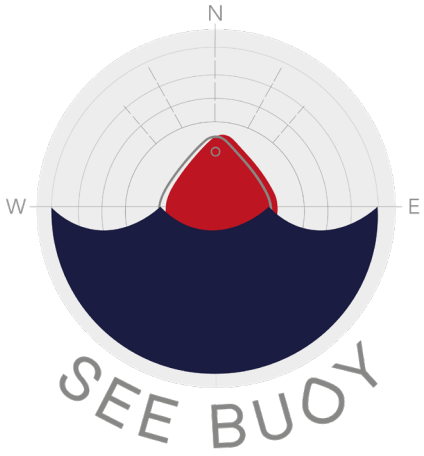
KIM BURKE
PRODUCT DESIGN
HONOURS PROJECT



PROTECTING OUR SEAS AGAINST GHOST GEAR

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Academic staff:

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Kara Brydson (Fisheries Innovation Scotland)
John Wheeler (Ghost Fishing UK)
Phil Taylor (Open Seas)
Richard Littlefield (Caledonian MacBrayne Ferry Captain)
Angus Young (Navigation Officer Royal Navy)

Fishermen:

Mario Paterson (Tayvallich, Lochgilphead)
John McArthur (Tayvallich, Lochgilphead)
Russell Burke (Rhu, Helensburgh)

The closure of DJCAD in March and creating my project from home (due to COVID-19), is not how I expected to be completing my final year at DJCAD. The cancellation of the degree show has been devestating. At times I've felt that I haven't had anything to work towards. But my passion for cleaner seas, free of ghost gear has driven See Buoy. It is a year of my life I will never forget. I would like to extend a huge thank you to my friends and family for being supportive during this time.

ABOUT ME

Hi I'm Kim, a Product Designer who loves creating meaningful and tactile responses to environmental issues. I have a passion for illustrating, making and designing through a lense of attention to detial. I am a hardworking and driven individual, who enjoys taking a hands on approach to disover new processes and design solutions.

My love for the sea stems from my childhood growing up on the west coast of Scotland and fishing with my dad for lobtser. In January of this year you would have found me surfing in the Canary islands. Returning with a nasty jellylfish sting has scarred me and given me a permenant reminder of the power of natue. I knew from this momment on that I wanted to harness this powerful energy in an alternate direction. I wanted to couple this with an effort to reduce ocean pollution, supporting my vision for a career designing for a cleaner future. This combination of facors framed the early developments of See Buoy.

The aim of this booklet is to provide an overview of the motivation, research and design process behind my honours project.

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WHAT IS SEE BUOY?

See Buoy has been developed to prevent the loss of fishing equipment, known as 'ghost gear'. Using wave technology See Buoy emits a high frequency light to ensure fishing equipment is visible at sea. Integrated into fishermen's working environment, See Buoy ensures protection of costly equipment and marine life, ending the cruel cycle of ghost gear polluting our oceans.

WHY SEE BUOY?

Witnessing the fishing industry first hand opened my eyes to the need for design intervention to protect our seas.

Under the sea, an environment we never see is a world we destroy daily. Scotland's seafood industry is critical to our economy, as is our environment. However, the industry is inadvertently polluting and destroying our ocean through discarded and lost fishing equipment, referred to as ghost gear. The heart of the issue lies above sea level. Buoys lack visibility. Large fishing vessels and passenger ferries collide with buoys detaching equipment. As a result, tonnes of deadly material is abandoned on the sea bed. Catch in creels become bait and creates vicious cycle of trapping and killing.

CONTEXT

A vivid example of the strain our planet is under from ocean pollution is the famous Great Pacific Garbage Patch (GPGP). Located between Hawaii and California, it is the largest accumulation of ocean plastic in the world.

Inspired by the efforts of The Ocean Clean Up to reduce the 80,000 tonnes of plastic **afloat** in the GPGP, I began to consider what I could do as a designer to contribute to their efforts.

Upon research I discovered that ghost gear accounts for 46% of the mass in the GPGP. Interaction from marine life with this discarded material often results in death.

After defining my direction, it was time to gain a broader understanding of the industry and the issues it posed. I wanted to find out more about how fishing equipment is curently lost at sea. Specifically how does loss of equipment affect fishermen?

RESEARCH

Researching further into Ghost Gear, I was horrified to discover that 640 tonnes of lost or disregarded fishing gear enters the worlds oceans every year. From there my goal was clear:

To reduce the amount of ghost gear polluting our seas.

I believe that taking a human centered approach to research is key to understanding the people I am designing for. I continually strive to ensure I use various research methods in order to contextually understand the sector I am designing for from various perspectives.

My honours project journey began by speaking to industry professionals and organisations, allowing me to understand the current efforts towards ensuring cleaner seas. This was extreemely beneficial as it highlighted the need for a designer to enter the industry, rather than another volunteer organisation. I began to see that a design led approach bringing innovation to the market was necessary.

I firmly belived in the motto, **'ACT LOCAL, THINK GLOBAL'**, as a driving force for this project. I used these words to gain perspective when the greater picture of ocean pollution felt overwhelming at times.

To gain a deeper understanding of the issue, I conducted several site visits and camera studies. I also carried out contextual research into the material properties of ghost gear.

Primary research was key to the outcome of my project and played a massive role in shaping the outcome of See Buoy. To understand the behaviours and working patterns of those potentially using the product, I explored the industry. Rising at 3am for a 12 hour shift, I joined the crew of commercial fishing vessle 'Delan-Dee'. Participatory design sparked key insights from this field trip and I used the power of the three why's to extract deeper insights during my time at sea.

INTERVIEWS

The following interviews each contributed to the development of See Buoy.

Dan Watson - Safety Net Technolgies (SNTECH)

Dan was my very first interview participant back in October of 2019 when my project was still very open. Through stumbling upon his own by-catch prevention project, I was inspired to find out more about SNTECH.Dan was a pot of gold for research and really inspired me to follow my goals. He also helped me establish a network of contacts to further my research Fisheries Innovation Scotland, Blue Ocean and the Global Ghost Gear Innicitive.

Phil Taylor - Open Seas

Phil Taylor, inspired me with his passion for change in the current sea food industry. Phil introduced me to Open Seas campaign for a healthier environment and more sustainable sea food across the UK. Supporting my project pathway Phil described gear conflict as depressing and illustrative of the problem the industry currently faces.

Kara Brydson - Fisheries Innovation Scotland

As the Executve Director of Fisheries Innovation Scotland, Kara was great to discuss my project with. Kara believed in my project and invited me to pitch my design idea at Scottish Fishing Confrence in July of 2020. In preporation for this, the Shark Tank presentation style largely framed the marketed outcome of See Buoy.

John Wheeler - Ghost Fishing UK

Diver and Commercial fishermen John provided primary data on the quantity, location and style of fishing gear recovered from sea. My key take away from speaking with John was the style of fishing equiptment recovered and that it was rare to find a full string of creels due to damage previously caused. This information nudged my project towards a prevention route rather than a recovery design.

Mario Patterson - Prawn Fishermen, Tayvallich

Mario is a commercial fishermen and played a vital role in shaping the outcome of See Buoy. Initially I gained inisights through a phone interview, which soon led to a full day at sea with him and his crew. This fuelled my understanding of the industry and led to a more participatory method of design.

Angus Young - Navigation Officer, Royal Navy

As a harbour master for the Royal Navy submarine base in Helensburgh, Angus' expert knowledge about navigation and lighting at sea was crucial to the development of See Buoy.

Richard Littlefield - Ferry Captain

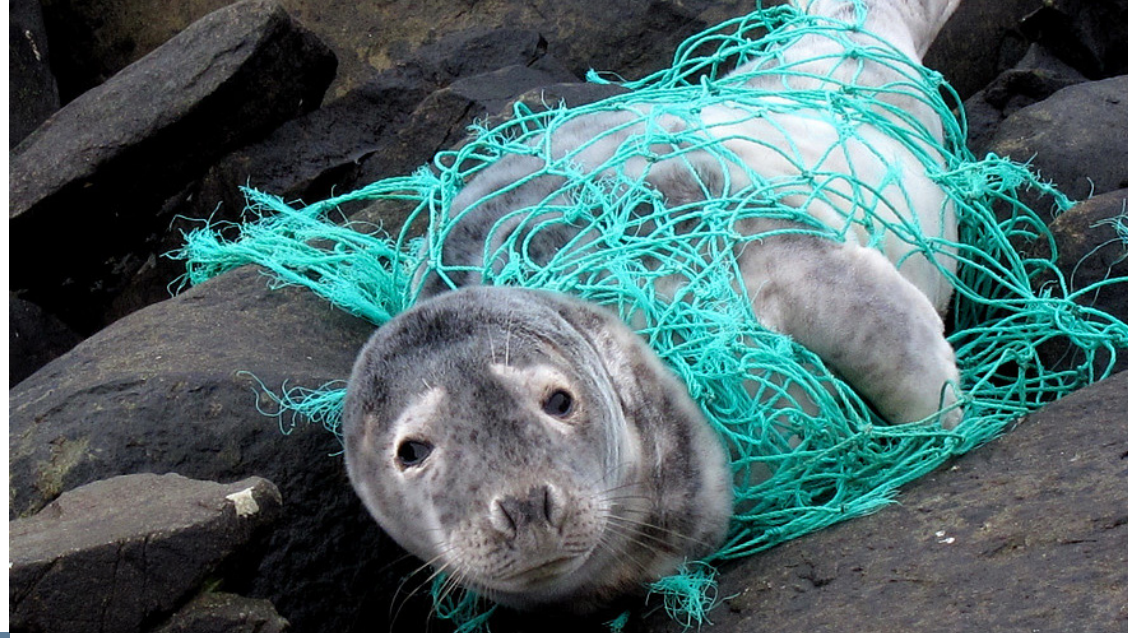
Richard has been a captain of various commercial passenger ferries for many years. Discussing identifyinig, manouvering and colliding with buoys, Richard's un-bias, first hand experience with fishing equipment was invaluable. Working in a popular fishing ground - and also one of the worlds most complex stretches of water - Richard was able to describe in great detial why captains struggle to identify buoys.

"If you do find a solution for this, you need to keep it cheap, because fishermen are notoriously tight".

UNDERSTANDING THE ISSUE

THE SCALE OF THE INDUSTRY

Employing 24,000 people, the UK depends on the fishing industry to feed millions. The UK currently exports 80% of what it catches to Spain and France with the EU single market, bringing in £430 million annually. However with the current political climate this is likely to change. There has been no better time to protect fishermens livelihoods. To continue to do so, we must protect and give back to the seas we take from.

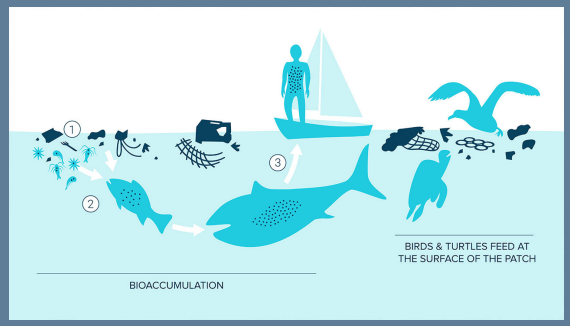


WHY STATIC EQUIPMENT?

