Project 1 Report

Heather Svec
Katie Thompson
Joey Bonavita
Nate Lisbin

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Team 8

Abstract
For the redesigning process of a hair straightener, our objective was to redesign a straightener to make it safer, easier to handle, and more aesthetically pleasing. We took a poll which resulted in the consumers' desire for an automatic shutoff feature and a shaft that is easier to grasp. In addition to these requests, we also decided to include a retractable plug feature, a light that will light up when the straightener is ready to use, and environmentally friendly materials. The result of this would be an environmentally friendly straightener that pleases the customer aesthetically, is easy to use, and, most importantly, is safe. We started the process by dissecting the straightener, and identifying all of the pieces involved in making the product. We then conducted outside research on the history of the straightener, the customer's thoughts on the current products, and the patents involved in making this product. From there we brainstormed a list of ideas that our straightener could consist of including the body design, the head design, the power generation, and the energy mechanism. From this list we narrowed down the concepts into realistic ideas by completing a pugh chart. After this we had a straightener that consisted of and automatic shut off feature, a retractable plug, a digital temperature control, an easy access on/ off switch, rubber ends to eliminate burning, rubber grips for easy managing, ceramic plates, and a new PLA material instead of the outside plastic. All of these added features were ones that the customer felt were necessary, and that we felt would increase the safety for customers. The change of material for the outside made the straightener sustainable, and also cheaper to produce. Additionally, the sleek one inch design available in many colors made the straightener aesthetically pleasing to the future consumer. The final product was a success because we accomplished all of our coals. We redesigned the hair straightener to be safer, easier to handle, environmentally friendly, and aesthetically pleasing. The overall product is actually cheaper to manufacture now as well.

1.0 Introduction

Our design team has been tasked with building a better and more sustainable hair straightener. Simply put, the hair straightener is very awkward to hold, it is not all that safe and it cost too much money. To correct this problem our group intends on fixing all the flaws we see in the product. To combat the awkward grip we intend on attaching a grip which will fit in a person hands nicely so the product will be comfortable. To fix the safety issues we intend to position switches and other assemblies which we must attach in a manner which does not put the user at risk of burns or other injury. To effectively lower the price of the product, we will incorporate materials which are much cheaper to produce, but are of equal or better quality, to ensure that the producer is able to make the same amount of profit without the strain on the consumer's wallet. To manage our teams progress we have been using an excel document which has set up a network diagram to track the overall progress. This allows us to make sure that we are on time wise to ensure we are able to accomplish the task that we have been asked to accomplish. We also are using Solid Works to manage drawings as well as three- dimensional models of our product. Following this section, a reader will find the problem statement in which we will explain in detail the full task that we have been asked to accomplish. In the customer's needs section we will discuss the findings of customer survey which have shaped the way we will design our product as well as the most important factors our consumers have said is what they are looking for in our product. In the revised problem statement section we have reworked the initial problem statement in according to our customer's needs survey as well as our own designs which were established before the customers were polled. In the External Search section we will explore and output the data we received in our own research of the product we intend on making much better through our entire design process.

1.1 Initial Problem Statement

We were given the problem of how to make a hair straightener that more environmentally friendly and efficient, as well as safe, and aesthetically pleasing. Most hair straighteners are made of plastic which can last up to 500 years before decomposing (Harris 2012). Using more biodegradable plastic materials would make the hair straighteners much more environmentally friendly and appealing to consumers (Harris 2012). The product will also be safer than the average hair straightener. Many straighteners can cause burn injuries. To help prevent burn injuries we proposed to a straightener that will shut itself off when not being used. The efficiency will also be improved by conserving energy when not in use .Overall the straightener will be more effective in many aspects while still being a price consumers are willing to pay, as well as having a large aesthetical appeal to consumers.

2.0 Customer Needs Assessment

One of the most important elements in the redesign process is considering customer needs. In order to determine what the customers' wanted from a hair straightener, we put together a survey that asked what consumers liked about their straighteners, what they didn't like, and what they would like to see improved. We asked customers questions like, "what would you change about your straightener," and "how much would you be willing to pay for a straightener." These questions among other important questions helped us determine that our straightener should include safety features such as an automatic shutoff light, and rubber plate above the ceramic plates. We also determined the need to make a sleek thin design in order to appeal to consumers, and we wanted to make the straightener user friendly, so we added a retractable plug, as well as a digital temperature dial.

2.1 Weighting of Customer Needs

In order to ensure a successful redesign of a product, it is crucial to map out a weighted hierarchal plan of needs. This can be done, by considering the most important aspects of the product that will enhance the customer's experience. This can be done by crafting surveying consumers on importance of characteristics of the product, determining what should be changed, and crafting an AHP chart to determine which of the customer's needs are the most important to consider (Ogot and Kremer, 2004, pg. 59).

First, the group made an initial customer needs list. Then the group created a survey to gain information on people what people like about their straightener, what they do not like, and what they would change about their straightener. After the survey results were recorded, the group made a constructed a second table of customer's needs, along with an AHP chart to show which features carried the most importance. Finally, the group constructed a table to show the weighted consumer needs obtained from the AHP chart.

The following tables are lists of customer needs obtained from our survey and outside research. The lists consist of all of the features that we find necessary to be in our straightener. The first table is just a general list. The second table is a hierarchal list obtained from our customers' thoughts.

