THE GLASGOW SCHOOL OF ART

University of Glasgow

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MSc Product Design Engineering
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Executive summary

A design opportunity was discovered after the horrible accident in Holland last year of May. Five surfers passed away due to unforeseen weather circumstances that created a very quick avalanche effect, on the water, with seafoam. This was the reason for the first research question: ''How might the application of possible compressed air, and other innovations improve the safety of surfers, without adjusting their current user experience?''

A bigger perspective was generated by getting in contact with multiple surfers, surf instructors, surf shop owners, and even people from the rescue brigade. A lot of the surfers faced panic attacks while being in the water. In more challenging situations, like being stuck in a rip current or having your leash (the connection between surfer and board) tied up in seaweed, the circumstance itself was not the problem. The biggest issue was that there was no one around to ask for help or their surf buddies were too far away to see or hear them. Almost all situations happened at quiet beaches, or at a moment that it was quiet, for example, in the winter.

So the improved research question became: ''Is there a possibility to improve the communication between, and therefore the safety of, surfers, without adjusting their current user experience?''

After the design opportunity was found, user scenarios, personas, and market research had been performed to gain key insights and user requirements. This was followed up by designing a big range of (out of the box) ideas with the help of mindmaps, biomimicry, and rapid ideation. In every stage of the process, a connection with the interviewed user group had been used to ask for feedback and opinions. Also, feedback from fellow PDE students helped to get different insights, which made the ability to make a good and well-thought decision for the final concept.

After deciding that the final product would be a communication device, which will send signals over radio waves (MURS), the next step was defining the correct placement. Different models and (video) prototypes were made to better understand the context of the final product and the needed interactions. In the end, the decision was between a hard casing that was located on the surfer's upper arm or a vest that had all the electronics spread out inside.

Gained feedback from surfers and tutors gave the insight to make a combination out of both concepts. The vest was used for the required comfortability, and the hard casing was used to keep all electronics in one part and therefore make it easier to keep the product waterproof.

With the communication device, an extra component was added to the final product. A small device on the surfboard is making contact with the surfboard over Bluetooth. When the connection is broken (one of the two underwater) or the distance is more than 1.50 meters, an emergency notification will be sent to Search And Rescue services. This measurement happens every 10 seconds and will give a small vibration. If there is a false positive, this can be shut down by pressing the push and talk button twice.

The final costs were calculated with some assumptions made in the last stage of the project, giving the approximate and reasonable price for this, out of HDPE made, product in the end. Final feedback from some of the surfers showed that this product ticked all the boxes and would improve their confidence and safety while surfing.

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Defining the problem

Motivation

In May 2020, I lost one of my good friends in a surfing accident in Holland. With him, four other young men died that day. They got into problems due to high sea foam that piled up in only a matter of seconds. It formed a wall of foam existing from algae of meters high, where the five men probably fell off their boards and got stuck in a kind of avalanche effect. They got disoriented and choked due to the lack of oxygen in the foam. [1]

My friend's body was the last one that got out of the water, almost two weeks after the accident happened. For us as friends, but especially for his family and flatmates, this uncertainty made it even worse than it already was.

This awful happening made a lot of impact on the whole surfing community worldwide.

Therefore, I wanted to design a product for the final graduation project that would improve the safety of surfers and maybe other watersports as well.

Background

Surfing belongs to one of the fastest-growing sports in the whole world. The International Surfing Association claims that around 35 million people surf worldwide (2019), a figure it forecasts will probably have risen to approximately 50 million by 2020. [2]

Australia, one of the extreme popular countries in the world for surfing, averages around 21 deaths per year from only rip currents. Talking to someone from the Rescue Brigade in The Hague, the beach where the accident happened last year, gave some interesting insights. **Only last year, that particular beach had 84 surfers that got themselves into trouble.**

User

The users are surfers from 16 to approximately 55 years old. This is the average age range when people start and end surfing. Those surfers could be men and women. The focus is mainly on beginners since those are the ones that get into problems more often than experienced surfers. Though, the experienced surfers are just as well taken into consideration. Multiple conversations showed that the experienced surfers also seemed to get in quite some trouble.

