Mug for Disabled People

Emily Datte, Richard Suhendra, Aditi Bokil, Aditi Arya
Engineering Design 100 Section 016
March 6, 2016

Abstract

In today's society, the popularity and consumption of coffee and caffeinated drinks is rapidly increasing and the large majority of people drink coffee or other hot beverages daily. Despite the many people that do consume coffee each day, there are few challenges that some individuals face that make it very difficult for them to carry out the simple task of drinking a cup of coffee. While most people take their hands the functionalities they provide in carrying out daily tasks for granted, the absence of a person's hand or part of their hand makes everyday tasks much more difficult. The people with the disability of having only one finger experience many difficulties in drinking coffee or other beverages due to the lack of mugs and cups that allow them to drink from easily. Through the design process, we have developed a successful design for a mug that is tailored to the needs of people who have one finger.

Key words: coffee mug, disability, one finger, product design

I. Introduction

The anatomy of the hand encomapsses a network of muscles, tendons, ligaments and bones that work together to accomplish daily tasks. When grasping an object, a person's fingers will wrap around the object and the palm supports the object. The entire hand applies pressure on the object when picking it up. This may seem like common sense since the majority of society can pick up things and put them down without a second thought. However, people with disabilities struggle with accomplishing normal tasks on a daily basis. The simplicity and ease with which healthy people lead their lives continuously eludes them. For instance, people who suffered partial hand amputation have to relearn how to eat, write, type or any other task that involves using fingers. This may seem like an oddly specific situation, but nearly 61,000 people have to amputate one or more fingers due to work-related injury or birth defects.
As engineers, we seek to use our innovative thinking to discover answers to old problems. We investigate, design and construct new solutions to usher society into a brighter and better future. Therefore, we set out to design a mug which would make drinking a hot beverage easy for a person with only one finger. First, we investigated how existing coffee mugs on the market did not fulfill the needs of people with this specific disability. Then, we implemented the design process to and the analytical hierarchy process to help us prioritize the needs of the customer and how we could meet those needs. Next, we used a design tree to generate several concepts of how we could make different mugs and from there we decided how to find the mug that best fulfilled our purpose with this design. Once we worked on making improvements on this design, we came up with our finalized result.

II. Literature Review

Prior to designing the mug, we had to study what products existed in the market that targeted our specific demographic. Feeding aids have their own niche market with a diversity of products which included a genre of adaptive cups. However, the mugs that we found on the market helped people with decreased wrist strength or suffered from tremors in their hand. These cups weighed more than normal mugs to prevent the contents spilling due to the user's decreased wrist motion or tremors. Most of the mugs specifically targeted people with tremors and spasticity issues. However, this would not help a person with one finger because an individual with this disability would not have the strength to lift such a mug. The Drive Medical Handle Cup also had two handles like our final design, but it had a drinking spout that very similar of cups designed for toddlers. This would not appeal to our demographic of adults because it would make our product look infantile. However, this would not help a person with one finger because an individual with this disability would not have the strength to lift such a mug. In designing our mug, we sought to fulfill different purposes than the products that already existed in the market. Therefore, we could proceed with our original design and continue improving upon that design.

III. Design Process

A new coffee mug needs to be designed to better accommodate the needs of those people who only have one finger. Traditional coffee mugs' designs often have handles that are difficult for someone with only one finger to use and control. The handle on the mug needs to be modified so that the disabled person has complete control over the mug when drinking so that it is safer for them to consume hot beverages. The size and proportions of the mug should also be modified so that it is easier for someone with very little hand strength to grasp and control. The newly designed mug should still be able to hold a minimum of 8 fl. oz. of liquid. The material of the mug should allow for proper insulation to keep the contents of the mug hot but also provide a safe barrier between the hot beverage and the user's hand. The new mug design will be portable as many people drink their coffee on the go these days. It should also be durable and the design should help to prevent spills. Any person with one or more fingers should be able use the product easily. We look to introduce the mug in the third quarter of 2016. Stakeholders include our development team, manufacturer, retailers, and consumers.

Research was conducted both internally and externally to aid in the design of the coffee mug. The group discussed foreseeable problems that people with only one finger encounter while using a normal coffee mug. The main issue discussed was the poor design of the traditional handle for those with one finger. A traditional mug's handle makes it difficult for a person with one person to control when tipping the mug to drink from it. We discussed possible characteristics of a new design for a mug that would be more desirable for a person with one finger. Externally, we surveyed peers from outside our group as well as customers themselves to compile a list of attributes that our mug design needed to include. This research helped us to define our primary and secondary attributes and aided us in ranking the importance of each attribute.

The next step of the design process was to identify the customer needs and decide which were the most important to be reflected in our design. All of our secondary attributes were categorized under the five main attributes; safe, durable, user friendly, portable and aesthetically pleasing.

