Project Deliverable H – Prototype III and Customer Feedback

GNG1103

Group 13

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Introduction:

This document will cover the third and final prototype of the modular heated sidewalk. This prototype is meant to be a fully functional example of the final product we set out to deliver. A focus will be made on the prototype testing, what goals should be accomplished, and how we will know when the tests have concluded. The prototype will be shown in images along with descriptions of what materials the prototype is comprised of, how it functions, and how it was tested. An explanation of the results from previous prototypes will be provided in order to justify the current version of the prototype, how it built upon previous successes and failures, and how it is the next step in our design process. Feedback from potential users and clients is also provided in order to gauge how our prototype fares in the potential marketplace.

Testing Outline:

This prototype is a fully functional heated sidewalk mat. The tests relating to this product are all to ensure that the product will be fully operational if implemented into the actual conditions of the project description. The tests are as follows: can the prototype melt a considerable amount of snow that falls on top of it? Is the mat able to be walked across safely in frozen conditions? Does it heat up uniformly and in such a way that energy is not overly wasted?

The first test is rather simple. It will consist of snow being dropped onto the prototype and seeing if the mat can melt the snow at a rate that would be sufficient to use outside during heavy snowfall. We will take fallen snow from outside which tends to be denser than falling snow, dropping it in such a way to simulate snowfall on to the mat, and observing the rate at which the snow melts. We will know if the test is successful once we get the rate of snowfall and compare that to the needs of what it practically must be able to do.

The second type will consist of a traction and comfort test. Water will be melted on the mat while still in freezing conditions and the mat will be walked upon numerous times in order to see if the surface provides sufficient traction to be traversed safely. It will also be important o check whether the mat is overly uncomfortable to walk upon, as it will have electronic components on the inside. This is important as the interior components may need to change if found to be too bulky. We will know whether the test is successful once the mat has been traversed numerous times in numerous conditions and found to have an acceptable amount of risk.

The final test is a test of uniform heating. A thermometer will be used at different ends and sections of the mat to ensure that all parts can do their job, and that there will not be snow build-up on any sections of the sidewalk. This will also let us know if the temperature of the heating element must be turned higher in order to melt the snow properly. Hopefully it does not need to be turned to such a temperature that the energy expense is deemed wasteful. We will know if this test is successful once the temperatures of the mat sections are tabulated and an optimal set temperature is found.

Prototype and Description:

This is the third and final prototype. This prototype encompasses all of the costumer's feedback as well as corrections we have made to our initial design. The main structure of the mat has remained then same. We will use a polyester topped winter mat. For the main heating element, we have opted to go with a simpler design as the components that we initially ordered were not what they were advertised to be. Instead of wiring the extension cord to a heating wire we will purchase a pipe warming cable. This is a cable that provides heat to ensure that pipes stay over freezing temperatures in the wintertime. This is the same goal we are trying to achieve with the sidewalk mat so it will work perfectly. We are still using the heat sensitive tape in order to attach the cable inside the mat so that it doesn’t move around at all.

A concern that the client had was that there was no sensor in our initial design in order to ensure that the mat wasn’t on all of the time and using unnecessary energy. This problem was resolved because the pipe warming cable has a built-in sensor that tells the heater to only turn on if the temperature of the mat is approaching freezing temperatures.

For the construction of the mat three layers of outdoor winter mat material was used. These three layers were layered on top of each other while the centre layer had a path cut out of it for the heating element to follow. By putting a centre layer of mat around the heating cable in ensures that the cable stays in place and also that the height will be constant in all places and there won’t be any budges due to the heating cable.



The heating cable was attracted with some duct tape to the bottom layer just to hold it in place while the centre layer of the mat could be cut out around the cable. The heating cable was laid out in this oscillating path to maximize the surface area of the mat that will be reached by the heat generated from the cable.



To finish the sidewalk warmer, a top layer of mat was secured to the top of the unit. Then this was all bolted together with six bolts. This is the surface that everyone will be walking on. The top layer is great for walking on as there is lots of traction from the polyester top and because of how level the surface is with no budges.



The bottom of the mat is a gripped rubber that sticks well on the concert sidewalk and prevents the mat from sliding around. There are six bolts that stick out of the bottom of the mat that hold the three layers together but also double as fasteners that will attach into the sidewalk bellow to ensure there is no theft of the mats.



On the heating cable is a temperature sensor that will control when the cable turns on and off. The cable will only turn on when the measured temperature is below freezing. If the temperature is above freezing, then there will be no snow and the mat can remain off. This will save money for the university as the operating cost of the mat will be much less then it would be if it was on all the time.



Explanation of Previous Results:

We get the mathematical result by ideal component composition, which works in one hundred percent efficiency. We used the quantitative number of our materials to plug into the calculation formula. It shows a perfect result works ideally without energy loss among components. When the tests begin, the experimental result might not reach the ideal figure.

For the stability of our project, we use bolts to fix the system to make sure the heated system and the mat can hold together. Also, at the bottom, there is a gripped rubber that prevents the mats movement. In this way, the sidewalk can be worked in a compact state.

Because we change the material in the heated system part, we replace the initial carbon heater tape, which connects to the cord to create energy, and alters it to pipe tracing heating tape cables. The heat energy changes into 42W. From the last project, we get the necessary power of melting 30.8kg of snow in 24 hours at a temperature of -25°C is 37.29 W so that this new cable could fulfill the need.

In addition, there is a sensor in this cable; it merely works when the temperature close to the freezing point. It reduces the loss of unnecessary heated energy. So that the cable created the energy under the freezing point. It spreads the energy to the surface, which leads to melting the snow. In this process, the heated energy can work in a high-efficiency way without extra consumption.

Feedback:

The users like the idea of the pipe warming cable which has the sensor that works when the temperature of the mat is approaching freezing temperature. This leads to make the mat heated, melting snow, and approaching a dry state all the time while it is snowing.

The users also encourage the bolts in the mat that increase the friction, and which make sure the surface is not budged and it will not be slipped.

For users’ safety, there are 6 bolts that the sidewalk heater will be attached to in order to ensure that there is no theft of the mats as our client wanted.

Conclusion:

The final prototype consists of a fully functional heated sidewalk mat. The matt is composed of a polyester-rubber rug with a heating coil running inside of it. The coil has a temperature sensor so that the mat saves power when weather conditions are not conducive to snow. The mat will be tested in order to show that it can melt a considerable amount of snow that falls on top of it, it is able to be walked across safely in frozen conditions, and it heats up uniformly in such a way that energy is not overly wasted. The conditions of our previous designs, prototypes, and tests have led us to think that this current prototype is optimal and will fulfill the clients needs. Feedback from potential users indicate that our product will be very well received.

Wrike:

