GNG 2101 - Report
Waterproof Hearing Aid
Deliverable D - Prototype

Written By:

GNG 2101 - Team A4

Omolola Omowa, 300130234

Benjamin Losier, 300051021

Brandon Joseph Broderick 300128727

Rehana Lawrence, 300124577

André Lacroix, 300117612

Submitted On:

Thursday October 8th

University of Ottawa

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1. Introduction

The objective of this deliverable is to create and present our first prototype. Prototypes are used to test assumptions made about our concept. Each prototype has a purpose this report will serve to outline said purpose. The results from this report will be presented to our client to ensure the product continues to meet her needs.

2. Client Feedback

Our second client meeting was successful, the concept of a water resistant case was able to satisfy our client's needs. Our goal with this case is to not only protect her current hearing aid but increase its current functionality. We gathered information on the make and model of her hearing aid (WiDex Evoke) in order to find its specifications online.

3. Updated Design

The design chosen is the waterproof hearing aid cover, this idea allows us to solve our client's needs while ensuring the final product is functional and reliable. Compared to our initial concept we aim to create battery level estimator software to accompany this design to increase functionality and allow her to go to work everyday knowing her hearing aid has enough power to last the entire day. The material used for the cover will be ABS plastic, this case will be modelled in SolidWorks and 3D printed at Makerspace.

4. Preliminary Bill Of Materials and Parts

3D Printed ABS	10$ + Design Specific Quote
Hydrophobic Mesh (Gore-Tex Fabric Patch)	16.82$ + tax
Ninja Flex Gasket	10$ + Design specific quote
Ninja Flex Push Button Cover	10$ + Design Specific Quote

Critical Product Assumption

We are assuming that our product will be water resistant. This will be done through finding a waterproof or water resistant material. The material selected will be used to create the shield that will be modeled after the client's current hearing aid. We assume that the design will be comfortable for the client and ease any strain on her ear.

We are also assuming that our product will be able to give the client an approximate calculation of the battery life of her hearing aid.

Prototype

The purpose of this prototype is to ensure that there are no difficulties or problems with the chosen concept.

The first part of the prototype is that of the water resistant shield. The main purpose of the water resistant shield is to allow the hearing aid to become resistant to penetration by water. For this to be achieved the shield has to be made with a fabric that is waterproof or coated with a waterproof material (waterproofing spray). The material chosen for this prototype has to be thin enough not to interrupt the quality of the hearing aid's amplifier and microphone. The shape of the shield takes that of the hearing aid as it has to be fitted enough to prevent the hearing aid from slipping out. The figure below is a sketch representation of the water resistant hearing aid shield.

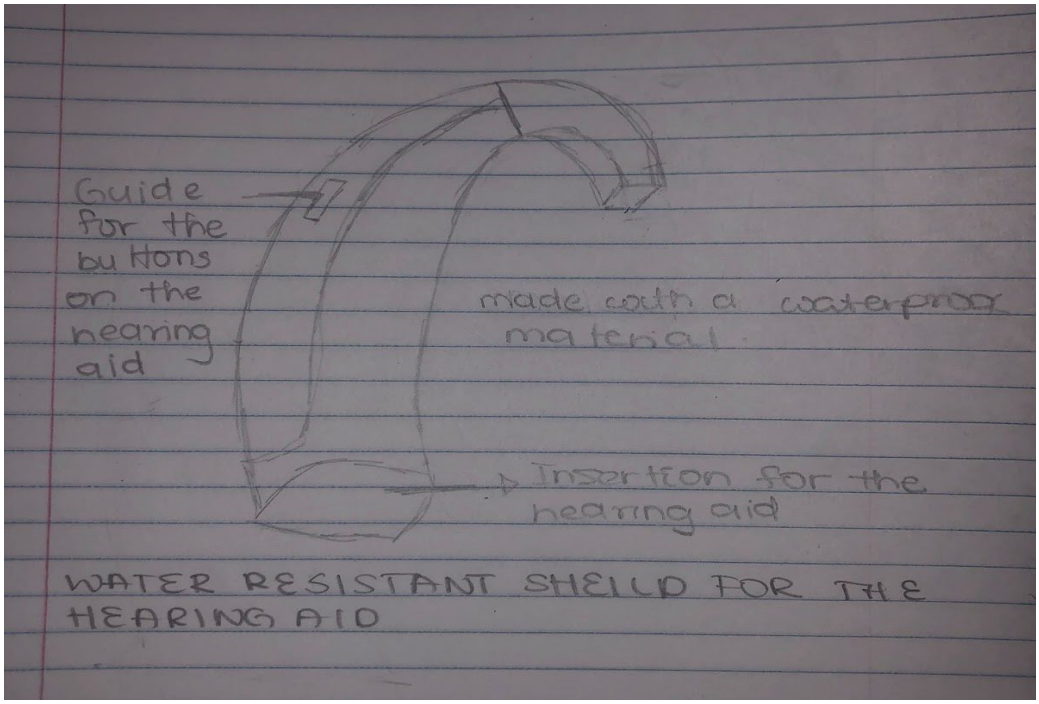

Figure 1. Shield Sketch.