Table 1. Initial Customer Needs List Obtained from Team Focus Group and Individual Interviews/Surveys

Safe
Heat Resistant top/grip
Ceramic plates
Automatic shutoff feature
"Ready to use" light
User friendly
Light
Thick top
Smaller base
Retractable plug
Durable
Wide enough clamp
Temperature dial
Grip
Aesthetically pleasing
Different colors/designs
Sleek design
Conserves energy
Saves Plastic

Table 2. Hierarchal Customer Needs List Obtained from Focus Group and Individual Interviews

1. Safety
1.1 Heat Resistant top/grip
1.2 Ceramic plates
F.1 Ready to use light
F.2 Automatic Shutoff
2. User friendly
2.1 Light weight
2.2 Grip
F.1 Retractable plug
F.2 Temperature dial
C.1 Smaller base
2.3 Wide Hinge
2.4 Large plates
3. Aesthetically pleasing
3.1 Different designs/colors
3.2 Sleek design
F.4 Cut side walls and tread
4. Environmentally Friendly
4.1 Safe Plastic
4.2 Conserves energy
C. 3 Retails under $100

The following AHP charts were used to distinguish the weighting of the different categories we came up with. By constructing the tables we were able to rate the categories in relationships to the others, and come up with an overall weight for each category. From our chart we have distinguished that Safety is our main objective. On our second table we have determined that the grip is the most important category of our user-friendly sub-objective.

Figure 1. AHP Pairwise Comparison Chart to Determine Weighting for Main Objective Categories

	Safety	User Friendly	Aesthetically Pleasing	Environmentally Friendly	Total	Weight
Safety	1.00	4.00	5.00	4.00	14.00	0.50
User Friendly	0.25	1.00	2.00	0.33	3.58	0.13
Aesthetically Pleasing	0.20	0.50	1.00	0.25	1.95	0.07
Environmentally Friendly	0.25	3.00	4.00	1.00	8.25	0.30

Figure 2. AHP Pairwise Comparision Chart to Determine Weighting of User Friendly Sub-Objectives

	Light Weight	Grip	Wide Hinge	Large Plates	Total	Weight
Light Weight	1.00	0.50	0.33	0.33	2.17	0.10
Grip	2.00	1.00	4.00	2.00	9.00	0.40
Wide Hinge	3.00	0.25	1.00	2.00	6.25	0.28
Large Plates	3.00	0.50	0.50	1.00	5.00	0.22

The following table is our hierachal customer needs list. We obtained this information from our interviews, as well as the AHP charts. The sub categories are all things that we want in our product. The sub-categories starting with F are all functions that we want our straightener to contain. We used our AHP charts to add weights to each category.

Table 3. Weighted Hierarchal Customer Needs List Obtained from Focus Group and Individual Interviews

1. Safety (0.50, 0.50) 1.1Heat resistant top/grip 1.2 Ceramic plates *F.1 Ready to use light* *F.2 Automatic Shutoff* 2. User friendly (0.13, 0.13) 2.1 Light weight 2.2 Grip *F.1 Retractable plug* *F.2 Temperature dial* **C.1 Smaller base** 2.3 Wide Hinge 2.4 Large plates 3. Aesthetically pleasing (0.07, 0.07) 3.1 Different designs/colors 3.2 Sleek design *F.4 Cut side walls and tread* 4. Environmentally Friendly (0.30, 0.30) 4.1 Safe Plastic 4.2 Conserves energy **C. 3 Retails under $100**

3.0 Revised Problem Statement

Our initial problem statement was to design a hair straightener that would be more environmentally friendly, cost effective, aesthetically pleasing, and above all safe for the consumer to use. We went into greater depth investigating want consumers want from a hair straightener. We learned that 54 % of customers received at least one burn injury from their straightener a week. In order to fix this problem, we plan to implement an insulting system near the ceramic plates to prevent consumers from getting burned. Next, our survey posed the question, "On a scale of 1-5 (five being least aesthetically pleasing) please rate the design of your straightener. It was found that 70 % of users were not completely satisfied with design of their straightener and rated their straightener's design below a "5." Also, survey asked safety question, "Does your straightener have an automatic shutoff feature?" It was found 66 % did not have an automatic shutoff feature, and people taking the survey said they straighten their hair at 300 degrees Fahrenheit or higher. To help the straightener be the safest it can possibly be, we plan to install a automatic shutoff feature on our straightener. Lastly, we plan to use a more environmentally-friendly and cost efficient plastic to ensure corporate responsibility, as well as reduce cost, in order to give our product a competitive advantage on the market.

4.0 External Search

In order to provide the consumer with an optimal product, we have researched things about the straightener such as brief history, costs of straighteners, parts that make up the straightener, as well as measured voltage the straightener produced.

4.1 Lab 1 & Lab 2 Reports

In order to get a more detailed look at our straightener, we needed to dissect it and see what parts internally we could possible make better. In the first lab, we filled out the parts sheet, and described that the Chi straightener was packaged in a cardboard box, which was very easy to open. Next, the group analysed the cost as well as other important factors of the hair straightener. The cost of the product is $145 and has been on the market since the early 1900's. The target population of this product is females ages 10 and up. The features we found that could be improved were safety, user and environmentally friendliness, as well as customer appeal. The last step in our lab was determine different patents on hair straighteners and determine which features we could use, and which we would have to make adjustments. Next we created the bill of materials once we dissected the straightener. We were able to determine the function of each part, the mass, material, manufacturing process, as well as cost, this is shown in more details in the pictures of each individual part.

DATA SHEET 1

Getting Ready for Dissection: Part I

Manufacturer/Model Number: GF153955W

General Product Information:
How many detachable pieces the product has? 0

Part number:	Part name:
1	Chi Turbo
_____	_____
_____	_____
_____	_____
_____	_____

Describe the pieces including their functions and their materials.

