GNG2101

DELIVERABLE C

Submitted by

TEAM B21

BEECH, COOPER

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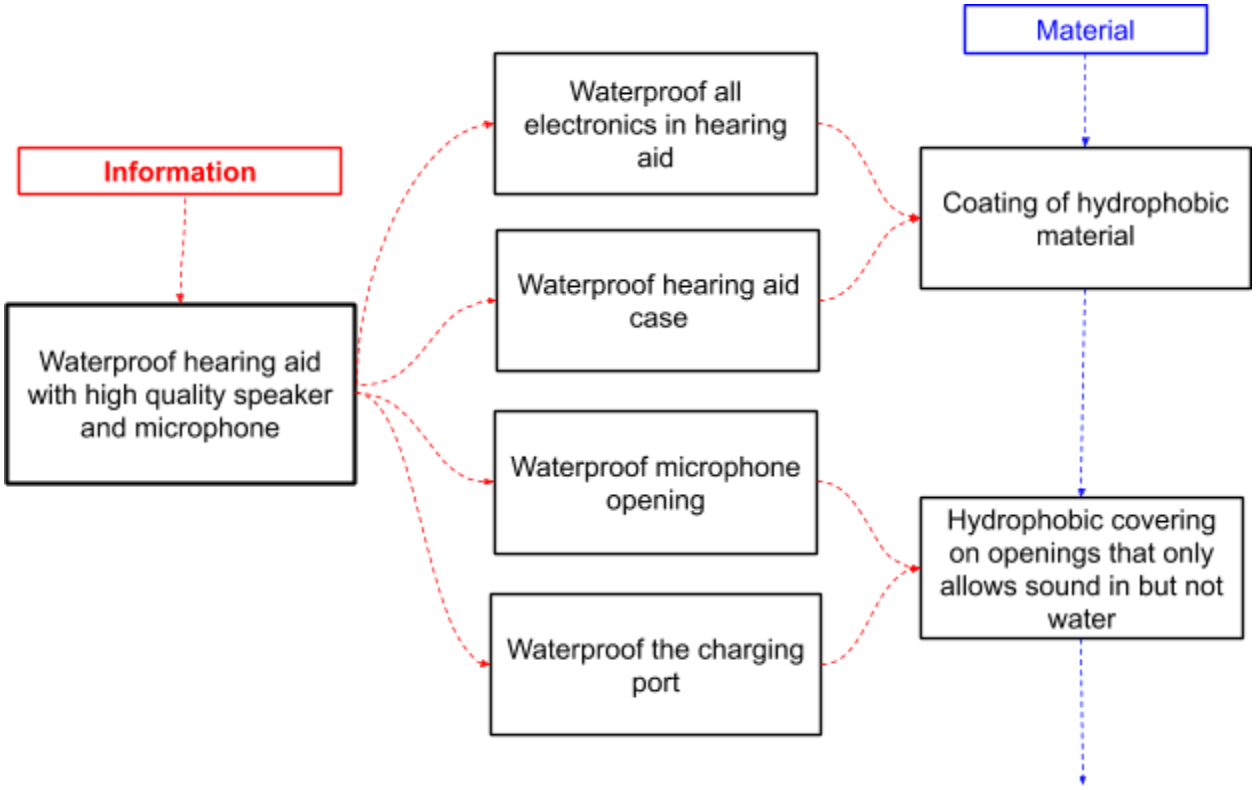
Introduction

Deliverable C covers the preliminary design, the project plan and the feasibility study. Following the meeting with the client, several needs were targeted. From these needs, design criteria have been defined. The deliverable will initially present different ideas of hearing aids. With regard to these ideas, it will be analyzed the positive and negative points based on the design criteria defined previously in the deliverable B. Secondly, it will be a question of the comparison of the different ideas developed and end with a detailed overall solution. The second section of this deliverable will propose a project plan and the third section will discuss the feasibility.

1.Conceptual Design

1.1 Core Functionality



1.2 Product Concepts

Andrea B

1. Produce a 3D printed case to go over the hearing aid to block off all ports where water can enter and can be removed for charging
2. Take off the original casing of the hearing aid and again, using a 3D printer, produce a casing to replace the original
3. Use pieces of a shower curtain to block off charging ports and waterproof the microphone

Cooper B

1. Cover speakers/exposed electronics with wax
2. Duct Tape over holes
3. Cover the hearing aid with a latex covering (similar to a balloon)

Frederique P

1. Recovering the hearing aids with neoprene.
2. Recovering the hearing aids with a protective silicone layer
3. Use waterproof shoes spray on the hearing aids

Kerollos G

1. Waterproof the electronics with clear nail polish or a hydrophobic spray and make a silicon piece to waterproof the charging port and cover the microphone with a water resistant fabric
2. Use caulking to seal all the seams of the hearing aid and make a silicon piece to waterproof the charging port
3. Fill inside of hearing aid with hot glue to waterproof the electronics and cover microphone with a mesh to only let sound in but not water

