Mission Statement

Team Heisenberg’s goal is to provide an inexpensive and effective means of charging a cellphone in low income nations, specifically those in Sub-Saharan Africa. We believe this will improve the quality of life and ease of communication in the region. The product is intended for rural, low income families, who stand to benefit from reduced expenses from owning a phone. In addition, cell phone and telecommunication companies could benefit from the product through the predicted increased use of cell phones.

Concept Development Summary
From research we learned that the country of Sierra Leone has a relatively high percentage of cell phone users, while still having little access to electricity. [1] This indicated the need for a low-cost way to charge a basic cell phone. Another aspect of Sierra Leone researched was the education in the country, which revealed that the country has a low literacy rate, and that there are many languages spoken throughout the country. [2] Knowing this, we prioritized simplicity in our first prototype, allowing for easy understanding of how to work the prototype through pictures.

![Figure 2. Sketches of early design ideas](image)

When developing initial designs, we stressed durability, efficiency, and cost. We believed that those were the most important and necessary features for the product. Having a low cost was deemed important because the intended market is low income families, where the income is as low as $1.50 a day. Durability was highly considered because we did not want the product to break easily and necessitate either maintenance or the purchase of a new product, incurring further costs on the targeted market. Lastly,
Efficiency was required of the product so as to be useful to those who bought it and so that it would be a viable means of charging a cell phone.

![Concept Scoring Matrix](image)

**Figure 3. Concept Scoring Matrix**

Through our concept scoring matrix, which emphasised durability, cost, and efficiency, we determined that a wristband solenoid design would best fit our customer’s needs. This design was chosen over a solenoid which would generate induced electricity from river currents and thermoelectric generators.

**Test Report for Prototype #1**
In order to test our first prototype, we conducted various experiments. The first test, as shown in figure 5, was a test of the device’s durability, which it passed, withstanding the weight of one of our members. As shown in table 1, we also tested the

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durability</td>
<td>Pass, withstood weight of person</td>
</tr>
<tr>
<td>Efficiency</td>
<td>20 days to full charge*</td>
</tr>
<tr>
<td>Simplicity</td>
<td>Pass, all asked understood</td>
</tr>
<tr>
<td>Cost</td>
<td>Passed, under $10 to produce</td>
</tr>
</tbody>
</table>

*Based on 15,000 steps a day. Does not take into account any other activity.
simplicity of the device by sketching picture diagrams of how to use it, and asked
members of the class to use the device. Everyone asked was able to use the device solely
through looking at the picture instructions. In order to test the efficiency of the device, we
calculated the induced electromotive force of the solenoids using Faraday's law, with
researched magnetic field strengths. We found that the device would fully charge a basic
cellphone over the course of 20 days. (Based on an average of 15,000 steps a day, not
accounting for other motions.) While this may seem like a long time, a basic cellphone
can hold a charge over the course of weeks, and does not need to be fully charged
everyday.

**Concept Refinement Summary**

Using data gathered from testing the 1st prototype, we realized we needed to
make the strap simpler, in order to make the product easier to use, as well as changing the
case to a more rigid material in order to increase durability. Feedback from the class showed a need for these improvements, as multiple people expressed confusion on the strap, and thought the case would not stand up to much movement.

Moving from our first to second prototype, we did not significantly change any of our design features. We refined a few dimensions on the solenoid inductors and of the case surrounding it. We did change the material of the case from foam to a high density foam, increasing the durability of the product while also reducing cost. We also switched to rare earth magnets, increasing efficiency due to the increased magnetic field strength. Furthermore, we changed the strap design to a simple nylon strip, allowing for the product to easily be secured.
Test Report for Prototype #2

Figure 6 Render of 2nd Prototype

In moving from our first to second prototype, we improved efficiency, simplicity, and durability. Through stronger magnets, the induced voltage of the Shakelite now charges a basic cellphone to full in 15 days, under the same conditions. The nylon strap is simpler to use and more intuitive than the previous design, allowing for quicker understanding and use of the device. The new high density foam (rendered as a clear glass in order to show the inside of the device) is more shock resistant than the previous foam, and is more waterproof. Both the nylon strap and high density foam also reduced the cost of the Shakelite, improving the cost efficiency of the device.

Cost Analysis

For cost, much research was done in looking into the wholesale of our prototype’s projected materials. The final cost of the main materials of the second prototype, these materials being the copper wire, the foam, the nylon, the polycarbonate, the magnets, and the capacitor, was found to be only $6.08. [3][4][5][6] This is well under the set ten dollar price constraint, and a dollar less than the main materials projected cost in the first prototype, which used a more expensive battery to store charge. This also leaves a lot
more room for the other not currently calculated costs, like the cost of manufacturing and product transportation.

**User Guides**

![Figure 6 Picture instructions for use of Shakelite](image)

**Re-Design Thoughts/Ideas**

1) The HESE students expressed that the prototype was designed well, with ease of use as top priority, keeping affordability and durability in mind. The evolution from prototype 1 to 2 enabled greater efficiency and reduced costs.

2) If the HESE students were to take on prototype 2 and develop it further; increasing efficiency to reduce charge time would serve as a great improvement. Our dream prototype would be much slicker and at least 20 times as efficient. Those two
improvements would not only make the product extremely effective but would also serve as a viable device to charge modern day smartphones and tablets.

3) As a whole we would use better manufacturing techniques to develop our prototypes so as to enable more accurate and practical tests. Eventually the ability to make a working prototype would aid the development process exponentially.

References