

**EDSGN 100**  
**Design Project #1**  
**Final Report**  
**Electric Toothbrush Redesign Project**  
**Introduction to Engineering Design**  
**EDSGN 100 Sec 024**

Design Team #8

Marco Musto – [mpm5404@psu.edu](mailto:mpm5404@psu.edu)

Josh Parmet – [jop5381@psu.edu](mailto:jop5381@psu.edu)

Steven Rohan – [smr5735@psu.edu](mailto:smr5735@psu.edu)

Josh Zahniser – [jvz5218@psu.edu](mailto:jvz5218@psu.edu)



**Submitted to: Prof. Sven Bilen**

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## **Executive Summary:**

Our objective during this redesign was to create a toothbrush that improved upon our existing model. We accomplished this by analyzing customer needs, benchmarking our competition and doing in house concept development to create a much higher quality toothbrush. We went through several initial models during the concept generation phase but eventually narrowed it down to one while combining several key aspects of many of the designs. Our final product was an approximately 9-inch 86-gram rechargeable toothbrush. It has a rubber grip for and ergonomic shape for easy handling and use. Its biggest feature is a mouthwash dispenser that shoots a small dosage of highly concentrated mouthwash when activated.

## **1.0 Introduction**

The Colgate 360 optic white toothbrush is a decent electric toothbrush in and of itself but it had some major shortcomings and failed to meet the customer needs of our target market. Our main goal is to take this product through a process of market analysis, bench marking, concept selection, and add some of our own creativity to create an overall better electric toothbrush and transition it into a new target market. This new market would be mainly compromised of 18+ adults who are moderately to very affluent. Our customer needs assessment allowed us to determine what our target market was really looking for in a toothbrush. Durability, cleaning effectiveness, comfort/handling, and battery life came out on top as the most important traits in an electric toothbrush. We also searched the market for overall reviews of our existing product and found patents as so we would not infringe on any existing technological rights. Then through benchmarking we were able to determine how much of an improvement our toothbrush needed in each category to be considered a high quality toothbrush. This process was made very difficult though by incorrect benchmarking by other groups. Our final process was our concept generation and selection. We initially created 8 concepts and narrowed down our selection while also combining several components of different concepts. This created our final product that we believe will be a hit with our target audience and excel in the market.

### **1.1 Initial Problems Statement**

We will redesign the Colgate 360 Optic white toothbrush to create a more comfortable, long lasting, effective, and durable toothbrush that caters to an affluent brusher market.

## **2.0 Customer Needs Assessment**

As one of the first stages in our toothbrush design process we began by gathering customer needs. We did this through 12 separate interviews. Each participant was asked to name five things they wanted in an electric toothbrush. From these interviews we found four main needs that customers were looking for. We then took these needs and split them into subcategories and had a focus group weight their importance. The participants in our interviews were all 18-20 year old college students (both male and female) who owned an electric toothbrush. The four main needs that we gathered were Cleaning effectiveness, Battery life, Durability, and Comfort/Handling. Noise level, appearance, and price were also mentioned but not enough to be deemed a main customer need. The tables containing initial customer need statements and weighted subcategories can be found below.

**Table 1: Initial Customer needs Obtained from interviews**

<i>Customer need</i>	<i># of times mentioned</i>	<i>Percentage</i>
<b>Cleaning</b>		
Effectiveness	<b>13</b>	<b>21.66%</b>
Durability	<b>14</b>	<b>23.33%</b>
Battery Life	<b>10</b>	<b>16.66%</b>
Comfort/Handling	<b>10</b>	<b>16.66%</b>
Appearance	4	6.66%
Noise Level	3	5%
Price	2	3.33%
Other	5	8.33%

## 2.1 Weighting Customer needs

After obtaining our initial customer needs we went on to further specify these needs by breaking up the four most mentioned customer needs into more specific components. We then asked a focus group of 4 college students to weight these components in each category. Its important to weigh customer needs specific customer needs because it allows you to find out exactly what your target market finds important and what you should put into your product

**Table 2: Cleaning Effectiveness**

<b>Evaluated</b>	<b>Whitens teeth</b>	<b>Cleans tongue</b>	<b>Freshens breath</b>	<b>Prevents Cavities</b>	<b>Total Score</b>	<b>Weight</b>
<b>Whitens teeth</b>	1.00	5.00	1.30	0.50	7.80	<b>0.35</b>
<b>Cleans tongue</b>	0.20	1.00	0.50	0.33	2.03	<b>0.09</b>
<b>Freshens breath</b>	0.75	2.00	1.00	0.40	4.15	<b>0.18</b>
<b>Prevents Cavities</b>	2.00	3.00	2.50	1.00	8.50	<b>0.38</b>
					<b>22.48</b>	

**Table 3: Durability**

Evaluated	Water resistant	Impact resistant	Strength durability	Brush head durability	Total Score	Weight
Water resistant	1.00	3.00	2.00	1.50	7.50	<b>0.39</b>
Impact resistant	0.33	1.00	0.50	1.00	2.83	<b>0.15</b>
Strength durability	0.50	2.00	1.00	2.00	5.50	<b>0.29</b>
Brush head durability	0.75	1.00	0.50	1.00	3.25	<b>0.17</b>
					<b>19.08</b>	

