Sleep Mask Phone Charger

Design for Emerging Markets (DEM) Project

[Image]

△ ILLUMINATI, Team 3

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Mission Statement

The company’s goal is to provide reliable, efficient, and affordable phone charging capabilities to lower income families in Kenya. In doing so it is important to take into consideration the daily life of those families so that no excessive energy or change in daily routine is required to charge their cellphones.

Concept development summary

Through location and context research, we have found the customer needs for people in Kenya. According to The World Bank, Kenya’s income level is lower middle income comparing to other countries. Although Kenya is on a path of economic growth, its unemployment rate still remains at 40 percent (reference 1). Those facts indicate that the product have to be affordable and efficient. Considering that close to 42 million of Kenyans (80% of the population) work as a part-time workers and most of agricultural out is from small scale (reference 2), they will be moving a lot on daily basis so the product should be portable and durable. Lastly we conclude that the product should be culturally acceptable and eco-friendly so that the product can be used without other problems such as cultural conflicts and pollution.

Through brainstorming, we came up with three different ideas: a cold and heat pack that uses a thermal generator, a hand pump that uses electromagnetic generator, and a sleep mask that uses a micro-wind turbine generator. We used design selection matrix (shown below) that used a weighted system based on which customer needs are more important. From the matrix we concluded that the sleep mask phone charger is the best idea.
Table 1. Design Selection Matrix

<table>
<thead>
<tr>
<th>User Need / Feature / Requirement (weight)</th>
<th>1. Affordable (4x)</th>
<th>2. Culturally Acceptable (5x)</th>
<th>3. Eco-Friendly (1x)</th>
<th>4. Durable (3x)</th>
<th>5. Portable (2x)</th>
<th>6. Efficient (1x)</th>
<th>Total (weighted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design 1: Cold/hot pack</td>
<td>1</td>
<td>2</td>
<td>1.2</td>
<td>3.9</td>
<td>2.1</td>
<td>2.1</td>
<td>29</td>
</tr>
<tr>
<td>Design 2: Hand pump 2.0</td>
<td>3</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
<td>3.6</td>
<td>3.15</td>
<td>40</td>
</tr>
<tr>
<td>Design 3: Mask 2.0</td>
<td>3</td>
<td>1.2</td>
<td>1.2</td>
<td>3.9</td>
<td>3.6</td>
<td>2.1</td>
<td>41</td>
</tr>
</tbody>
</table>

Test Report Summary for Prototype #1

After choosing our best idea, we created our first prototype. We made our first prototype to look and act as if it were the final product to the best of our ability. After we created our first prototype, we were able to test it based off of our customer needs. We designed a table (shown below) with the customer needs, test, and then a pass or a fail column.

Table 2. Prototype 1 Test

<table>
<thead>
<tr>
<th>Customer Need</th>
<th>Test and requirement(s) to pass</th>
<th>Pass or Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affordable</td>
<td>If the total cost is less than $10 per person by adding up the parts needed to make then the mask then it passes.</td>
<td>Passed</td>
</tr>
<tr>
<td>Durable</td>
<td>If the prototype is dropped from the average height of a Kenyan (5 feet 3 inches) and it is functional with no broken pieces then it passes.</td>
<td>Passed</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Eco-friendly</td>
<td>If no pollution is given off or created by the product, then it passes.</td>
<td>Fail- Can use improvement</td>
</tr>
<tr>
<td>Efficient</td>
<td>If the mask can charge half of a phone battery in under 4 hours of sleep and require no more than 400 calories of work then it passes.</td>
<td>Passed</td>
</tr>
<tr>
<td>Culturally Acceptable</td>
<td>Survey our classmates and see if they find our product offensive and if less than 10% do, we pass.</td>
<td>Passed</td>
</tr>
<tr>
<td>Portable</td>
<td>If it weighs less than 1 lb. and has dimensions of less than 6in by 6in by 3in then it passes. This is done by adding up the weight of the parts and measuring the dimensions.</td>
<td>Passed</td>
</tr>
</tbody>
</table>

