Prototype 1

Design Team 6

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As our team generated ideas for our first prototype, we determined that along with a physical representation of our design we needed to prioritize testing the filter. Since our idea revolved around filtering out sand, testing out different types of filters with different types of sand was the most logical prototype to first test out. We designed a filter with circular holes and 3D printed it out prior to the lab so as to maximize our time. We then proceeded to build a first draft of the hopper out of cardboard, attaching the filter and the ramps to the bottom. We designed our first prototype to be a scale model of what our final project will be. The reason behind this difference in scale was to save time (printing) as the results would be the same regardless of overall dimensions. During the lab we obtained other filters with different hole shapes and diameters and utilized them in our testing process.

Steps:

1) Design a prototype filter on Autodesk 360.
2) 3d print the filter
3) Gather the necessary cardboard
4) Collect cardboard, measure and fit the cardboard to the filter utilizing tape to secure it
5) Cut out stands and tape it to the 4 corners of the hopper
6) Cut out ramps and strategically place
7) Cut and install the rail blockers
8) Collect Sand and wet sand
9) Test

One of the largest threats to our design's success is the clumping of wet sand and its inability to be filtered out. Because our design revolves around the sifting of sand, it was crucial to have the filter component be tested as soon as possible. This prototype was intended to test and note failings of the filter, as well as be a physical model of our design.

The most critical component of the test was determining the effectiveness of our filter. It was paramount that we found if our design would sift the sand out of the hopper. Test objective 2 was ensuring that our mock cigarette butts did not pass through the filter along with the sand. The testing of this design gave us knowledge in relation to the filtering ability of our initial design as well as the ability of the filter to retain the small trash contained in the hopper.

The actual testing of our first prototype needed to involve challenging the sifting component of the hopper. Our overall project relied heavily on the outcome of this test which put a large

dependency on the results. If during the test the filter performed poorly we would need to consider changing the dimensions so as to let more sand pass. If in the case of the filter performing in a way that met our criteria, we would print another version that was in the exact dimensions of our final design product.

In order to properly test our prototype, we needed to first collect sand from a local park. Since the main goal of our project is to filter the sand from the hopper, determining whether the first prototype was able properly filter the sand was the main goal of this testing phase. In addition, we tested the sifting ability of other filters. When we tested the first prototype with wet sand, 3 mock cigarette butts and 2 water bottle caps, the majority of the sand was not able to filter out while the prototype was still. However, when we shook the prototype slightly to simulate the vibrations of Bowie as he moves, all of the sand filtered out of the hopper and down the ramps without any issues, while keeping all 5 items in the hopper. For the next step of the testing, we took wet sand and placed it in the hopper with the same 5 items and shook it slightly to account for Bowie's vibrations. When we did this, we noticed that the wet sand got stuck in the areas between the holes of the filter, and only a partial amount of the sand would be removed from the hopper. In the next step of testing, we tested filter 2 which was a square grid filter with 2cmx2cm holes. It performed extremely well, removing nearly all sand satisfying our design criteria. Since it was only used for the prototype it had not been set to the exact scale of the final design and therefore would need to be reworked in order to be used in prototype 2.

Analysis of critical components:

The filter:

The first filter evacuated the sand significantly less than our target specifications demanded. Having the 1st filter perform at the level it did requires a change in design. The 1's design was oriented towards ensuring trash did not pass, but as a result the sand had significant difficulty passing the sifter. The performance of the filter fell well below our requirements and would therefore need to be redesigned.

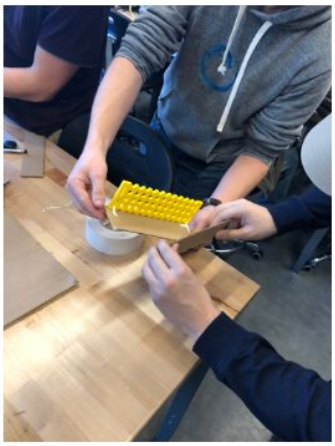
After testing the second filter, which had square holes with dimensions' of 2cmx2cm, we determined that a grid filter with similar sized cuts would be ideal for our design. During testing the filter evacuated the sand efficiently while keeping the trash in the hopper meeting all of our specifications. The risk of having trash pass through filter was addressed by having mock cigarettes interact with the sifter. Our team used many strategies and situations to try to facilitate the letting through of small trash. Of all the trials that were completed, the cigarettes did not pass the filter. Since the second filter met our design criteria, it will therefore be used to influence future designs.

