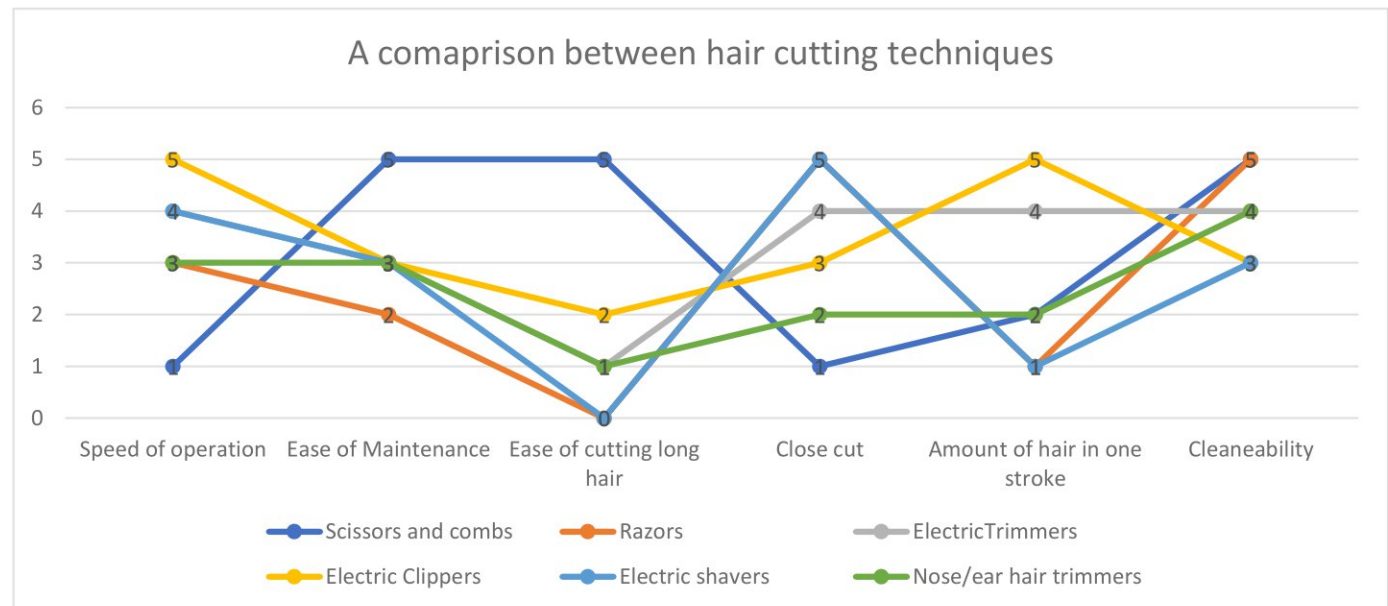


Figure 4: A comparison between hair cutting techniques

## c. Motors used in electric trimmers and clippers

### 1. The Magnetic Motor

The magnetic motor is found in almost all of the most inexpensive clippers on the market. This motor design is simple and generally reliable, with few moving parts. The motor consists of a spring and an electromagnet working in tandem to vibrate the blade back and forth. While the magnetic motor provides less power than the other two motor designs, it may be sufficient for occasional uses.

### 2. The Pivot Motor

The pivot motor is similar to the magnetic motor, but uses two electromagnets and no spring. While the blade speed is actually reduced, pivot motor clippers produce at least twice the cutting

power over magnetic motor clippers. This added power makes cutting through wet hair a breeze. Pivot motor clippers are used by professional stylists and are ideal for everyday cutting.

### 3. The Rotary Motor

Rotary motors are the engine behind the most powerful clippers on the market, and come in AC and DC powered units. Many DC powered units are cordless, powered by batteries. Although DC units are less powerful than AC units, the freedom of cords can be a welcomed delight. Rotary motor clippers are often expensive and used for bulk hair removal applications along with dog and horse grooming.

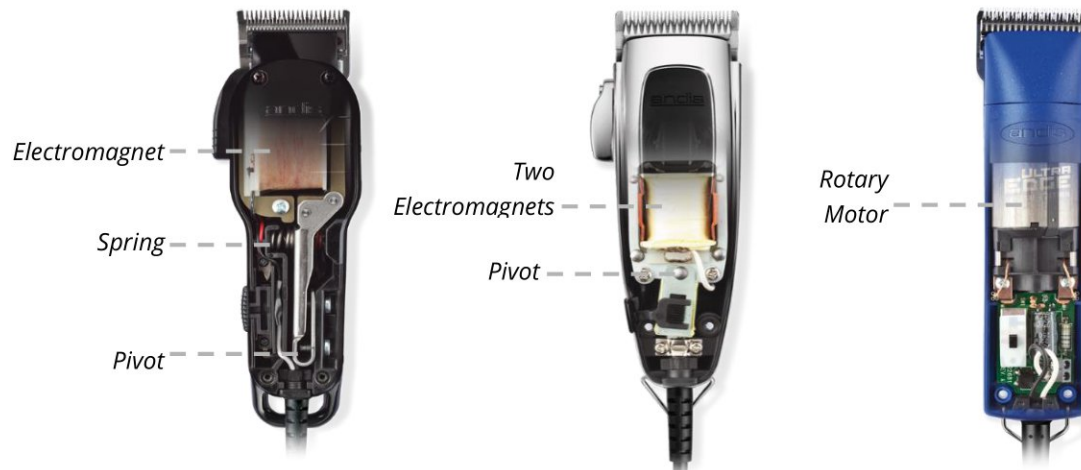


Figure 5: Magnetic motor; Pivot Motor; Rotary motor (Left to Right)

#### d. Comparison between the motors

Rotary motor works on DC current and therefore, it can be used in wireless trimmers using Li-ion batteries. Magnetic and pivot trimmers need AC current to operate and cannot be used with a battery.



	MAGNETIC MOTORS	PIVOT MOTORS	ROTARY MOTORS
<b>Blade Speed</b>	High blade speed	Lower blade speed	High blade speed
<b>Battery</b>	No Battery	No Battery	Battery operated
<b>Wireless function</b>	Wired	Wired	Wireless
<b>Hair type</b>	Best for lighter texture dry hair	Best for thick, coarse hair	Cuts all types of hair
<b>Complexity</b>	Simple design and fewer parts	More complex than magnetic trimmers	Most complex design, moving parts may need replacing often

## d. Market Research on devices for hair cutting

### 1. Flowbee

The Flowbee is an electrically powered vacuum cleaner attachment made for cutting hair.