Part number:	Material & Functional Description:
1	Plastic, velvet & ceramic plates and rubber cord
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Is it easy to detach each part?

Part number:	Detachment (Easy, difficult, use of force etc.):
	Parts Do Not Detach

Describe the packaging. Is it easily opened? Describe the opening procedure.
The packaging was easy to open. First slide towards the opening side. Then open the box and remove the product.

DATA SHEET 1	
Getting Ready for Dissection: Part II	
Cost (Be prepared to record multiple values and sources)	Chi website- $145 Farouk website- $120 or $150
How long has the product been in the market?	The early 1900's
Target population	Female ages 10 and up
Versions of the product (Previous versions of the product)	Heated combs and hot irons
What are improvements between versions of the product?	Safety, easier to use, quality increased, more efficient
How is it sold (TV infomercial, drugstores, etc.)	Everywhere
Patented Features (Please include patent dates).	

Filing date	**Issue date**	**Title**
Dec 3, 1986	Apr 19, 1988	Electrically heating hair styling tongs selectively usable to crimp or straighten hair (Taylor 2012).
Jul 9, 1990	Jun 11, 1991	Horse mane grooming device (Taylor 2012).
Oct 9, 1990	Feb 25, 1992	Hair curling iron for creating an inwardly bending curl and heating apparatus (Taylor 2012).
Jan 27, 1992	Jun 29, 1993	Hair styling iron for straightening and curling (Taylor 2012).
Jun 18, 1992	Mar 15, 1994	Hair clip for heating and shaping root-area hair perpendicular to the scalp and an electric heating unit for heating the clips (Taylor 2012).
May 6, 1996	May 4, 1999	Hair processing method and apparatus (Taylor 2012).
Mar 8, 2001	May 14,	Hair iron (Taylor 2012).

		2002	
	Oct 12, 1988	Jan 22, 1991	Hair curling brush or similar article (Taylor 2012).
	Oct 12, 1988	Feb 5, 1991	Hair curler or similar article (Taylor 2012).

DATA SHEET 2

1. temperature

Location:

	temperature
Straightener head 4 in away from thermometer	23 degrees Celsius
Straightener 3 in away from the thermometer	23 degrees Celsius
Straightener 2 in away from thermometer	23 degrees Celsius
Straightener 1 in away from the thermometer	46 degrees Celsius

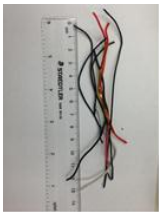
2. Power Measurement:

Voltage supplied to the circuit:
122.6 v

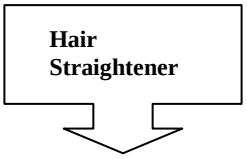
	Bill of Materials										
Product Manufacturer/Model Number:											
Date:											
Disassembly method: *Subtract and Operate Procedure (SOP): Yes, No.* *Force (Energy) Flow Diagram: Yes, No.*											
Team leader name(s)	**Part#**	**Part Name**	**QTY**	**SOP** Effect	**Function**	**Mass** (1b, g)	**Material**	**Manuf. Process**	**Dimensions**	**Cost**	**Time to Complete Part Dissection**
	1	spring	1	No	To clamp straightener	**.018**	**metal**	**Bent**	**5.4x1.3**	**3.00**	**1.0**
	2	Big bolt	1	No	Hold spring in place	**.020**	**metal**	**Molded**	**1.9x1.0**	**1.5**	**1.5**
	3	Screw	1	No	Inserted in bolt	**.012**	**metal**	**Molded**	**2.5x.4x.2**	**.25**	**1.6**
	4	Plastic cover	2	No	Cover spring	**.002**	**plastic**	**Molded**	**2.7**	**3.00**	**2.0**
	5	Little Screw	8	No	Hold plastic pieces together	**.002**	**metal**	**molded**	**.8x.4**	**.25**	**2.2**
	6	Ceramic Plate	2	No	Heats up to straighten hair	**.068**	**ceramic**	**heated**	**5x8.5**	**10.00**	**2.3**
	7	Motherboard screw	1	No	Holds motherboard in place	**.082**	**metal**	**Molded**	**.5x3x2**	**.25**	**2.7**
	8	Outer Shell	2	No	Protective users from internal parts	**.174**	**plastic**	**molded**	**25x2.8**	**3.00**	**3.0**
	9	Motherboard+switch	1	No	Regulates function	.022	**Silicon**	**molded**	**6.5x2.2**	**50.00**	**4.0**
	10	Plastic backing behind ceramic plate	2	No	protection	.032	**plastic**	**molded**	**8.1x3.9**	**3.00**	**5.0**
	11	Copper plate	2	No	Heating element	.022	**Copper**	**molded**	**1.5x4.5**	**1.50**	**5.3**
	12	Temperature switch	1	No	Adjusts temperature	.002	**Plastic**	**molded**	**2x.5**	**.10**	**6.0**
	13	On/Off Switch	1	No	Turns straighter on or off	.002	**Plastic**	**molded**	**2x.5**	**.10**	**6.5**
	14	Aluminum Plate	2	No	Heating element	.006	**Aluminum**	**pressed**	**6.25x2.25**	**.25**	**8**
	15	Metal Plate	2	No	To prevent damage/bending	.002	**Metal**		**7x1.5**	**1.00**	**9**
	16	Copper Wire	1	No	Provides electricity to all the electrical	.008	**Copper**		**54x25**	**3.00**	**10**

					devices						
	17	Insulator	1	No	Protectors bit	.378	**metal**		**.1x1.5x1.5**	**5.00**	**11**
	18	Bit	1	No	Inserts cord into straightener	.008	**Metal**		**2x1**	**4.00**	**13**

Below are pictures of the parts in our dissected straightener. To dissect the straightener, we started by unscrewing the outside shell. There were a total of eight screws, and once those were out the straightener consisted of basically two pieces held together by wires. We had to snip the wires to separate the two halves. Each half had the pieces necessary to operate a ceramic plate. All of these pictures show us the individual pieces, and tell us the components of a functioning straightener. These pictures were taken by all of our group members.