Problem

At first, the focus was on designing a product that could help the user breathe in more challenging circumstances to prevent people from choking in high waves or seafoam. Though, after having a lot of conversations with eight surfers, a surf instructor, a surf shop owner, and two people from the rescue brigade, the project brief had some slight changes.
The biggest problem coming out of the interviews was that people get panicked quite fast, and they cannot easily communicate for help.

Think of getting stuck in a rip current, being unable to get out of a fast set of waves, or even touching seaweed with your feet. This could give anxiety if someone cannot reach surf buddies, or even strangers, to ask for help.
A problem that follows is that the rescue brigade often has to come when someone gives an alarming call. This costs a lot of money, and in some scenarios, it is not even necessary. If the surfers can communicate and in this way help each other, you could tackle multiple problems.

Also, creating a product for this more common problem could help to reduce the chance of people getting stuck in dangerous situations, like the seafoam situation of last year. If you can warn people from a distance or ask for help, it might make a huge difference.

Design opportunity

The opportunity contains designing a product where the user is capable of communicating with other surfers. Those could be **surf buddies** but should also include **strangers**, in the case of solo surfers. It must be waterproof and easy to use the product, with the opportunity to ask for help when necessary.
It should also be considered that some of the surfers mentioned being afraid to get knocked out by their surfboards. What would happen when they are unconscious? This is something that will be kept in mind while brainstorming for different concepts.

Reflection: At first, it felt a bit hard to change the research question a bit since this felt like taking a step back instead of taking it forward. Though, it taught me that broadening your perspective can lead to more useful insights and a better understanding of the real problem.

Refining the problem

Scenario with solution

1

Anne (beginner) and Kevin (experienced) go on a surf trip together.

2

After a while, Anne get stuck in a rip current.

3

She started to feel scared, but uses the device to alert Kevin that she needs help. His response makes her feel calm.

4

Kevin reaches Anne quickly and explains to her how she can get out.

Environment of use

All the surfers who shared their stories at the beginning of the project showed what kind of place/beach this happened. Most panic attacks or surfers getting into trouble happened on quiet surf spots. Those were long beaches with almost no one to be seen on approximately a mile away. When they got into trouble, it sometimes did not work out to ask for help or, in some cases, after a very long time of paddling, panicking, and getting exhausted.

Key insights (wanted user experience at appendix 1)

Should be low in costs.

Reach a distance of approx. 2 miles

Provide better visability/audibility.

Easy way of use while surfing.

Based on anthropometric sizes.

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Reflection: Refining the problem was actually very interesting in this process. By having a lot of conversations with the user group, it became pretty easy to get a good focus on the 5W's (Who, Where, What, When and Why) and key insights. Good communication was beneficial.

User and specifications

Personas

Sam MacPhee (33)

Sam is an experienced surfer, born and raised in Scotland. When he is on holiday, he always takes his surfboard with him. He traveled already around the world, preferably on his own, to check out the best surf spots. Those vary from busy beaches in Australia to quiet beaches in the top of Scotland. When he goes surfing in **quiet places, he likes the peace that the environment offers.** He sometimes wonders what would happen if he got into an accident and no one was close to him.

Sarah Winters (22)

Sarah is new to surfing. She is originally from England but studies in Scotland. This is where Sarah joined a surf club. When she goes surfing, she always makes sure **she takes a surf buddy with her. Not only to have good company and a chat now and then, but also for her own safety.** She sometimes takes lessons with safety instructions, though she does not feel a hundred percent comfortable yet in the water.