Figure 6: Flowbee Hair Cutting Device

### 2. Conair Even Cut



Figure 7: Conair Even Cut

### 3. Man-Groomer

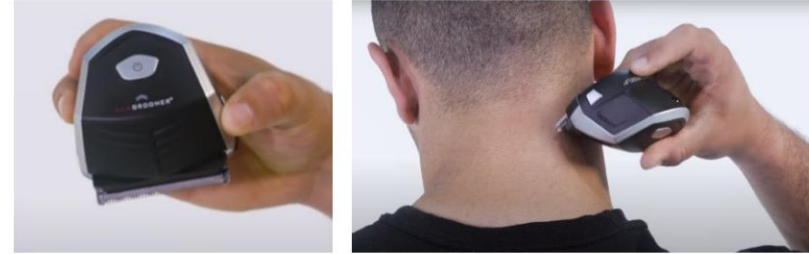


Figure 8: Man-Groomer

### 4. Phillips QC5580



Figure 9: Phillips QC5580



## e. Market research on accessories used for assisting haircut

### 1. Beard Templates



Figure 10: NuSense Beard Guide Shaper

### 2. Neckline Shaving Template



Figure 11: NEKMATE

### 3. Neck Template



Figure 12: Reva Neck Template

### 4. EWIN Hair Cutting Cloak



Figure 13: EWIN cloak

f. Understanding important aspects of Hair cut



Figure 14: Using **Clips** to separate the top hair



Figure 16: **Bald line** that separates the hairy and non-hairy regions



Figure 15: **Fade** to transition from the bald part to the hairy region



Figure 17: Using regular comb for a bigger **Fade**



Figure 18: **Wetting** hair with water helps in untangling



Figure 19: **Cutting** the top hair using Scissors

### **3. Primary Research**

#### **a. User studies**

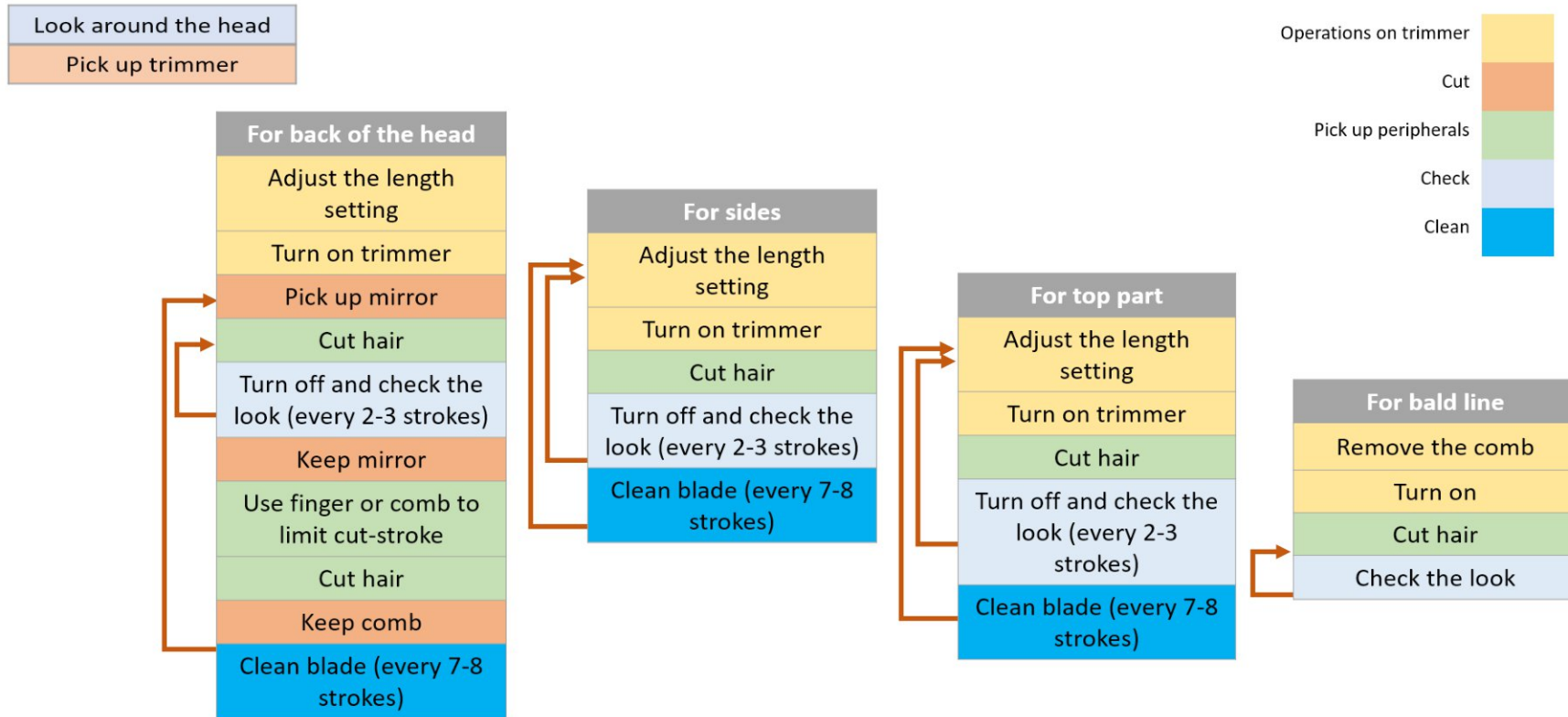
In order to understand the issues faced while having self-hair cut using electric trimmers, user interviews were undertaken with the people fitting the target group. In total 8 users, from the age group of 20 to 30 years, were interviewed who had used trimmers for cutting their own hair.

Following were pain points identified through the user interviews.

