The Robins

Deliverable F - Prototype I and Customer Feedback

Maria Hal: 300344919
Jonathan Pereira: 300360439
Lara Al Nakeeb: 300404916
David Whitehead: 300421446
Sophia Hos: 300432663

Client: Frederick Conn

Introduction

Our first prototype is a 3D-printed model of an insulated case designed to hold the vibration sensor. Its purpose is to protect the sensor from all weather conditions, ensuring it remains dry and concealed. The prototype is constructed from MDF and consists of six pieces: the top, base, and sides. One side opens up to allow for battery replacement if the sensor becomes inoperative. The design was created using Inkscape, as shown in Figure 1. We have begun testing to evaluate the case's water resistance and durability. During testing, we identified small gaps between the sides that allowed water to seep in, which is why we have to search for a solution to address this issue. Which is the objective of this deliverable, to enhance the prototype based on our test results.

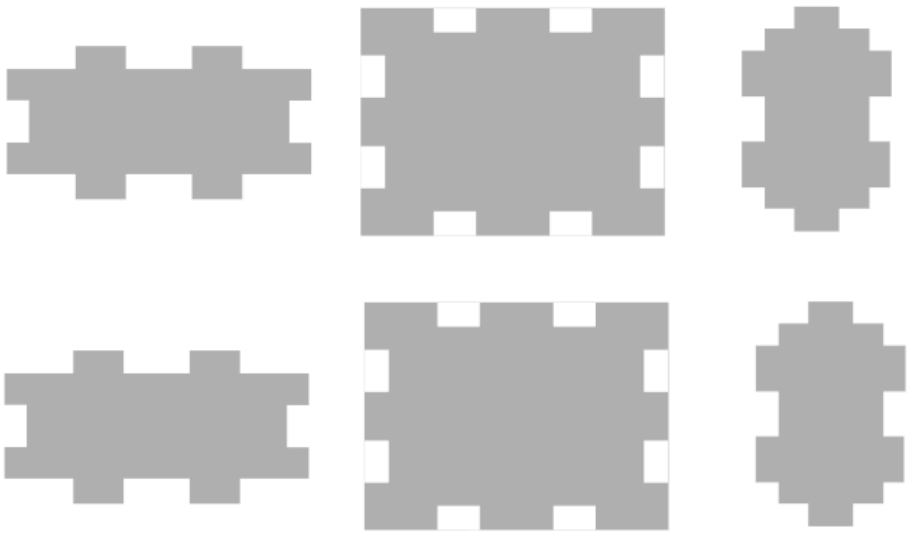

Figure 1. Inkscape Design of the Sensor Case

Analysis of Components and Systems

For prototype one, we chose to make it out of MDF, through laser cutting. Making the template and printing the case took a total of two hours, however assembling it took about roughly ten minutes. Given that the prototype is similar to puzzle pieces, the only issue was if it was loose, we would use wood glue to make it sturdy. In later prototypes the case will be made of cedar wood, and would be assembled either by wood glue or screwed together. A hinge along with a latch will be added on one of the sides, in order for it to open to replace the battery the sensor is using. To make sure no water seeps in, we might use wood oils, in order to seal off the sides, and ensure no water will damage the sensor.

Prototype 1 Test Results

Test 1
This test was done by testing the assembly of the sensor box. Considering the box design is not complicated, it was done within 15 minutes. This time did not include the time it took to cut out the pieces needed. Including the material prep time, the total moves up to about 2 hours. However because some of the pieces did not properly fit together, the design was changed for the proper metrics.

Test 2
The next test was for durability. We ended up dropping the box from a high level to see if it broke. It ended up breaking, we are assuming due to the glue. For the assembly, we used hot glue, which is less binding than wood glue. This means that part of our budget will need to be used for proper glue or the use of screws.

Test 3
Considering that the box will need to withstand Ontario weather, the next test was for water resistance. The test included adding water to the box and seeing how it impacted the material and if it leaked. It ended up leaking through mostly the corners and the material itself was not moisturized. For the next prototype, we shall add some type of sealant and test the material's reaction to prolonged water impact.