John Miller (60)

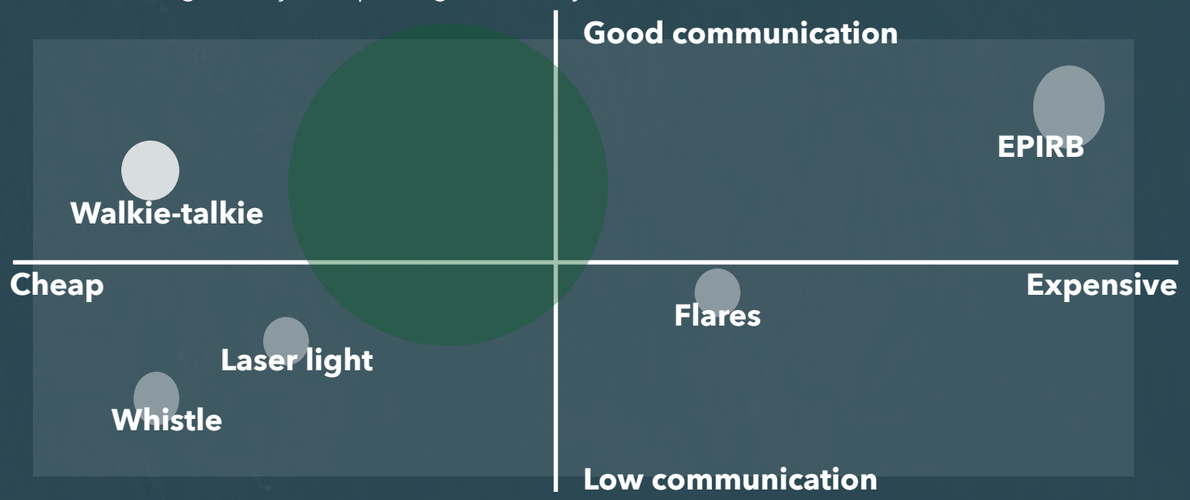
John works at the SAR (Search and Rescue) Brigade in Scotland. When there is an emergency on the water, he has to rescue the person(s) by lifeboat or sometimes even by helicopter. Sometimes people on the land think they see someone struggling in the water or someone that is panicking. **We have to come immediately, which in some cases is not even that necessary. ''It is not that we don't want to help, but it does cost a lot of money for us to go out there.''**

Key user requirements:
Not in use when not needed, easy access, automatic measurement, improving confidence.

Current way to ask for help in the water

Market research

Research for existing products has been performed to find opportunities, but also to get some inspiration. In the process journal (page 14), a mood board is made to show other emergen-cy communication products. Think of communication systems that are used on the water, on boats, or in emergency life vests, for example.
They also have been ordered on the quality of communication compared to the price. Except for some walkie-talkies, there was not a very good and waterproof (emergency) system for a reasonable price. Especially the young surfers said they did not want to spend a lot of money on something that is just improving their safety.