1	**2**	**3**	**4**	**5**
6	**7**	**8**	**9**	**10**
11	**12**	**13**	**14**	**15**
16 	**17**	**18**		

Component, subassembly, assembly hierarchy:



Assembly Level Whole aperatus

Component Level

1-18

4.2 Patent Search

In this section, the group investigated patents to prevent any lawsuits. We looked at hair straightener patents and the features we plan to include in our design. We have found that all the patents have expired after the 17 year mark and we are able to make our straightener, and include all the necessary features to make the straightener the most effective straightener on the market.

Table 4. Art-Function Matrix for Hair Straightener

Function	operating conditions include a timer indicator and a temperature setting indicator	predetermined operating time at which time the device automatically shuts off	A retractable power plug comprising: a housing with an internal space sufficient to enclose all external conducting elements which would normally be outside the housing during use	timer indicator and a temperature setting indicator actual temperature indicator and a temperature setting indicator
Ready to use light				US 20050011533
Automatic Shutoff		US 20050011533		
Retractable plug			US 20120220150 US 6776392 US 8197267	
Temperature dial	US 20050011533			

4.3 Product Archaeology

Table 5. Art-Function Matrix for Hair Straightener

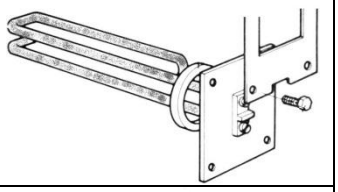
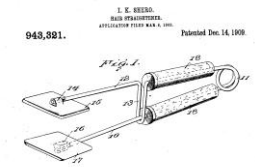
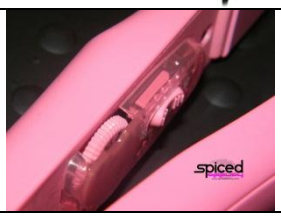
Year	Details	Picture
1872	Erica Feldman created first “hair straightener” by using heating rods to straighten her hair.	
1909	Isaac K. Shero patented a hair straightener composed of two flat irons that are heated and pressed together.	
1912	Scottish heiress Lady Jennifer Bell Schofield refined and combined previous efforts into a hinged, two plated, heating iron.	
1950s	Women would use clothes irons on an ironing board to straighten their hair.	
1980s	Companies started manufacturing hair straighteners. The hot plates were set inside plastic handles.	

Table 5. Art- Function Matrix for Hair Straightener Continued

Present	The most effective flat irons have ceramic plates for better heating, and to cause less damage to the hair.	
Present	Most flat iron plates are made of aluminum and coated with ceramic.	
Present	All ceramic irons produce ionic, far infrared heat that helps to seal in moisture and oils that help to seal in moisture and oils while reducing static and frizz.	
Present	Temperature selectors allow adjustments in the amount of heat output.	

4.4. Benchmarking

The purpose of benchmarking is to compare different aspects of four different straighteners on the current market, and determine what is good about the straighteners and what is inadequate. We compared the four most popular brands of hair straighteners according to our survey results. We compared the packaging, aesthetics, use of use, environmentally friendliness, safety and other features of a Chi, GHD, Paul Mitchell, and ConAir flat iron.

Table 6. Benchmarking of Four Products

Feature	Chi Home CA1010 Flat Iron	GHD Classic Styler Ceramic Hair Straightener	Paul Mitchell Flat Hair Iron	Conair 3/4" Ultra Slim Ceramic Hair Straightener
Packaging	5 –A nice slide out box with easily removed tape makes this product very easy to unpackaged.	5- Very embellished slide out box with ease of unpackaging.	4- Decorative box. Overused tape makes it hard to get the product out though.	2- Unappealing box with overused tape to make it hard to unpackage the product.
Aesthetics	4 –Comes in 4 different colors but plain overall. Polished colors make the product pleasing to the eye.	5- Very decorative, polished colors, very pleasing on contact overall.	4- Black backround green heat plate. No decorations but the color combination is pleasing to the eye.	3- Black unpolished backround with yellow ceramic plate. Very bland overall.
Ease to clean/use	5- Works on all hair styles and finishes the job quickly. Just unplug when finished.	5- Works on all hair styles and just unplugs to clean up.	4- Works on most types of hair but not all. Unplugs when finished.	2- Takes a long time to heat up and cool down making it time inefficient.
Environmentally Friendly	3- Plastic handles. Ceramic heat plate. Energy Efficient	3- Plastic handles. Ceramic heat plate. Energy Efficient	3- Plastic handles. Ceramic heat plate. Energy Efficient	2- Plastic handles. Ceramic heat plate. Energy inefficient
Safety	4- Safe but burn injuries could occur if not careful	3- Burn injuries are more plausible since all the switches are located directly below the ceramic plating.	5- Plastic cover over the switches to help prevent burns.	2- Easy to burn since it takes a while for the product to cool down after use. Also switches are very close to the plate.
Convenience of on/off switch	4- Switch is located on the side of the handle. Could be back a bit further to avoid burn risk.	3- The switch is back far enough from the plating but it's very easy to burn yourself at the current location.	4- Switch is located under the plating but is protected by a plastic cover to help prevent burn injuries.	4- Switch is located on the side well away from the heating plate.
Temperature control system (adjusted temperature use)	5- Adjustable up to 450 degrees F.	2- Directly below the plate very easy to burn yourself. Adjustable.	5- Adjustable and protected up to 450 degrees F.	1- Adjusts to 400 degrees F but takes a while to heat up. Control system is located next to the heating plate increasing burn risk.

