DESIGN PROJECT 1

We were presented with one problem, which was to design a mug for disabled people (only one finger), so they could hold the coffee mug without spilling all the liquid that is inside, or burning their hands. Our mug had two handhelds, which was able to be grabbed with the palms, and one little handle inside of one of the two big ones, so the person was going to be able to put his or her finger and grab the entire mug in an easier and stabilized way.

To do this designed we did some research first, where we found the US patent 5558240, which featured a cup that had both an outer handle and inner handle. The inner handle had grip that allowed someone's fingers to comfortably fit into.

After doing the research we started thinking about the design and we came up with numerous ideas and to decide which one to use, we used different methods. These methods are:
- Identify customer needs.

- Top five customer needs were: user friendly, durable, portable, flexible, and one-finger use.

- After having the top five customer needs, we apply the classification tree, which guesses affiliation of cases or objects in the classes of a categorical dependent variable from their measurements on one or more predictor variables, to make different combinations.

- To decide which option was better we use AHP (analytical hierarchy process), which is a structured technique for organizing and analyzing complex decisions, that helped us rank the options.
Abstract

Through the years technology has improved because of men’s desire of making a better place to live and simplify our daily activities. Engineers are the individuals who are responsible for doing these tasks, but no one has ever paid complete attention to people who have disabilities such as having only one finger. That is the reason why we, as engineers, want to design a mug accessible for people with only one finger. This mug has two handhelds, which can be grabbed with the palms, and one little handle inside of one of the two big ones, so the person will be able to put his or her finger and grab the entire mug in an easier and stabilized way.

Keywords: mug, missing fingers, disabled people, design.

Introduction
Nowadays the market for disabled people is really small compared to the market for people in good health conditions, even though there are about 56.7 million people who have disabilities in the United States. One example is the people who only have one finger, either because they were born this way or because of war or related work injuries. Almost everything is made for people who have all of their fingers such as mugs, glasses, plates; but no one has thought about how uncomfortable it would be to grab something without using all of them. We were presented with this problem and as a result we designed a mug for people with only one finger that will let them grab the mug with ease and without harming themselves.

Literary Review

One patent reviewed during this project was US patent 5558240. This patent features a cup that has both an outer handle and inner handle. The inner handle has grip that allows someone’s fingers to comfortably fit into. The cup is made to be held in a more comfortable way,

The idea of a bigger and smaller handle on one side of the cup inspired us, but obviously we needed to change it to accommodate our market. We moved the smaller handle to make it attach to the cup and made it smaller. We also did not include finger grips because ours was made for people with only one finger.

Design Process

The design process took much consideration and deliberation. First, we identified the problem. In this case, the problem was that it was difficult for people with one finger to
hold a traditional coffee mug. Our job was to create a coffee mug for people with hand disabilities to use easily and efficiently. Next, we identified our customer needs. Our top five customer needs were user friendly, durable, portable, flexible, and one finger use. These would be our first-level attributes in our Customer Needs Hierarchy. We then used the analytical hierarchy process (AHP) to rank these five attributes. The AHP revealed that one fingered use was the most important, followed by user friendly, durable, portable, and lastly, flexible. Next, we formulated 18 second-level attributes. Each would be a subcategory for the five first-level attributes. For example, under portable was handheld and lightweight. After we had our 18 second-level attributes, we ranked them using an AHP. We compared the attribute that fell into the same subcategory. So, handheld and lightweight were ranked in the same AHP because they both fell under portable. After doing this for each subcategory, we knew which attributes were more important than others which was taken into consideration when designing the mug.

Our next step was to create possible designs for the coffee mug. The top priorities for our design were that the cup would be unbreakable, could be held by people with a variety of disabilities on either hand without creating joint strain, and safe to use. We created a concept generation table with possible design. Possibilities included whether the cup would be made from steel or plastic, whether there would be a handle on one side or both, and whether the cup would have a rubber sleeve or not. There were 48 possible concepts that could be derived from the concept generation table.

From the 48 possible concepts, we picked the 16 we thought were best. The next step was generating a concept screening table. 1 of the 16 concepts was the reference and we compared the 15 other possible concepts to it. After doing this we were able to rank
the concept in order from what ones we thought were to the ones we didn’t favor as much.
Then, the concepts ranked from 1-5 moved on to the next step in the design process. The
final step in the process was the concept score table. In this step, we took our 5 top
concepts and were able to determine the top one based off of customer needs rankings.
Since our group was happy with the final concept, this would be the design for our project.
The design process was over and the next step was to form a prototype!

**Design Result**

The design result meets all customer needs and wants. The product will be made out
of plastic and contain an air void between the inner and outer walls of the mug, so the
customer does not get burned or feel any discomfort from heat when holding the mug.
The design and material will allow the mug to be dishwasher safe, or, if a dishwasher is
unavailable, very easy to clean. The mug will also be shatterproof and will be able to
sustain being dropped. The mug will have a large 15.5 ounce carrying capacity. The
design of the handles will meet the unique needs of a customer with a single finger as it
incorporates two large handles in which the palms will fit, and one smaller handle for the
single finger. This smaller handle increases stability when the mug is being held by
amputees. Additionally, with such a simple design, the mug will be relatively inexpensive
to produce allowing for a lower selling price. So our mug should be very competitive in
the market.

**Conclusion/Summary**
Our group successfully reached our goal, which was to use the engineering design process to generate and develop a coffee mug that could be used by a disabled person who has either lost all of their fingers except one, or was born with only one useable finger. The first step to completing our goal was to generate five key attributes that we felt would pertain to this kind of cup. We then used the AHP table to rank the importance of these attributes. After that, we broke the first layer attributes into several second layer attributes that specifically accomplished what the first layer attribute required, and used the AHP tables to rank all of these second layer attributes.

With the second layer attributes ranked, we selected the five that obtained the highest score and used the concept generation table to come up with physical features that met the requirements set by the second layer attributes. With these ideas generated we then had 48 different combinations of ideas that we could use to make our cup, and then we narrowed them down to five using the concept selection table. We then finally determined the best design by determining which of the five designs best represented our five original attributes.

Our last step in trying to design a cup that would provide easy use to people with only one finger was to bring our ideas on paper into the real world. We created a three dimensional drawing of our design using the software Solidworks and then made a clay model of what we envisioned the cup to look like.
In the end, we were successfully able to use the engineering design process, tables, charts, along with other techniques to create what we feel to be the best way to enable people with only one finger to drink out of a mug.

References

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