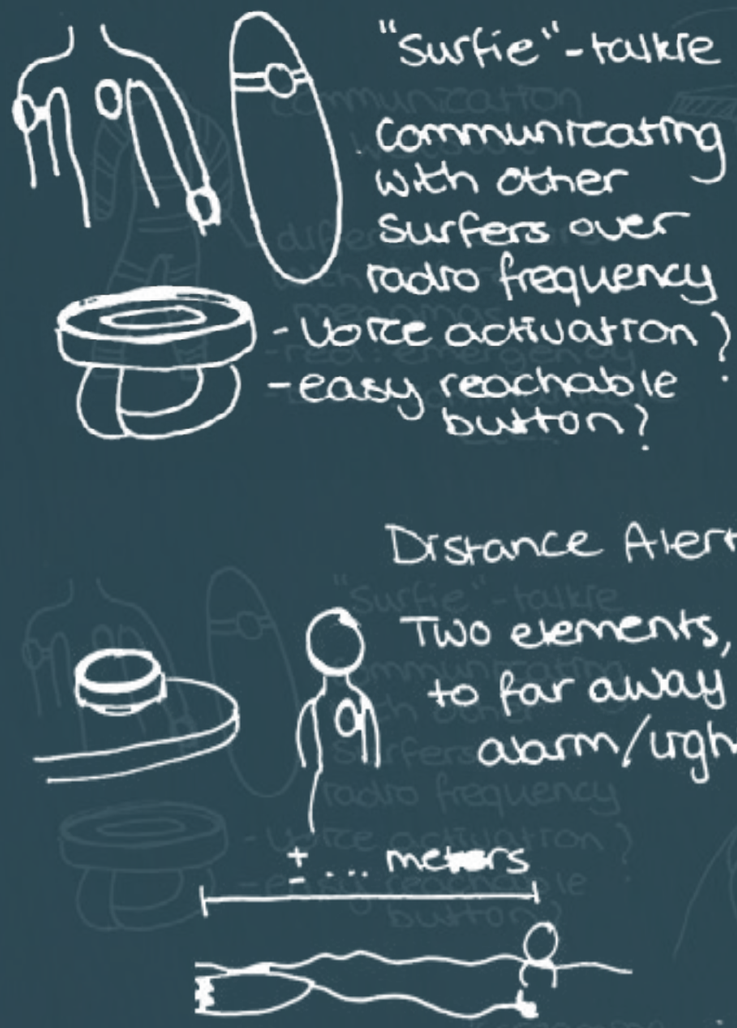


Reflection Creating different personas of the possible involved users really helped to state some of the user requirements. Those requirements combined with the earlier stated key insights were used as a sort of checklist for the concept phase.

Concept evaluation

Concept generation

By using brainstorming techniques like mind-mapping, biomimicry, and rapid ideation, 16 ideas were generated. Those ideas are shown in more detail in the Design Journal (page 21).



Feedback Iain:

The 'surfie-talkie' really has potential. I like the idea that you could just communicate with others. Though, I'm wondering how this works in situations where you don't have your hands free, like an emergency.

Feedback Mia:

"I also like the one that gives an alert when you're too far away from your board. Maybe good to combine this with an amount of time? In case you are unable to reach your board."

Concept evaluation

The ideas were shown at the previous interviewed user group to see their favorite concepts and especially why. Those feedback moments are documented in detail in the journal as well.

By far, the most exciting concept for the users was the 'surfie-talkie,' where the surfer is possible to communicate with others by talking at a distance. Again, one of their main concerns was brought up; having the fair of getting unconscious and that no one is noticing the emergency. Therefore a measurement system between surfer and board is also implemented.

Feedback from Fred (19):
"..but the main thing that I needed when I was out in tumultuous water was a radio so that I could contact my brother and tell him I needed help exiting.

Even if it's just him saying: "Leave at the left side of the beach because that's where the waves don't break and you can swim out."

The concepts were also shown to fellow PDE students to get input that is more focused on design and realistic technical opportunities. They ordered the different concepts in four separate rows, showing the most interesting ideas from their perspective.

The concepts were also shown to fellow PDE students, to get an imput more focused on design and realistic technical opportunities. They ordered the different concepts in four different rows, showing the most interesting concepts in their perspective.

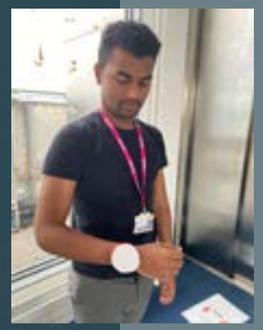
Concepts have been chosen with user requirements and some of the early key insights in mind as well:
- Not in use when not needed, easy access, automatic measurement, improving confidence.
- Easy way of use while surfing, distance reachable of approx. 1-2 miles.

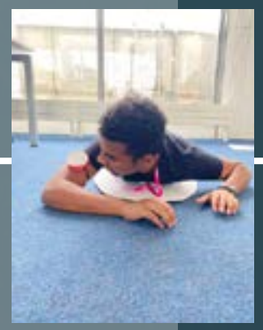
Reflection: The concept phase is always the part of the process that makes me the most confident. Quickly creating a lot of different ideas is something that I think is very fun. The challenge was then to listen to the user's feedback that was maybe not always what I hoped.