Compared to mobile equipment such as large trawling nets, the loss of static equiptment (creels) is often overlooked. Often referred to as the oceans silent killers, creels are 'out of sight of mind', but continue to trap and kill for years to come. Equipment is rarely retrieved by fishermen themselves due to the difficulty, danger, expense and time it requirers to find ghost gear.

According to the Food and Agriculture Origanisation of the United Nations 2019 report:

'80% of the global fishing industry uses static nets and cages.'



Visualising the cycle of ghost gear.

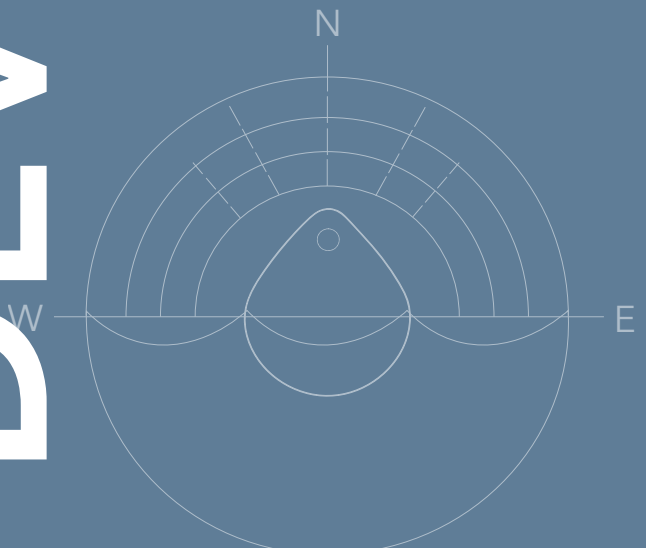
INITIAL IDEAS

- Upcycling solutions to recycle and repurpose found equipment.
- Could I develop a product to retrieve detached creels?
- Method of educating children in sustainable fishing practice.
- Device to track and locate lost creels.
- Could a biodegradable net/pot be made?

I was largely driven by the environmental effects lost static equiptment has on marine life and eco-systems. Although I was also driven by the financial repercussions for fishermen of loosing creels and wanted to protect their livelihoods.

DEVELOP

Identifying key themes and defining the different visions for my project. Combining my research together to develop See Buoy. Exploring how I brought my concept to life through various sketching and prototyping methods.



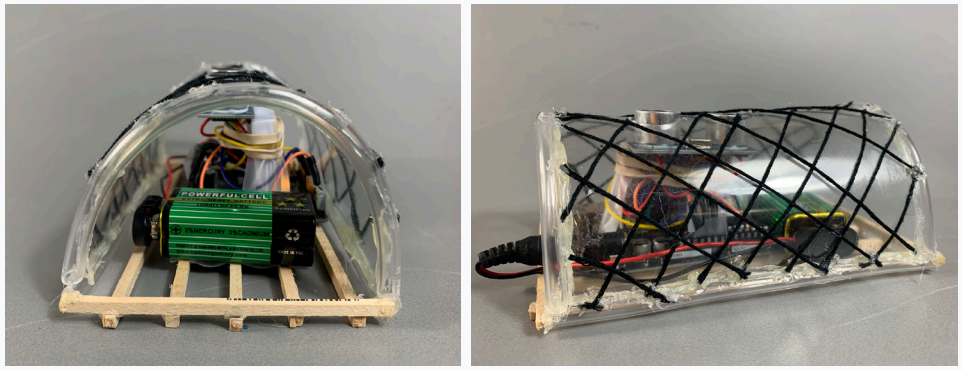
CONCEPT DEVELOPMENT

The initial stages of my concept development have been split into the three folowing sub-sections: LOCATE, RETRIEVE and PREVENT.

LOCATE

At this stage my brief lent towards a product that would assist in locating lost fishing equipment. This would be beneficial if equipment had moved from the originally plotted location shown on navigation instruments onboard the boat.

This would allow fishermen to retrieve equiptment using current techniques. A method explaind to me by fishermen Mario, was to cast another fleet of creels over the top of the lost creels in hope that they will snag the lost creels. Whereas inland fishemen John explained he can try to use a 'creeper' (a large metal pole) in shallower waters to achieve the same result.



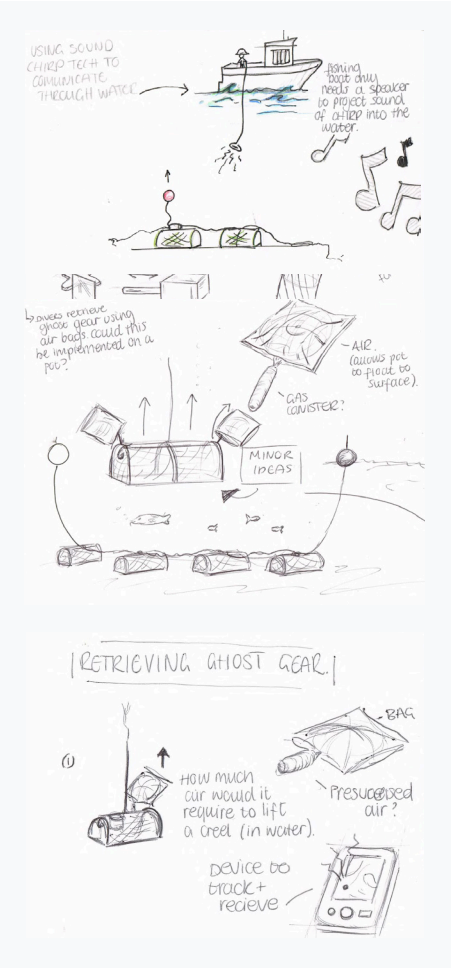
Model showcased the interaction of a sonar device similar to the behaviour of a radar reflector.

RETRIEVE

My aim through the development of retrieval solutions was to allow fishermen to retrieve their costly equiptment that had been moved/ damged as a result of gear conflict or accidental damage.

Although quickly it became very technical and complicated and I soon realised that this was not an affordable viable concept.

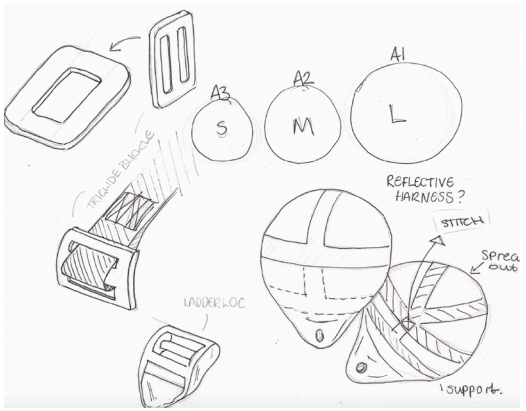
The initial idea of an emergency buoy releasing from the creel was inspired through the function of an inflatable life jacket. This would provide a location and method of retrieval for lost equiptment. To trigger this action I considered using sound to activate the device. During this time I researched into Chirp.io technology, which would send a unique sound profile to trigger the buoy.

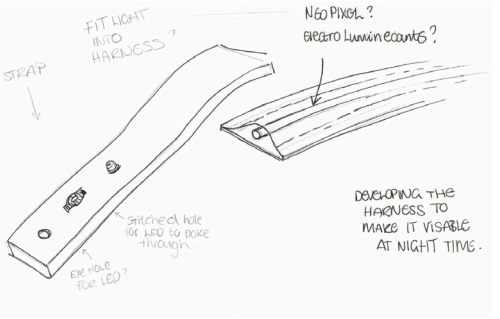


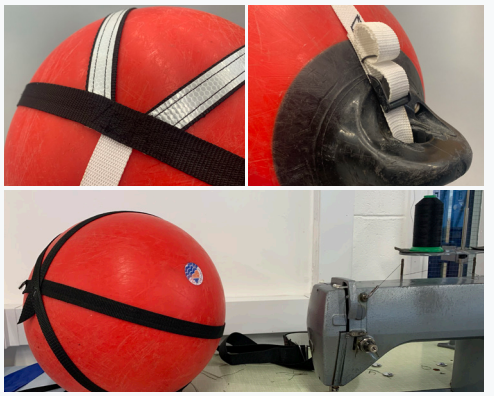
PREVENT

What can I do as a designer to prevent the loss of static fishing equipment?

Venturing in a different direction, I returned to the drawing board to assess the root cause of ghost gear. It soon began to realise that the issue lay above sea level and the buoy marking the creel was a key piece in the puzzle to tackle this global issue. In seas now consumed by transportation, sports and cruising, the buoy has became outdated and vulnerable to







Prototyping a reflective harness for the buoy, I aimed to develop an affordable and simple solution to increase the visability of the buoy in the water. I also considered the intoduction of electroluminescent lights but ran into the issue of a power source. This was in response to fishermen Mario stating that he had tried to use neon tape previ-sously but 'it had just peeled off'.

GURUS' DAY

WHAT IS GURUS' DAY?

Gurus' Day is an opportunity to discuss and gain feedback on your current design ideas with industry professionals from various backgrounds.

I entered Gurus' Day with three themes: locate, retrieve and prevent. I aimed to keep the conversation broad to disucss a wide range of design opportunities. It became apparent that a design solution to **PREVENT** the loss of equiptment was favoured by industry professionals. James Williams reinforced that I needed to have clear branding to illustrate my product well. This stayed with me and I have tried to deliver this in my final outcome.

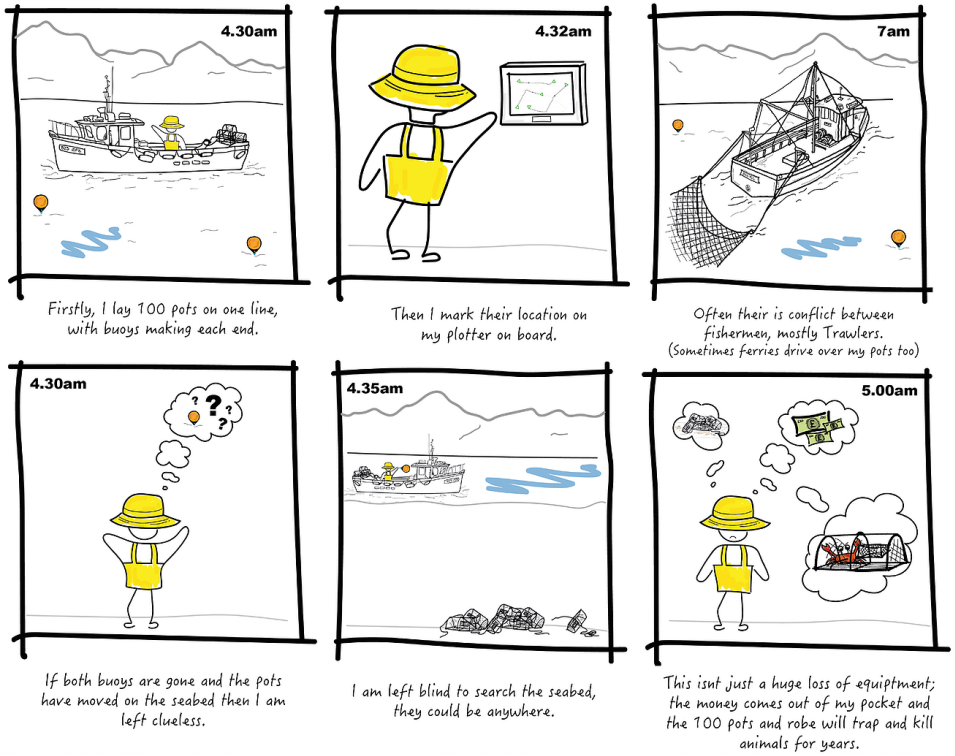
KEY INSIGHTS

- Keep it simple and effective.
- Ensure the product is affordable.
- Promote and highlight the products services, e.g. how much marine life does it save? How much money does it save fishermen?
- Investigate renewable energy sources such as solar and wave energy to provide the product with a low maintinance, low cost power source.