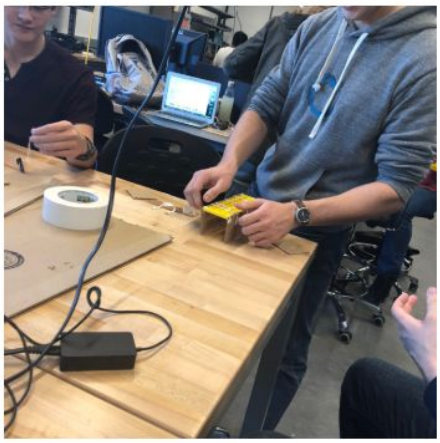
Ramps:

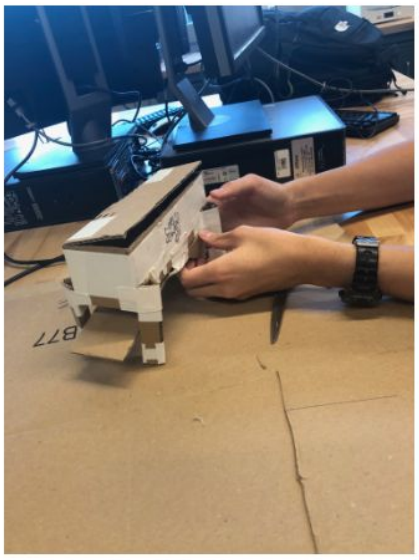
In order to properly remove the sand once it falls through the filter, the ramps have to be at a

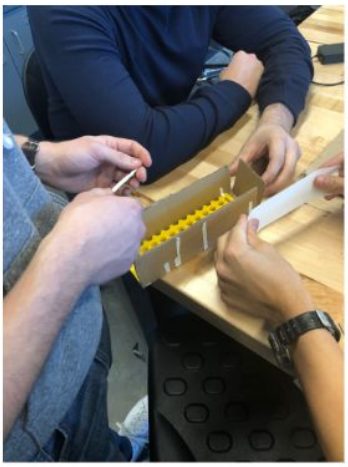
sufficient angle where sand does not stuck on the ramp. However, this angle can not be too steep since it would require the hopper to be raised too much, thus altering the weight distribution of Bowie beyond a comfortable margin (leading to unwanted instability). In order to be certain that wet sand would not get stuck on the ramp, we determined that the best angle for the ramps is 20-25 degrees.

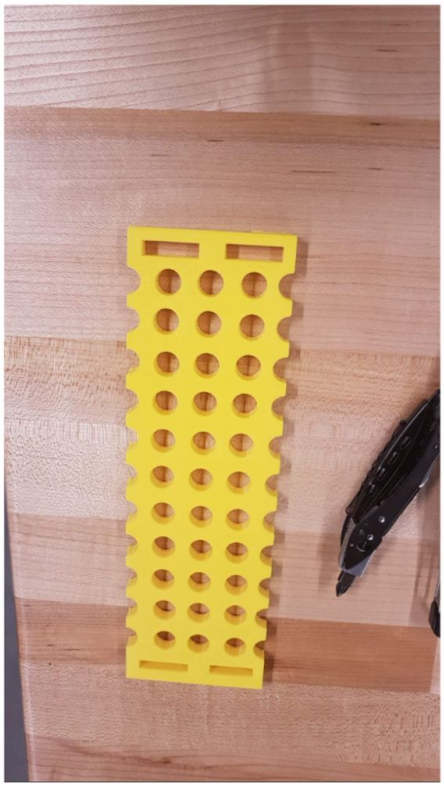
One issue we encountered while testing the ramp was where the 2 ramps came in contact with the filter. In this location, sand would get stuck and clog the center of the filter. This was because of the lack of space between the filter and ramps. In order to fix this, we will create a small peak at the center of the filter to diverge the sand from the center of the the filter.

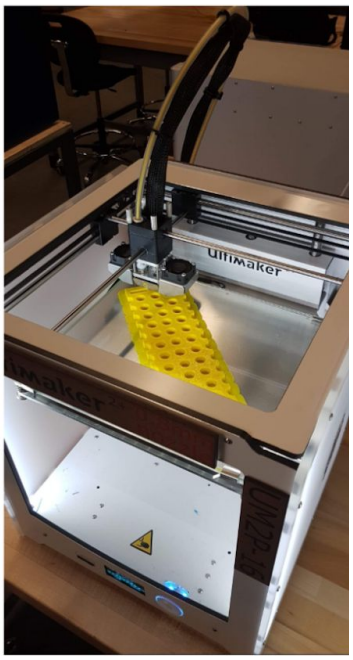








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