Prototyping

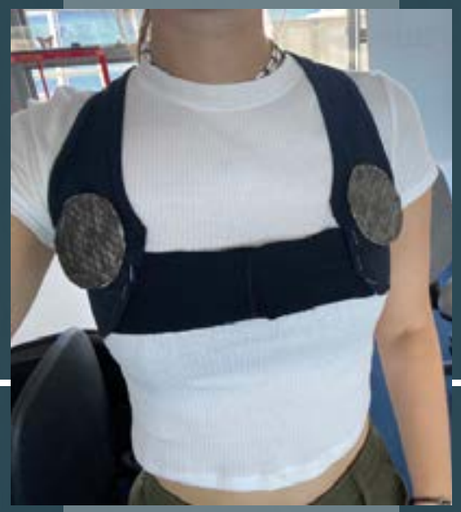
Testing speaker on board **or** surfer

Testing best position while talking





Testing with final two concepts



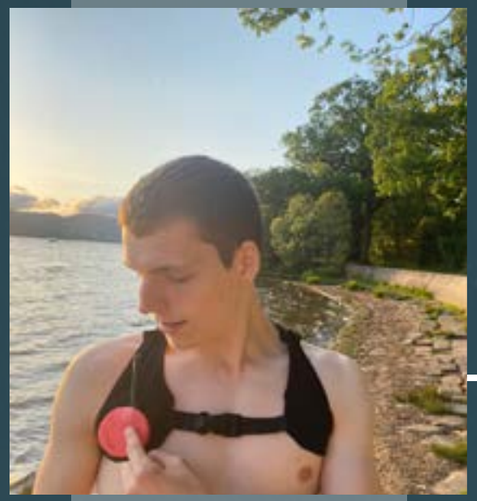
After testing in the required positions and ease of use, talking while making paddling movements, feedback from the early interviewed users was collected, and the decision was made to combine the last final two concepts.

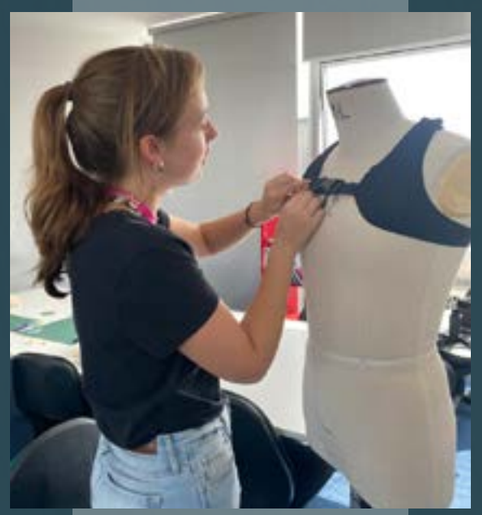
Reflection: Prototyping was something I really wanted to use as good as possible in the design process since this is something I missed a bit in previous projects. It really helped to get quick feedback from users and to gain information about interactions.

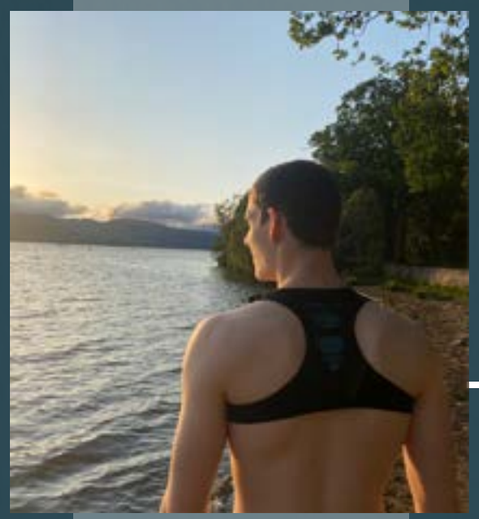
Concept decision

Finalising product shape

Testing with combination







Final prototype and design

It was decided to keep a round shape of the casing from the product since it is easier to make this waterproof instead of sharp edges. It also gives a more friendly appearance that fits the environment of water.