The second part of the prototype we designed is for developing the software we are building to calculate the battery level of the clients hearing aid. The purpose of this is to design software that would notify the user an estimate of the battery life. This would allow the user to know the battery life during the day. Below is a flow chart of how the app will perform.

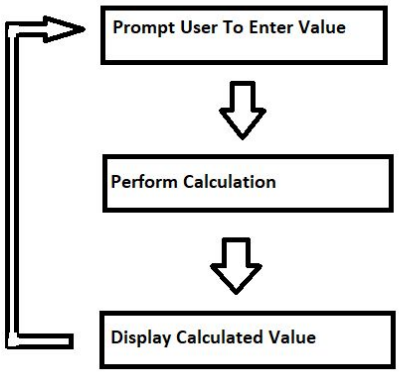

Figure 2: Program Flow Chart.

As the diagram illustrates the program will have 3 simple steps, then the client will have almost the exact amount of time remaining in the battery before it dies. Every battery has a specific Amp-Hour(AH) rating which indicates how long the battery can supply the specific amount of current for, we will use this value and the value for the amount of time the hearing aid has been on for to calculate the remaining battery life .We plan to build this software and then deploy it using an app the client can download. We will build the user interface for this app in our second prototype.

The third part of the prototype was testing materials that would allow for the most water resistance. Through research we found a material that may work called Acrylonitrile butadiene styrene (ABS). ABS has properties that allow for it to be waterproof. We think that this may be a good product to use because it is quite inexpensive, damage resistant and it is harmless because it does not have any toxic carcinogenic properties. Due to the fact that we are unable to 3D print a random object made out of ABS to test in such a short amount of time, we found the next best alternative which was to test items in our house made of ABS. These items include LEGO, keyboard caps and plastic binders.

Experiment Outline:

Components:

-ABS SpaceBar from a Keyboard
-Shallow Dish
-Toilet Paper
-Tap Water

Procedure:

The space bar will be laid across the shallow dish and filled with the tap water. Toilet paper will be placed at the bottom of the dish to catch any water that would seep through the ABS if it is not waterproof. The toilet paper will be checked for moisture after 15, 30 and 60 minutes. If after all three checks the toilet paper is still dry we will consider the ABS water resistant for at least 1h.