- Hand-eye coordination is tough when looking into mirrors
- Maintaining precise length of cut stroke is difficult
- Cutting bald line or boundary line is difficult
- Comb attachment which come with beard trimmers is not suitable for longer hair
- Disposal of cut hair is a problem
- Battery back-up of a trimmer is low

## b. Task Analysis

Task analysis was conducted by the author by using a beard trimmer to cut their own hair to understand the problem better



### c. Key Insights from task analysis

Following insights were derived from the task analysis

- The second mirror works best if angled at approximately 45° from the main mirror and at a distance of 30cm.
- It takes over 60 minutes to have a basic hair cut with the trimmer.
- The battery backup of a regular beard trimmers is just enough for having a hair cut.
- Beard trimmer motors are not ideal to clip large amount of hair in one stroke.
- Adjustable combs get filled with hair and requires frequent cleaning while having the hair-cut.
- Disposal of the hair is tedious in normal washroom environment.



Figure 20: Difficulties while cutting hair

## 4. Design Brief

### a. Objective

To redesign a beard trimmer kit that will allow users to have a basic haircut

### b. Usage

Redesign of the form to improve accessibility of the trimmer to cut hair from the back part of the head

1. Include features that will allow for controlling length of the cut stroke
2. Dexterity of the user should not affect the effectiveness of the product

### c. Target users

The product will be targeted towards users in the age group of 17 to 30 years, who stay away from home.

### d. Areas of intervention

1. Making the trimmer blade rotatable (Redesign of trimmer)
2. Designing for two mirror set-ups (Redesign of handheld mirrors)
3. Designing for control on the length of the cutting stroke (Redesign of combs)

## 5. Initial Ideations

### a. Ideations to improve the accessibility of the trimmers

One of the key insights from the secondary research was that the trimmer shape and the blade orientation makes it difficult to cut hair from the back of the head. It is difficult to reach all the areas of the head with one hand and the user also has lesser control on the orientation of the blade. Achieving fade with this configuration is also not easy. The hand also blocked the view of the cutting area making it difficult for the user to see where exactly the blade is positioned.

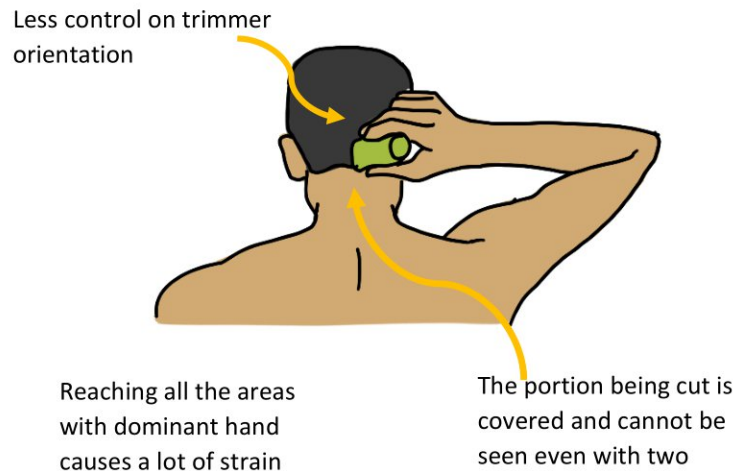


Figure 21

One possible solution for this was to have the blades towards the side of the trimmer. This would help in reducing the strain on the shoulders and arms. This configuration, which is used in combs, can also give more control on the trimmer. This configuration also allows for the hand to be away from the cutting area, thus improving the visibility

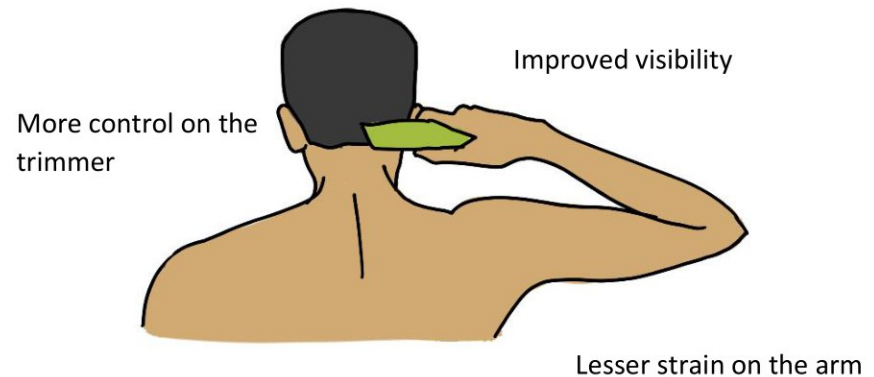


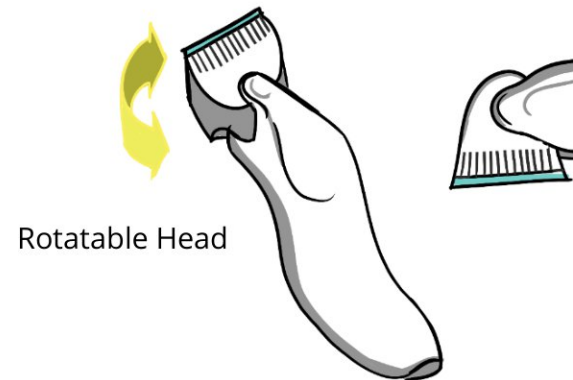
Figure 22

### a. Ideations to improve the accessibility of the trimmers

The 'blade-at-the side' concept was considered for initial ideation. This can be achieved by having a form that has the blade at the side (as shown in *concept 1*) or having a movable or rotatable blade (as shown in *concept 2*) that will allow the user to have different configurations of the trimmer.

The problems with the first concept are; since the blade is fixed

at one side, it can't be used as a traditional trimmer. It also cannot be used with both hands for cutting the hair. Therefore, the second concept was selected to take the idea forward. Since the trimmer can have multiple configurations, it can be used with both the hands as well as can be used as a traditional beard trimmer.