**Table 4: Comfort/Handling**

Evaluated	Weight	Fit in hand	Not slippery when wet	Total Score	Total Score
Weight	1.00	2.00	0.33	3.33	<b>0.29</b>
Fit in hand	0.50	1.00	0.50	2.00	<b>0.18</b>
Not slippery when wet	3.00	2.00	1.00	6.00	<b>0.53</b>
				<b>11.33</b>	

**Table 5: Battery Life**

Evaluated	Replaceable Batteries	Chargeable Battery	Time between charge	Time between replacement	Total Score	Weight
Replaceable Batteries	1.0	0.3	0.5	0.5	2.3	<b>0.1</b>
Chargeable Battery	3.0	1.0	2.0	3.0	9.0	<b>0.4</b>
Time between charge	2.0	0.5	1.0	3.0	6.5	<b>0.3</b>
Time between replacement	2.0	0.3	0.3	1.0	3.7	<b>0.2</b>
					<b>21.5</b>	

**Table 6: Hierarchal Customer Needs List obtained from Focus Groups and Individual Interviews**

1. Durable
  - 1.1. Water resistant
  - 1.2. Strength durability
  - 1.3. Brush head durability
  - 1.4. Impact resistant
2. Cleaning Effectiveness
  - 2.1. Prevents cavities
  - 2.2. Whitens teeth
  - 2.3. Freshens breath
  - 2.4. Cleans tongue
3. Battery Life
  - 3.1. Chargeable battery
  - 3.2. Time between charge
  - 3.3. Replaceable battery
  - 3.4. Time between replacement
4. Comfort/Handling
  - 4.1. Not slippery when wet
  - 4.2. Weight
  - 4.3. Fit in hand

## **2.2 Revised Problem Statement**

Our customer needs analysis allowed us to specifically target what areas of the Colgate 360 we want to improve upon and how we should bring it into a more affluent product market. We have decided that we wish to create a toothbrush that is more durable overall, cleans teeth and freshens breath more effectively, has a rechargeable battery, and a generally light weight and ergonomic grip that remains adhesive while wet.

## **3.0 External Search**

After doing internal research with focus groups and interviews to evaluate customer needs we went out into a broader area of research to find information related to our product. External research is important because it allows a team to gauge what the public knows about their product market and what they prefer within that market. In our external search we found various patents relating to our product. We also found articles recommending certain products within our market and articles that provided information on brushing and electric toothbrushes.

### 3.1 Literature Review

“5 benefits of electric toothbrushes”

<http://health.howstuffworks.com/wellness/oral-care/products/5-benefits-of-electric-toothbrushes.htm>

“Tooth Brushes”

<http://www.consumerreports.org/cro/toothbrushes.htm>

8 Benefits of Brushing Your Teeth – That Have Nothing To Do With Your Teeth!

<http://www.wfamilydental.com/blog/8-benefits-of-brushing-your-teeth-that-have-nothing-to-do-with-your-teeth/>

“Choosing a Toothbrush: The Pros and Cons of Electric and Disposable”

<http://www.webmd.com/oral-health/guide/choosing-a-toothbrush-the-pros-and-cons-of-electric-and-disposable>

“Teeth”

<http://www.webmd.com/oral-health/picture-of-the-teeth>

### 3.2 Global Issues

“ How the rest of the world brushes their teeth”

<http://www.mnn.com/health/fitness-well-being/stories/how-the-rest-of-the-world-brushes-their-teeth>

“ Oral Hygiene Statistics “

<http://www.statisticbrain.com/oral-hygiene-statistics/>

There is currently an epidemic of tooth decay and lack of oral hygiene not just in our own country but also around the world. In America only 49% of adult males and 56.8% of females brush their teeth twice a day. This has led to an influx in cavities and loss of teeth. But these numbers are comparably good to the amount of people who regularly brush in many African, South American, and eastern Asian countries. For many of these countries the number of people who brush their teeth regularly is below 15%. This is not surprising though since many of these countries are very poor countries. Oral hygiene is an easy thing to pass over when your budget can include just enough for food, clothing, and various other essentials.

### 3.3 Patent Search

While doing external research we discovered five patents that were extremely similar to our own design. This included a rechargeable battery, ergonomic grip, mouth wash dispenser, replaceable head, and insulated quiet motor. The most surprising of these was the mouthwash dispenser; we thought this was an original idea that would have not been already controlled in the marketplace.

#### 3.31 Mouth Wash Dispenser

Patent number: US20110286783

Filing Date: Dec 22, 2010

Description: A special compartment that houses either liquid mouth wash or mouth wash strips that when it runs out can either be refilled or replaced by another head