VISUALISING THE ISSUE

In preparation for Gurus' Day I created a storyboard to illustrate the issue I am designing for. By doing so I was able to explain this niche subject clearly to individuals who were perhaps not as farmiliar with the indsutry.

The storyboad aimed to communicate the timeline of fishermens working patterns and highlight the regular occurance of damage to equipment. In particular this storyboard illustrated gear conflict between trawlers and creelers. However it lacked detail and insights vital to the development of See Buoy, as it took place prior to my research trips.



Conducting primary research and investigation trips at sea to gain a greater understanding of the fishing industry.

EXPLORE

EXPLORE

FIELD RESEARCH

The initial phase of primary research for my project began with investigation trips to witness the issue first hand. I took myself away from the hustle and bustle of the city to the West Coast for a night, to spend time in the small fishing village Tayvallich.

I visited some hot spots which I knew may be prime examples of disregarded fishing gear. The multitudes of creels, rope and plastic scattered across the shoreline sparked material investigation and gave me ideas about re-purposing old equiptment to feed back into the industry. If this was on land; I questioned what the bottom of the sea bed must look like?

AS PART OF THE EXPLORE PHASE I WENT ON TWO RESEARCH TRIPS WITH FISHERMEN. FIRST, I JOINED THE CREW OF A COMMERCIAL FISHING VESSEL, AND SECOND I OBSERVED A HOBBYIEST FISHERMEN TO GAIN A BROADER UNDERSTANDING OF LOSS OF GEAR WITHIN THE INDUSTRY.

FISHING TRIP #1

On the 25th of November I joined the crew of 'Deelan-Dee' to fish off the Sound of Jura for prawns. Over the course of the day the three fishermen hauled and lay 900 creels. I was surprised to discover 100 creels were placed on each line, using a buoy at either end to mark the start and end of the string. The cost of one string of creels, rope and buoys totalled an estimated £6-7,000. Seeing the physcial mass of this material alone was staggering.

Whilst I discussed current project ideas, it allowed the fishermen to share the circumstances surrounding loosing equipment in greater detail and they shared several stories about the loss of equipment on previous occasions. This highlighted a broad range of issues they face at sea. Taking a participatory, co-design approach to gain deeper insights, using pen and paper, two of the crew each loosely sketched some ideas they had related to the point of discussion. Ideas included neon tape, light and sound.

Witnessing their working pattern opened my eyes to the raw working environment fishermen face on a daily basis. It was insightful to see on a commercialised level the source of our seafood first hand and this soon became the ground research for See Buoys development.

FISHING TRIP #2

In December of 2019 I joined hobbyiest lobster fishermen Russell on ‘Hope’. Fishing in Loch Sween, Russell hauled and laid 6 creels, each on individual lines with one buoy.

This research trip was an insight into the life of fishing for leisure. However Russell was equally as keen to catch food for the table and protect equiptment as any commercial fishermen would be.

This research trip allowed me to analyse the issues the industry faces with regards to loosing equipment from a diffrent perspective. Russell explained that the financial cost of loosing equipment for him was far greater - as he does not benefit from bulk buying equipment - compared to commercial fishermen. Russell estimated that over the course of 4 years he has lost 8 creels.

KEY INSIGHTS

- Mario and his crew discussed that they often loose gear due to ferries colliding with their buoys. They explained that they were forced to fish close to the ferry path due to overfished waters, risking their equipment and their wage by doing so. In an attempt to increase the visability of their buoys in the water, Mario expressed that they had tried to use neon tape on the buoys but 'it just peeled off'.

- I was surprised that no navigation lights were used in the pitch dark at 3am to manouver out to the fishing ground. This was an eery feeling as the fishermen soley relied upon their digital instruments to dircect the boat. If anything unexpected was in the water, it would simply be hit.

- The fishermen expressed that gear conflict can occur as fishermen from neighbourinig waters encroach on other fishermens ‘turf’. Mario shared his experience from 18 years in the industry and expressed that trawlers move, damage and destroy laid creels accidentally or as an act of vandalism. This was a very sad insight and was an eye opener to the competative nature of the industry.

- It reiterated that anything I designed had to withstand the extreeme elements and a fast paced working environment.

- They emphasied that any new product brought onto the market must remain cheap to make it economically viable for them. Fishermen need an incentive.

This was a turning point in my development and highlighted that there was a need to increase the visabiliy of equipment to deter damage whilst also aiding locating equipment.

DEFINE

Defining my brief. Establishing the issue I have identified, whilst dictating who I am designing for. Stating what I aim See Buoy to deliver.

DEFINING MY **BRIEF**

To reduce the quantity of ghost gear entering our seas by preventing accidental damage to marker buoys.

WHAT IS THE ISSUE?

The fishing industry is sadly inadvertently polluting and destroying our oceans through discarded and lost fishing equipment. The heart of the issue lies above sea level. Buoys lack visibility. Large fishing vessels and passenger ferries run over buoys, detaching equipment. As a result, plastic equipment is abandoned and left to pollute our seas. This poses a dual environmental concern, as catch in the creels become bait and fuel a vicious cycle of trapping and killing for years to come.

WHO AM I DESIGNING FOR?

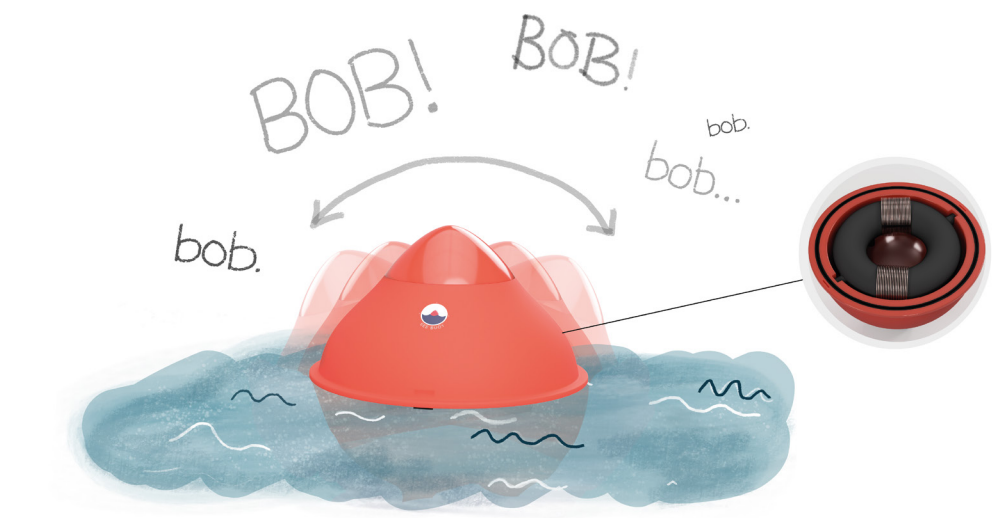
Fishermen at the heart of the seafood industry suffer the consequences of accidental damage towards equipment the most. The financial loss of equipment alone is staggering. This doesn't account for lost catch within the creels, or compensate for the time spent trying to locate and recover lost creels. The knock-on effect is devastating.

WHAT AM I DESIGNING?

See Buoy aims to prevent accidental damage of marker buoys at sea through vastly improving the buoys visability with the aid of light. Passers-by are given time to navigate around See Buoy. The self-sufficient product harnesses the natural forces of the ocean ensuring it remains low maintinace and encouages fishermen to use the product. In turn See Buoy ensures protection of their costly equipment and puts an end to the vicious cycle of ghost gear.

WHY WAVE ENERGY?

Directing my attention toward increasing the visibility of the buoy, I was immediately drawn to light. My focus travelled to developing how the light would work at sea. Renewable energy sources; including wind, wave and solar grasped my attention due to their affordability and environmental benefits. Research showed that wave energy is the most reliable yet underutilised energy source. Living in Scotland surrounded by this unutilised energy, I was intrigued to harness this power. The idea that See Buoy could harness the natural force of the sea to give back to the environment was pleasing.



RESEARCHING WAVE ENERGY

Whilst researching wave energy I first stumbled upon 'Polamis'. Often referred to as a sea snake, the device uses a hydraulic system moving with the movement of the sea to generate energy. Tested on the West Coast of Scotland, I was amazed that the product could generate enough power to consistantly supply a small village.

Another company tapping into our seas to generate energy is 'CORPOWER Ocean'. Their buoy is located offshore in the far North of Scotland and contibutes to powering villages on Orkney.I reached out to both companies to ask some questions and develop my design solution, however never gained a response.

Funnily enough my greatest insight was gathered when watching You-Tube videos. I came across a video that explained many forms of harnessing wave energy. One example used a magenet and copper wire. Through this discovery I strongly believed I could develop an affordable viable product for the market. After establishing that I could use the basic function of friction with copper and a magnet, my next step was to begin sketching and protyping the buoys generator.

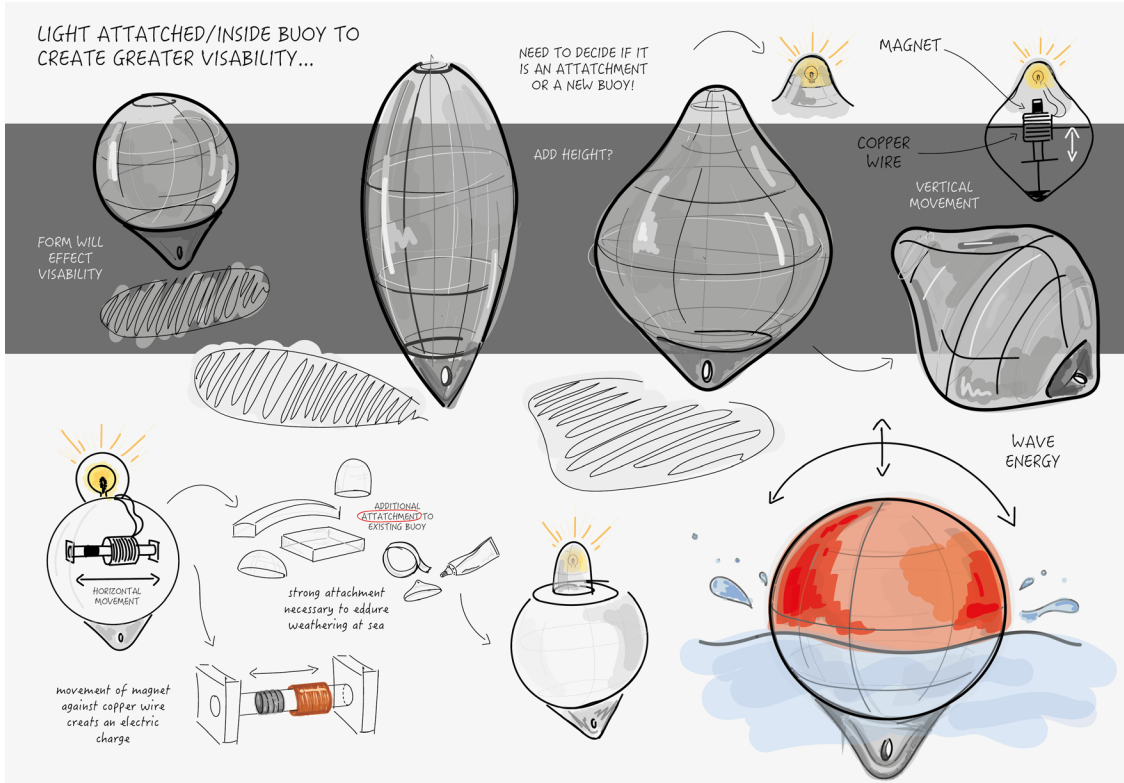
EXPLORING FORM & FUNCTION

After establishing my direction I began sketching and prototyping ideas. Reflecting on the insight that the product would benefit from being afforable I brainstormed ideas.