Table 1. Primary Customer Needs

	Safe	Durable	User Friendly	Portable	Aesthetically pleasing	Total	Weighting
Safe	1	1.4	2.3	1.4	7	13.1	0.359
Durable	0.7	1	1.6	1	5	9.3	0.255
User Friendly	0.4	0.6	1	0.6	3	2.9	0.079
Portable	0.7	1	1.6	1	5	9.3	0.255
Aesthetically pleasing	0.1	0.2	0.3	0.2	1	1.8	0.049
Total						36.4	

Table 1 shows the first layer attributes to be included in our design. These five attributes were ranked and weighted using the analytical hierarchy process (AHP). Safe was ranked as most important at 7 and aesthetically pleasing was ranked least important of the five attributes at 1.

The same analytical hierarchy process was used to then rank the secondary attributes under each of the five primary attributes.

Table 2. Secondary Customer Needs

Safe 7 (0.359)
Insulated on the outside (0.093, 0.261)
Insulated on the inside (0.093, 0.261)
Lip at the Bottom of the Mug (0.039, 0.110)
Spill proof (0.065, 0.183)
Controlled liquid flow (0.065, 0.183)

Durable 5 (0.255)
Microwaveable (0.105, 0.413)
Shatterproof (0.074, 0.293)
Doesn't stain easily on the lid (0.074, 0.293)

User Friendly 3 (0.079)
Simple Design (0.010, 0.135)
Special Handle Design (0.025, 0.320)
Heat Retention (0.025, 0.320)
Dishwasher Safe (0.017, 0.226)
Easily Removable Lid (0.017, 0.226)
Eco-friendly (0.017, 0.226)
Easy to hold (0.025, 0.320)

Portable 5 (0.255)
Lightweight (0.089, 0.352)

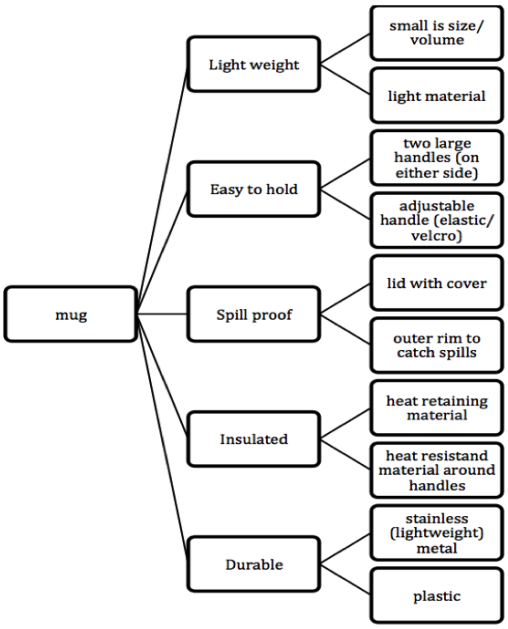
Smaller Cup (0.063, 0.248)
Fits standard cup holder (0.063, 0.248)
Inexpensive (0.038, 0.150)

Aesthetically Pleasing 1 (0.049)
Many Patterns & Colours (0.030, 0.619)
Comes with Printable Text (0.018, 0.380)

The secondary attributes under each primary attribute were ranked and weighted using the same process as the primary attributes. The weighting of each attribute was used to make sure the necessary customer needs were reflected in the new mug design.

After considering the customer needs, the next step in the design process was to generate concepts to meet the needs of the customer and the desired characteristics. As a group, we chose five customer needs that were representative of the primary attributes and created two concepts for the new mug for each need. Figure 1 details the possible design concepts that were generated.

Figure 1. Concept Generation



After generating these concepts, we combined the concepts together to come up with thirty-two different mug designs. These designs were then assessed how well the fit the customer needs and ranked the overall designs in order to reach the best concept for the new mug.

Table 3. Mug Concept Rankings

Criteria	AAABB	AAAAB	AAABA	AABAA	ABAAA	BAAAA	AAAAA	AABBA	ABBAA	BBAAA	AABAB	ABABA	BABAA	ABAAB	BAABA
Light weight	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Easy to hold	0	0	0	0	-	0	0	0	-	-	0	-	0	-	0
Spill proof	0	0	0	-	0	0	0	-	-	0	-	0	-	0	0
Insulated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Durable	0	0	+	+	+	+	+	+	+	+	0	+	+	0	+
Sum +'s	0	0	1	1	1	1	1	1	1	1	0	1	1	0	1
Sum 0's	5	5	4	3	3	4	4	3	2	3	4	3	3	4	4
Sum -'s	0	0	0	1	1	0	0	1	2	1	1	1	1	1	0
Net Score	0	0	1	0	0	1	1	0	-1	0	-1	0	0	-1	1
Rank	5	5	1	5	5	1	1	5	17	5	17	5	5	17	1
Continue?	no	no	combine	no	no	revise	yes	no	no	yes	no	no	no	no	no

This is table only shows the first 15 designs although the extended table included a total of 32 designs.