### b. Ideations to control the length of the stroke

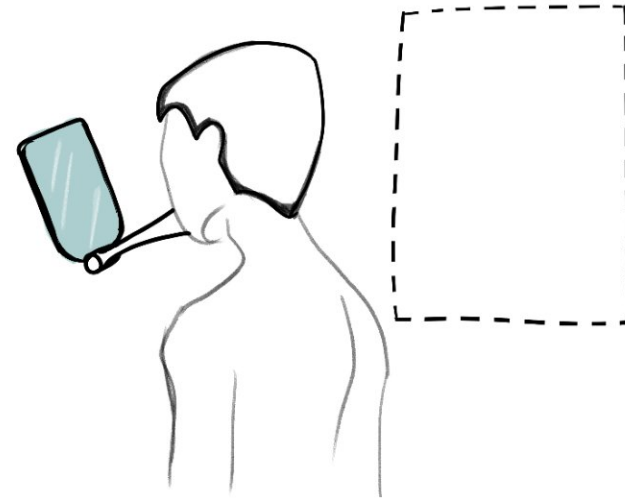
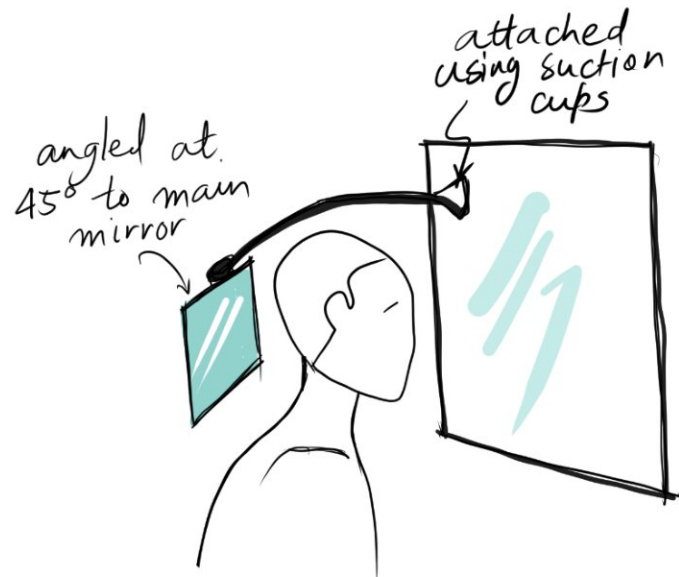
The second area of intervention was controlling the length of the stroke. This can be achieved by using bare finger or traditional comb, but fingers don't give a precise control while combs have straight edge and is not very effective on the contoured back part of the head.

Three concept ideations were done to control that might help control the length of the stroke.



### c. Dual mirror

Dual mirror setup is very helpful in having the haircut. Ideations were done to have hands-free dual mirror setup so that the second hand can be used for controlling the length of the stroke. In the first concept the second mirror is attached to the first mirror using suction cups. The second concept was to have a mouth mounted setup for the second mirror. The third concept was having a glove with attached mirror. This would reduce the time taken to pick up the mirror.

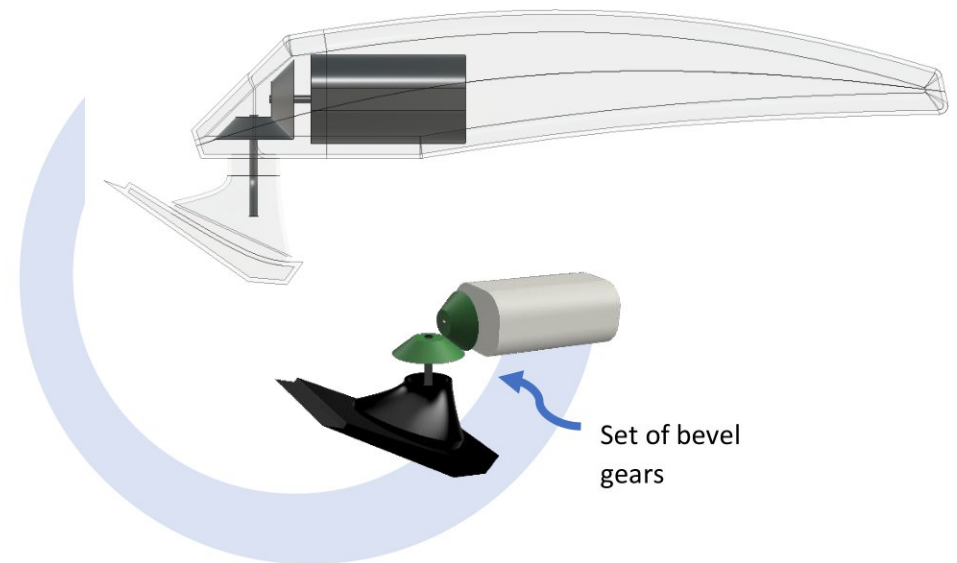
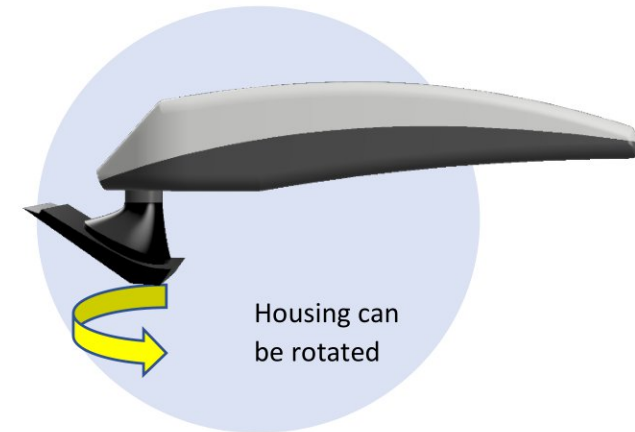
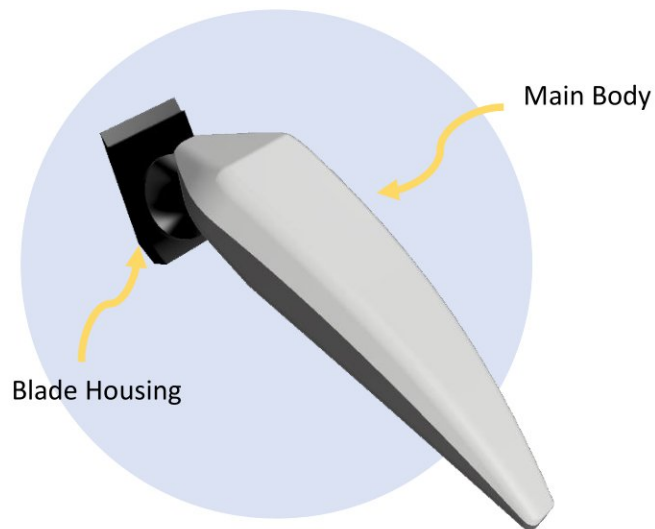


## 6. Concepts for changing blade configurations

To make the blade orientation changeable, the axis of the cam should be same as the axis of rotation of the blade part. Three concepts were generated to allow for the user to change the orientation of the blade when required.

