Project One: iBrush

EDSGN 100 Section 11
Team iDesign
Submitted to: John Correll
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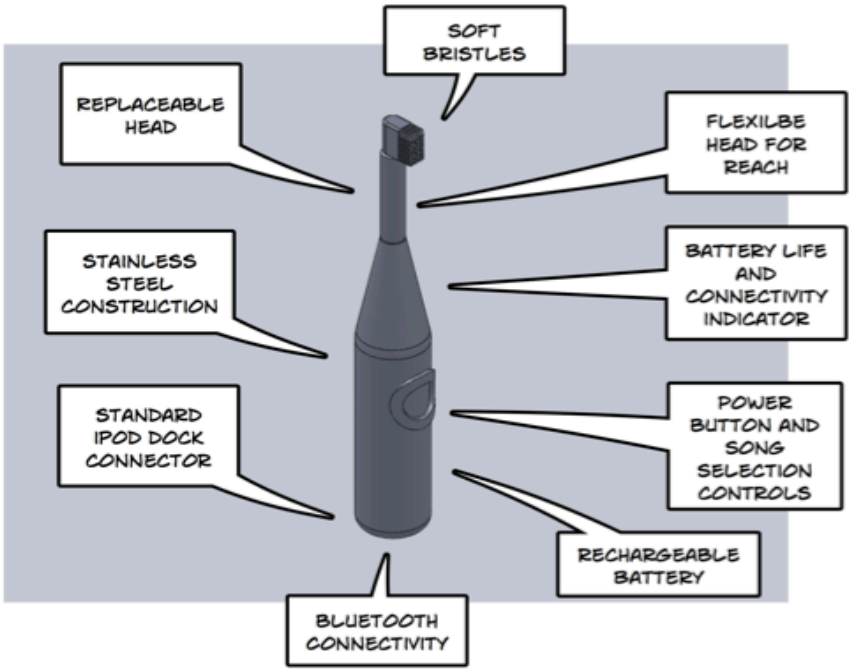
Sridhar Pisupati – skp5110@psu.edu
John Michaels – jcm5400@psu.edu
Carl Greenley – cdg5128@psu.edu
Chris Dorogy – cdd5123@psu.edu



I. Abstract

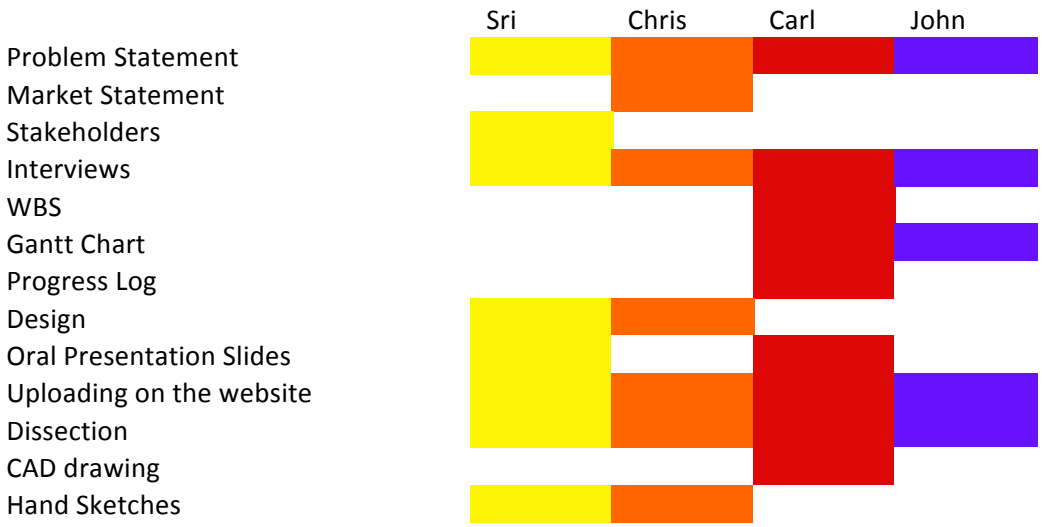
The objective for project one is to redesign an electric toothbrush. By analyzing customer needs and undergoing the process of concept selection, the toothbrush design created is an entertainment toothbrush that can be synced with an iPod. Using Bluetooth technology, this toothbrush will not only play music from the user's iPod, but will sync toothbrush vibrations with the beats of the music. Furthermore, the toothbrush will feature a reach head, soft bristles, a stainless steel design, syncing with a computer to upload music, and a rechargeable battery.