4.5 Design Target

We have concluded that we need to have a convenience of switch location, temperature control, an automatic shutoff feature, and retractable cord. In addition to all of these conveniences, we also need to use a different plastic to try and increase our environmental friendliness. We will also continue to use ceramic plates since they heat up the quickest, and provide as little damage to the hair as possible.

5.0 Concept Generation

5.1 Problem Clarification

Below are two of the drawings completed of a straightener in SolidWorks. They show the front, side, and top views of the object, and contain most of the features we feel are necessary in a quality straightener.

Figure 7. SolidWorks Straightener

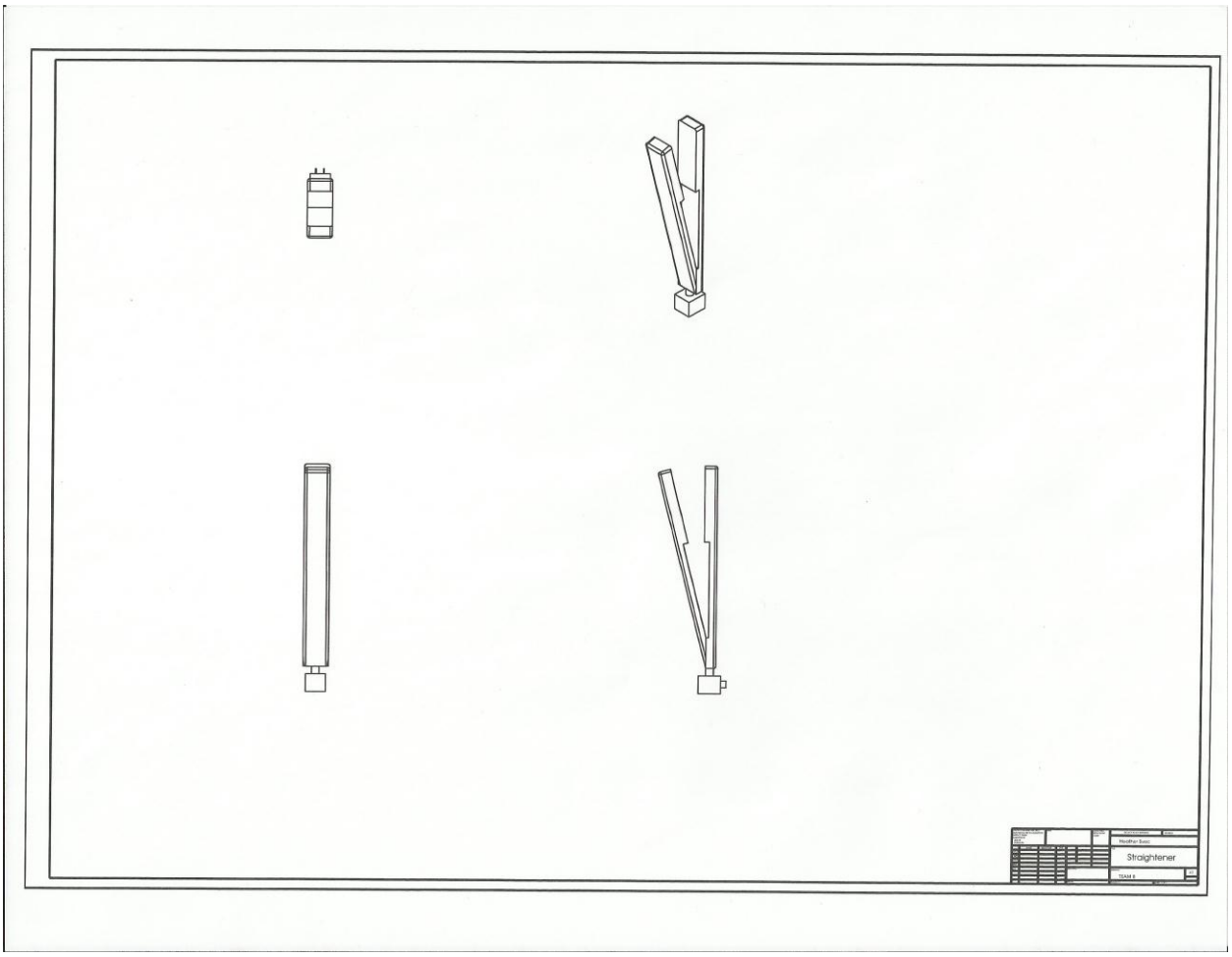
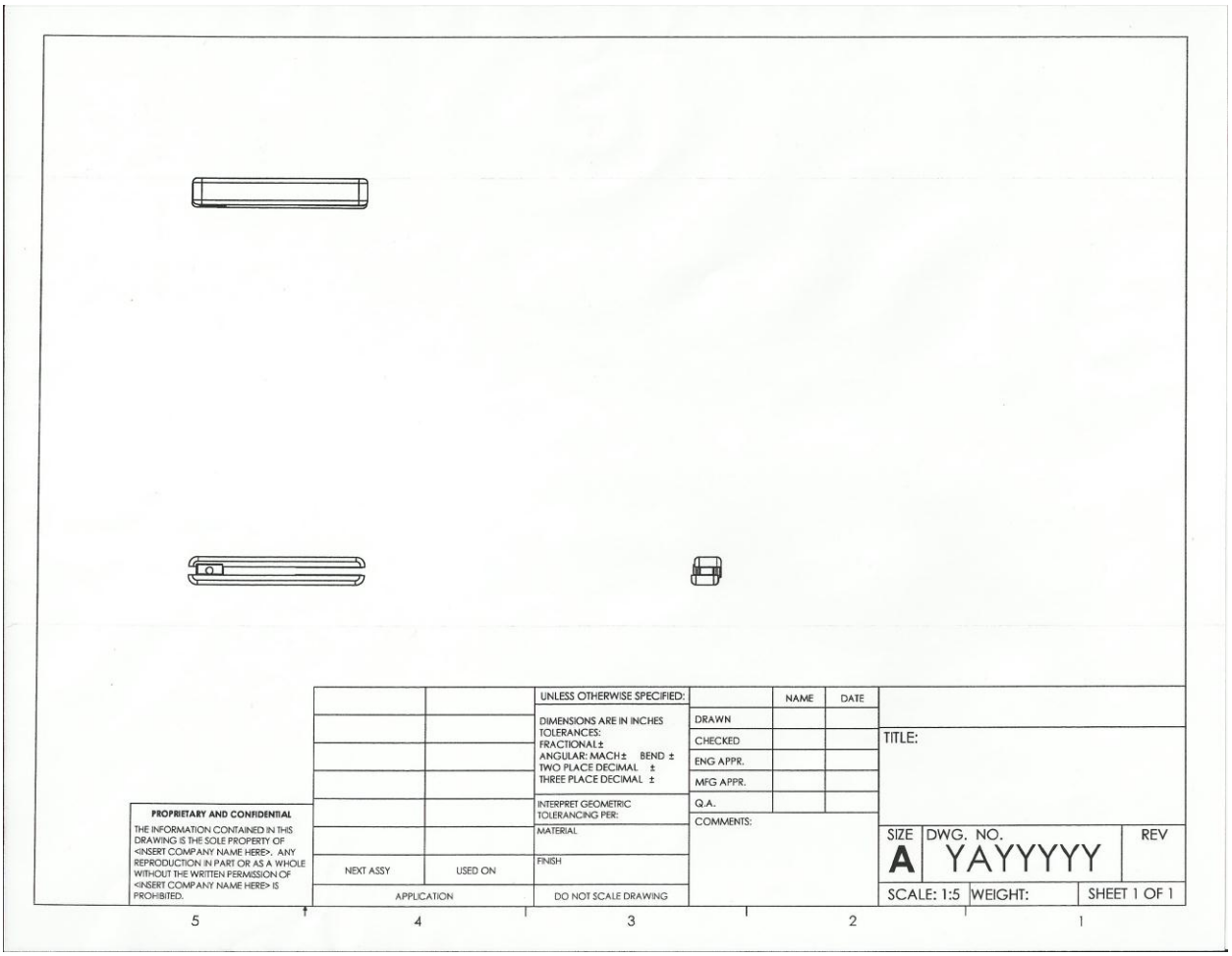