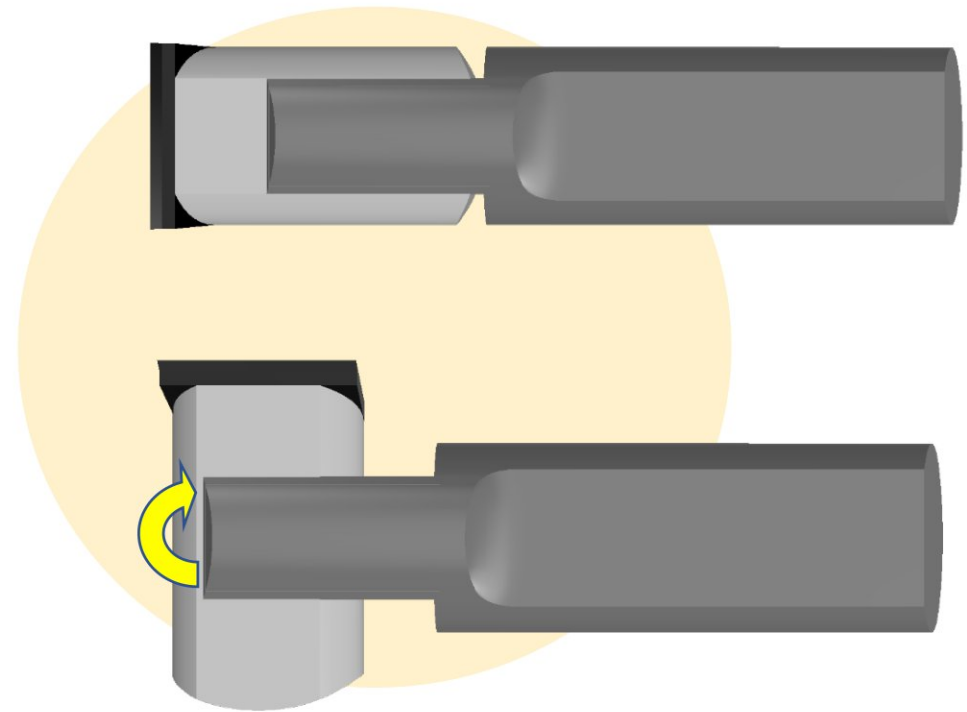
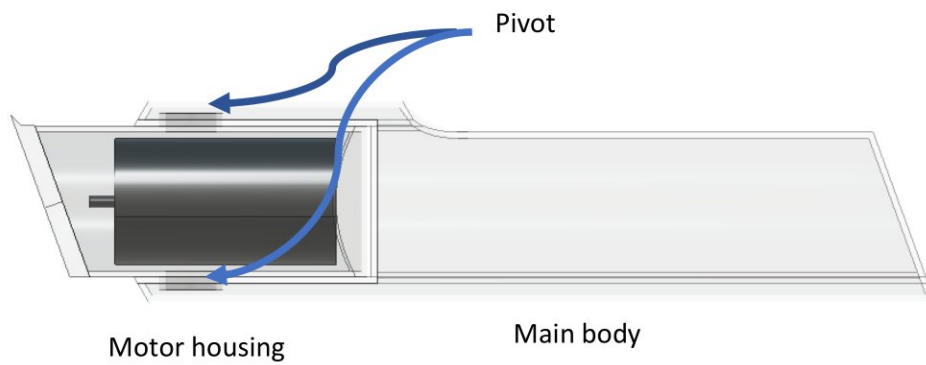
### a. Concept 1

Here bevel gears are used to transmit the motor rotation to 90 degrees.



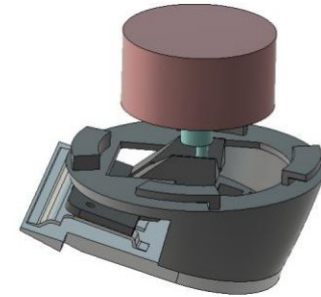
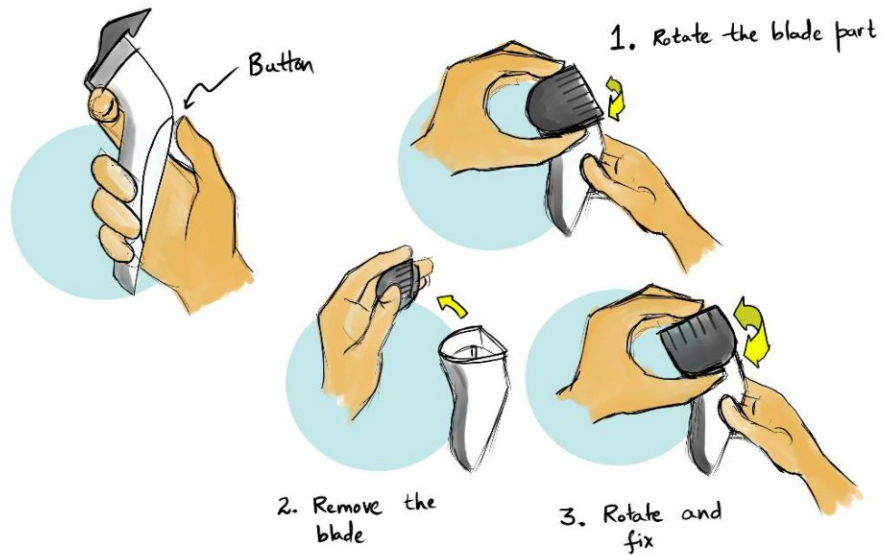
## b. Concept 2

In this concept, the motor is housed in a separate compartment which can be rotated to change the orientation of the blade. The second compartment houses the battery and the control module. The main body acts as a handle for the motor compartment whenever it is rotated.



### c. Concept 3

In this concept the motor orientation is changed so that the axis of the blade rotation is same as the axis of the motor. The motors used in trimmers and clippers typically operate on a voltage range of 1V to 6V. The no-load RPM range of the motors is between 7000 to 12000 RPM.



## 7. Design for Proof of concept

Proof of concepts needed to be made to test the above concepts. Since the intervention in the design would only add new components to the trimmer and change its form, a decision was taken to use a trimmer that is available in the market to serve as a base for the design.

Nova Professional NHT 1073 trimmer was used in this regard.

The trimmer was dismantled and its blades, battery, control module and motor were used to design the proof of concepts.