Figure 3: Experiment Components

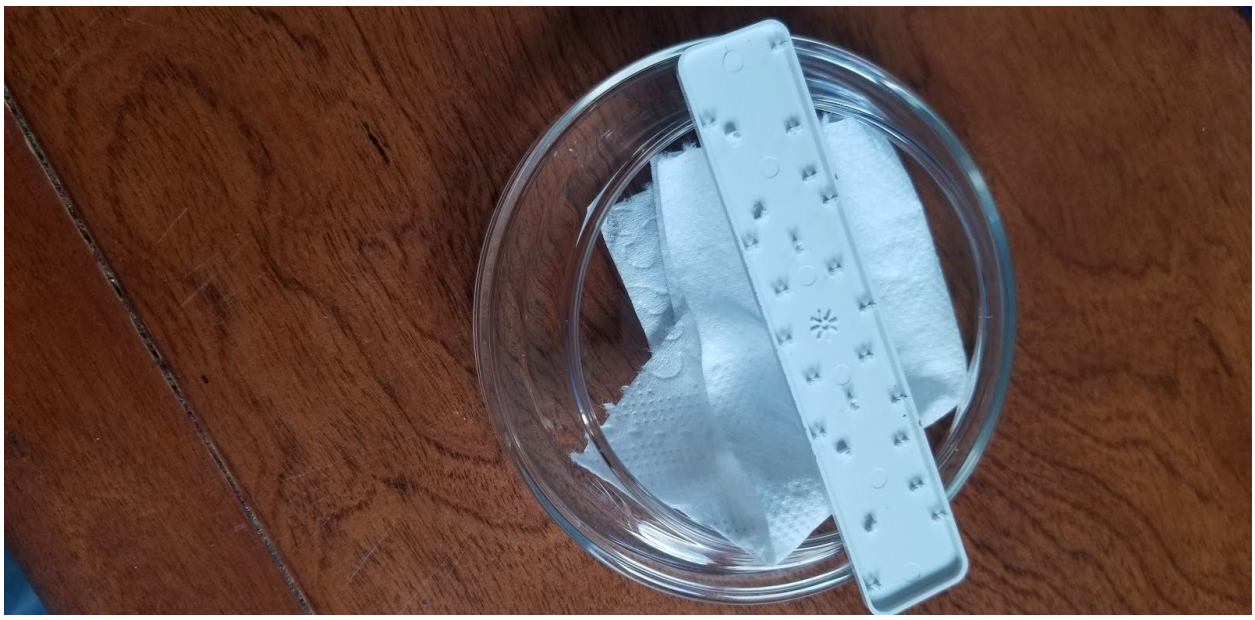

Figure 4: Experiment Setup

Results:
15mins: Toilet Paper fully dry
30mins: Toilet Paper fully dry
60mins: Toilet Paper fully dry
Conclusion/Limitations: This experiment does not test for water under pressure or for water resistance while submerged. Therefore we cannot claim that ABS is fully waterproof but we do know that ABS should be able to withstand moisture from sweat or from rain water with no issue.

The fourth and final part of the prototype is a crude engineering design of the shield and its components. The purpose of this prototype is to identify how the shield will be built and how all the parts will come together practically. Thinking through this design is also useful to ensure no obvious issues have been missed and our bill of materials is complete. **Figure 5** and **Figure 6** below fit together to form the complete ABS shield, NinjaFlex is used for the push button as well as for the gasket creating a seal between the two parts. A Gore-Tex mesh is used over the microphone to allow sound to pass through but prevent water from seeping through.