Introduction

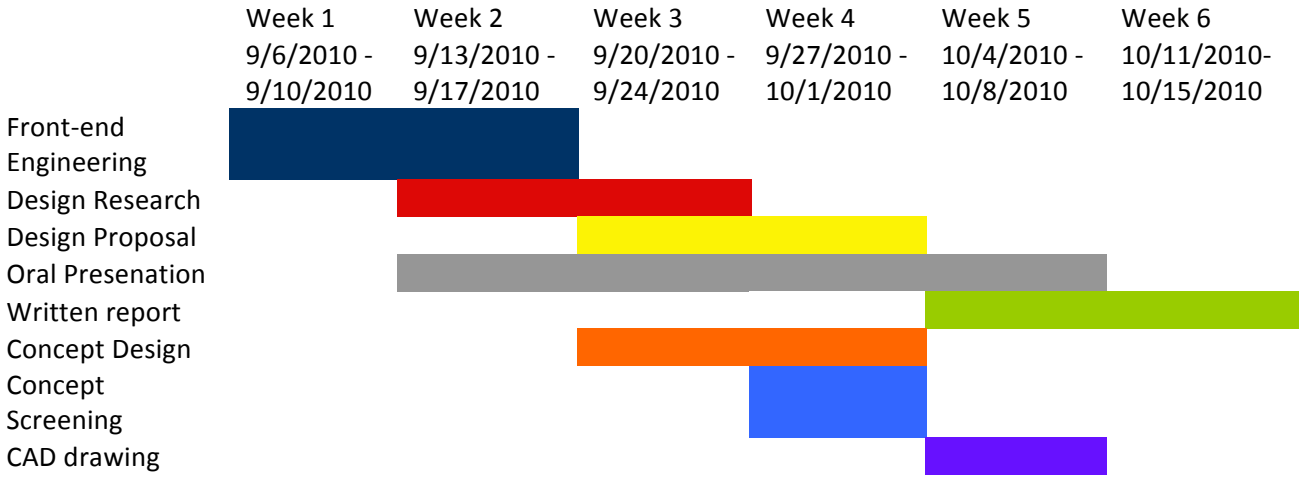
The purpose of this project is to design a product for the engineering department of a company that specialized in the development of an electric toothbrush. The team is assigned to the task of redesigning the electric toothbrush to effectively represent the needs of a consumer base that we determine to target. Through analyzing consumer needs, generating concepts using techniques such as benchmarking and product dissection, and selecting and designing a concept within the team, we will create a redesigned electric toothbrush to be presented to the company.

Problem Statement: Redesign the electric toothbrush to better reflect the needs of the customer and provide a design that goes above and beyond the customer expectation.

Work Breakdown Chart



Gantt Chart



III. Mission Statement

Our mission is to excel in the engineering design process through teamwork and communication to attain "A's" for each individual while maintaining a light and fun atmosphere during work periods. Through this process, we will create a redesigned electric toothbrush that satisfies the needs of our consumer base.

IV. Customer Needs Analysis

In order to determine a hierarchy of customer needs, each individual group interviewed 3 people and then the class data was collected. Figure 1 shows the class data that was collected and figure 2 shows the needs the group chose to focus our redesign on.

Figure 1: Class Data

Long Battery Life	17
Has Timer	12
Quiet	17
Easy to Clean	
Head of the toothbrush spins	23
Easy to hold in hand	43
Inexpensive	54
Lightweight	3
Compact	6
Lasts after repeated use/ Durability	22
Efficient when cleaning	8
Replacement brushes	6
Cleans under Braces	1
Attractive Casing	15
Flossing device	4
Tongue Cleaner	8
Efficient Head size	27
Efficient charging dock/ Rechargeable	41
Adjustable Speeds/Settings	10
Simple Controls	6
Soft Bristles	30
Ease of Use	19
Toothpaste dispenser	12
Folding Action for Travel	0
No need for Charging	0
Bristle Options	5

Long Bristles	0
Plays Music	1
Power Level Display	14
Pressure Sensor	3
Powerful	1
Length of head	1
Adjustable head angle	1
Polishing Capabilities	1
Use Indicator	2

Figure 2: Customer Needs to Focus on

Customer Needs
Comfort
Easy of use
Power Efficiency
Durability
Style/Entertainment
Inexpensive

V. External Research

External research is a key component to the development of a new, innovative product. It is not possible to create something without researching and exploring what has already been done. Due to this, it was necessary for benchmarking, research, and a product dissection to take place. Before diving into the creation of various concepts, the competition's products were explored. Through benchmarking, we were able to guide the development of our toothbrush by learning what was already on the market. Below displays some of the information of different tooth brushes on the market.