Motor used in this trimmer has a nominal voltage of 2.4V and draws a current of 4.20 A at stall. No load speed of the motor is 7900RPM.



Figure 24



Figure 23

### a. Mechanism to make the blade rotatable

The blade part or the 'head' has four tabs which go into the four slots in the body. These tabs and slots are identical to each other hence the head can be attached to the body in four different orientations. These also makes the head easy to clean.

Four tabs on the circumference of the plastic head. These tabs go into the slots on the main body. The head can be attached to the body in four different positions because of this arrangement

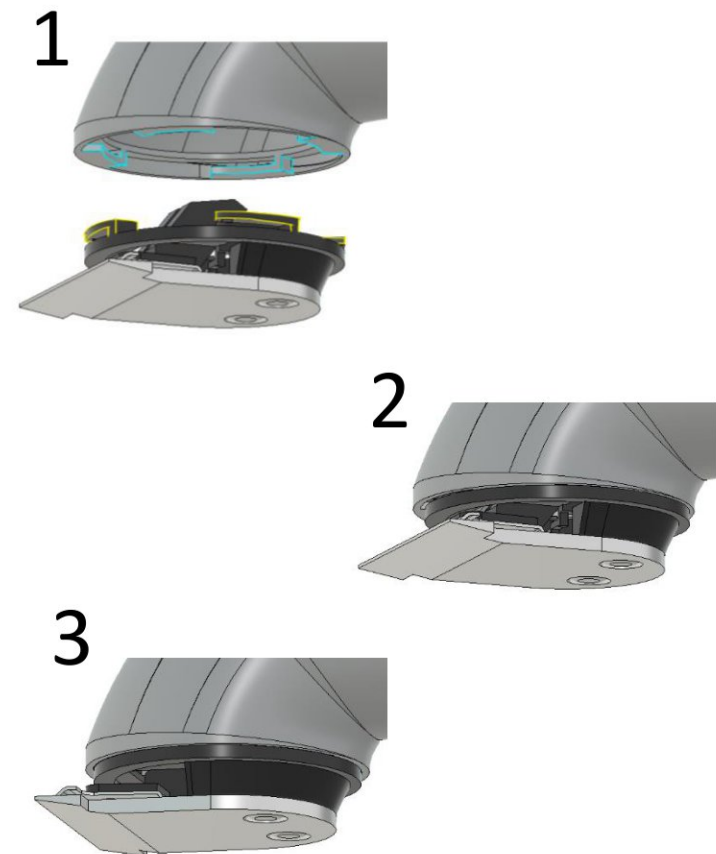
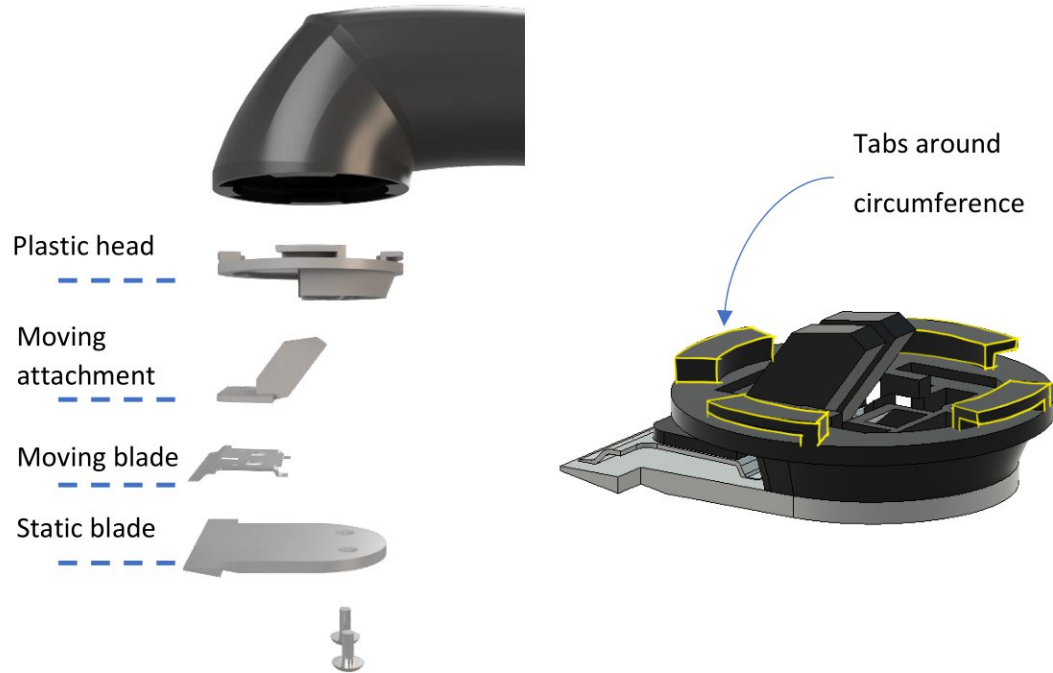


Figure 25

### b. POC design of bevel gears

Bevel gears were designed that will transmit the torque from motor to the cam at 90 Degrees. The gears were designed with a speed reduction ratio of 13:16. The head had to be specially designed to house the bevel gear and also allow for easy assembly. Material for can be either Steel or Copper. The gears are designed with involute teeth profile.