I questioned whether I could design product that could attatch to existing buoys.

By creating a product attachable to current buoys I would eliminate the need for fishermen to invest in an entire new buoy. Lower product volume would also reduce material and manufacturing costs. According to Mario, their Polyethylene buoys typically last for 10 years unless lost or damaged.

Standard Polyethylene fishing buoy priced between £40-£80 depending on size.



I made the decision that the outer appearance of See Buoy shouldn't be too dissimilar to what is on the current market relatively early on in my design process. The reason being that the buoys identity should not be highlighted through a flashy design to encourage theft. Through my research I already stablished that 'turf war' and vandalism of equipment can occur between fishermen, so I would not want to advertise a tech filled buoy.

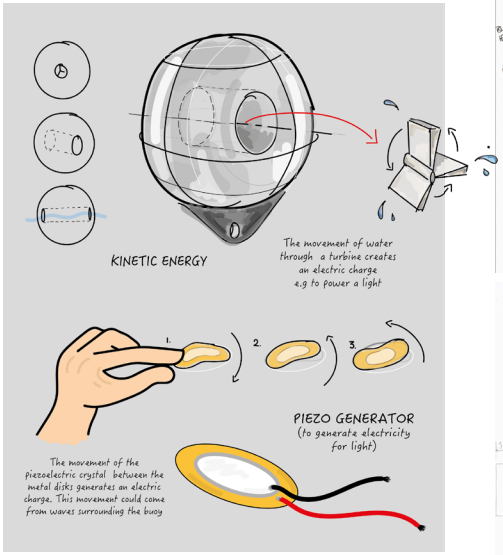
The second reason for the buoy being visually in keeping with what is on the market is simply that it is in keeping with what fishermen are used to. Through my research I heard reoccurring statements from individuals stating that fishermen are 'set in their ways' and 'don't like change'. By keeping the buoy visually similar, I hope to get around this barrier.

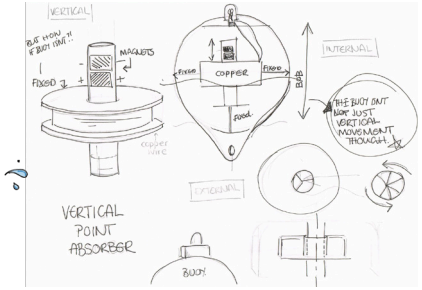
HOW WILL IT WORK?

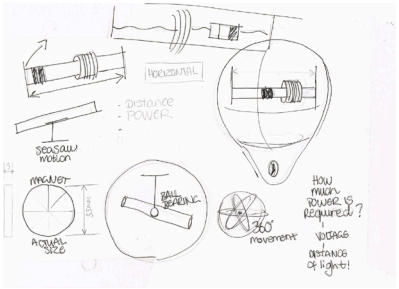
Having focussed on harnessing wave energy to power a light either within or on the buoy, it was now time to sketch, plan and prototype how the technology would work within a standard fishing buoy. Researching further into the basic principles of wave energy, I discovered several methods of how I could harness the movenment of the waves to power See Buoy.

I focused on the most cost effective and simple method. To produce the electric current, three elements were required:

- A supply of an electric charge (electrons) which are free to flow - this would be a magnet.
- A form of push to move the charges through the circuit - this would be the waves moving the buoy from side to side.
- A pathway to carry the charge - this would be copper wire to carry the charge to the battery to store the energy generated.

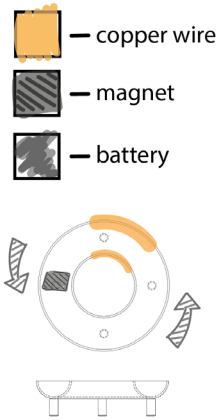




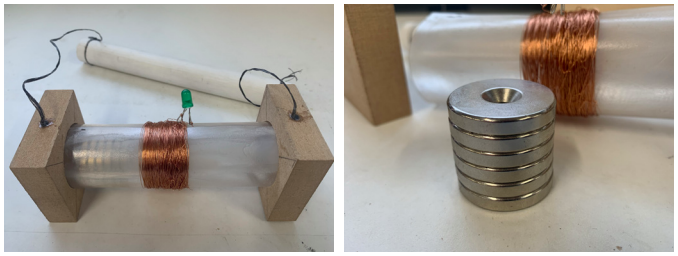


THINKING THROUGH MAKING

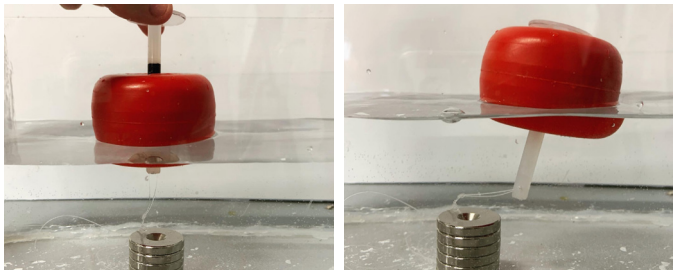
I prototyped each concept of the generator to test and discover their performance and electrical output. Wiring the prototypes up to a voltmeter with the aid of technician Ali Napier, it became apparent that I needed a greater charge of electricity. Ali explained that this could be achieved through a larger scale model.



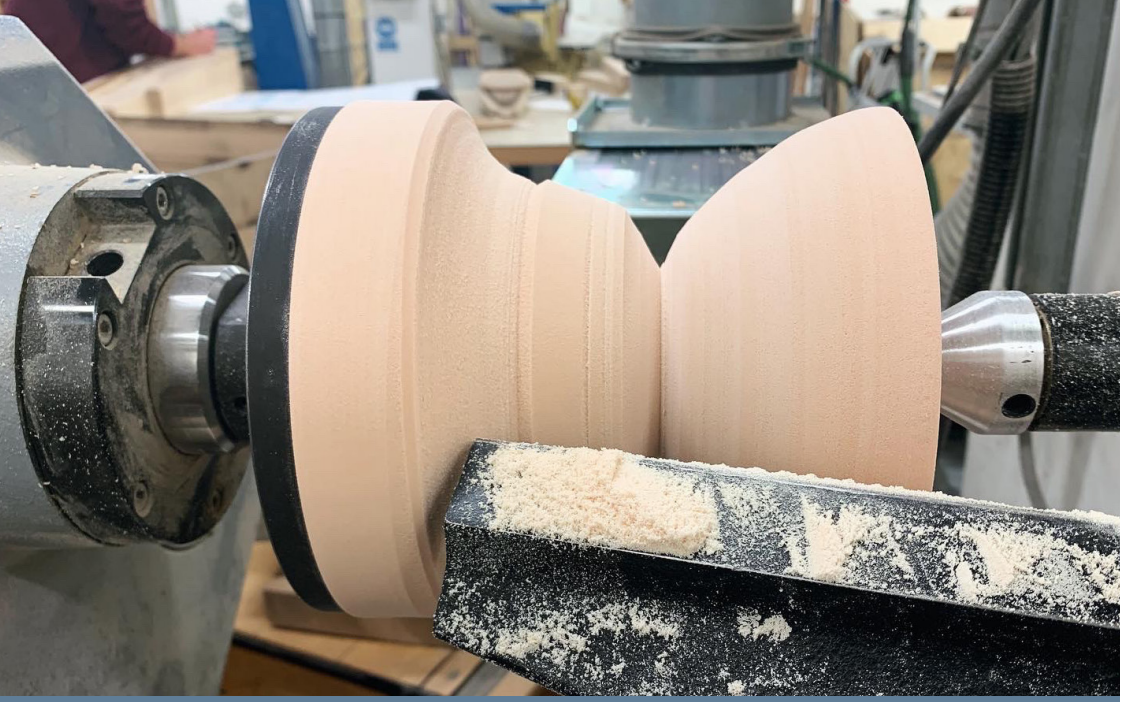
1 HORIZONTAL GENERATOR



2 VERTICAL GENERATOR



3 SPHERICAL GENERATOR



MAKING

Thinking through making is a phrase that followed me throughout the process of developing See Buoy. When creative blocks hit, I moved environments and formed shapes of the buoy on the lathe and my thoughts rolled.

I used various prototyping techniques such as 3D printing, turning, laser cutting, digital 3D modelling and sculpting foam.

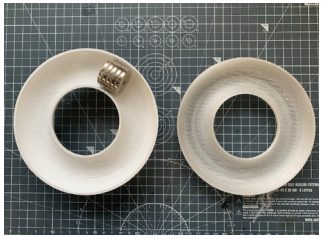
I struggled with the technical aspects of See Buoy. Despite knowing what I wanted to achieve, I found it difficult to think and make through the engineering side of where my design solution had taken me. I contacted industry professionals and gained assistance from technicians when required.

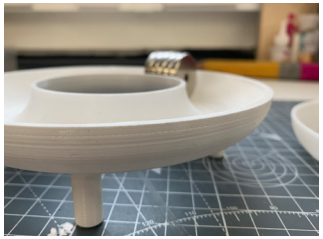
DEVELOPING THE GENERATOR

I decided to develop the spherical form as it allow the magnet to flow freely and not just on one axis. On the first 3D prototype of the generator the track seemed a little tight for the magnet to flow freely on small movements. Accordingly, I adjusted the model to allow for a wider track, minimising the inside circle.

I tested both small and vigorous movements to see how the voltage responded to each and as predicted greater voltage was generated according to faster movements of the magnet inside the doughnut form.

To secure the generator within the buoy, I added three feet onto the base of the ring which I intended to be moulded to the interior of the buoy.

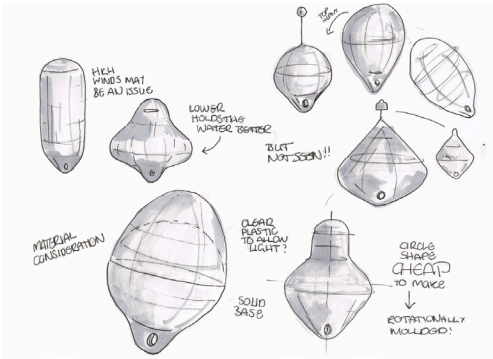


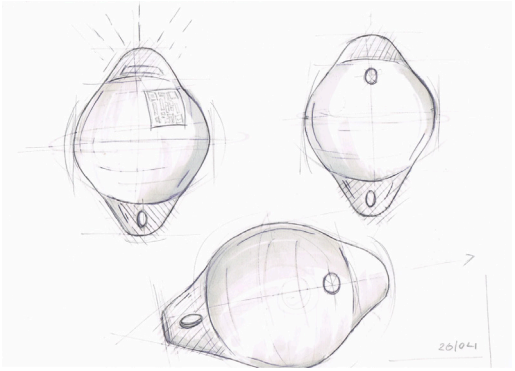


SECURING THE GENERATOR

In the early stages of digital 3D modelling I hadn't considered the attachment and fitment of the generator into the buoy other than moulding the generators legs to the internal base of the buoy. This was an element that had to be secure to withstand the movement of the waves and of course the force of the magnet within the ring.