Dual Action Power Toothbrush by Equate
Price: $3.97

Description (from Walmart.com):
•Two unique moving brush heads
•Brush head is replaceable (Fits only Equate Power Toothbrush head)
•On/off button
•Two replaceable Duracell AA batteries
•Dual Action

Brushpoint Vital Health Oral Care System
Price: $7.50

Description (from Walmart.com):
•1 toothbrush
•2 replacement heads
•1 interdental arm
•20 flosser heads
•2 sulcus tips
•1 gum stimulator
•High-Rotation Cleaning Power to actively clean teeth
•Dual Zone Replaceable Head with Soft Dupont Tynex bristles
•Two replacement heads included in each system
•Light blue brush handle with soft rubber grips
•Interdental Power Arm that can interchange the floss, sulcus tips and gum stimulator
•Interdental cleaning tips are ideal for those with braces, bridges and crowns
•Requires 2 AA alkaline batteries (included)

Oral B Pulsonic Power Toothbrush
Price: $57.99
Description (from Walmart.com): •Lightweight slim handle
•2-minute timer
•Professional timer
•Sonic technology in our slimmest form. Rechargeable Oral B toothbrush Pulsonic offers customized brushing modes to meet your cleaning needs.
•Rechargeable Oral B toothbrush promotes naturally whiter teeth by gently polishing off

surface stains.

The following data was obtained through both research and the dissection of the toothbrush. The original brush was researched to find out further information like its cost and other available models. A question we proposed to ourselves was, “How does it work?” This led us to the dissection of the toothbrush. It was taken apart and we determined whether parts were necessary or not and what exactly their function was.

Table 1: Pictures of Product Disassembly

Table 2: General Information

Manufacturer/Model	Arm and Hammer/ Spinbrush Pro Clean
Cost	$8.99 - $10.13
Versions	Soft Bristles, Medium Bristles
Improvements in models	Rechargeable Battery
How is it sold?	Stores (Walmart, Target...) Online
Packaging	Attractive, simple, easy to open, informative
Aesthetics	Silver and white with purple button
On/off switch	Push up and down
Battery Location	Bottom, in the hand grip
Handle (Ergonomics)	Finger grips, all plastic
Quality	Mediocre, lines in design do not match
Weight with batteries	116.1 grams
Other features	Dual action head
Noise	25 dB
Target Population	Teens, Adults

Table 3: Removable Parts

Part Name	Function	Detachment Ease
Head	Bristles for cleaning	Easy
Battery Housing	Holds batteries, insulates circuit	Difficult, lots of rotational and linear force needed

Table 4: Noise Level Measurements

Location	Noise level
Brush head 4” away from decibel meter	24 dB
Brush head 3” away from decibel meter	26 dB
Brush head 2” away from decibel meter	27 dB
Brush head 1” away from decibel meter	28 dB
DC motor 4” away from decibel meter	16 dB
DC motor 3” away from decibel meter	18 dB
DC motor 2” away from decibel meter	20 dB
DC motor 1” away from decibel meter	23 dB

Table 5: Noise Level Summary

Approx duration per day	4 min
Average noise level	28 dB

Table 6: Battery Information

	Battery Type	Volts (V)
Battery 1	AA	1.5

Battery 2	AA	1.5
Battery 1 and 2	Series	3 Volts

Table 7: Current Measurements

Current Measurements	Average Current Value (10A)
No load	.28
First load test	.48
Second load test	.70
Third load test	.42
Fourth load test	.41
Mean current under load	.50

