GNG2101

PROJECT DELIVERABLE G

Submitted by

TEAM B21

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Introduction

Deliverable G covers the development of a test plan and the development of the second prototype as well as obtaining customer feedback and comments. It was following the meeting with the client that several needs were identified. From these needs, design criteria were defined, then a global solution was determined. From this solution, three different prototypes will be produced. For this deliverable, we are interested in the second prototype which focuses on a comprehensive type prototype. This deliverable will then present, first of all the retraction obtained by the customer during the presentation of prototype 2. Secondly, it will be a question of the test plan of the prototyping, as well as the modeling of this one to finish with the results and analysis of the second prototype.

1. Client meeting and Feedback

For the third meeting with the client, we presented our second prototype to her since it was finished before the meeting. We explained to her how the prototype was assembled as well as its response to the testing; how the microphone was the only issue as it only started working again after several hours.

Following the presentation of this to the client, she expressed that she was very impressed with the progress and was pleased to see the magnetic charger working as she really appreciated this idea. She also stated that the earpiece was a similar shape and size to her current one which reassures that the hearing aid will be a comfortable fit and familiar to the client.

As microphone quality was, and still is, a primary concern for the client, we explained to her that it would need some working on, which she agreed with, thus, this will be the main aspect we will be focused on for our next prototype.

Prototype and Testing

2. Prototype II

2.1 Development of prototype II

For the development of the second prototype, we decided to test subsystems. We therefore used hearing aids to make the test. So here a list of different materials that we used for testing our product:

- Hearing aid
- Clear nail polish
- Magnetic charger
- 1.10z silpoly
- Hot glue

First we started with opening up the hearing aid to expose the circuit board, microphone, amplifier, charging port and all the wires connecting them together. Everything that was inside the hearing aid was coated in several layers of clear nail polish to waterproof them. After closing the hearing aid back up, we fully sealed the outside of the hearing aid with clear nail polish and

a bit of superglue. Next, we plugged the tip of the magnetic charger into the hearing aid and superglued it in and coated it in clear nail polish.

2.1.1 Test plan

For this prototype, the goal was to design a prototype with all the subsystems. These subsystems that meet the design criteria ensure that the hearing aid functions properly, whether it is water resistant, rechargeable, it fits behind the ear, is compact and ensures that the microphone is of good quality.

2.1.2 Objectives

The goal of this second prototype was to give us a better understanding of the problem and get user feedback, which helps reduce the risks associated with a particular aspect of the concept. This prototype also helps us to measure the performance of our solution and better understand its functionality in real time, which means that it can always be improved and perfected to arrive at the best final solution while saving money and costs in long term time. More precisely, the objective of this second prototype is to test the waterproofing efficiency of the materials chosen: the clear nail polish and see the performance of this one. As well as to test the magnetic recharge. To test the nail polish, we will use a hearing aid that we will open to apply several layers of nail polish to the electronic components that are sensitive to water. We will check if they still work when submerged in water. We will also test the effectiveness of the magnetic charger and check if the other targets specifications are met.

2.1.3 Specific objectives

For the water resistant it's important to test if the hearing aid is still working when it is in contact with water. In fact, the hearing aid must resist the rain since the client does not want to have to remove her hearing aid on rainy days. The openings of the device must therefore be sealed in order to prevent water infiltration which would damage the device and the electronic components must be protected.

For the rechargeable battery, the hearing aid must be able to recharge. The charging port should be able to resist water and continue to charge when the device has been wet.

For the compact criteria, the hearing aids the weight of the hearing aids must be under 145 grams.

For the fit, the hearing aids need to fit behind the ear.

For the microphone quality, the microphone needs to work well after the modification that we did to the hearing aids.

For the battery life, it must be greater than 18 hours.

2.1.4 Test criteria

- The test criteria for success is the hearing aids work when submerged in the water
- The test criteria for success is the magnetic charger work after the hearing aids is in contact with water

- The test criteria for success is the hearing aids is less than 145 grams
- The test criteria for success is the fit of the hearing aid it's behind the ear
- The test criteria for success is the battery life of the hearing aids is more than 18 hours
- The test criteria for success is the microphone work well when submerged in water
- The test criteria for failure is the hearing aids do not work when submerged in the water
- The test criteria for failure is the magnetic charger doesn't work after the hearing aids is in contact with water
- The test criteria for failure is the hearing aids is more than 145 grams
- The test criteria for failure is the fit of the hearing aid is not behind the ear
- The test criteria for failure is the battery life of the hearing aids is less than 18 hours
- The test criteria for failure is the microphone doesn't work when submerged in water

2.1.5 Prototype type

The type of prototype for this third prototype is physical-comprehensive. The physical side makes it possible to better communicate information with the customer as well as to test the different components. The understanding side allows for several rigorous tests to improve as much as possible until the final product. It also allows you to observe and test all systems in the final solution.

2.1.6 Test dates

We have planned about one hour for each test that we will start after the second client meeting to make sure to consider the client feedback.

2.1.7 Test results

Test 1: Nail polish

For the first test, we will coat the entire electronics of the hearing aid in nail polish and submerge it in water and spray it with water using a shower head at different angles and at different pressures to simulate rain (as seen in Figs 1.1-4) and a puddle (as seen in Fig 1.5). The nail polish was able to keep the water out of the hearing aid.











Fig 1.1

Fig 1.2

Fig 1.3

Fig 1.4

Fig 1.5

Test 2: Magnetic charge

For the second test, we decided to test the rechargeable battery by first testing different magnetic charging heads covered with layers of nail polish. Once we noticed that the charge was still working, we applied this principle to the micro-usb head that we inserted into the hearing aid. We then sealed everything. Following our manipulations, we noticed that it was possible to recharge the hearing aid. (as seen in Fig 2.0)



(Fig 2.0)

Test 3: Weight

For the third test, to find out if the hearing aid is compact, the hearing aid is placed on a scale to ensure the hearing aid weighs less than the target specification. The total weight of the hearing aid is 10.4 grams.

Test 4: Fit

The fourth test is quite simple, to be sure if the fit is behind the ears we only have to check the model and try it. In this case we can clearly see that the hearing aid is worn behind the ear. (as seen in Fig 3.0)



(Fig 3.0)

Test 5: Battery life

The fifth test consists of testing the life of the battery. To do this, we decided to leave the hearing aid on and check how long it would take for the battery to be completely discharged. We see that it takes 32 hours before the battery dies.

Test 6: Microphone quality

The sixth test consists of testing the quality of the microphone. To do this, we decided to wear the device and subjectively assess the quality of it. After the rain and puddle tests, the microphone at first did not work however after 24 hours, it started working again at the same level that it was performing at before the tests.

Criteria	Target specification	Expected result	Actual result
Water resistant	IP68	Hearing aids work	IP54
Battery	Rechargeable	Hearing aids recharge	Hearing aids recharge
Weight	Less than 145 grams	The weight is less than 145 grams	10.4 grams
Fit	BTE	The hearing aids fit is behind the ear	BTE
Microphone quality*	N/A	The microphone is working well	The microphone works
Estimated battery life	More than18 hours	The battery life is more than 18 hours	Up to 48 hours

Table 1: Summary of the test result

Conclusion

To conclude, it was seen in this deliverable that following the feedback made by the client with respect to the first prototype, it was possible to design a second prototype. The prototyping test plan was also discussed in order to model this latest. A documentation of the tests as well as their analysis was also presented. For the next steps, either the design of the third prototype, it would be interesting to improve the product to meet all the client needs.

^{*}Note that microphone quality wasn't in the target specification, but it was an important need for the client, that's why we decided to make this test.