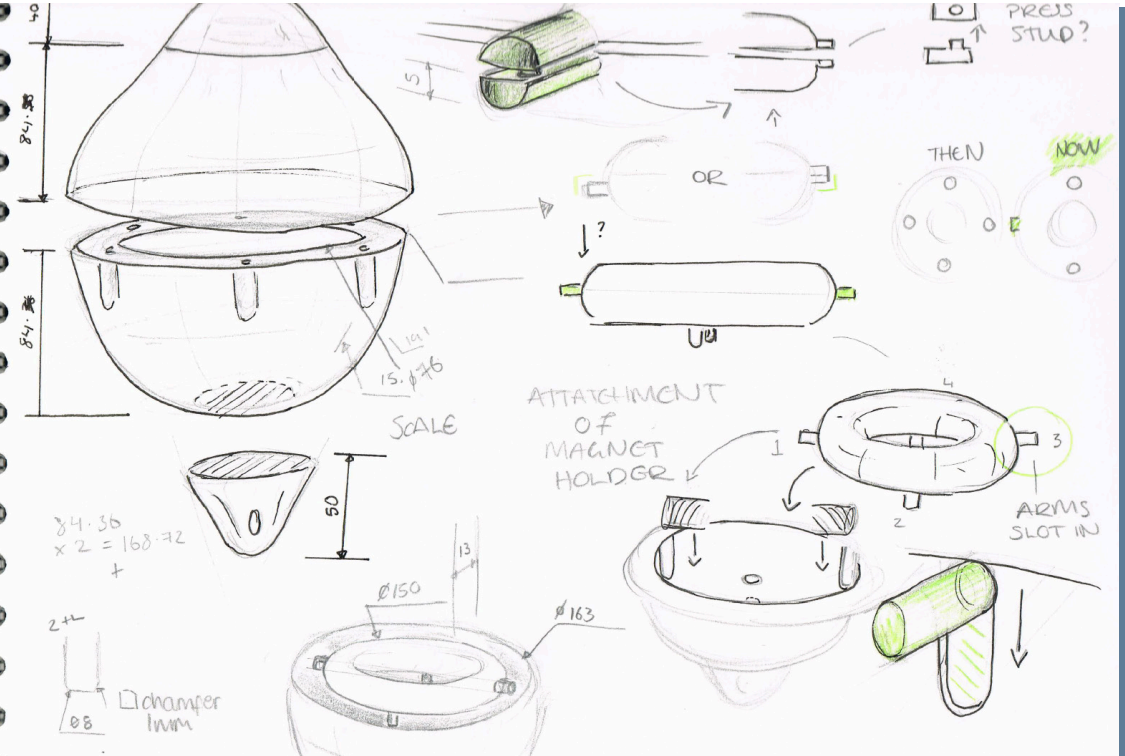
Through sketching, I designed a slot cut into the internal side of the buoy. This was a sleek solution to allow the generator to sit tightly inside the buoy. The addition of pins to attach the two halves of the generator rings (showed below in the sketch) ensure that the two rings are tightly attached together but adaptable to take apart if necessary. The copper wire wrapped around the exterior of the ring would act as extra protection, holding the two halves of the ring tightly together in its harsh marine environment.





SEE BUOYS FORM

The unique shape of the final outcome of the buoy has been influenced by the need for the buoy to sit higher in the water. This knowledge was aquired from Richard Littlefield (Ferry Captain), who said, "often the issue was that the buoys were submerged in the waves". To address this I added height to the form of the buoy meaning the buoy is unlikely to become **fully submerged**. The light located internally at the top peak of the buoy is guaranteed to remain visable and project light to highlight the objects prescance in the water.



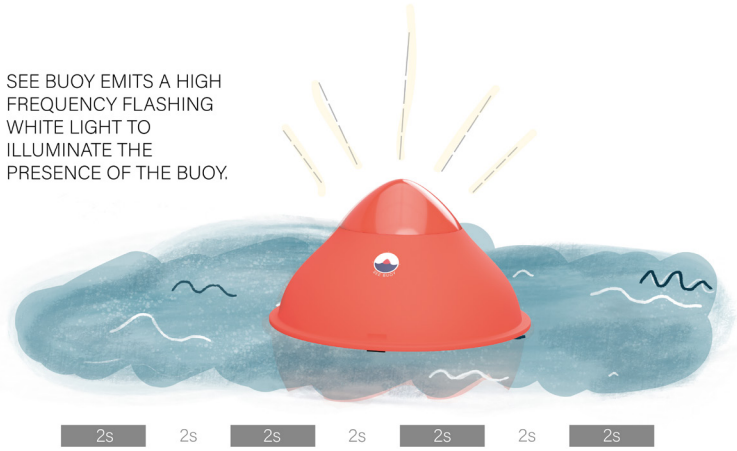
Focussing on my strenghts, I made the decision that I was going to strongly concentrate on illustrating the concept to the best of my ability, rather than spending a large amount of time creating a fully working integrated model. This was a big decision to make but one that reflected my strengths as a designer, rather than trying to be an engineer. My plan was to create a wizard of oz prototype representing the final form of the buoy and key internal components.

However, Coronavirus had other ideas and the closure of DJCAD in March meant working from home for the foreseeable future. With limited materials and and no workshop space to create a well resolved 'wizard of oz prototype', I finalised a final physical prototype of See Buoy to the best of my ability.

LIGHT

As light is the main output of the buoy, this element took a lot of consideration. Including what type of light I was using, placement of the light, colour of the light and of course the lighting sequence. The lighting sequence was particularly important to avoid interference with existing navigation at sea. I read up on the rules of the sea online and through 'Adlard Coles Book of Navigation'.

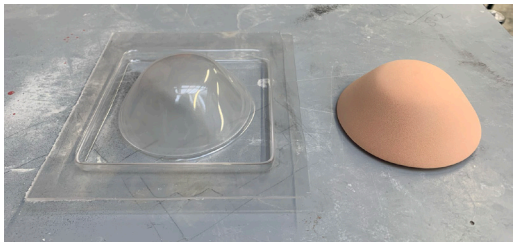
To generate the best possible outcome I spoke with a Angus Young, a Navigation officer from the Royal Navy. I concluded that a cold white, high intensity flashing light was best for visibility and would avoid any clash with current lighting at sea. To ensure boats could see the buoy, I chose for the light to be located in the top peak of See Buoy. With this in mind I chose to use a ring and a strip of High Intensity (HI) LED's. Having both would ensure that I had 360° light and light emitting from above. Allowing ships sitting higher in the water to see the light just as clear.



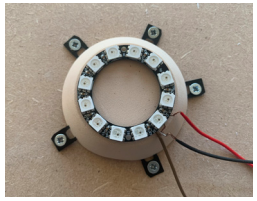
FLASHING EVERY 2 SECONDS, FOR A 2 SECOND DURATION. (SEE BUOY IS UNIQUE TO ANY OTHER NAVIGATION LIGHTING SEQUENCE AT SEA).

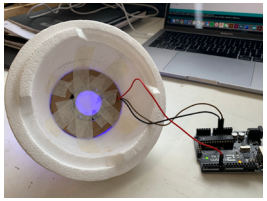
PROTOTYPING THE LIGHT

To create a casing for the light to emit from and safely hold the lighting components, I lathed a foam shape to match the top peak of the buoy.

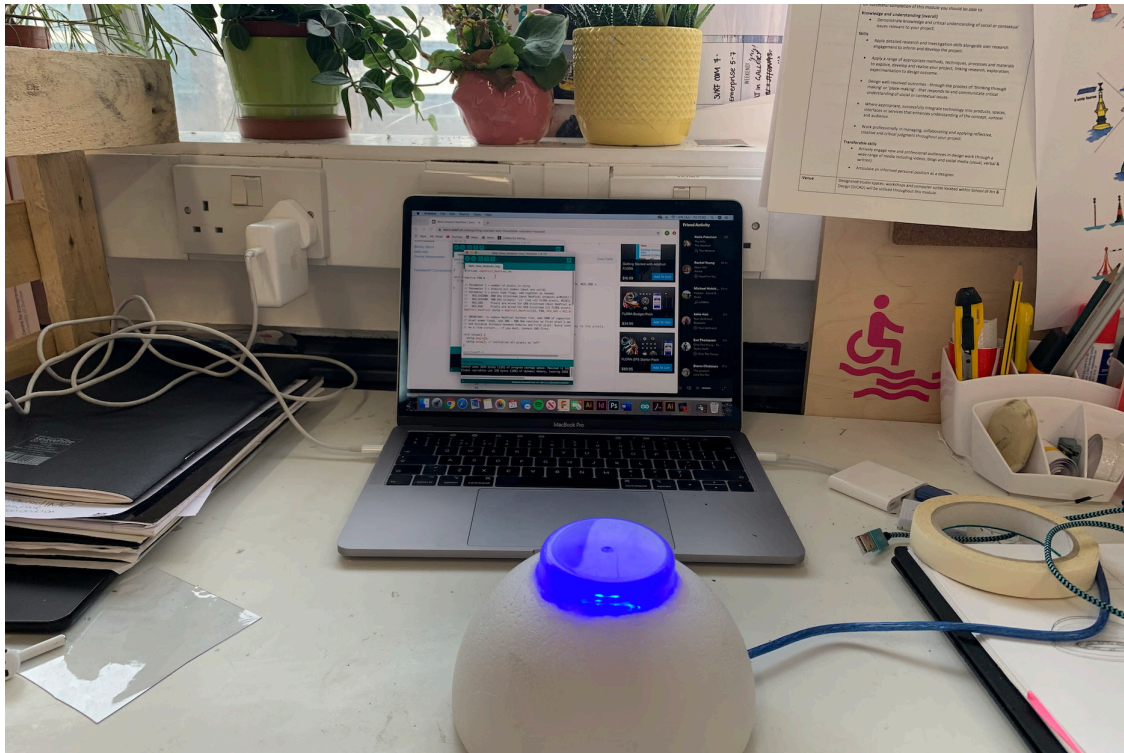


Using clear high impact polystyrene and a vaccum former I was able to achieve a transparent watertight case. To finish I frosted the casing by sandblasting ensuring it wasnt fully transparent. Applying a muted effect to the light would make sure it was still bright but not blinding.





Additionally I used Arduino software paired with a neopixel ring to prototype the flashing lighting sequence. I tested variuos CMYK colour profiles from various distances with participants to confirm that white was the most visible.