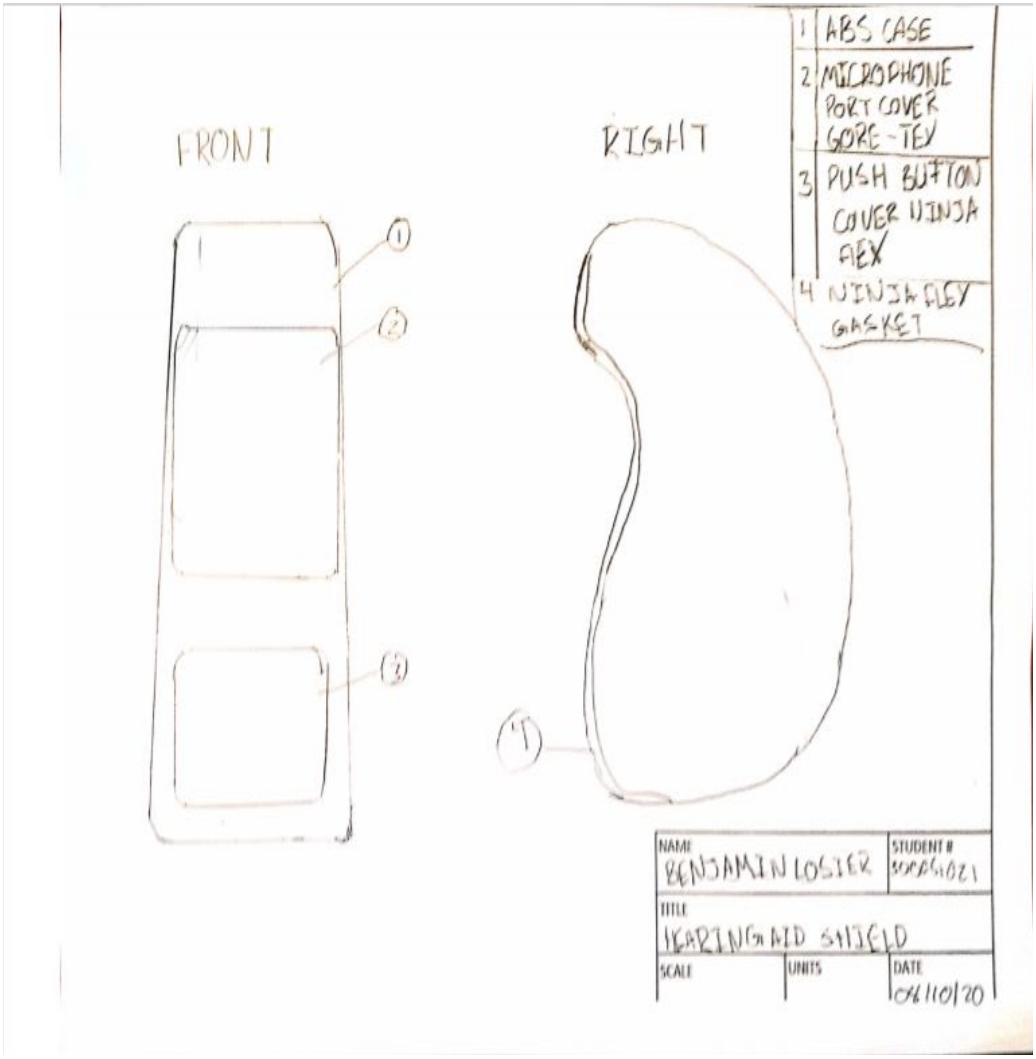

Figure 5: Hearing Aid WaterResistant Case

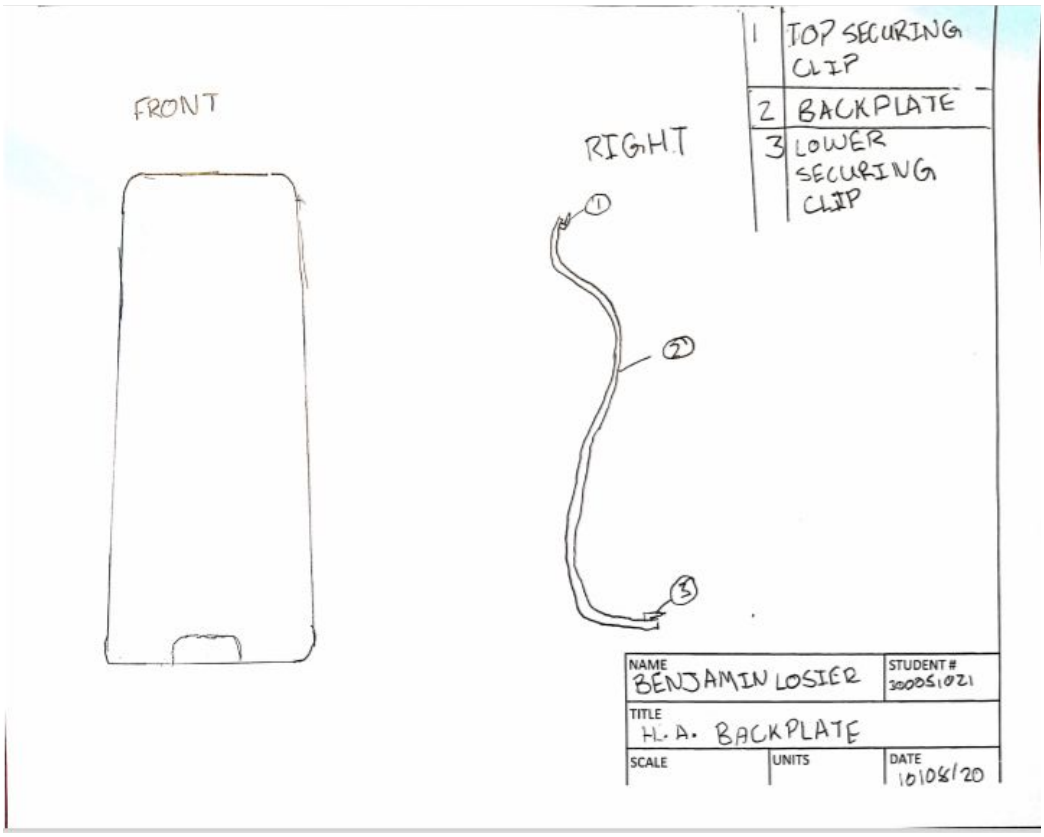

Figure 6: Hearing Aid WaterResistant Case Backing Plate

Conclusion

Through our second meeting with the client, we managed to specify our design plans into a waterproof case for their existing hearing aid and an app to facilitate the measuring of the battery life of the hearing aid. We've currently decided on using Acrylonitrile butadiene styrene (ABS) as our case material for its ease of access and ability to be modified easily, as a commonly used 3D printing material. While we haven't yet been able to show it being waterproof, online research suggests it is and a simple experiment has been performed that shows it's water resistant. As for the application, it will ask the user for the current time utilising the hearing aid, and will calculate the remaining battery life accordingly then display it to the user.