Figure 26

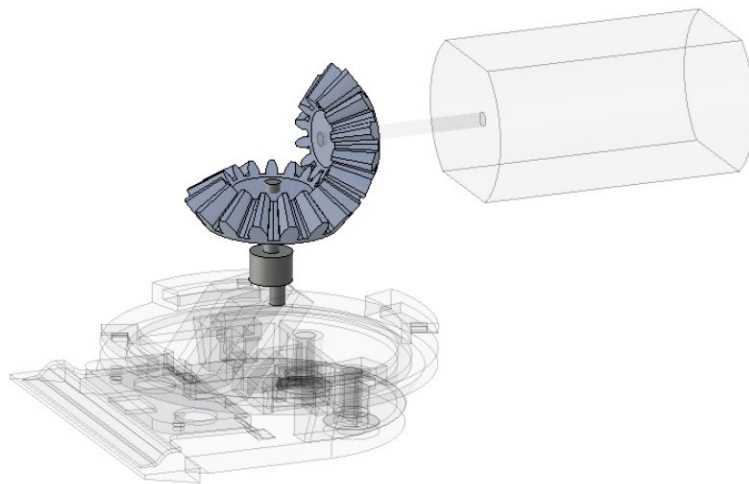
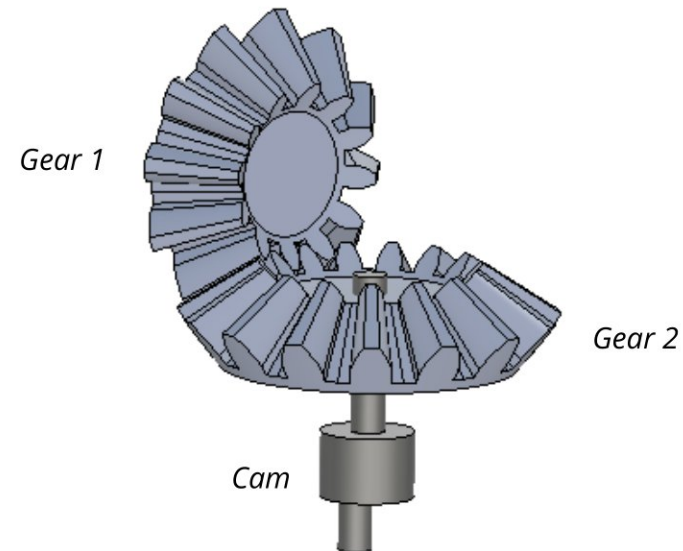


Figure 27





### c. POC design for vertical motor orientation

Flat motors were checked with the battery module of the Nova trimmer and a design was made that would house these motors and allow for rotation of the head at the same time. Flat motors, although having similar RPM specifications as the original motor, did not possess the same stall current profile as the original motor. Further assessment is needed to check the effectiveness of these motors in the design.

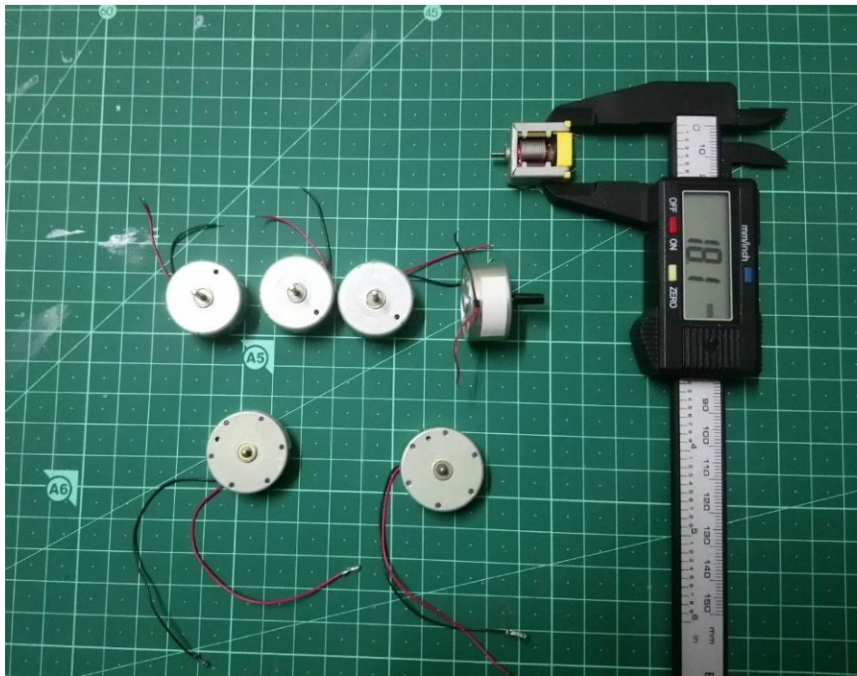


Figure 29

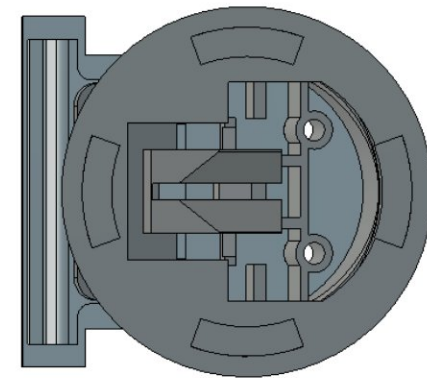
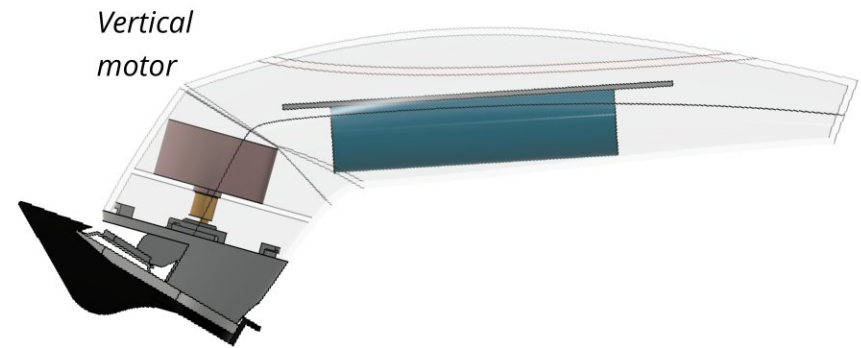
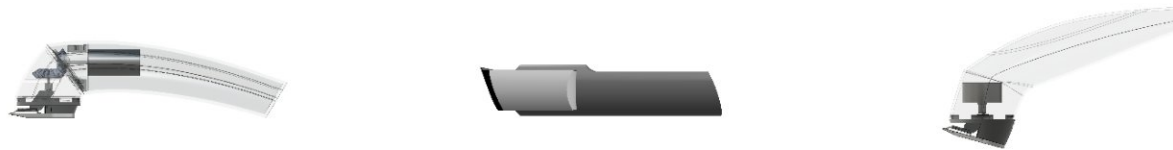


Figure 28

#### d. Comparing the Concepts

The three concepts were compared based on ease of construction of the design, stability of design, power loss in blade and noise and vibration produced during operation.

Concept 3 (with vertically mounted motor) was found to be the most suitable design direction for the rotatable blade.