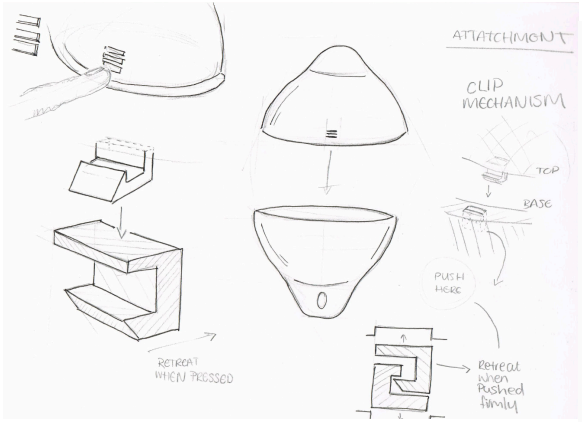
ASSEMBLY

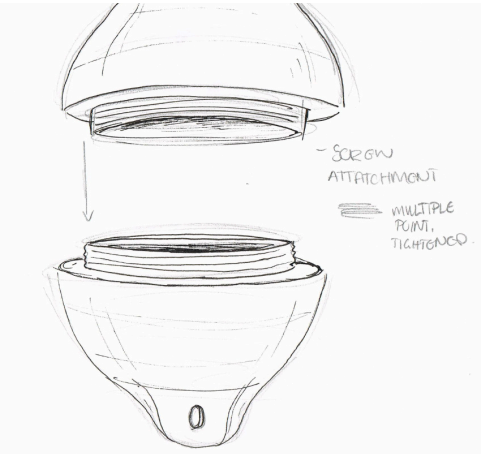
Ensuring the buoy and its components were assembled correctly and securely was vital as the buoy would be used in harsh marine climates.

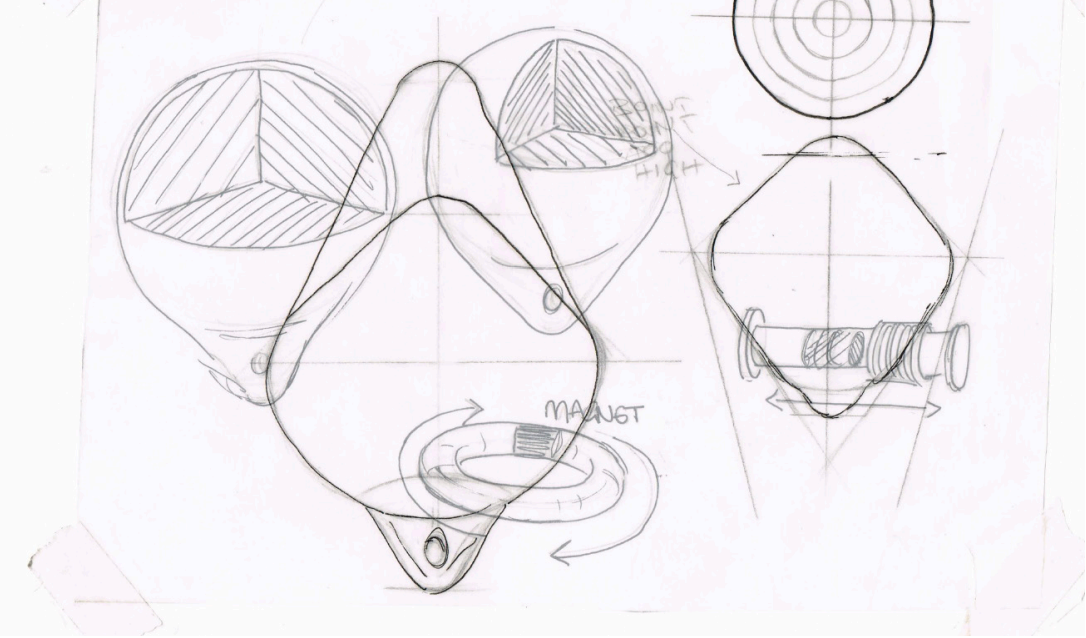
To allow the buoy to be taken apart if necessary, I developed a form of detachment, splitting the buoy into two halves. Later in the development, I decided to locate the power button for the light internally, allowing the light to be turned off when the buoy was out of use.

My first prototype of a suction seal (shown in image 1&2) used a combination of an ABS body and Agilus30 a rubber like material, 3D printed together.

Making the first digital 3D model of See Buoy, I developed an attachment using screws around the rim of the buoy (see image 3). However through feedback from hobbiest fishermen Russell, I quickly established that this would not ware well and rust/carode at sea due to salt water and abrasion.

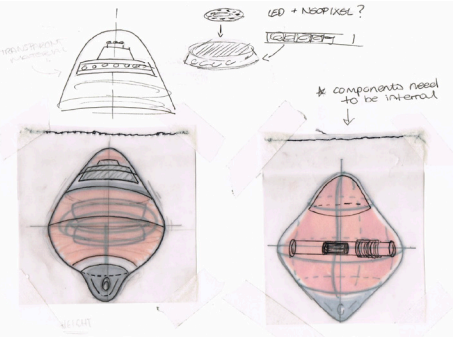


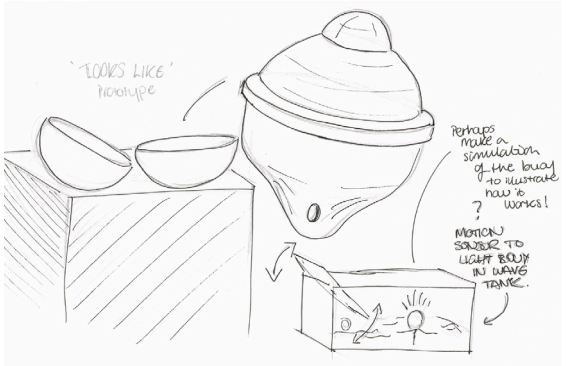




REPRESENTING THE DESIGN

To help me move forward in the development of the project I began to generate ideas of how I wanted to represent the final design. Focused on a physical 'wizard of oz' model, I began to plan how this may look. I also explored the idea of layered drawings to allow the viewer to 'flip through' a 2D visualisation of the product and its internal components.



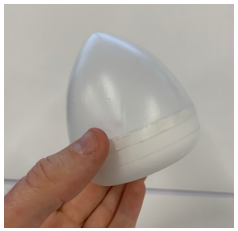


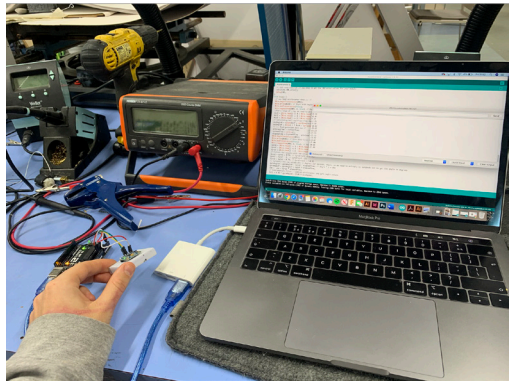
Display a section view of physical model?

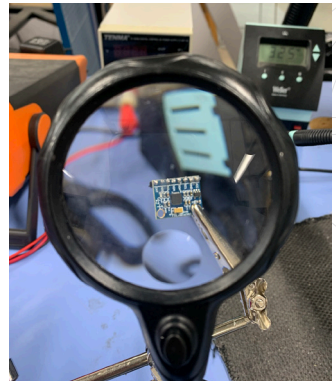
INTERACTION

Reflecting the decision to narrate the concept of my product, I decided to build an interactive wave tank. With the vision of showcasing a small replica of See Buoy lighting up from movement when waves were generated. This would be an engaging piece to feature at the degree show and clearly illustrated the intended function of the product.

To make the form of the minature buoy, I lathed a foam shape and vac-cum formed several materials, exper-imenting with thicknesses, heat and time to gain the best results possible. (see results below)







To make this possible I coded an accelerometer to read the measurements of movement from the buoy. This would accordingly light a flashing white light within the buoy. A barrier I faced was the placement of technlogy so close to water. As the buoy was so small, I would need an external power source which meant that the buoy had to have wires leaving it and the wave tank.

A CHANGE OF PLAN

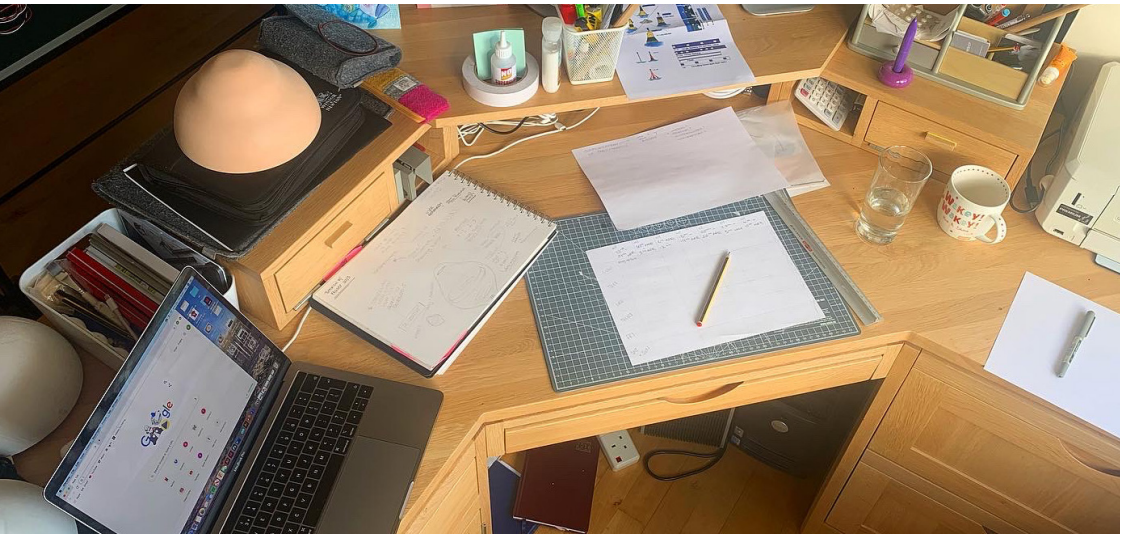
During the time I was developing the technology to sit inside the small buoy, DJCAD unexpectedly closed. Without the correct tools to complete the wave tank and buoy - such as a soldering iron, acrylic heating iron and workshop facilities - I decided to compromise. I diverted my attention to CAD modelling and delivering the concept of the product to the best of my ability. This decision was largely based on the fact that I was going to be incorporating technology and water in close proximity and I did not want to create an unsafe/botched model, with improper workshop or materials, from home.

MARK 2 PROTOTYPE

Mark two prototype presentations didn't go exactly to plan, as two weeks previously DJCAD had closed and I had moved my studio home to Helensburgh to live with my family. Giving a brief overview of my progress until now, I solidified my current focus and covered the prototypes I had previously made in DJCAD. I also introduced the new QR code element in more detail and shared my illustrative storyboarding development.

NEXT STEPS TO ACHIEVE PROJECT OUTCOME:

- Continue with making and sketching to further the development of the buoy. I wanted to make sure the physical prototype was as well resolved it could be.
- Finalise the development of the digital 3D model of See Buoy to represent the final prototype of the design. I belived I could achieve a digital model closer to the industry standard I was striving for, as making a final physical prototype was no longer possible.
- Solidify a name for the product and develop a brand. I wanted to ensure the product goals and outcome was represented well and that I produced a coherent design solution.



STORYBOARDING

I turned to focus on illustrating the narrative of the product due to my previous design to deliver See Buoys concept. This decision was supported by coronavirus limitinig my physical modelling development.

Design storytelling in the form of storyboarding was a great way to illustrate the product in its intended workinig environment. I spent a lot of time developing fun and communicative illustrations. In the end I chose to combine renders of the CAD model into the illustrations to allow the sharpness of the polished product to 'pop' and contrast with the loose sketchy style of the surrounding environment.