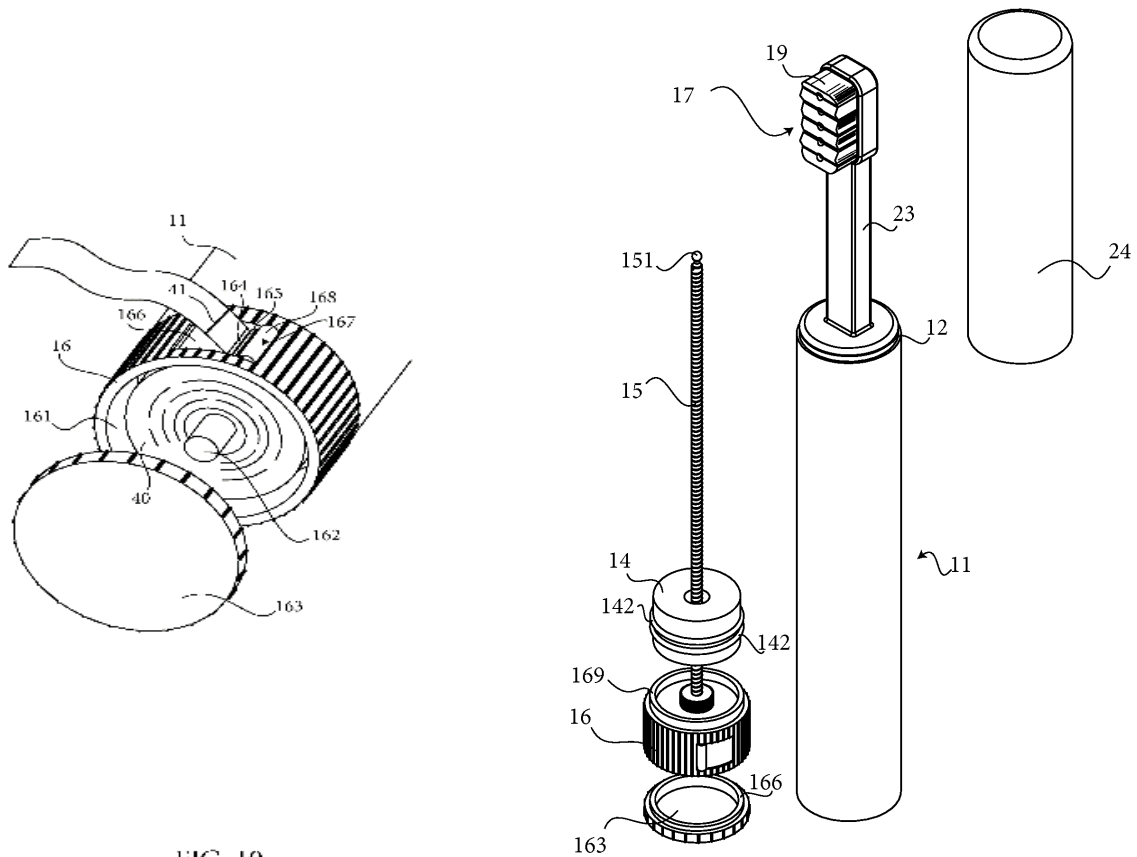


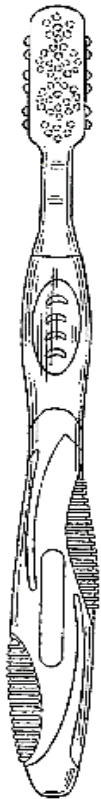
FIG. 10

### 3.32 Ergonomic grip

Patent number: USD67950

Filing Date: Oct 11, 1997

Description: Ergonomic grip that is shaped in such a way that provides maximum comfort and efficiency



**FIG. 2**



**FIG. 3**



### 3.33 Replaceable Head

Patent number: US20130247311

Filing Date: May 17, 2013

Description: Toothbrush head that when a button is pressed can be released from the body and disposed of. Then allowing for a new head to be attached

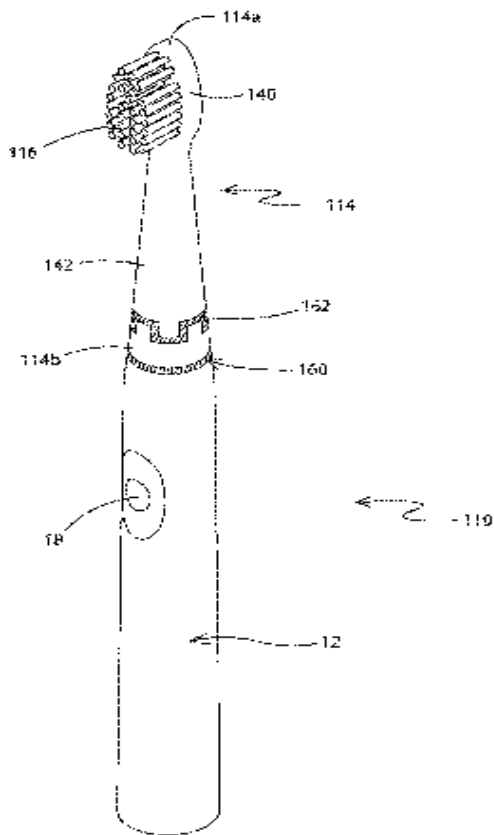


FIG. 5

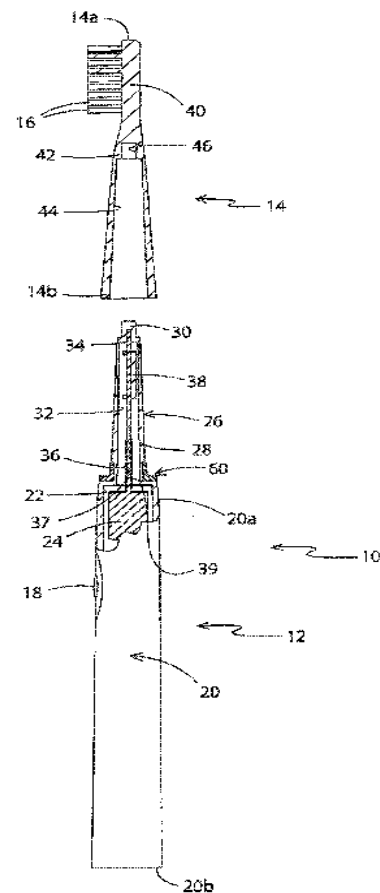


FIG. 3

### 3.34 Quiet motor sound

Patent number: DE202005003516

Filing Date: Mar 4, 2005

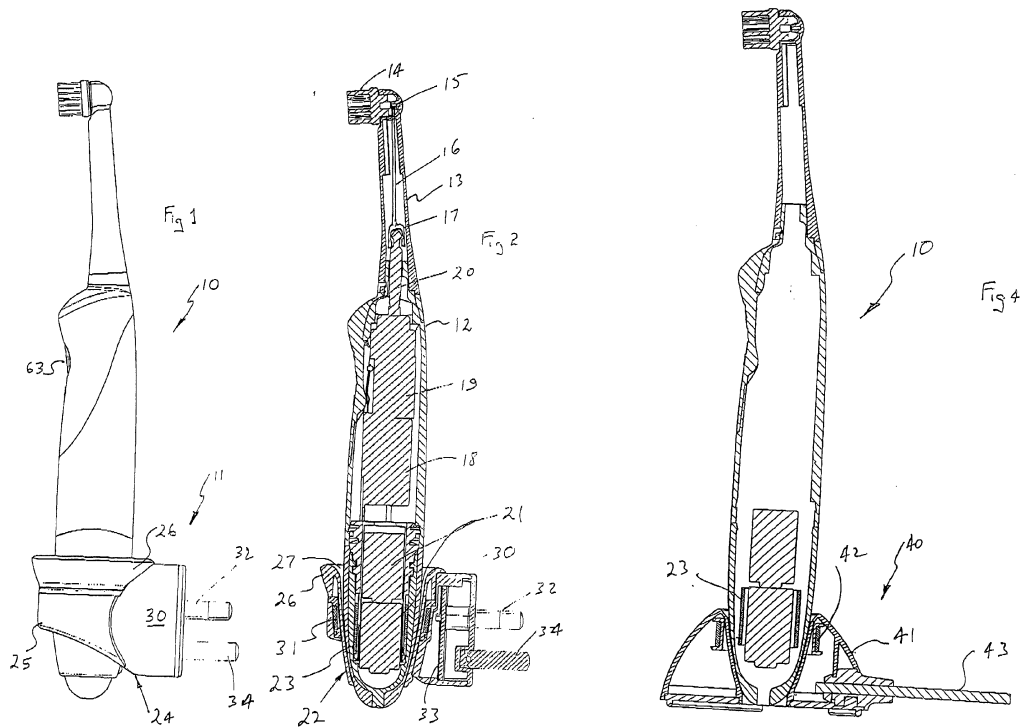
Description: Toothbrush will use insulation around the motor to minimize sound output. Thus allowing for a more comfortable and enjoyable brushing experience.

### 3.35 Rechargeable toothbrush battery

Patent number: CN202446285

Filing Date: Dec 26, 2011

Description: A high quality and waterproof rechargeable toothbrush battery.



### 3.4 Benchmarking

During our benchmarking phase we gathered all relevant available data and organized it into a table for comparison. There were several serious problems with groups not properly recording their data, which posed a difficulty for benchmarking.

	Weight (g)	Cost (\$)	Battery Power (W)	Battery Durability (h)	Noise Level (db)	Oscillations (Hz)	Brand
Team 1	140.7	11.39	2.352	2.55	70.425	79	Oral B
Team 2	33.6	6.79	5.406	6	69.4	57.8	Up and Up
Team 3	73.6	4.69	0.377	3.575	73.59	??	Colgate
Team 4	83.7	5.00 - 9.00	0.903	2.07	67.3	43.53	Arm and hammer
Team 5	N/A	9	0.24	14.4	60	Vibrating	Up and Up
Team 6	112.7	6.99 - 8.29	0.6608	4.44	71.4	54.1	Colgate
Team 7	95.3	5.99	0.872	14.93	70	24.97	Gum
Team 8	107	8.49	0.979	3.614	30.125	95	Colgate