Table 8: Power Summary

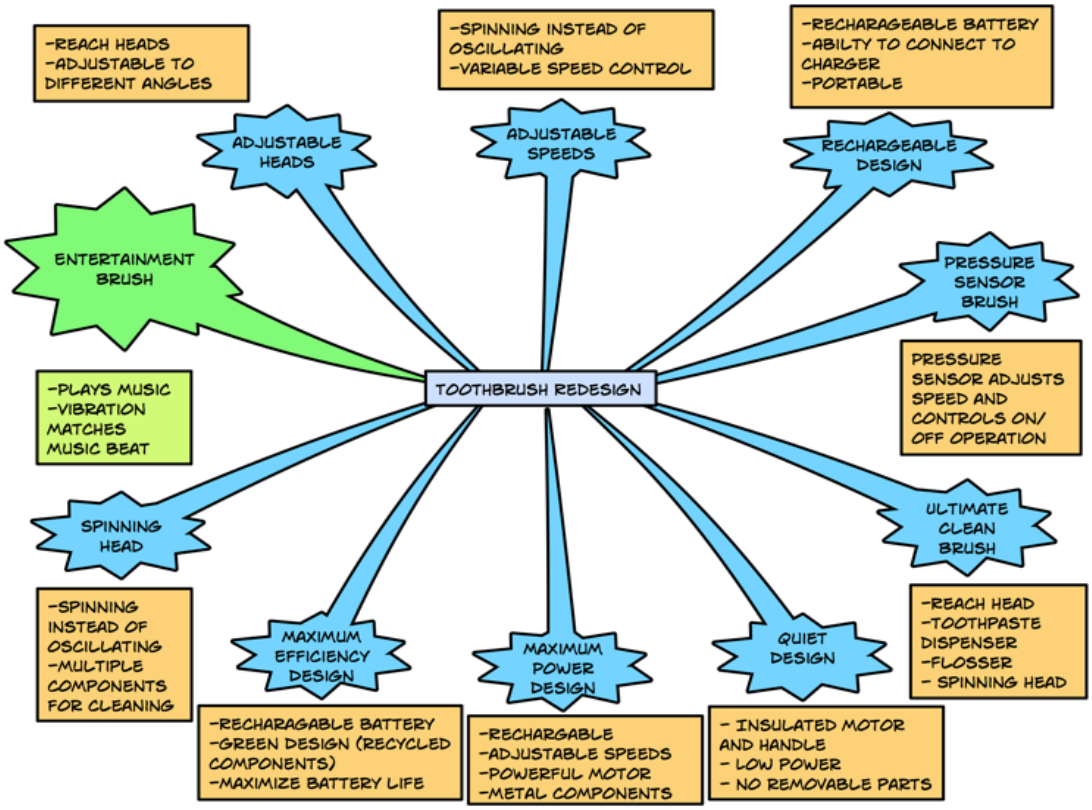
Power	Voltage	Current	Power	Units
No load	3.1	.28	8.7	Watts
With load	3.1	.50	15.5	Watts

Table 9: General Battery Information

Hours per charge 'under load'	Duration of brushing	Days before replacement	Make sense?
20 hours	1/15 hours per brushing	300 days	yes

VI. Concept Generation

Concept generation is what really got us thinking. Our initial brainstorming session took place is class. As a group, we participated in the 6-3-5 Method. It was slightly adapted to fit the constraints of being in four person groups. This method involved us sitting in a circle and each developing three ideas during a set period of time. The solutions were then handed to the person next to you who either expanded on the existing ideas or developed three new ones. This continued until everyone had everyone else's paper. Following this session of developing ideas, we combined and compiled everything into a list of 10 concepts. These are displayed below. Accompanying these ideas, were sketches. A sample sketch is also displayed of the entertainment model, which was the main foundation of our final concept.



Revised Problem Statement: Redesign the electric toothbrush to better reflect the customer needs of comfort, ease of use, power efficiency, durability, style, and low cost, and provide a design that goes above and beyond the customer expectation.

VII. Concept Selection

Concept selection is a very important component of the design process. This is where all of the ideas have been proposed and it is time to combine and evaluate all options to narrow it all down to a final concept. The design process, as learned in class, uses a very specific process. This begins with concept screening. This consists of comparing the new designs to the reference product. The net score allows for the ranking and the combination of concepts. The top few continue onto concept scoring. Before concept scoring can occur, weight calculations must be completed. This is done by determining which customer needs are more important. With this, the remaining concepts can be ranked in terms of customer needs on a scale from 1 to 5 and then multiplied by the corresponding weight to achieve a weighted total for each design as shown in the tables below. This led to the selection of the entertainment concept. It was

able to pass concept screening and subsequently scored the highest in concept scoring. All of the results from the concept selection process are displayed below.

