Heating mat

Deliverable F

Team 10

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Contents

Introduction

The goal of this deliverable is to devise a test plan, develop the first protype. A prototyping test plan will be outlines based on the "Prototyping test plan! Provided in lecture 11. Furthermore, a prototype will be developed, and it will be used to achieve the objectives the team has set out in this plan. This deliverable is divided into three main sections: prototyping test plan, 3D model of the Design, and finalized items bill.

Prototyping test plan

Why?

Why is this test being done?	Testing the prototypes allows the group to see the effectiveness and functionality of the prototype. It also is an opportunity to develop ideas on aspects of the product that was not considered before. In this case, testing the concept of an electric mat would also expose any safety issues with the wiring or heating component of the mat. Additionally, a test allows the group to check the feasibility of the design as the design was developed in a short amount of time and the group members' limited experience. Therefore, testing prototypes allows checking the effectiveness, functionality, safety issues, and feasibility of the product.
What are the specific test objectives?	Test objectives include the effectiveness, functionality, safety issues, and feasibility of the prototype. For our first prototype, we are using a computer aided design to model a 3-dimensional version of the concept. This method of prototyping allows us to see the dimensions of the exterior and how well the interior heating components and wiring will fit into the exterior. This allows the testing of functionality and feasibility of our concept.
What is communicated and learned through the prototype?	The prototype allows the group to learn the dimensions of the product and how functional or practical the concept is when it is developed into a 3-dimensional model. It gives insight into how to develop the second prototype in terms of appropriate sizing, available materials, cost management, and design adjustments. This is a learning opportunity for the group as the members lack experience, so this will communicate to the group about the adjustments on design and other aspects of the prototype to decrease its difficulty. The knowledge from prototype 1 can be converted into building a second prototype which can be made physically.

How are results assessed?	Results are going to be measured qualitatively instead of quantitively. Since this is the group's first prototype, results will be categorized under "practical" or "non-practical". This allows space for improving the aspect in question without requiring the building of a physical prototype. The tested aspects of the prototype can be assessed on a scale of 1-5 with five being the most practical and one being least practical. This method of assessing results allow the group to understand how well the prototype can meet the client's needs and adjust the next protype accordingly. Furthermore, building a physical protype and testing the functionality of each component is an ideal test, but the time constraint and decreased accessibility to resources makes the current assessing method ideal.
What are the criteria for success and failure?	In general, this prototype will be testing if the product can be built physically while meeting the client's needs. If the prototype can meet all or most of the client's needs, then it is a success, and the next prototype will be influenced greatly by this prototype. If the product fails to be a practical method to meet the client's needs, then the failed categories will be ameliorated to make an improved product.

What

What is the prototype?	The prototype will be presented both physically and analytically. In deliverable F, the prototype will be described analytically while it will be represented physically over the last two prototypes (deliverable G and H). The prototype will be described analytically first to visualize the final look accurately. This will allow the group to have a good estimation of the dimensions and the body of the design (exterior). Accordingly, the group will be able to apply changes accordingly. On the other hand, the design will be described physically to actually know if it would work. It will be built using simple items. Refer to the last section of this deliverable.
What materials are required and what is the approximated cost?	For the analytical design: - CAD For the physical design: - Snow melting heating cables. - Anti-slip waterproof silicone rubber sheet.

	- Temperature and humidity sensor for Arduino. - Resistor kit. Refer to the last section of this deliverable for more details.
What is the test setup? How will you build the prototype?	The analytical design was built using CAD from the previous knowledge gained in this course. The physical design can be built using the following procedure: - Place a silicon rubber sheet on the floor. - Place the snow melting cables on the silicon rubber sheet and apply glue to it to stick it. - Adjust the resistors, humidity and temperature sensors to the design. One could refer to YouTube for guidance. - Place another silicon rubber sheet at the top.

How

What information will be measured? Is this important data?	From the physical description of the design, one can test if the mat will melt snow. One can obtain the rate at which snow will melted, required energy for the mat to work, and other data. All this data is important to know whether the design will work or not. For example, we need to know the rate of snow melting as this will determine if the design successfully works. If the snow melting rate is more than the snow falling rate, then our design would work.
How will the results be recorded?	Initially, since the protype is simple, no major recordings are required. All what matters at this point is to make the mat works. After performing multiple tests, one can start upgrading the research by collecting the rate of snow melting and such. The recordings will be stored in a control panel that will be installed later.

When

How long will the testing take and are there any dependencies for the testing to happen?	The tests will take a few hours as it is going to be judged by the team members and other potential users of heating mats such as family and friends. There are no dependencies as it is a model made on an online software which is accessible to everybody.

When are the results required and what depends on the results?	The results are required before 7 March 2021 as it is due date for Deliverable F. The results from this protype will influence the second protype's developments. Without this prototype's results, the group cannot improve the product and it will delay the rest of the project plan. The Gantt chart provided explains the estimated test periods with the given time constraints taken into consideration.