### 3.5 Product Dissection

#### Colgate 360 Optic White Measurements

##### In package Measurements

Weight - 107 g

Height - 23.5 cm

Width - 5.4 cm

Depth - 3.2 cm

Package Colors - Red, white, Translucent plastic

##### Out of package measurements

Weight - 90.3 g

Height - 20.4 cm

Width - 3.2 cm

Depth - 2.9 cm

1 - neck + head

2 - body

3 - battery holder

4 - batteries

5 - motor

6 - motor holder

##### Neck/Head

Weight - 7.5 g

shaft length - 6.58 cm

head length - 2.76 cm

Number of bristles - 45

Bristle height - 0.82 cm

Bristle head rotates clock wise

Back of head has a textured tongue scraper

##### Body

Weight - 50.6 g

Height - 10.1 cm

Width - 3 cm

Depth - 3.5 cm



## Battery Holder

Weight (w/ batteries) - 32.3 g

Weight (w/o batteries) - 8.5 g

Height (w/ batteries) - 5.6 cm

Height (w/o batteries) - 4.8 cm

Width - 2.7 cm

Depth - 2.5 cm

## Motor

Weight - 36.1 g

Height - 3.2 cm

Width - 2.03 cm

Depth - 1.55 cm

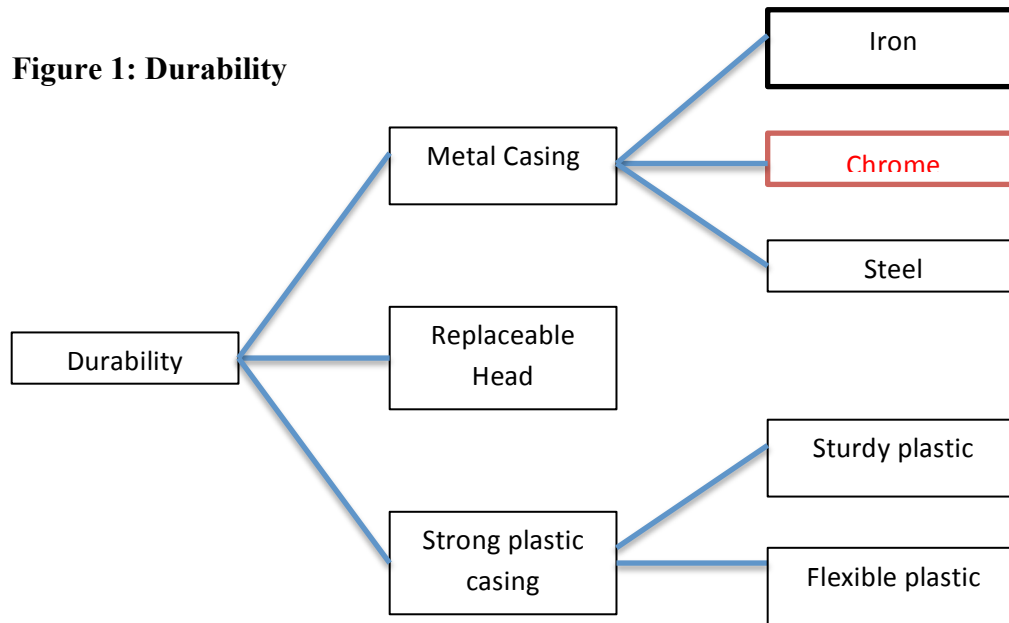
## More Features

- Ergonomic handle that fits hand well
- Bristle colors - Blue, white, Green
- Price - \$6.00 to \$8.49
- Replacable head
- Water proof head & neck

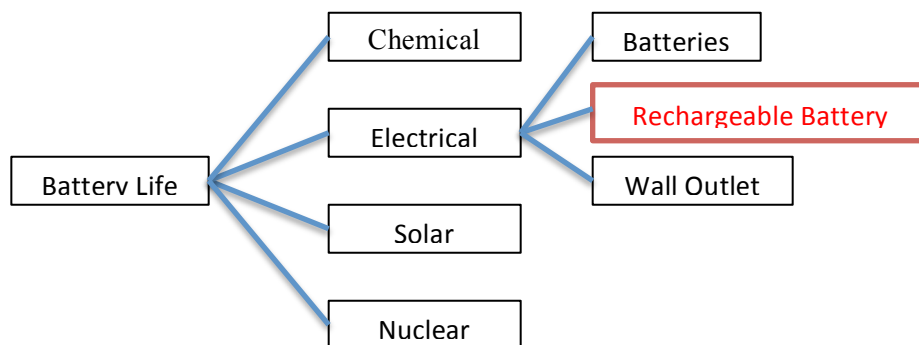
## 4.0 Concept Generation

During our concept generation we used several methods and went through several stages of design. We took our four main customer needs and made trees to determine different ways to go about satisfying those needs. We also made rough initial sketches with basic functions and descriptions of each design.

