GNG2101 Report

Water-Resistant Hearing Aid
Project Deliverable J- User Manual

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Submitted by

GNG 2101 Team A4

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Abstract

At the beginning of the course, we were tasked to find a solution to help our client who lost the ability to hear through the right ear by adding additional features to her current hearing that would make the hearing aid more effective. For this to be accomplished, certain constraints were respected. Budget and time were the most important constraints that were associated with this product. Cumulatively, an idea was chosen as a potential solution to our clients needs. Using various techniques and acquired knowledge we were able to create a product. In order to get the best quality of our product, we had three different prototypes, the third one being the final prototype. Overall we developed “DIVE” a water-resistant hearing aid case accompanied by a battery level indicator that the client can use with her current hearing aid. This was done by 3D printing a case with ABS material and developing a web app that helps to indicate battery level.

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Introduction

A hearing aid is a small electronic device that is worn in the ear. Its main purpose is to improve the quality of sound. It makes some sounds louder so that a person with hearing loss can listen, communicate, and participate more fully in daily activities (nidcd.nih.gov). Study shows that 4.6 million Canadians had hearing problems and only 25% wore a device since the device is not suitable for everyday life (Statistic Canada). Most people that use hearing aids have to take certain measures to prevent the hearing aid from moisture. Not only people engaged in water sport are in need of water-resistant protection for their hearing aid but also individuals who go about their daily activities and individuals who live in arid climates. Some people may not want to buy a water-resistant hearing aid because of the cost or because they own a fully functioning hearing aid but would still like some kind of protection. This where the water-resistant protection case comes in. People generally tend to forget things or lose track of things, that being said a person who uses a hearing aid may forget to charge the battery (if rechargeable) or change the battery. When this happens, the battery dies when the hearing aid is still in need, and this can serve as a problem for the user. With a battery level indicator, the user would be able to estimate the amount of battery life when such a problem occurs.

That's why our group found it important to design a water-resistant hearing aid and a battery indicator that can be bought separately but still function with any current hearing aid. Our product, dive, is better than what it's on the market for several reasons. First, Dive is really affordable and can be made to work with any current hearing aid. The cost of the hearing aid case is less than $100 compared to the cost of the new water-resistant hearing aid currently available in the market. Secondly, dive has the option of a battery indicator that gives an estimate of the hearing aid's battery life. As we can see, Dive is a product designed using a versatile concept to help improve the features of current hearing aids.

Features

The case allows the hearing aid user to go about their daily lives without the concern of water damage from rain or humid climates. When the user receives the product, they will receive the 3D printed case that will come in a bag. The bag will contain the front and back components of the case. The case is made out of ABS plastic so it will not deteriorate easily from direct impact such as dropping. In the bag, there will also be instructions for the usage of the web app. The web app will be fairly useful for the user as it will help them to plan their day accordingly. The key feature of the web app is that it accounts for uncertainty. This is a crucial feature as we can not expect users to know exactly how long they have been using their hearing aid.