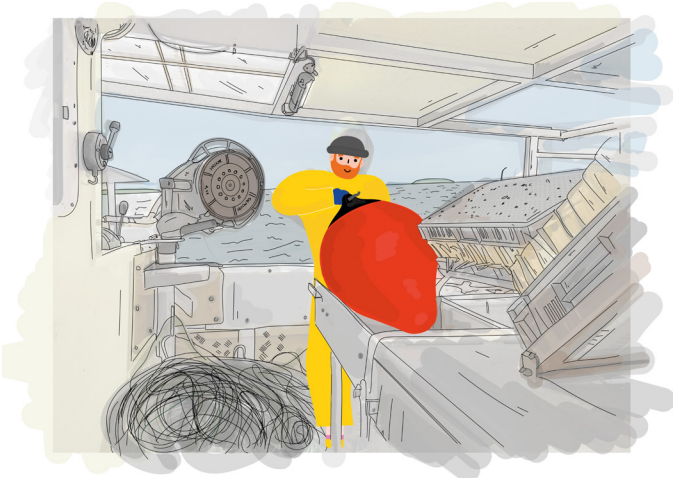


Illustration developed using an image captured during my explore phase on fishinig boat Deelan-De.

PERSONALISATION

Currently buoys are identified through their licence number or boat name, typically written in permanent marker on the side of the buoy. Friction against boats, abrasion from the sea and UV damage from the sun can result in the fading of this identification. Fishermen are familiar with other boat numbers and can identify vessels accordingly due to local knowledge. However if the buoy became detatched the general public would be unable to identify the owner through this method.

This is how I came to find solution that is accesible for all. A QR code moulded within the exterior surface of the buoy that is activated through scanning with your mobile phone camera.

Linked to the product website, the QR code would direct the public to a contact page, tailored to the product owner. (This would remain private from public access).

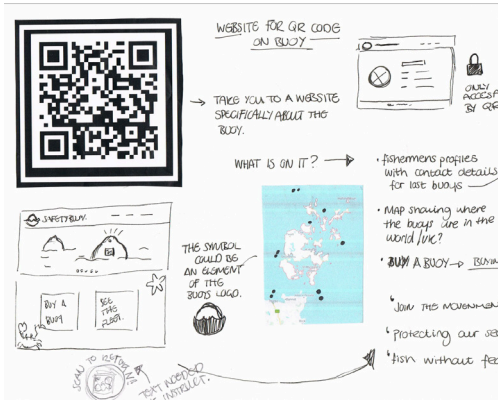
I was aware that this feature does not directly reduce the quantity of equipment lost at sea. However, it is an additional feature that ensures the traceability and the retrieval of lost equipment if See Buoy became damaged or detatched.

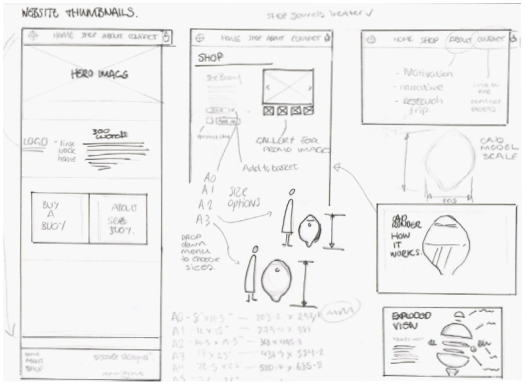
WEBSITE

Reflecting on feedback from my tutors during the Mark 2 presentation, I decided to expand on the connection between the QR code and the website. To make this website as professional as possible, I bought a domain (www.seebuoy.co.uk) to market my honours project and link it back to my own website.

My aim for the website developed into a business platform that could:

- Allow lost buoys to be scanned and returned to their owner. (Contact pages would remain hidden from general traffic to the website and only accessible through the QR code located on the buoy.)
- Provide more information about See Buoy, acting as a marketing tool to spread the products message and brand further.
- Include a buying page to allow members of the public, or fellow fishermen, that were interested in the product to make an enquiry or purchase a buoy.





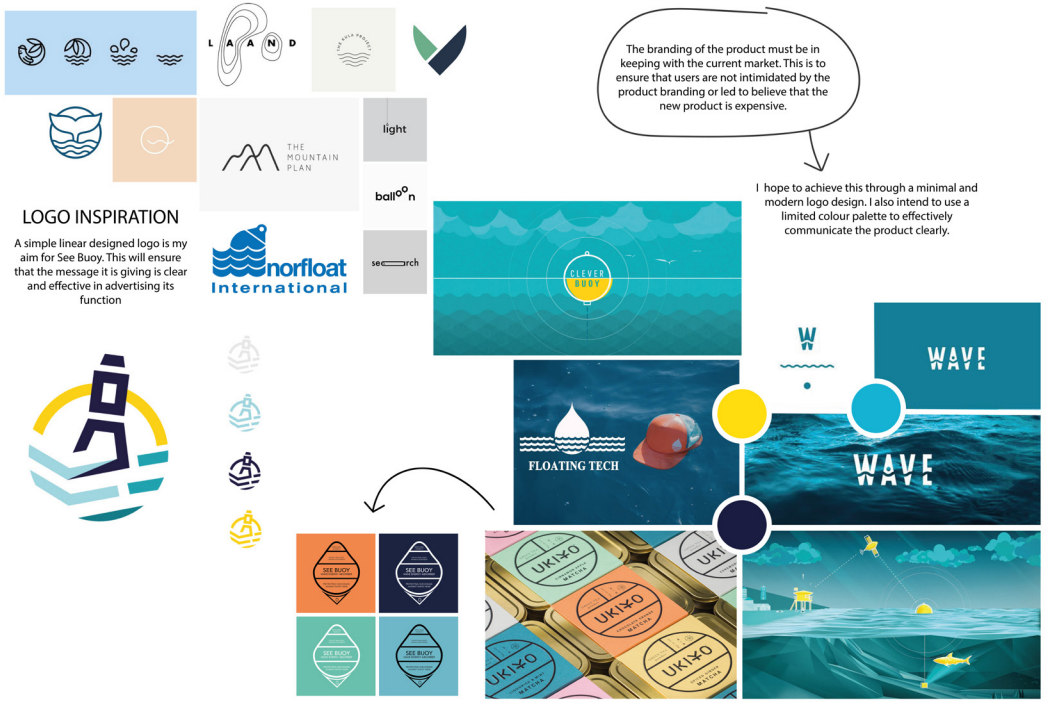
BRANDING

Highlighting the products services well and clearly is a key element of my design. I aimed to communicate the products money saving and environmental benefits to drive the products success.

To begin the branding process I generated a mood board to establish a colour palette and generate a feel for my target market.

Who is my target market?
Whilst fishermen are my primary target market, the buoy may also interest other water users such as yaught owners.

Where does the product sit beside others on the market?
There is not yet a product simialr to See Buoy on the market. See Buoy would be competing against large well established manufacturers such as Polyform and Norfloat, who currently supply standard A-series fishing buoys to the industry.



SEE BUOY - BRAND INSPIRATION KIM BURKE

SEE BUOY - BRAND DEVELOPMENT KIM BURKE

BRAND INSPIRATION

At this stage in developing the product brand, I took inspiration from a product I had discovered during my research period called Clever Buoy. Designed to make beaches safer, this buoy uses sensors to alert others to the presence of sharks in shallow water.

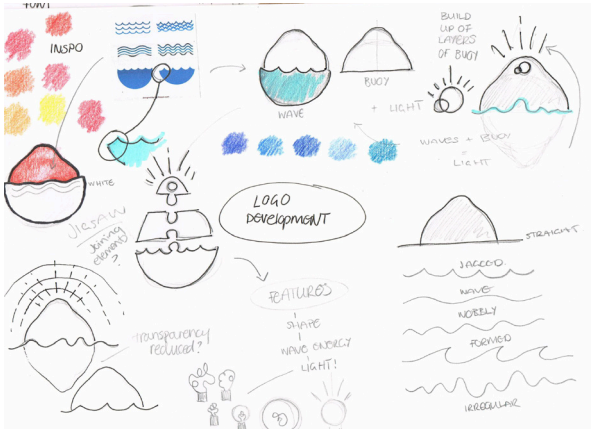
I particularly liked the style of graphics they used to illustrate the product. Through the use of line and shape, it visually provides more information than just an image. This form of communication I felt would benefit the technical nature of my product and explain it clearly for those who may not be familiar with the creel fishing process.

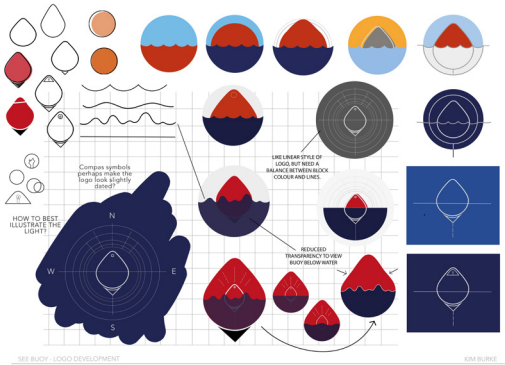
LOGO DESIGN

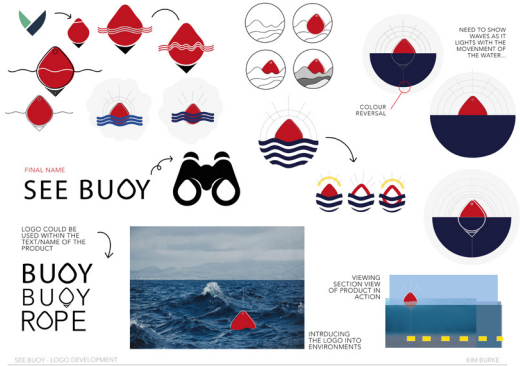
As See Buoys physical appearance is fitting with the current market, I wanted to ensure that the branding of the product was in-keping with the current marine product market also. I took inspiration from naughtical brands such as Musto, Gill and Gale Force Marine.

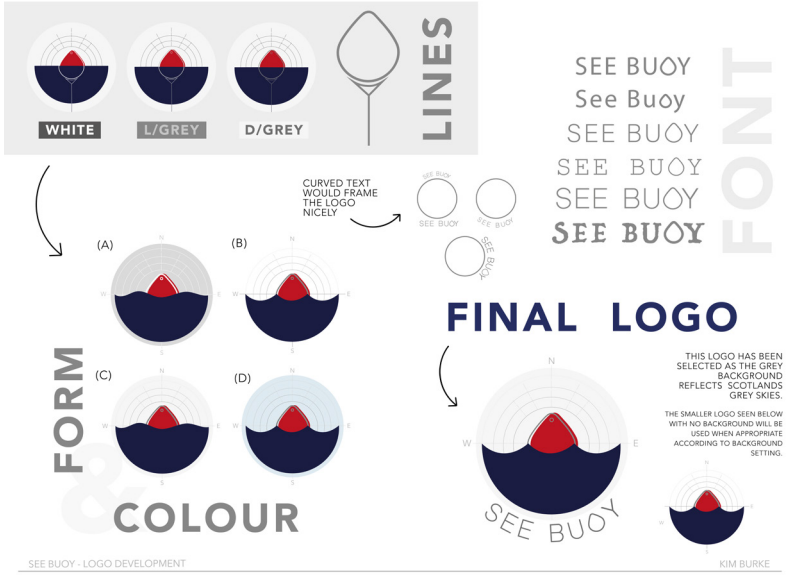
By adopting this strategy I hoped to navigate around the barrier of existing brand commitment.