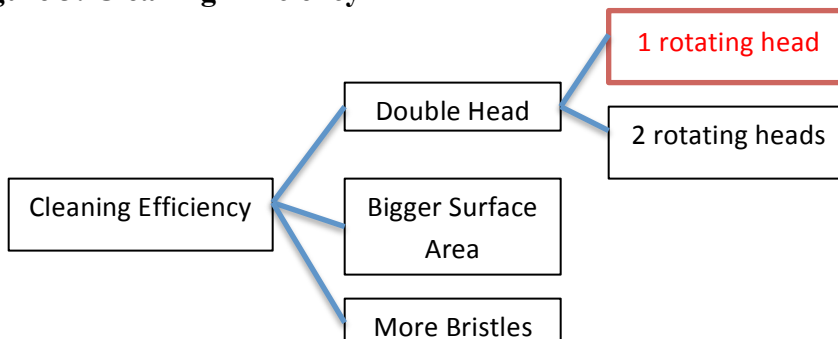
**Figure 1: Durability**



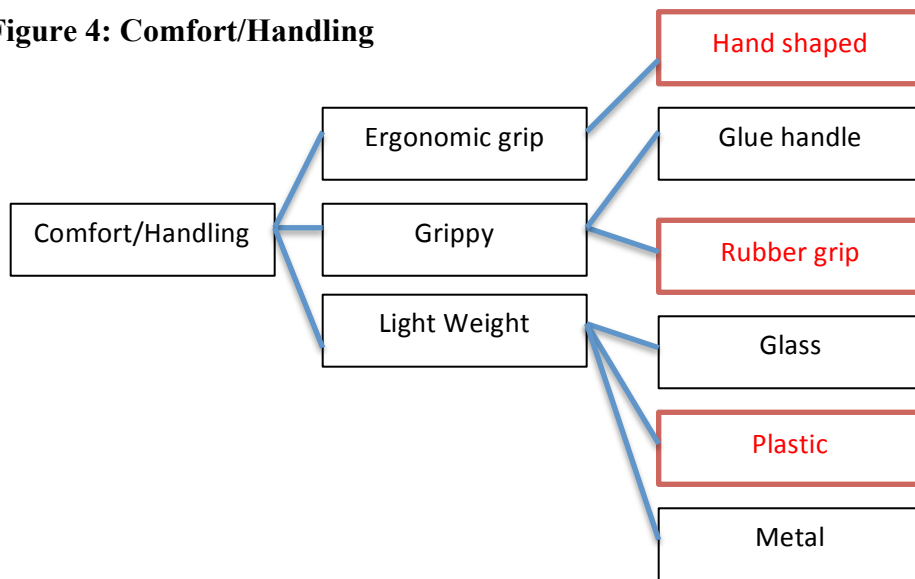
**Figure 2: Battery Life**



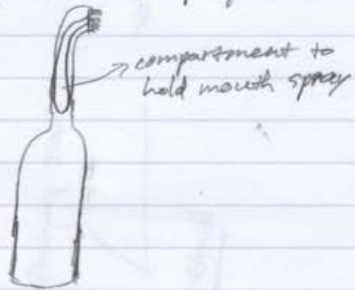
**Figure 3: Cleaning Efficiency**



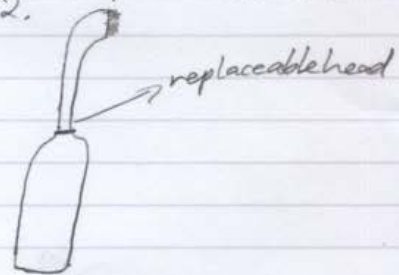
**Figure 4: Comfort/Handling**



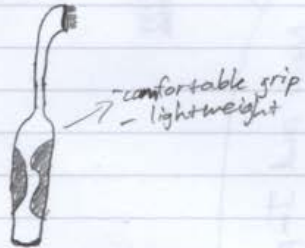
1. Mouth Spray



2. Replaceable head



3. Sleek look



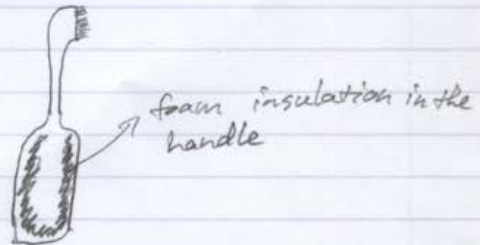
4. Rechargeable battery with stand



5. More powerful



6. Quieter





1. Mouth spray - In this design there is a compartment in the neck of the toothbrush which holds a strong mouth spray. This provides a strong burst to help clean teeth faster and more efficiently.
2. Replaceable Head - In this design the head of the toothbrush can be popped off and replaced. This allows for less wasted money by not having to buy a whole new toothbrush, but only replaceable heads for it.
3. Sleek look - We made the toothbrush have a sleeker and more appealing look. It also is lightweight which prevents arm from getting tired while brushing, and it has a comfortable grip to feel good in your hand and prevent from slipping out when wet.
4. Rechargeable battery with stand - This makes for long lasting life, and very convenient. Never have to worry about buying or replacing the batteries in the electric toothbrush. It is a nice easy place to store your toothbrush also.
5. More powerful - This provides for a faster and deeper clean. The larger battery increases the total power under load.
6. Quieter - the foam<sup>insulation</sup> in the handle softens the noise of the electric toothbrush when on. This allows you to brush your teeth in early morning or late night without having to worry about waking other family members.