Parsa S

1. Put regular hearing aids in custom waterproof casing made of silicon
2. Use waterproofing spray on regular hearing aids to make them waterproof
3. Make hearing aids that go over the ear like headphones with waterproof materials

1.3 Concept Analyses

	1	**2**	**3**	**4**	**5**	**6**
Metric	**Cost**	**Water Resistance**	**Weight**	**Battery**	**Estimated Battery Life**	**Fit**
Andrea 1	$25	IP58	>145g	Recharge	16 hours	BTE
Andrea 2	$25	IP68	>145g	Recharge	16 hours	BTE
Andrea 3	$35	IP45	>145g	Recharge	16 hours	BTE
Cooper 1	$38	IP68	>145g	Recharge	16 hours	BTE
Cooper 2	$33	IP56	>145g	Recharge	16 hours	BTE
Cooper 3	$45	IP68	>145g	Recharge	16 hours	BTE
Frederique 1	$45	IP68	>145g	Recharge	16 hours	BTE

Frederique 2	$33	IP68	>145g	Recharge	16 hours	BTE
Frederique 3	$45	IP46	>145g	Recharge	16 hours	BTE
Kerollos 1	$75	IP68	>145g	Recharge	16 hours	BTE
Kerollos 2	$55	IP68	>145g	Recharge	16 hours	BTE
Kerollos 3	$75	IP68	>145g	Recharge	16 hours	BTE
Parsa 1	$33	IP68	>145g	Recharge	16 hours	BTE
Parsa 2	$45	IP46	>145g	Recharge	16 hours	BTE
Parsa 3	$45	IP46	>145g	Recharge	16 hours	BTE

1.4 Concept Choices

After evaluating our solutions, our group decided that there are three ideas that we could develop further. The first one is to “Waterproof the electronics with clear nail polish or a hydrophobic spray and make a silicon piece to waterproof the charging port and cover the microphone with a water resistant fabric”. The second idea is to “Take off the original casing of the hearing aid and, using a 3D printer, produce a casing to replace the original”. The last idea we chose to develop further is to “Produce a 3D printed case to go over the hearing aid to block off all ports where water can enter and can be removed for charging”. These three ideas provide a wide range of solutions for our client.

1.5 Group Design

In order to come to a mutual agreement about our final design, we first had a discussion about the feasibility of some of the chosen concepts. We decided that based on our limited resources, the concepts involving 3D printing would require much more time to produce therefore it would be difficult to be able to multiple prototypes. Additionally, we would need much more experience with CAD programs in order to create a casing that is the perfect shape for it to be completely airtight which is important in order for it to be waterproof.

We then discussed Kerollos’ idea, which was originally our first pick, and decided to use the idea of waterproofing the electronics, microphone and charging port separately with suitable materials.

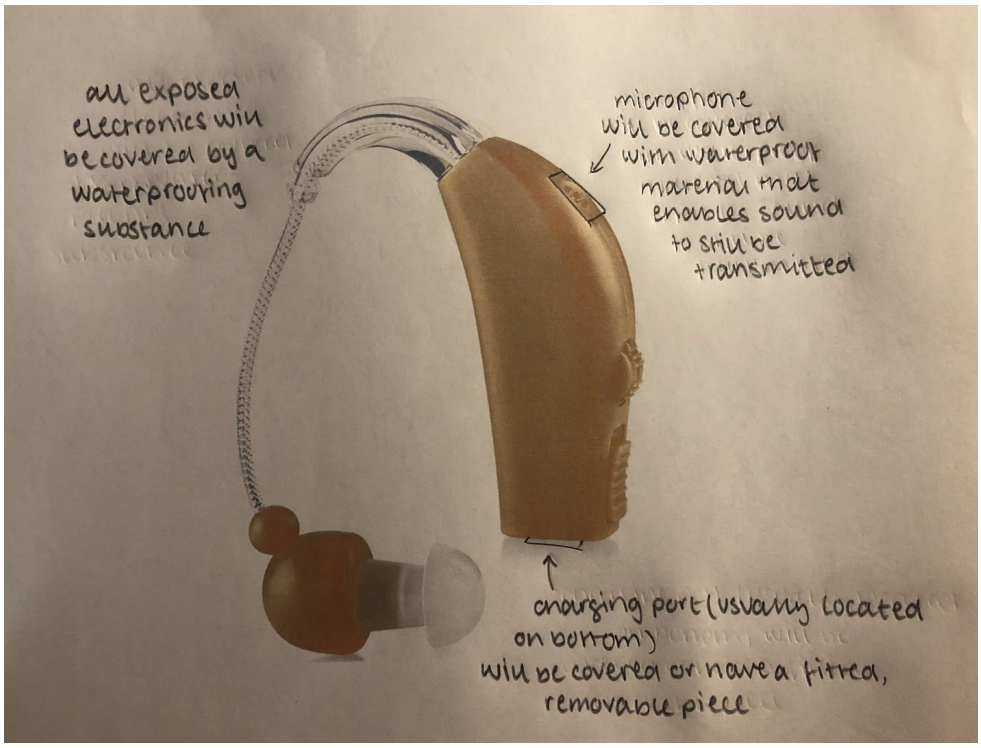
In order to decide which materials would work best to waterproof each part of the hearing aid, we will integrate ideas from other team members by testing the efficiency of some of the materials stated in their ideas as well as Kerollos’ original idea. Our final choices of materials that we will test are:

- clear nail polish, hydrophobic/shoe spray and wax for the electronics
- a silicon piece and shower curtain for the charging port
- water resistant fabric and shower curtain for the microphone.

Once we test all these materials for their waterproofing effectiveness, we will implement them onto an already built hearing aid that we will purchase online.

1.6 Visual Representation

To show our idea, we obtained a picture of a hearing aid that resembles one we want to purchase and labelled it to show which parts would be altered



1.7 Concept Summary

This concept was chosen because it meets all of the target criteria which includes; IP68 water resistance, weight, a rechargeable battery, 16 hour battery life and BTE fit. Although this concept meets all of our target specifications, the cost of the materials will take up most of our budget since it requires a lot of materials. Which includes and not limited to a hearing aid which will be modified, water resistant fabric and a hydrophobic spray/ clear nail polish.

2. Project plan

2.1 Please refer to other file

3. Feasibility Study

3.1 Risks and Uncertainties

One of the largest risks with our project is if our design fails and lets water into the hearing aid. This would likely damage the hearing aid which would cost us or the client time and money. As well, this would present the risk of electric shocks, although these would likely be too small to cause any serious injury. Another issue we have is verifying the hearing aid is absolutely waterproof. We have neither the time, nor the resources to properly verify that our product will withstand all conditions the client would use it in. We also won't have any realistic way to give any sort of durability or lifespan estimates of the product.

3.2 Feasibility Evaluation

It is possible to determine the feasibility of the project due to the acronym TELOS which allows to define five areas of feasibility. This evaluation is presented below.

Technical

Is the project technically possible?

Our team is composed of one biomedical mechanical engineering student, three mechanical engineering students and one electrical engineering student. Having different fields of engineering is very interesting since everyone has knowledge specific to their field of study which will be very useful during this project. In addition, accessibility to the project manager and the teacher assistant gives us additional expertise. However due to covid situation, it will be more difficult to have access to technical resources like tools, machines and 3D printers, so it's important to take this into consideration.

Economic

Can the project be afforded?

For our project, it is essential that we have access to hearing aids. Hearing aids are easily found and the price varies between different models. In order to respect the budget we will use hearings aids which are sold on amazon at a cost of 48$. In addition to the hearing aids we will need other materials like fabric to modify the hearing aid to meet the client's needs. The fabric it's not expensive, so it is possible to say that the realization of the project is possible with a cost of 100$.

Legal

Is the project legal?

Since our product is only a draft and the product will not be sold, there is no legal aspect to consider. However, if we decide to release it on the market, given that for our project we will be using existing hearing aids that we are going to modify, there are certain legal issues. So it would be important to meet with legal experts to make sure we do it properly while respecting the laws.

Operational

What are the organizational constraints and other factors?

The biggest constraint that could influence the success of our project is the fact that we cannot meet in person. So communication and mutual aid will be the important keys to ensure that we offer a quality product to our client. Time is also a constraint to be taken into consideration since the time to design our product is limited. It will therefore be important to order parts quickly to start the first prototype and test it.

Scheduling

Can the project be done in time?

- October 8th: Detailed design and prototype 1
- October 16th: Project progress presentation
- October 22th: Business model
- November 5th: Prototype 2 and customer feedback
- November 19th: Economics report and 1 minute video
- December 3rd: Final prototype, user manual and design day
- December 2nd to 8th: Final project presentation
- December 10th: Intellectual property

By consulting the deadlines below, we realize that the deadlines are tight but reasonable if we work as a team and we divide the tasks. For the first prototype we have to finish it by October 8th, which means we have less than a week to find the material for the design. This is tight but it will be realisable. The second prototype is on november 5th, it's after the reading weeks, so it would be important to use this week to get as far as possible on the design of the prototype 2. After the customer feedback on november 5th, it will be possible to start the final prototype. That means that we have less than a month to modify and finish the final product which is reasonable.

Conclusion

To conclude, several ideas for the design of waterproof hearing aids have been seen in this deliverable. The positives and negatives of each were discussed to determine the best choice for our product design. Subsequently, we proposed a project plan and analyzed the feasibility of the project. The next step will be to discuss the choices with the client to get her feedback before starting the first prototype.