The final prototype was tested while surfing on two users. The final prototype fits already some of the key insights that were stated at the beginning of the process, without the complete technology:
- Providing better visibility (possibility of bright coloured vests and emergency lights.
- Easy to use while surfing, without reducing the current user experience. (One of the users even forgot that he was wearing the device afterward). No need to look for the button when someone wants to talk, easily reachable.
- The product buttons are based on anthropometric sizes, which improves comfort during the use of the device. Think of vest and button sizes, for example.

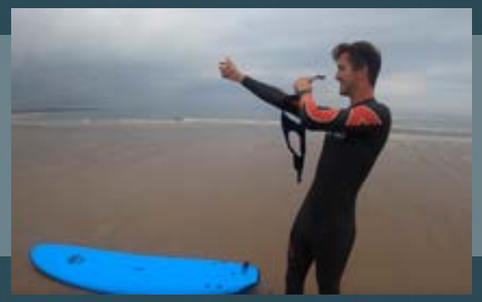
The complete video prototype can be found in the presentation.
An earlier version of the video prototype will also be uploaded along the submission.

Reflection: At first, I was a bit unsure about diverging the design perspective again since I already had a final concept in mind. Though this really gave a better outcome in the end, which made me realize taking a step back and think it all over can be very useful.

Demonstrating in context

Scenario

Solo surfer (Sam)



Iain goes surfing on his own, it is a quiet beach since the weather is not great.

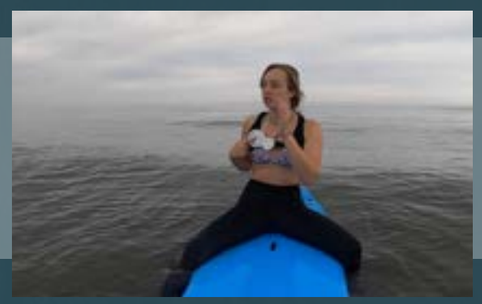
With the WAFE he feels confident to go into the water, even without experience.

After a while, Iain gets stuck in a rip current, he keeps paddling and paddling..

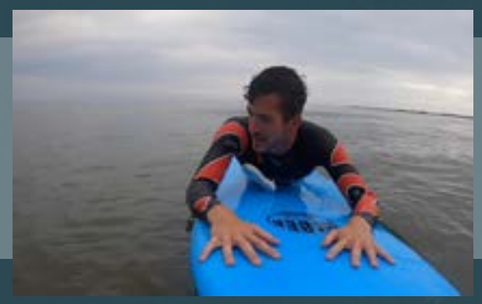
With the WAFE he tries to get in touch with other surfers to get advice/help.

Beginner (Sarah)

Function 1
Communication



A mile away, Anne gets his message and explains that you can get out on the side.



Since the device is quite close to his head, Iain can hear it loud and clear.

Now he understands that you have to paddle to the side instead of against it.

Iain can now enjoy surfing again and even made a new friend on the water.

SAR (John)

Function 2
Emergency

Iain gets hit by his surfboard in a wave and is unconscious

The WAFE is underwater turns in emergency mode after 10 seconds (with light).

It knows Iain is too far away from his board for too long/no connection.

After half a minute, a message is sent to rescue services with a GPS signal.

This context is also showing the use for the different persona's/user requirements involved.

Other, less common, scenarios are described in the process journal on page (..)

By demonstrating the product in context, the final prototype was tested and evaluated with the key points from the user research: **it is not in use when not needed, it has easy access, is automaticly measuring and improves the user's confidence.**

Reflection: Testing the final prototype made all the pieces come together. The scenarios were in line with the personas and the user requirements. For the next project, I will also focus more on the (smaller) interactions with the product, which I think would be helpful.

Technical specifications

Main device and vest

The vest is made out of Neoprene rubber, which is the same material that is used in wetsuits.

Rubber rings around the edge of the casing will create extra protection against liquids and will make a waterproof product (IP68) using enough pressure.

The circuit board is created out of an assumption and is made as big as possible but might be smaller in the future. The approximate size of circuit boards in other walkie-talkies have been taken into consideration.

By pressing the (+ or -) volume button and the (+ or -) channel button at the same time, a standard text message with GPS location will be sent to a family member/friend over the same MURS band.

The battery can hold up to 11 hours of use. The device is mainly in standby mode, so this is calculated with the 5/5/90 rule that is created for walkie-talkies.

The result of those calculations also resulted in the final size of the product casing.

The battery can be charged wirelessly because of the inductive charging coil and will constantly be keeping its battery power in standby mode, with the

The WAFE will use the MURS (Multi-Use Radio Service) band to communicate with other people. The main reason for this decision is that there is no need for a license, and it can travel quite a far distance since it is in the VHF range. [3]

The (stubby) antenna fits the VHF requirements and is only 4 centimeters in height. Therefore it can be protected partly by placing it behind the back casing.

A big button is provided to meet human factor standards and make it easy to use the push-and-talk function. Voice activation is not chosen on purpose, so the user will not hear every unnecessary conversation and save battery power.

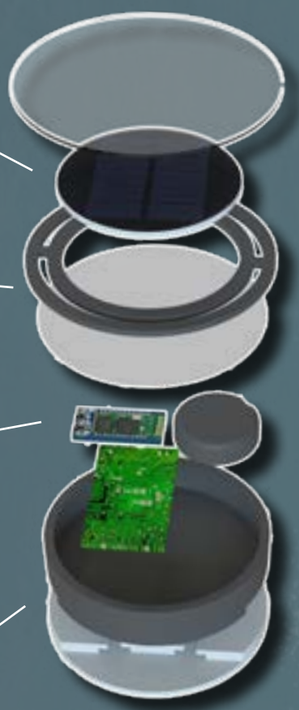
Surfboard component

The product is completely sealed to provide complete waterproofness. This is possible because of the solar charging.

This component needs a smaller battery which is being topped up by solar charging since this small part does not drain a lot of energy.

An extra rubber seal is placed just under the solar cell to make sure the electronic components will not get in contact with water.

Every 10 seconds, they make a connection over Bluetooth with the HC05 component in both devices. If they are more than 1.50 meters apart or when the link is broken (one of the two underwater), an alarm will turn on.



The component is delivered with multiple attachment plates that can be added to different surfboards. It can be placed onto those plates and has enough friction to prevent movement.

The little attachment plates can be placed on the surfboard and will be stuck because of an adhesive.

Final cost of the product: with all components into consideration, an assumption of around £50-60 is defined. Which is a reasonable price with all the functional possibilities of the product taken in mind.

The interactions with the product (buttons etc.) are shown in appendix (2).
Further insight about the decision making and caclulations can be found in the technical report.

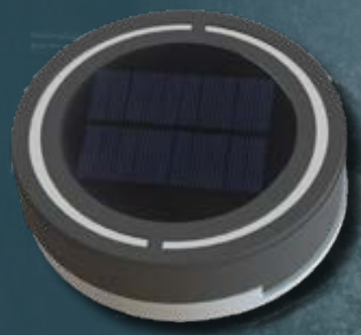
Reflection: The technical part of the product was definitely my biggest fear due to my lack of experience and knowledge. Though, having excellent communication with my GU supervisor and a good schedule made sure that this was not a problem at all in the end!

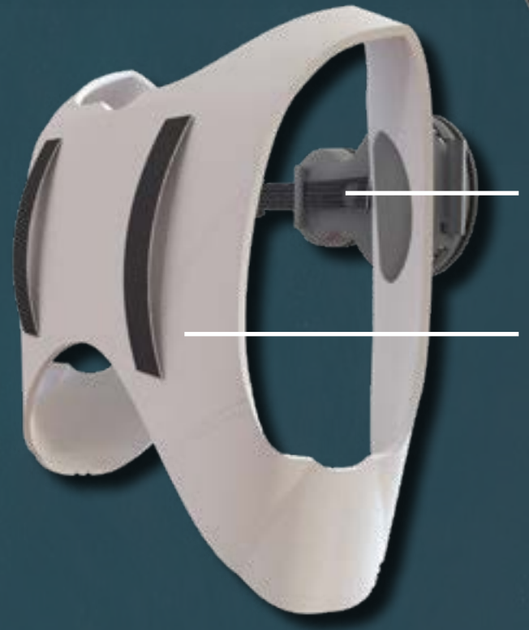
Final product

Volume buttons

Light (in emergency mode)