Figure 8. SolidWorks Straightener



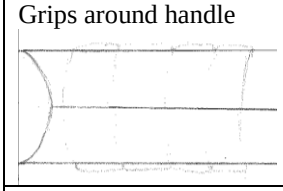
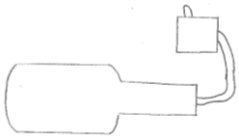
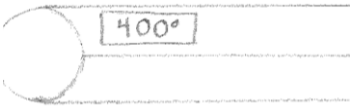
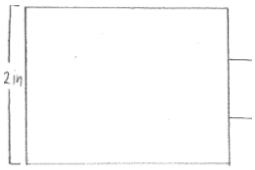
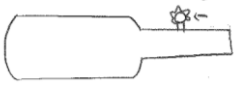
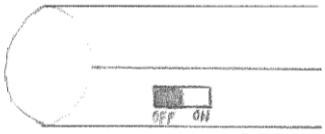
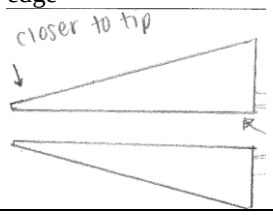
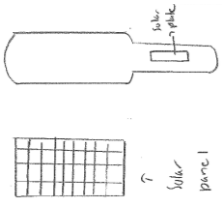
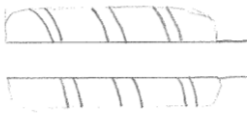
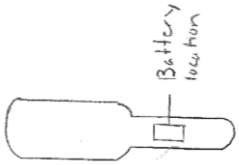
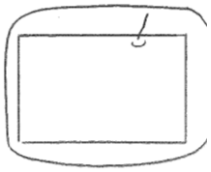
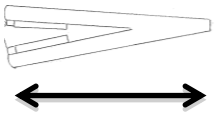
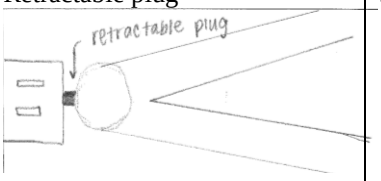
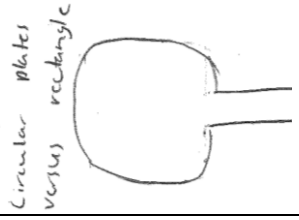
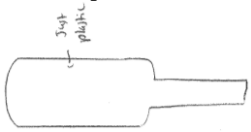
5.2 Concept Generation

We divided the straightener into four main functions: Power Generation, Energy Mechanism, Human Factors of the Body, and Head Design. Using these functional groups, we brainstormed concepts that could be included into our straightener. From these ideas, we included sketches to show these concepts.