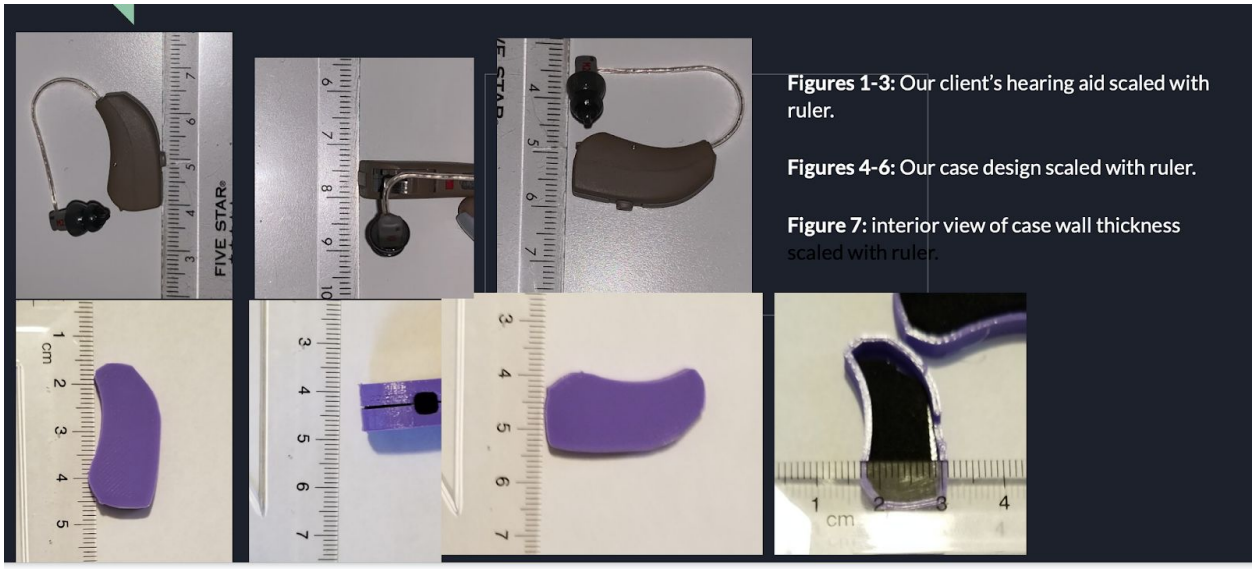
Instructions

The case was made using ABS material and a 3D printer. The case was designed using CAD software and downloaded to the 3D printer. Below is the final design and a detailed description of how it was created.

3D Model:
This preliminary design of the case demonstrates the idea behind it's functionality. The client's hearing aid will be enclosed within these 2 ABS shells that will fully cover the hearing aid.

How it's made:
This 3D model was designed using scalable vector graphics (.SVG file) and a direct profile view picture of the client's hearing aid. Using photo editing software to convert the profile view into a silhouette type view it is possible to convert the image into a usable .svg file. This profile can be directly uploaded into fusion 360 CAD software to create a fully defined sketch.

Below is a screenshot of the printed case next to the hearing aid.

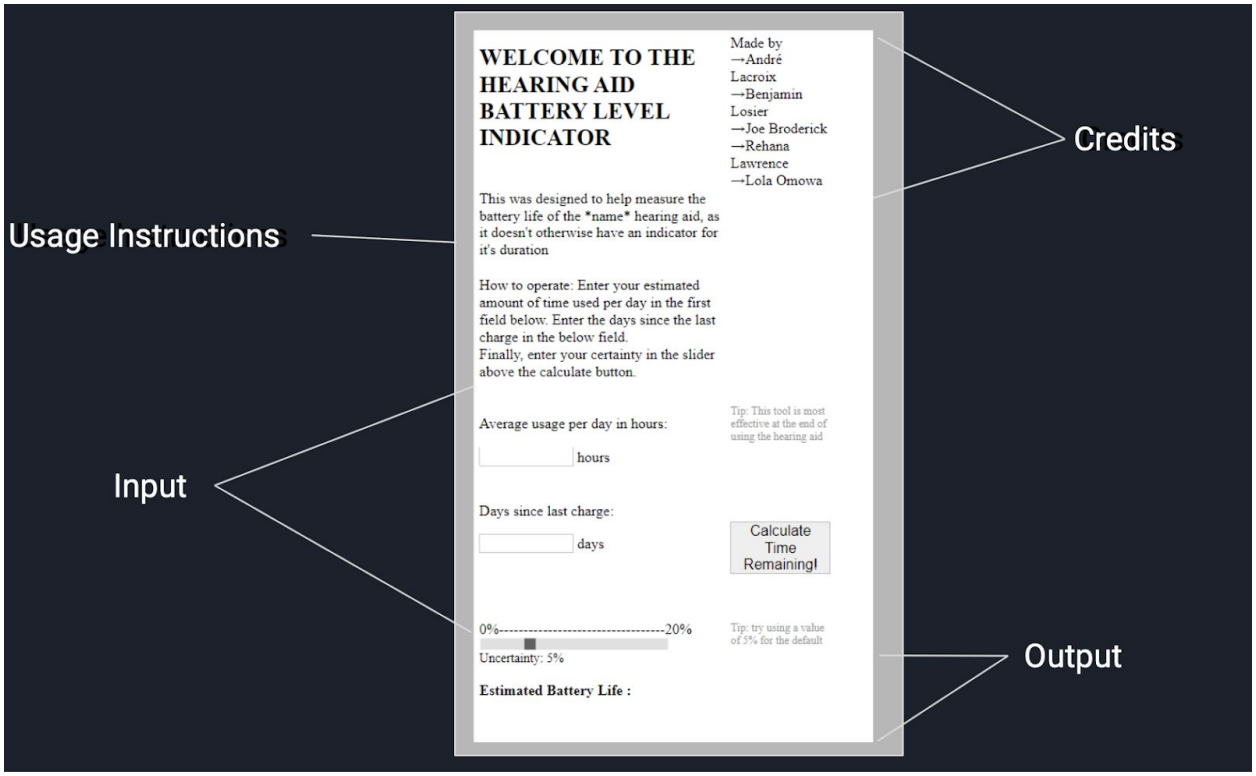


Figures 1-3: Our client's hearing aid scaled with ruler.