Selection Criteria	Adjustable Heads	Adjustable Speeds	Rechargable	Pressure Sensor	Ultimate Clean
Ease of Use	0	-	0	-	0
Comfort	+	+	0	+	0
Power Efficiency	0	-	+	+	0
Durability	0	0	0	0	0
Style/ Entertainment	0	0	0	0	0
Cost	-	-	-	-	-
Net	0	-2	0	0	-1
Rank	5	9	3	2	8
Continue	No	No	No	Yes	No

Quiet	Max Power	Max Efficiency	Spinning Head	Entertainment	Ref.
0	0	0	0	-	0
0	-	0	+	+	0
+	-	+	0	+	0
0	0	0	0	+	0
0	0	0	0	+	0
-	-	-	-	-	0
0	-3	0	0	2	0
4	10	6	7	1	
No	No	No	No	Yes	

Weight Calculation								
	Ease of Use (max)	Comfort (max)	Power Efficiency (max)	Durability (max)	Style/Entertainment (max)	Cost (min)	Row Sum	Weights
Ease of Use	1	0	1	0	0	1	3	0.1429
Comfort	1	1	1	0	0	1	4	0.1905
Power Efficiency	0	0	1	0	0	1	2	0.0952
Durability	1	1	1	1	0	1	5	0.2381
Style/Entertainment	1	1	1	1	1	1	6	0.2857
Cost	0	0	0	0	0	1	1	0.0476
							21	1

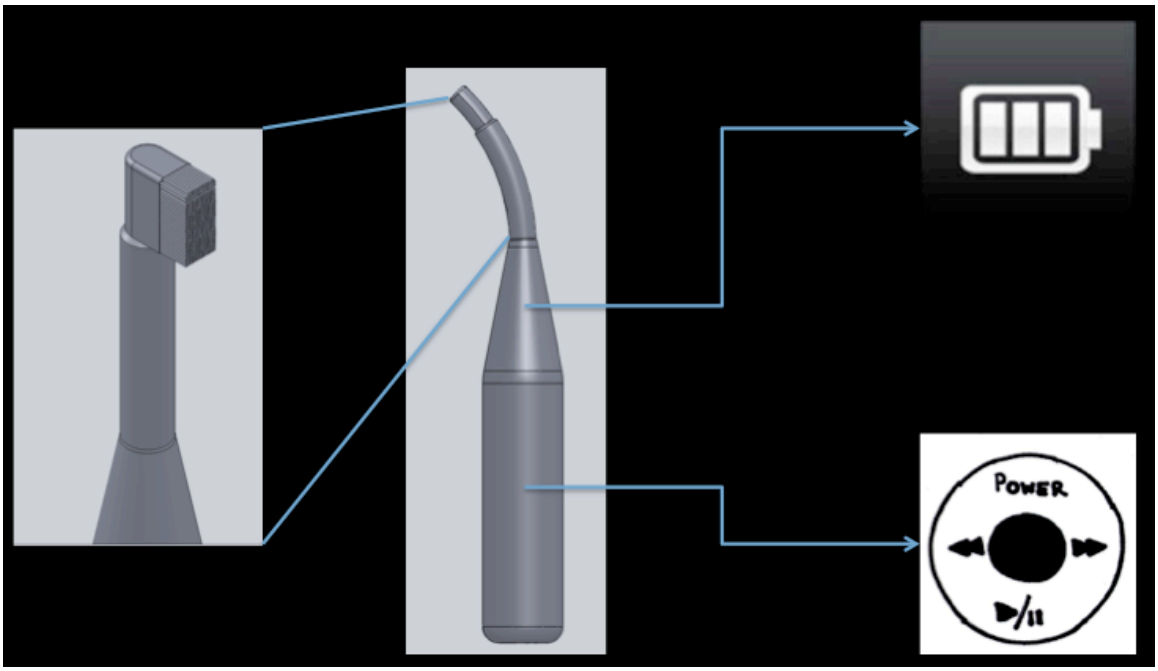
Concept Scoring					
		Rechargeable/Entertainment		Pressure Sensor/Quiet	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score
Ease of Use	14.29%	4	0.5714	4	0.5714
Comfort	19.05%	5	0.9524	3	0.5714
Power Efficiency	9.52%	5	0.4762	4	0.3810
Durability	23.81%	4	0.9524	3	0.7143
Style/Entertainment	28.57%	5	1.4286	3	0.8571
Cost	4.76%	1	0.0476	2	0.0952
	Total Score	4.4286		3.1905	
	Rank	1		2	
	Continue?	Develop		No	