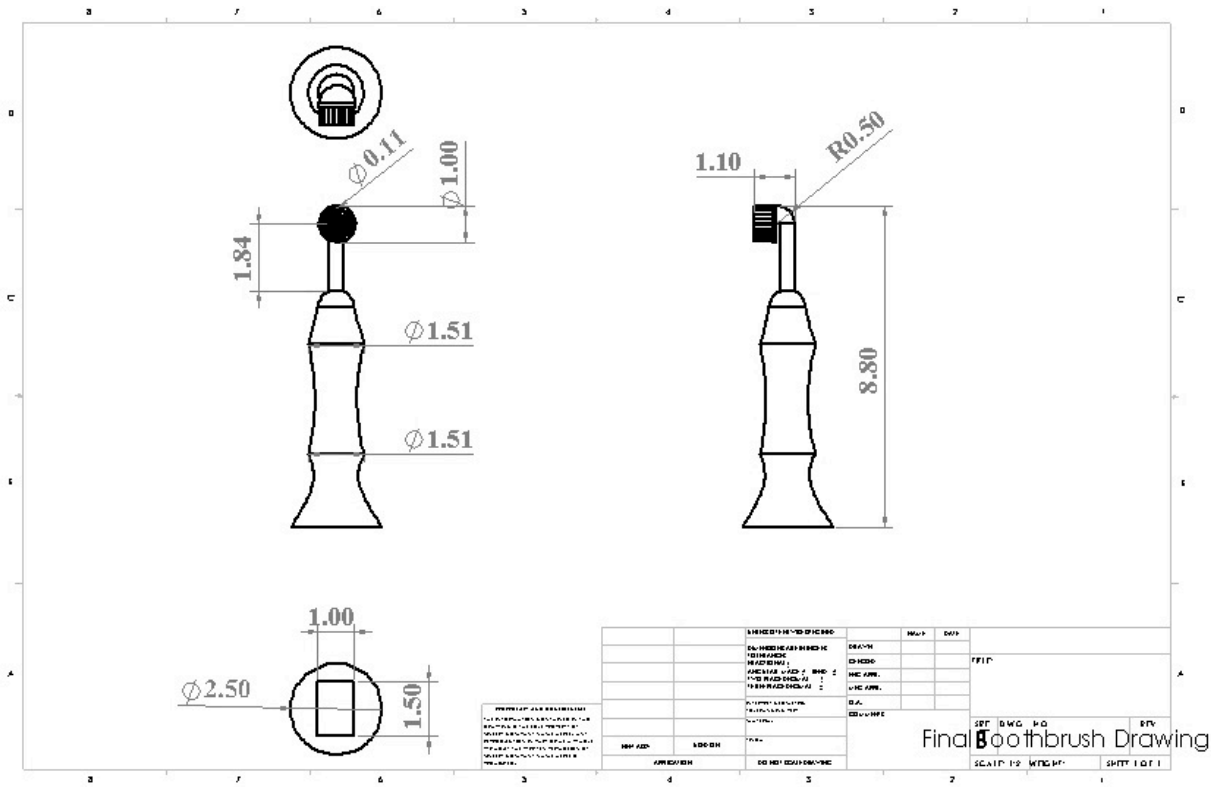
## **5.0 Concept Selection**

After going through concept generation and seeing putting all of our designs on the table we decided to make a combination of most of our ideas. Because we combined all of our ideas is the reason we didn't make a Pugh chart because we already knew no design would be clearly above the rest. Only when combined did the design stand out from the rest. After deliberation and design we came to our final product, which you can find below.

## 6.0 Final Design

Our final design is a sleek highly efficient toothbrush with an ergonomic design that helps fit to the contours of a users hand. It also has a stylized rubber mesh grip to prevent the toothbrush from slipping out of a users hand while wet. The toothbrush uses a rechargeable lithium-ion battery that is charged by connecting it to its holder while not in use. The toothbrush also contains replaceable heads to keep the brush sanitary and the bristle strength strong. All of these features drastically increase the life of the toothbrush. The final and most important piece of the design is a built in mouthwash dispenser inside the head. The mouthwash is highly concentrated and releases a small amount when the button right below the power button is pressed. There is enough mouthwash to last 50 brushes, which is the recommended amount till brush head replacement.





6.1 Design Drawings

Figure 1: Brush Head

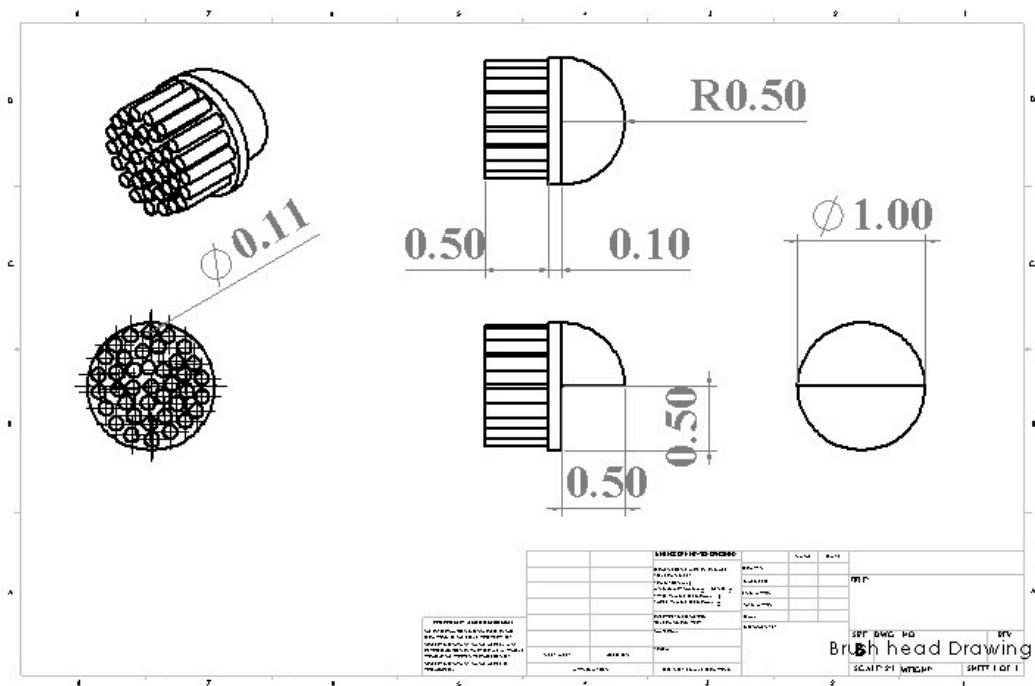
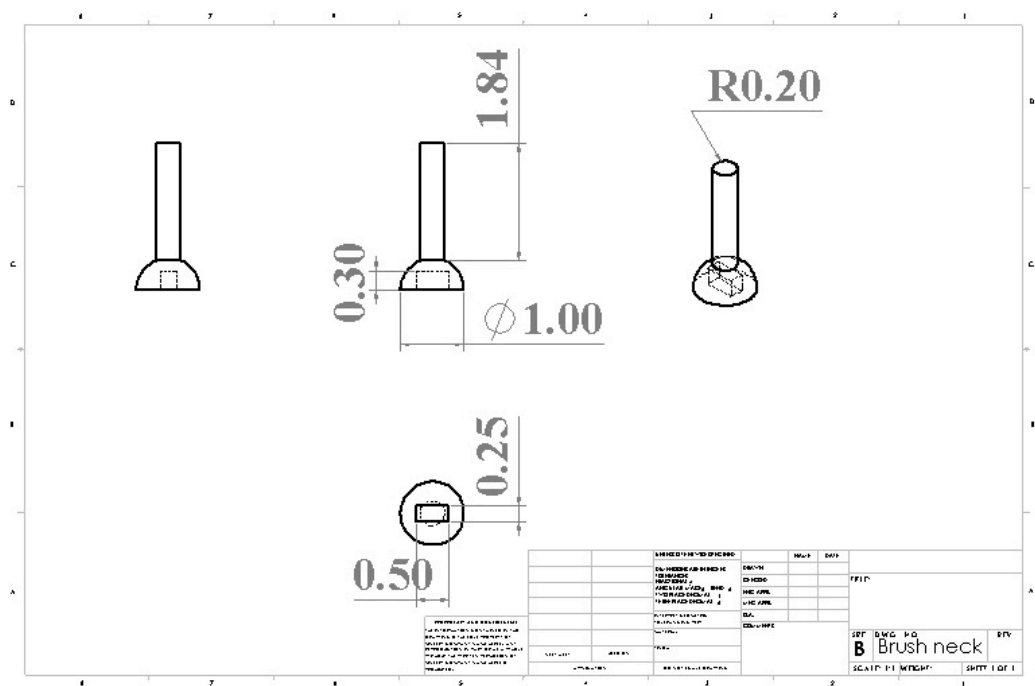


Figure 2: Brush neck



Technical drawing of a toothbrush body showing three views: front, top, and side. The front view shows a tapered body with a base diameter of 2.50, a middle section of 1.51, and a top section of 1.00. The top view shows a circular base with a central rectangular hole. The side view shows the profile of the body with a total height of 6.00. Dimensions are given in inches.

## 6.2 Bill of Materials

Part Number	Part Name	Qty	Function	Mass	Material	Dimensions (in)	Cost
1	Head	1	Hold bristles	4.00g	plastic	R0.5 x 1	\$0.15
2	Neck	1	Support head	5.00g	Plastic	R0.2 x 1.84	\$0.20
3	Bristles	1	Cleaning teeth	1.00g	Nylon	R0.055x 0.5	\$0.25
4	Motor	1	Rotates head for more effective cleaning	25.0g		1.26 x 0.79 x 0.61	\$1.00
5	Body	1	Contains motor and batteries, allows user to grab toothbrush	15.0g	Plastic	R1.25 x 6.00	\$0.25
6	Rubber grip	1	Makes the toothbrush easier to hold	1.00g	Rubber	N/A	\$0.25
7	Mouth wash dispenser	1	Squirts out mouthwash to enhance cleaning efficiency	3.00g	Plastic (with mouthwash inside)	R0.1 x .1	\$1.00
8	Rechargeable battery	1	Powers the motor	30.0g		1.06 x 2.2 x 0.98	\$3.00
9	Chrome finish	1	Aesthetic appeal	2.00g	Chrome	N/A	\$1.20
Total		9		86.0g			\$7.30

## **6.4 How does it work?**

To operate the brush, press down the power button. This activates the motor, which is connected, to the lithium-ion battery in the base of the body and the motor causes the head of the toothbrush to start rotating. After brushing, simply press down the power button to turn off the toothbrush. In the neck of the brush there is a dispenser of mouthwash that shoots out small amounts of high strength mouthwash. To access this feature, press the button on the neck of the brush. This acts like a trigger on a water gun and the pressure from pushing the button in allows the mouthwash to shoot out of the dispenser. To remove the head, grab the base of the head of the brush and rotate counter-clockwise until the head is off of the brush. To put the head back on the brush line the head up with the neck of the brush and rotate clockwise until you hear the brush lock into place. To charge the battery, place the base of the body of the brush on the power stand and leave it there until it's fully charged. This will take approximately thirty minutes after a full depletion of battery

## **7.0 Conclusion**

We believe that after going through an extensive design project we have successfully meet all the requirements and have developed a superb product. Our product is a little below average weight with comfortable and stable handling. It is an extremely durable product being made mainly out of plastic and metal with a rubber sealant to prevent water damage and a rubber grip to prevent dropping. The battery is high quality and rechargeable to create a very long lasting electric product. The most rail piece of the toothbrush; the head is replaceable allowing for less breakage, strong bristles, and better hygiene. And our truly most unique piece is the mouth wash dispenser. This unique piece is in no other popular toothbrush on the market and we our proud have it be implemented in our product.