We made the tests to see if our prototype would satisfy our customer needs. We performed each test and concluded whether our prototype passed or failed in meeting our customer needs. We were able to test our prototype in class, using our chart to guide us. The efficiency of our design was found by using the 5V battery we found. It produces 5V with 1.2 amps. Using this information, we concluded it would take about three and a half hours to charge a phone like the one previously mentioned in class. We then took that and multiplied it by the amount of calories one burns in one hour. A 150 pound person burns 63 calories per hour while sleeping (reference 3). This means that the mask requires about 221 calories. From our calculations that means our prototype passes on efficiency. The survey had a result of 0% of
people finding our prototype offense which means it passes. Figure 1 and figure 2 show the before and after, respectively, of the durability test which caused us to conclude that it passes. After all of the testing we concluded that it passed every test except for eco-friendly since it is made of plastic. For that customer need we concluded that there can be improvements made to the mask so that our product better satisfies the customer. These improvements were made in the design of prototype 2.

(Figure 1) (Figure 2)

**Concept Refinement Summary**

After testing prototype 1 we represented our idea to our peers and instructor for different insights to create an improved second prototype. This new prototype would be better developed to meet our customer needs and look more like the final product. Although prototype 1 passed most of the tests, we found that there was some room for improvements. The first change was related to materials that we used. In order to increase portability and overall cost we decided to use a different kind of plastic for the mask. We considered this to make the mask thinner by
using less plastic. This would produce less pollution since there is less waste with the thinner plastic. Also, we decided to find the plastic molds to one’s face to be more comfortable to wear and to be more durable. For prototype 1, we did not use the exact material for the test so we had to speculate the result. However for prototype 2, we would be able to test the actual durability of the product and that would give us better insights for improvements. Lastly, we concluded that we need to focus more on the aesthetic design of the mask. As many our classmates thought the product might be uncomfortable, we needed to make it look better or to work on a way of pitching this to people who are not used to sleeping with something like a mask on their face.

**Test Report summary for Prototype #2**

For prototype 2, we focused more on the aesthetic design of the mask and the plastic of the mask more eco-friendly. For the first part of the improvements, the aesthetics, we smoothed out the mask’s overall design, making it look less like the medical mask and more like something a customer would be comfortable sleeping with on their face. As for the eco-friendly part of the new design, the plastic was made thinner, about .5 mm thick (Figure 5). This was the thickness that gave the best combination of durability and strength for the customer. This thin design also reduced the environmental impact. The mask will be made of High-Density Polyethylene (Reference 4), which is malleable but strong, in addition to being easily recyclable.
Cost analysis

The two main parts of our product are a wind-turbine power generator and a mask. We were looking for a power generator and a wind-turbine but we found a product that those two products are connected. It is called a “micro-wind turbine power generator” and it costs 4.99 US dollar (reference 5). For the mask part, we found CPR mask that is 4.45 US dollar (reference 6). The other part that we need is the cord that connects a cellular device and a mask. We found cords that are under a dollar if we buy in bulk on cablewholesale.com (reference 7). If we were to buy in bulk it would most likely decrease the overall cost of the product. The products could be imported from another country such as China.
User Guides

Table 3. User Guide

There would be an instruction manual with the mask, giving basic instructions on how to use the mask. It will also have a warning attached, telling users to properly clean the mask before another person were to use it in order to prevent the spread of any diseases.

Re-design ideas/thoughts

If we were to redesign the mask for a third time, the focus would be on two major areas: finding a better overall plastic and making changes to the design in order to maximize user comfort. In terms of the plastic we chose, HDP, it was a fairly quick decision, as none of us know that much about plastics. If we were to go more in-depth in our research, we would likely find a plastic better suited for this product. We also did not focus much on the overall comfort of the mask. If the mask were to be comfortable, then more people would likely buy it, as they wouldn’t be as turned away by the uncomfortable design we have now.
References