Figures 4-6: Our case design scaled with ruler.

Figure 7: interior view of case wall thickness scaled with ruler.

To use the case all the user has to do is open the case and insert the hearing aid, ensuring it is properly aligned, and then close the case.
The application to calculate the remaining battery life of the hearing aid is very simple to use. You must download the software onto your computer, and input the appropriate values. Below is a screenshot of the app.



How to operate the app

First, enter the average amount of time the hearing aid was in use since the last charge in hours.
Next, enter the amount of days of use since the last charge in days. (If decimals are used, they must be represented with a period [.] and not a comma [,])
Then, if you feel very or barely certain about your numbers inputted, drag the uncertainty slider based on your confidence (It's recommended to not lower it past 5%)
Finally, click on the button labeled "Calculate Time Remaining!" to display your output on the bottom of the screen.
The battery life will be indicated in hours and as a range of 2 values, unless the uncertainty slider is set to 0%. The larger of the values is the best case battery life for the hearing aid, and the smaller value the worst case for the battery life.
A helpful message will also be shown at the bottom right of the screen, which will display the need to charge the hearing aid based on the worst case battery life estimate.

Health and safety guidelines and precautions

Please make sure to keep the case away from small children or pets. If ingested, call 911 or go to the nearest hospital. Try to keep the case out of direct sunlight as the sunlight can affect the effectiveness and durability of the case.

Technical/Troubleshooting instructions

If the case is not working properly it is probably because it was not inserted correctly. Take the hearing aid out and ensure it is aligned properly with the border of the case.If there are issues with the website simply reach out to the creator of the software and he will be able to help.

MakerRepo Design File

This section provides a link to the MakerRepo website where one can find all the design files created for this project. Each file has a clear name, so one will be able to know exactly what kind of content is in the file. The link is below.
https://makerepo.com/joeyB/water-resistant-hearing-aid-cover-a4

This document will also include a link to each design file with a description of what it entails.

The first document link is below:
GNG2101_Deliverable B.pdf
The document contains the design criteria and main user needs for the project.

The second document link is below:
DeliverableC_TeamA4.pdf
The document contains a high level functional decomposition and all of our concepts.

The third document link is below:
Deliverable D Prototype 1.pdf
The document contains our client feedback and critical product assumptions

The fourth document link is below:
Deliverable F-2.pdf
The document contains the business model.

The fifth document link is below:
Deliverable G Proto 2.pdf
The document contains our second prototype and a detailed analysis.

The sixth document link is below:

GNG 2101_Project Presentation_TeamA4.pdf
The document contains our presentation half way through the project to our class. Sums up important topics

The seventh document link is below:
Economics Report.pdf
The document contains our expected cost if we started a company that created this product

The eighth document link is below:
GNG2101 Presentation.pdf
The document contains our final product and final class presentation

The ninth document link is below:

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The document contains the CAD files used for 3D printing

Conclusions and Recommendations for Future Work

There were many lessons learned throughout the designing process. We learned to start working as early as possible in order to develop the best product and settle any unexpected problems. Make sure to organize tasks in some sort of organizing software to keep on track. It is also important to evenly distribute tasks. Good communication among team members is essential and that prototyping is a very useful way to communicate with the client to be certain that all of the client's needs are satisfied.

Bibliography

Gouvernement du Canada, Statistique Canada. “Taux De Perte Auditive Chez Les Canadiens De 20 à 79 Ans : Résultats Audiométriques De L'Enquête Canadienne Sur Les Mesures De La Santé De 2012-2013.” Gouvernement Du Canada, Statistique Canada, 27 Nov. 2015, www150.statcan.gc.ca/n1/pub/82-003-x/2015007/article/14206-fra.htm.

Hall, Jeff. “Guide to Waterproof (Water-Resistant) Hearing Aids.” ZipHearing, 27 Mar. 2020, www.ziphearing.com/blog/waterproof-water-resistant-hearing-aids/.

“Hearing Aids.” National Institute of Deafness and Other Communication Disorders, U.S. Department of Health and Human Services, 6 Mar. 2017, www.nidcd.nih.gov/health/hearing-aids.

Appendices

Bill Of Materials

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
Neoprene foam tape 1/16 inch	$18.46