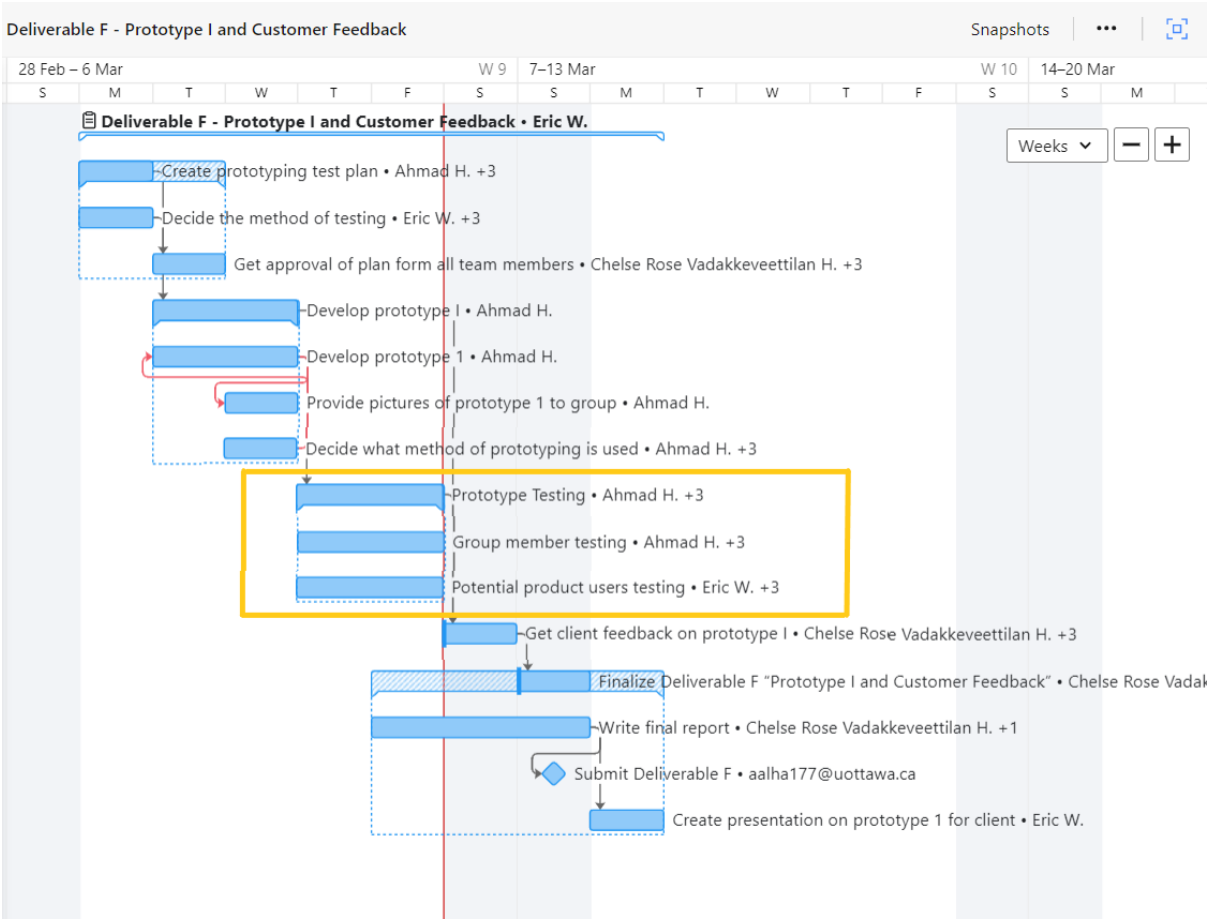

Figure 1. GNG1103 Team 10 Deliverable F Gantt Chart (yellow squared part indicated testing period)

Bill of Materials

Materials needed for prototype II

Item	Cost	Link to item
Snow melting heating cables	CDN$54.40	https://www.amazon.ca/PRIME-RHC150W30-Gutter-Icing-Heating/dp/B01M4S4QJ1/ref=pd_di_sccai_2?pd_rd_w=IWxCk&pf_rd_p=e92f388e-b766-4f7f-aac1-ee1d0056e8fb&pf_rd_r=QYR6P2EGESYPXZ4PX1Y1&pd_rd_r=436e6046-cf9b-44aa-a778-97812222819b&pd_rd_wg=0DxhJ&pd_rd_i=B01M4S4QJ1&psc=1
Anti-slip waterproof silicone rubber sheet	CDN$16.72	https://www.amazon.ca/Textured-6x6-Inch-Neoprene-Plumbing-Protection/dp/B01MQ0VBJ0/ref=pd_sbs_7?pd_rd_w=1QpbE&pf_rd_p=ac0ba40f-1b2a-4803-91f7-9d36ccf6dbf9&pf_rd_r=3WCVAN2Q5KJ3RVQ68BTM&pd_rd_r=18054d53-c9cb-4fe9-942a-69bb88d12a47&pd_rd_wg=nv99w&pd_rd_i=B01MQ0VBJ0&th=1

Prototype II will cover the most expensive materials used in the system as we will test the most critical part of our design with this prototype.

We will reuse the materials purchased in prototype II for prototype III, here is the list of improvement parts to be purchased for prototype III.

Materials needed for prototype III

Item	Cost	Link to item
Temperature and humidity sensor for arduino	CDN$14.99	https://www.amazon.ca/DSD-Temperature-Humidity-Arduino-Raspberry/dp/B07CM2VLBK/ref=sr_1_6?crid=1ME7L2AVKBNA5&dchild=1&keywords=temperature+and+humidity+sensor+arduino&qid=1615137809&sprefix=Temperature+and+humidity+sensor+%2Caps%2C171&sr=8-6
Resistor kit	CDN$7.49	https://www.amazon.ca/Projects-100EP5141K00-Ohm-Resistors-Pack/dp/B0185FGTSS/ref=pd_sbs_2?pd_rd_w=Ucbco&pf_rd_p=2e4406eb-8a85-4054-91ce-de4164472fa9&pf_rd_r=37GMW7RQK9D2542C6ASH&pd_rd_r=58815ec4-ccb0-41f3-a94e-4295315d4bef&pd_rd_wg=TDuac&pd_rd_i=B0185FGTSS&psc=1

*All purchases will be done on amazon, the final amount with shipping and taxes included is CDN$99.55.

3D model