Process:
1.Brainstorm
2.Individual Sketches
3.Compare/Discuss
4.Group Decision

Functional Groups:
1.Power Generation
2.Energy Mechanism
3.Head Design
4.Human Factors Body Design

Table 9. Morphological Chart

Human Factors Body Design	Head Design	Power Generation	Energy Mechanism
Grips around handle 	1 inch	Plug 	Electrical
Digital temperature 	2 inch 	Wind 	Mechanical
Easy access on/off 	Triangular edge 	Solar Plates 	Solar
Light turn on when ready to use	Coils around head for curling 	Battery 	Chemical
Automatic shutoff	Ceramic plates 	Shake Design 	Mechanical
Retractable plug 	Shape of plates 	Crank Design	Mechanical
Rubber at top	Outside plastic 	Induction heating	Electrical

6. Concept Selection

We used the Pugh Charts to narrow down our concepts and select the best ones for our new design. We decided to include the top ranking concepts in our actual product of our straightener.

Human Factors Body Design Pugh Chart						
	Environmentally Friendly	Safety	User Friendly	Aesthetically Pleasing	Total	Ranking
Weighting Concepts	0.2	0.2	0.5	0.1		
Grips around handle	0	0	0	0	0	5
Digital Temperature	0	-1	1	1	0.6	3
Easy access on/off	0	1	1	0	0.7	2
Light turn on when ready to use	1	0	1	0	0.7	2
Automatic shutoff	1	1	1	0	0.9	1
Retractable plug	0	0	1	1	0.6	3
Rubber Top	0	1	0	-1	0.2	4

Head Design Pugh Chart						
	Environmentally Friendly	Safety	User Friendly	Aesthetically Pleasing	Total	Ranking
Weighting Concepts	0.2	0.2	0.5	0.1		
1 inch	0	0	0	0	0	2
2 inch	-1	0	0	-1	-0.4	5
Triangular Edge	0	-1	0	-1	-0.3	4
Coils around head for curling	-1	-1	0	-1	-0.5	6
Ceramic Plates	0	1	1	0	0.7	1
Shape of Plates	0	0	-1	0	-0.5	6
Outside Plastic	1	0	-1	1	-0.2	3

Energy Mechanism Pugh Chart						
	Environmentally Friendly	Safety	User Friendly	Aesthetically Pleasing	Total	Ranking
Weighting Concepts	0.2	0.2	0.5	0.1		
Electrical	0	0	0	0	0	1
Mechanical	0	1	-1	0	-0.3	3
Solar	1	-1	0	-1	-0.3	3
Chemical	0	-1	0	0	-0.2	2

Power Generation Pugh Chart						
	Environmentally Friendly	Safety	User Friendly	Aesthetically Pleasing	Total	Ranking
Weighting Concepts	0.2	0.2	0.5	0.1		
Plug	0	0	0	0	0	1
Wind	1	-1	0	-1	-0.1	2
Solar	1	0	-1	-1	-0.4	6
Battery	-1	0	0	0	-0.2	3
Shake	1	0	-1	0	-0.3	4
Crank	1	0	-1	-1	-0.4	5
Induction Heating	0	-1	0	0	-0.2	3

6.0 Final Design

Our final design of our hair straightener includes many new features in order to make our product safer, easier to use, environmentally friendly, and lastly more aesthetically pleasing. First, we decided that safety was our biggest concern for our product. We do not want our product to burn customers and, we also want to prevent house fires. In addition to fire hazards, we want to protect the consumers' hair, by using ceramic plates to cause less damage and breakage of hair. In order to ensure the safest product we plan to have an automatic shutoff feature in our flattening iron that will cut off power to the straightener after 3 hours. Next, to prevent burn hazards we places the on/off switch on the on the side of the straightener inside of on the inside so the consumer would not be close to the heated ceramic plates. We also decided to put the temperature dial on the outside of the straightener as well for the same reason. Lastly, we placed rubber on the top of straightener to prevent the consumers' fingers from receiving burns when they are straightening their hair.

The next aspect we wanted to address was environmentally friendliness. It is important to create a product that works but is good for the environment as well. We intend to use polylactic polymers (PLA polymers) inside of plastic for the outside shell of the straightener. PLA polymers only cost $0.90-$1.00 per pound versus plastic which costs $2.17 per pound PLA polymers have the rigidity to replace polystyrenes and PET's, but the real advantage of this plastic substitute, it decomposes within 47 days in an industrial composting site (Trimarchi and Giuggio). Also, when this plastic substitute is burned it will not emit toxic fumes, and the manufacture of these products uses 20-50 % less of fossil fuels than petroleum-based plastics (Trimarchi and Giuggio). By using this type of plastic for the outer shell of our straightener, we will reduce waste because decomposition is faster, as well as consume petroleum because this plastic does not require as much as the plastic currently used. This will ensure we are creating an environmentally friendly product.

Next, we determined our product should be user-friendly. In order to make a user friendly hair straightener we made grooves on the handle of the straightener to ensure the straightener does not slip from the users' hands. Also, we are using a retractable cord on the straightener for better storage options for the straightener as well as to prevent the cord from getting tangled which in the end could damage the wires in the cord. We also will put a feature on our straightener that will light up when the straightener is at the desired temperature. The last feature we are adding to our straightener is our digital temperature dial that lets the consumer set the desired temperature. These features will all add to a positive experience when using the straightener as well as making the straightener easier to use for the consumer.

Lastly, we determined that our straightener should be aesthetically pleasing to the consumer. We plan to achieve this by designed a sleek slender design that is very colorful. The aesthetic design can be seen in the Solidworks model.

6.1 Design Drawings, Parts List and Bill of Materials

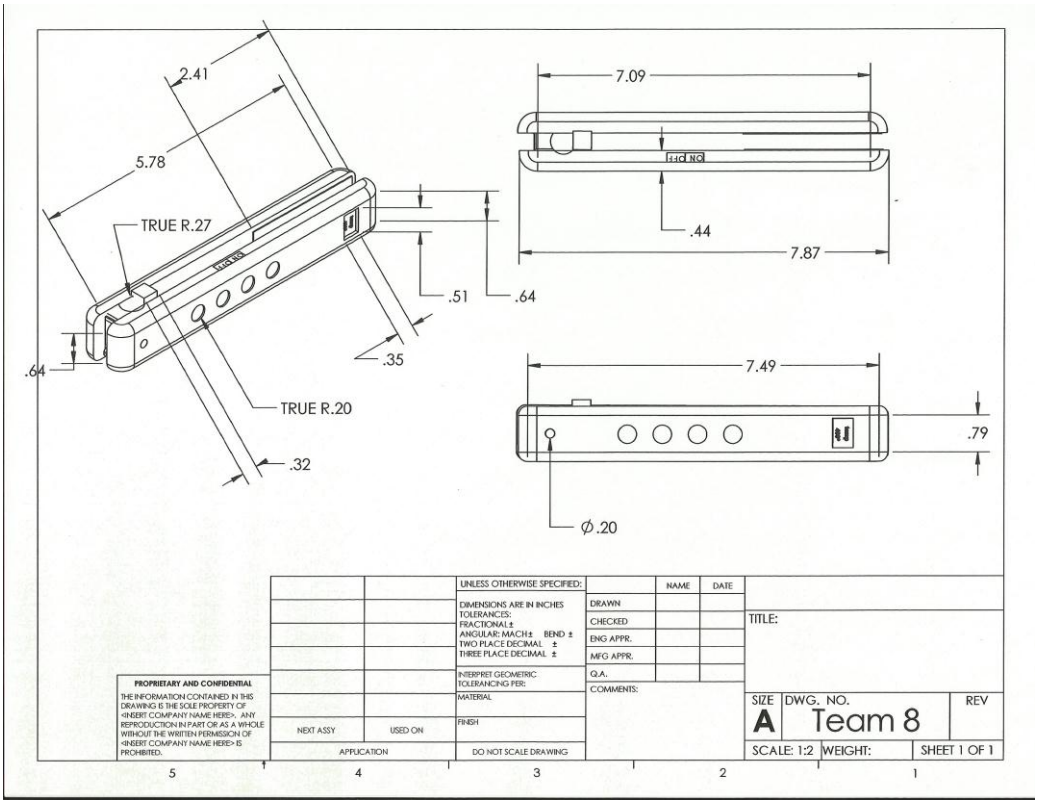
These drawings are for the redesign of our hair straightener. The added features can be seen below, in the sleek, aesthetically pleasing design. The features include a retractable plug, automatic shutoff feature, easy access on/off switch, digital temperature control, added grips for comfort, and rubber on the edges so the user does not burn themselves. There are no parts to our component because the straightener does not have detachable pieces.

Figure 10. Front View of Straightener

Figure 11. Top View of Straightener

Figure 12. Right View of Straightener

Figure 14. Dimensions of Straightener



6.2 How does it work?

A hair straightener is first plugged into the wall to receive electrical energy. Once the straightener is has the energy it runs through the wires to the aluminum conducting plates. The conducting plates then heat up the ceramic plates, which are able to retain the heat. Once the ceramic plates are heated the straightener is ready to use. Then the straightener clamps the hair and straighteners it.

7.0 Conclusions

The first step of our redesign was to determine what our customer wanted out of a new straightener. After analysing our results we came up with four main components to focus on to improve our straightener. These components were safety, user-friendliness, environmentally-friendliness, and lastly aesthetic appeal. By focusing in on these main components, we were able to revise our problem statement. Once we had our problem statement, we went into the lab to dissect our straightener to see the internal parts and what we could possibly improve upon. Once we did this, we researched patents to make sure we were not in any violation of any laws, compared other products currently on the market, and went through the history of a hair straightener. Next, we generated concepts and came up with eight different possibilities for each of the four functional groups (power generation, energy mechanisms, human factors of body, head design). Once we had all our ideas we placed them in a morphological chart and generated Pugh Charts to determine which ideas should be included in our redesign. Once we calculated our highest scoring ideas we were able to make our SolidWorks model for our final redesign model. We also included the CAD sketch with dimensions in our report.

We believe that our project was very successful. We were able to create a new product, while increasing the sustainability and keeping the customer's desires in mind. We designed a straightener that consisted of an automatic shutoff feature, a retractable plug, an easy access on/off switch, digital temperature control, a light that turns on when the straightener is hot enough to use, grips for added comfort, and a sleek aesthetically pleasing design. We also used a different type of plastic (PLA) which would reduce the cost, and increase the environmental friendliness. This would increase the straightener's sustainability, and be an overall better product.

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Appendix

All papers are attached.