The A or B code corresponds to one of the two concepts we created for each of the five parts of the design of the mug. Positives, negatives, and neutrals were used to examine the attributes of each specific design. By comparing each design to a base or reference design we can examine how well the design meets the customer needs. Designs that were lacking a specific desirable attribute compared to the base design would receive a negative in that category. Similarly, if a design meets a specific attribute very well it would receive a positive. The positives, negatives, and neutrals were then added up in order to rank all 32 designs.

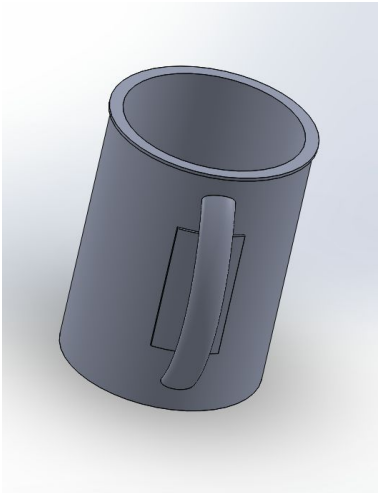
Table 5. Concept Selection and Weighting

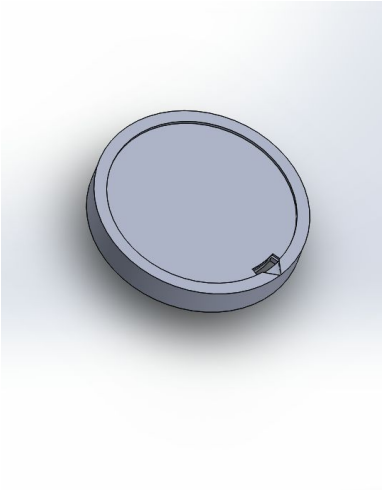
		AAAAA (Reference)		AAABA+BABAA		BBAAA		BAAAA+	
Selection Criteria	Weight	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score	Rating	Weighted Score
Lightweight	25%	3	0.75	4	1	4	1	4	1
Ease of Hold	35%	3	1.05	4	1.4	2	0.7	4	1.4
Spill Proof	15%	3	0.45	5	0.75	3	0.45	3	0.45
Insulated	15%	3	0.45	4	0.6	3	0.45	3	0.45
Durable	10%	3	0.3	3	0.3	3	0.3	3	0.3
	Total Score		3		4.05		2.9		3.6
	Rank	3		1		4		2	
	Continue		No		Develop		No		No

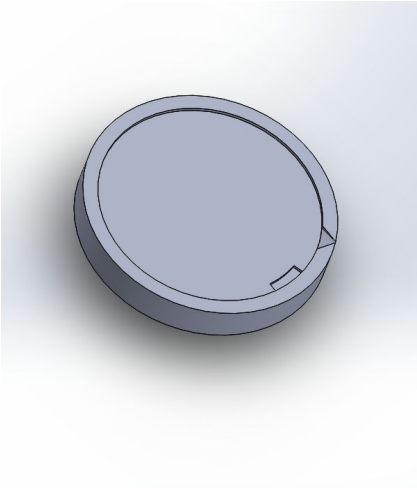
After ranking our concepts, we revised a design to combine to two designs and considered our top four designs. As shown in Table 5 we used weighted attributes to assign numerical scores for each concept based off of the reference concept, which was given a score of three. This ranking allowed us to choose our best design for our final product.

IV. Design Result

The final design for our product includes two large handles that allow people with only one finger to easily pick up and drink from the mug. The two handles allow the disabled person to place the palm of their hands in the handles and pick up the mug. This mug will be made out of an insulated BPA free plastic and the sides of the mug between the handles will have rubber grips that protect the customer's hands from the heat of the drink while also preventing the mug from slipping in their hands. The lid of the mug helps to prevent spills and allows the mug to be more portable. The lid can easily be removed from the top of the mug with one finger by popping it off.







V. Conclusion & Summary

Throughout the design process we focused our ideas and created many designs for a coffee mug that could easily be used by a person with only one finger. The designs were evaluated and refined until we reached our final design of the mug. The final design is a versatile mug that can be used by many people, even those with an array of disabilities. Throughout the design process we did experience some difficulties while prototyping and revising our original design to keep the mug simplistic and designed best to fulfill the purpose of this project. Experiencing these difficulties allowed us to think about our design critically and revise the final design until we felt that it would be best fit for the goal of the project. Our final design better accommodates the needs of those people who only have one finger.

References (APA)

Drive Devilbiss Healthcare . (2016). *Drive Medical* . Retrieved from drivemedical.com: http://www.drivemedical.com/index.php/clear-2-handle-cup-645.html

E.J. Davies, B. F. (1970). Amputees and Their Prosthesis . *Artificial LImbs* , 19-48. Retrieved from http://biomed.brown.edu/Courses/BI108/BI108_2003_Groups/Hand_Prosthetics/stats.html

eSpecial Needs, LLC . (2016). *eSpecial Needs*. Retrieved from especialneeds.com: http://www.especialneeds.com/weighted-two-handle-mug.html