Channel switches





Clips for safety and easy attachment/detachment

Extra: Safety straps to help the rescue brigade getting someone on the rescue boat

Providing fun and safety

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Decide which components you need

Reflection

As an overall reflection, I wanted to add that I am very proud of this final project. It taught me the last bits of the design process that I needed—taking steps back, gaining feedback, and be confident over your work. The final delivered product is something that I think could be a real game-changer in watersports, especially surfing. Although the first week of this project was a bit intense due to upcoming memories, I am pleased that I choose this direction. It made me very passionate about the project, which I think was a significant advantage.

Also, I really tried to get around the limitations of the coronavirus, for example, not being able to get into the workshop by going to the studio as much as possible and create smaller mock-up prototypes. In the end, I managed to get the 3D printers working in the MSc studio, which made me able to have a final prototype that showed how the product is going to look like in real life.

I also really want to thank Nick Bell, Aileen Biagi, Stuart Bailey, Jon Barnes, and Donald Ballance for the valuable feedback and advice during meetings and tutorials.

Future work

Since the final project only had quite a small amount of time, not all the required work for a ready-for-production device has been done. The work future work is, for example, testing with the chosen frequency in different weather circumstances. Does the user hear the other person good enough, or is there a noise cancellation needed, for example? Also, the waterproof and dust resistance tests should be done before getting the required IP ratings. Another next step would be to look at the needed software for the different components and functions and write some first pieces of code.

The future work is mostly technical to get an actual final working prototype. Then first tests can be done with user groups in different environments to gain more feedback before the product is entirely produced.

It would also be interesting to see f this could be a product which can work in combination with someone's insurance, like ski helmets, if more safety can be generated. Or maybe it is an idea for surf schools to rent those out next to surfboards, wetsuits, etc. In this way, young surfers do not have to pay for one but can share it with others. Though, the fair price of the device should give them the ability to buy one for themselves as well.

References

[1] A. Holligan, "Surfing tragedy that stunned a Dutch beach community," BBC , 21 June 2020.

[2] E. Ross, "National Geographic," 2019. [Online]. Available: https://www.nationalgeographic.co.uk/travel/2019/10/get-board-why-theres-never-been-better-time-take-surfing. [Accessed 2021].

[3] "Tech Wholesale," 2015. [Online]. Available: https://blog.techwholesale.com/2015/09/29/walkie-talkie-frequency-guide/. [Accessed 2021].

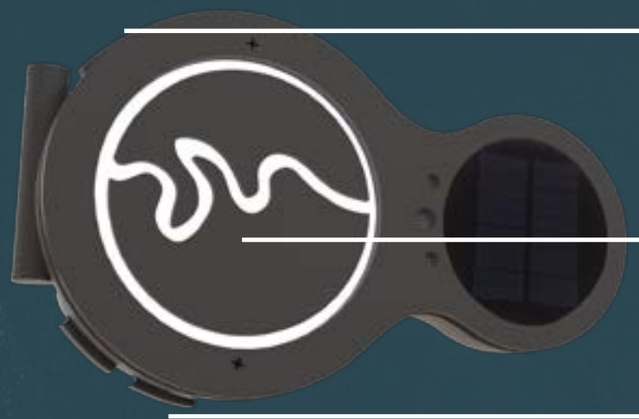
Other references used for the knowledge to make technical decisions, can be found in the technical report.

Appendices

Appendix 1 - Wanted user experience.

Appendix 2 - Interaction with the product.

- Press both (-) or (+) buttons in case at same time in case of emergency text.



- Volume buttons (+ and -)
- Press one of the volume buttons for 5 seconds to turn device on/off
- Push and talk button
- Press twice in case of false positive (surfboard)
- Channel buttons (+ and -)

- Amount of buttons as low as possible, easier to keep device waterproof.