	Bevel Gear	Rotatable compartment	Vertical motor
Construction	<b>Complicated</b>	<b>Moderate</b>	<b>Simple</b>
Stability	<b>Stable</b>	<b>Unstable</b>	<b>Stable</b>
Power loss	<b>High</b>	<b>Low</b>	<b>Low</b>
Noise and Vibrations	<b>High</b>	<b>Moderate</b>	<b>Low</b>

### e. POC

A frame was designed for the components of *Nova Professional NHT 1073* which will also have the mechanism for rotatable head. The parts were 3D printed using SLS technology with Nylon (PA2200) material

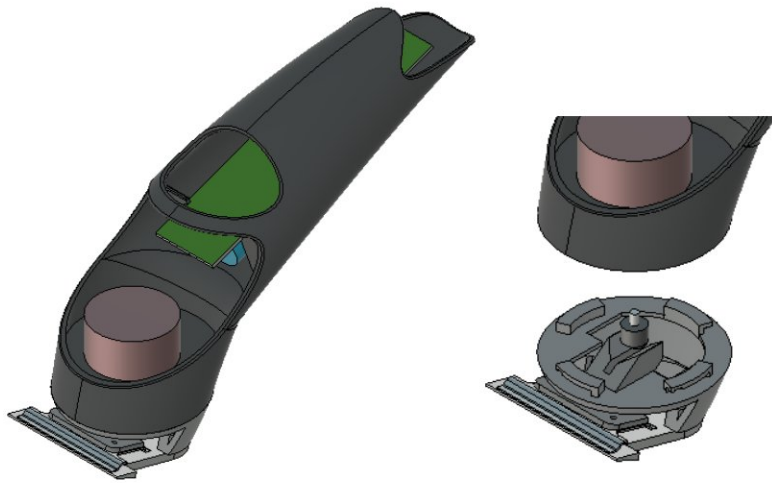


Figure 31



Figure 32

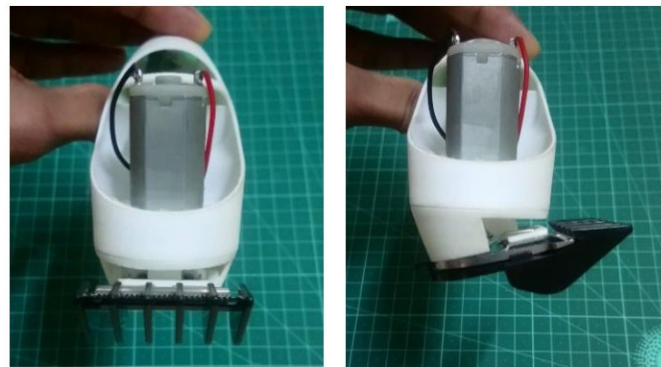


Figure 30

### f. Testing the POC

Initial testing was done to check the effectiveness of the new orientation of the trimmer. It was found that the new orientation did reduce the strain in the shoulders while cutting the hair from the back part of the hair. The visibility was also improved. It was also realised that the angle between the blade and the body can further be reduced for a more comfortable grip.



Figure 33

## 8. Final Design

### a. Design Attributes

Final Design will be targeted towards males from the age group of 17 to 35 years of age.

R-140 motor is used in the design which has an operating voltage of 2.4V at no load.

The final form would carry following expressions.

- Strong
- Masculine
- Precise
- Soft



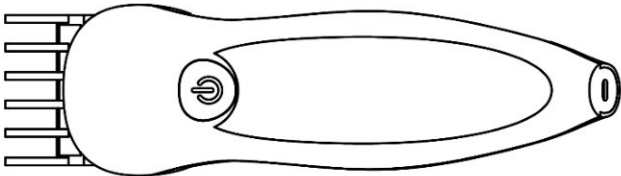
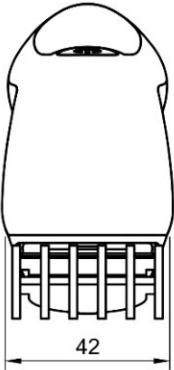
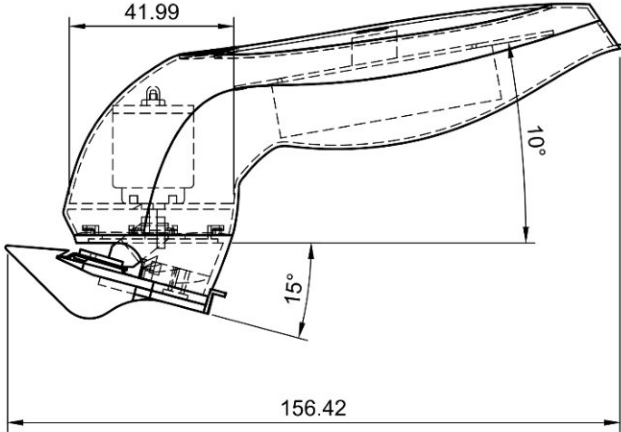
b. Renders



### c. Components



d. Overall Dimensions





e. Product Interface



## **9. Conclusion**

### **a. Conclusion**

The final form is yet to be designed for the current mechanism. The product will be targeted towards the age group of 17 to 35 years and the final form needs to appeal to this age group. The prototype needs a few more tweaks and need to be tested for the quality of haircut that can be achieved with it.

### **b. Future Scope**

Variable length comb attachment to achieve fade.

Compact mirror attachments for front mirror.

## 10. References

### **Clipper Motor Chart Comparisons:**

<https://www.marlobeauty.com/pro2pro/andis-clipper-motor-comparison-chart/a350/>

**Flowbee Hair cutting System:** <https://flowbee.com/>

### **Conair Even Cut System:**

<https://www.conair.com/c/24a35/even-cut-cordcordless-circular-haircut-kit/324>

### **Ultimate Pro Self-Haircut Kit with Lithium Max Power:**

<https://www.mangroomer.com/products/ultimate-pro-do-it-yourself-haircut-kit-with-lithium-max-power>

**DIY Hair clipper:** [https://www.philips.ae/c-p/QC5580\\_13/headgroom-do-it-yourself-hair-clipper](https://www.philips.ae/c-p/QC5580_13/headgroom-do-it-yourself-hair-clipper)

### **modern haircut, great video, Men's Hairstyle , #stilistelnar**

**,HAIRCUT:** <https://youtu.be/UySrm9AM28g>

**Mabuchi Motors:** <https://product.mabuchi-motor.com/detail.html?id=32>