Test 4
The next test was for access. Originally the design included hinges so that the box would open on one side, but due to a laser mishap, they were cut off. Due to this, the box itself could not be tested properly. This means for the next prototype, the way the user will be able to access the sensor will need to be changed.

Test 5
For the last test, we checked the durability of our material. It’s very important that the material itself does not bend or break. To do this, we placed three textbooks on top of our little box. This was done twice, the first time was done on one side, and the other, the box was rotated and the test was done again. Both times, the box did not break, meaning that the material we’re using will stay the same.

Customer Feedback

Our customer feedback included the following comments:

- No post for mounting the bat box needs to be considered for the design.
- Mounting supplies must be included in the pricing and materials of the bat box.
- The design of the sensor should work for preexisting bat boxes (aka easily applicable to bat boxes that are already deployed). This is considered through our single-package design for the sensor.

- Exactly what data/inputs the sensor is collecting needs to be relayed to the client. For instance, the amount of force needed to trigger the vibration sensor needs to be clearly defined. This is something we will consider during calibration. Along with this, the limitations of the sensor must also be clearly outlined to the client.
- The box will only be in use from April to October, so extremely cold temperatures and harsh winter weather generally do not need to be considered.
- Large external forces, such as heavy weights on top, do not need to be considered in the design process.
- The aesthetics of the box do not need to be considered.
- The spacing inside the bat box chambers should be ¾" in width for ideal roosting conditions.
- A door on the front or bat may significantly interfere with the bats. With this in mind, we have changed the location of the hinged door to the top.
- During our next meeting, we should explain our decision-making more thoroughly to back up our ideas and explain why we made certain decisions.

We will take these comments in mind as we design our future prototypes and continue to develop the product.

Prototype 2 Test Plan

Test ID	Test Objective (Why):	Description of Prototype used and of Basic Test Method (What):	Description of Results to be Recorded and how these results will be used (How):	Estimated Test duration and planned start date (When):
1	Test the assembly time.	Putting together the sensor box.	We will record how long it takes for us to put together the box	Estimated time: 15 mins Should be done before: Nov 9th
2	Test the durability	Test how much the weight the box can withstand	We can record the weight by adding weights (textbooks) onto the box and test the durability	Estimated time: 30 mins Should be done before: Nov 9th
3	Test the water resistance	Testing the sensor box by putting it through water tests.	Add water to the inside, if water leaks out, it means water can also get in. Additionally cover the box with water and	Estimated time: 30 mins Should be done before: Nov 9th

			wait 2 hours to see the impacts it has on the materials	
4	Testing the box's endurance	Testing to see the how much of an impact the box will take	Dropping it from different heights and seeing at what height it would break apart	Estimated time: 30 mins Should be done before: Nov 9th
5	Test the sensor inside the box.	Test how the sensor responds to vibration inside the box	Record the data from the sensor through the different impacts the box will take and narrow down the sensitivity	Estimated time: 3 hours Should be done before: Nov 9th

Revision of Specifications & Design

We will need to change the bonding method used for the next design, as hot glue broke quite easily under strain or impact. We also will add weatherproofing in the form of either a silicone based or caulk type sealant around any cracks in the box, and around the door. The second prototype will include the electronics system, and will feature mounting either via adhesives or screws to a demo bat box.

Conclusion

After thorough testing and evaluation, we identified several issues with the prototype. One significant concern is the water seeping inside the box, which increases the risk of damaging the sensor in rainy conditions. This issue is important, as protecting the sensor from liquids is essential. Additionally, we identified the need for a more durable design that can withstand potential impacts and environmental changes, ensuring the box remains intact in the event of any impacts. With these considerations in mind, we aim to resolve all these problems in the second prototype. Our goal for prototype two is to enhance the functionality and durability of the case to better protect the sensor.