VIII. Final Design Description

Our final product design is named the "iBrush." It is the prototyped design of our entertainment brush concept that had been selected through the screening process. The objective for the project was to redesign an electric toothbrush and we believe the iBrush not only fulfills this objective but is innovative and truly revolutionizes the toothbrush. The iBrush is the toothbrush of the future and will become the backbone of your bathroom. The rudimentary design aspects of the iBrush are not so different from any other electronic toothbrush. It has soft bristles for maximization of consumer comfort during use. Also a flexible brush head and shaft to facilitate easier cleaning in all those frustratingly hard places to reach, however it flexes only a handful of centimeters in either direction and there is resistive flex so it will not deform or hinder consumer brushing during regular usage. In addition the iBrush has rechargeable batteries, like so many other technologies now a day when asked consumers said that the greener renewability and longevity of these batteries are greatly preferred over their non-rechargeable counterparts. It reduces unnecessary waste and future costs associated with the brush (i.e rebuying the brush when it fails or having to constantly buy batteries). The brush features a removable head as well, this means easier cleaning of the device and greater longevity of the toothbrush overall. No one wants to continually have to re-purchase their toothbrush as the bristles wear down; with the iBrush renewed bristle integrity is just a single part replacement away. In addition to the simplicity and convenience of removable head design the iBrush plans to be unique to competitors in that replacement heads will be cheap: only projected to be two or three dollars per head. This is in great contrast to current replacement heads on the market that cost almost as much as the original toothbrush itself in some cases. The shell of the iBrush will be constructed out of a stainless steel then covered with a black ergonomic rubberized ambidextrous grip for maximum comfort. The grip will cover

the upper of the toothbrush leaving stainless steel bands on the head removal point and base of the toothbrush for a modern sleek aesthetic appeal. This combination of ergonomic design and sensual appeal is perfectly tailored to the target consumer base for high end luxury toothbrushes. In addition to the above the toothbrush will contain a small traditional LED display to show the battery life remaining, a simple solution to the age old problem of never knowing how much battery life remains in your toothbrush. Now the truly innovative side of the iBrush, and what it owes its name to, is that it has the ability to wirelessly network with local devices through internalized Bluetooth technology. This feature will allow the iBrush to wirelessly sync with your iPod to load a small playlist of music; ideally the iBrush will contain enough memory to hold approximately two CD's worth of content. The iBrush will have the ability to register heavy and light base OR treble keys in music (you can select which to tailor the iBrush to your likes) and will oscillate harder or softer to a small degree with the rise and fall of the music if you turn this feature on. The goal of this is to create a full body engaging music experience and make the iBrush an enjoyable brushing experience. Of course this feature will not always be on and the user can choose to simply brush at a regularized steady oscillation speed as would a normal brush. The goal of Team iDesign is to use the iBrush to create a whole infrastructure within the bathroom. We envision a bathroom of the future where wireless communication is the norm; a central dock will control all functions of the bathroom, heated floors, lighting, etc. The iBrush will be its backbone, communicating with the installed speakers to play your music and make brushing something everyone wants to do. The entertainment aspect has duel functions, not only will it make the iBrush the first fully integrated entertainment focalized toothbrush on the market, but it will also encourage better brushing habits. The key to most instances of tooth decay in Americans today is a lack of proper dental hygiene. Brushing at least for two minutes is the recommended brushing length, with the iBrush people will brush for longer and brush happier, prospectively sharply affecting the prevalence of tooth decay and related dental troubles in iBrush users. For old school iPod lovers the iBrush will also contain the traditional Apple iPod dock connector port that doubles as a connector for the charger. The dock is the perfect way to connect accessories and expand upon the iBrush itself.

The iBrush is simply the best high end toothbrush in production or development anywhere. It will create the ultimate marriage between ergonomic comfort and luxury entertainment for the bathroom of tomorrow. Our motto here in team iDesign: "The Future is Today."



IX. Conclusions

The purpose of this project was to design an electric toothbrush that not only fulfilled the needs the customers found most important, but also to make a toothbrush that was something that would grab the interest of potential customers. Our goal was to attract the more technologically apt age group by combining a toothbrush with a very popular item, the iPod. By crafting a toothbrush that would sync with the users iPod to make brushing more enjoyable for the user, we created a toothbrush that made brushing a more enjoyable process for the user while introducing a new feature to toothbrushes.

X. References

Braun, Carrie. *Introduction to Engineering Design*. Boston: McGraw-Hill Learning Solutions, Inc., 2008. Print.

1) Amazon.com- http://www.amazon.com/s/ref=nb_sb_noss?url=search-alias%3Daps&field-keywords=spinbrush+pro&x=0&y=0
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3) Consumer Search –http://www.consumersearch.com/electric-toothbrushes/arm-hammer-spinbrush-pro
4) Spinbrush.com- http://www.spinbrush.com/Products_SpinbrushProClean.html