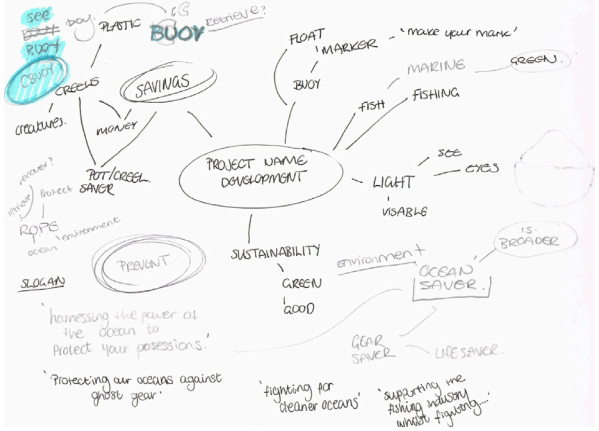
I began the development process by sketching an array of shapes, line and colour, which I then translated digitally using Adobe illustrator. Gaining feedback from the public using social media platforms helped me narrow down the final outcome.







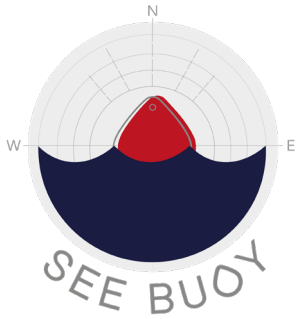




NAME GENERATION

Generating a name for the product took some time and it wasn't until I began designing the logo that I settled on a name. So See Buoy was chosen! Communicating clearly that the aim is to 'see' the buoy, whilst having a play on word 'sea' works nicely.

Say it out loud. It works better than me trying to explain it...



The logo design has been inspired by the unique shape of the buoy. Using a limited colour palette of red and blue. The contrasting logo is clear and communicative. I have chosen to use line to represent the buoys main feature of light, with the combination of waves ilustrated through the blue shape to touch upon its energy source.

DELIVER

Showcasing the final deliverables of See Buoy.

INTRODUCING SEE BUOY

Under the sea, an environment we never see is a world we destroy daily.

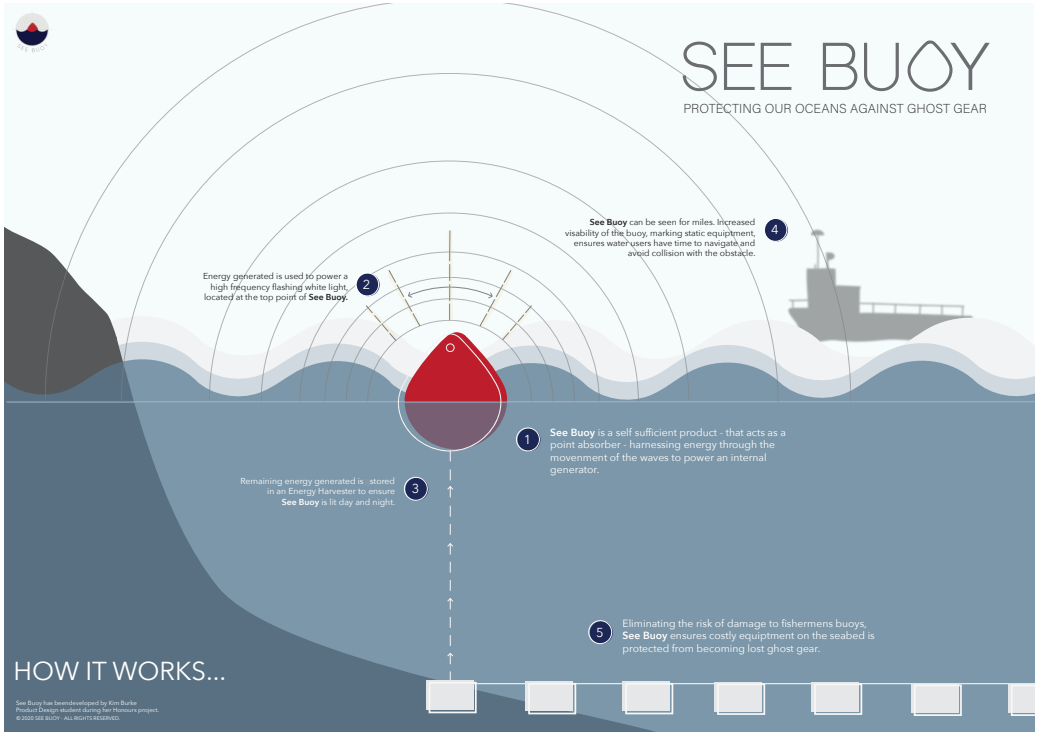
See Buoy harnesses the power of the ocean - using the fundamentals of wave technology - to power a high frequency flashing light ensuring equipment is visible at sea. The affordable, self-sufficient buoy provides time for passers-by to navigate around See Buoy. Integrated into fishermen's working environment, See Buoy ensures the protection of costly equipment and ends the cruel cycle of ghost gear polluting our oceans.

See Buoy. See Profit. See Clean Seas.

HERO IMAGE:

HOW IT WORKS

I created an infographic-styled board to describe the function of See Buoy step by step. I felt that it was beneficial to illustrate a string of creels on the sea bed for those that aren't as familiar with the creel fishing process. Using this descriptive style of presentation was also a good tool to use within the website and marketing material.



ILLUSTRATING THE NARRATIVE

My aim for the storyboard was to communicate the function of the product, whilst providnig a detailed account of fishermens working patterns. This was important to highlight as accidental damage generally occurs during hours of dark. I also wanted to highlight the products two main goals, environmental benefit and financial benefit for fishermen.

Keeping the storyboard fun, simple and 'jargon free' was important to allow everyone to understand the issue clearly alongside the design solution.

PERSONA

To narate I created a persona. The narrative of the stoyboard was based upon fishing trip with Mario, however the characters name was changed for the purpose of this excercise.

STORYBOARD

I generated a story board to visually communicate the suer experience surrounding See Buoy. The following graphics illustrate how the buoy is set up, used and delivers.

Follow John's journey as he uses See Buoy for the first time...

START HERE

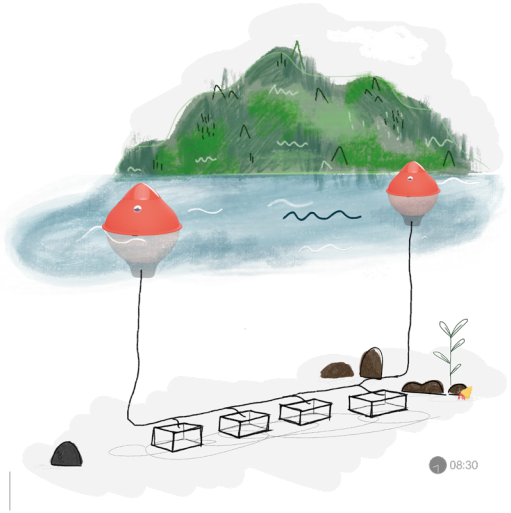
1.

FIRSTLY I SEPRATED THE BUOY THROUGH THE CLIP MECHANISM AND PRESSED THE INTERNAL POWER BUTTON TO START CHARGING THE BATTERY.

2.

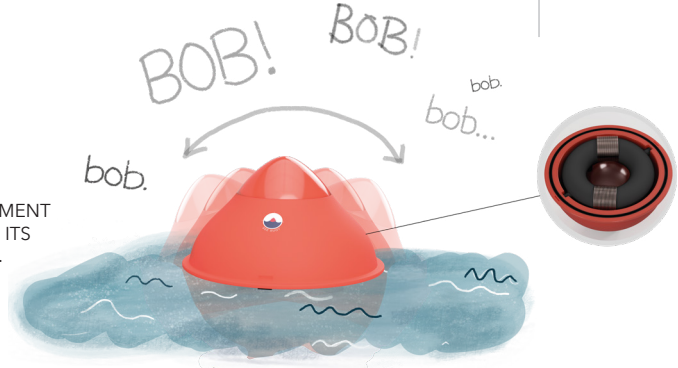
I THEN ATTACHED THE BUOY TO THE END OF THE ROPE WHICH WAS ATTACHED TO MY CREELS.

3.



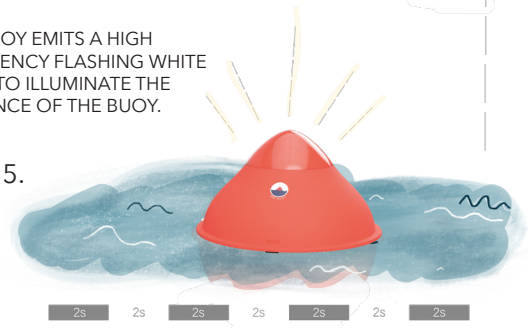
I SET MY STRING OF CREELS AS USUAL FOR THE NEXT 24 HOURS. I ATTACHED SEE BUOY AT EITHER END OF MY STRING FOR ULTIMATE PERFORMANCE, AS RECOMENDED TO PROTECT MY EQUIPTMENT.

4.



SEE BUOY IS SELF-SUFFICIENT AND HARNESSES THE MOVEMENT OF THE SEA TO POWER ITS INTERNAL GENERATOR.

5.



SEE BUOY EMITS A HIGH FREQUENCY FLASHING WHITE LIGHT TO ILLUMINATE THE PRESENCE OF THE BUOY.

FLASHING EVERY 2 SECONDS, FOR A 2 SECOND DURATION. (SEE BUOY IS UNIQUE TO ANY OTHER NAVIGATION LIGHTING SEQUENCE AT SEA).

KEEP GOING

KEEP GOING

6.

22:30

PASSING FERRIES, SHIPS, YACHTS AND FELLOW FISHERMEN WILL BE ALETED TO THE PRESENCE OF GEAR IN THE WATER THROUGH SEE BUOYS FLASHING LIGHT. THIS PROVIDES TIME FOR BOATS TO NAVIGATE TO AVOID THE OBSTACLE.

7.

03:00

TRAWLERS CAN EASILY IDENTIFY TWO LIT BUOYS IN CLOSE PROXIMITY, HIGHLIGHTING THE STRING OF CREELS CONNECTED BELOW.

TRAWLERS PASSING BY BENEFIT FINANCIALLY, AVOIDING DAMAGE TO THIER NETS BY SEEING BUOYS HOLDING STATIC GEAR.

8.

06:05

ON MY JOURNEY TO RETRIEVE MY CATCH, THE LOCATION OF MY CREELS WAS HIGHLIGHTED BY SEE BUOY FLASHING. IN CHOPPY SEAS OR IN THE DARK THIS CAN BE DIFFICULT.

9.

09:30

MY COSTLY EQUIPMENT IS SAFE! I WILL TRUST SEE BUOY IN THE FUTURE. IT HAS PROTECTED MY GEAR AND MY LIVELIHOOD.

THERE IS AN END TO THE VICIOUS CYCLE OF GHOST POTS TRAPPING AND KILLING CREATURES. OUR SEAS ARE FREE FROM POLLUTION THROUGH SEE BUOY.

10.

14:10

SHARING MY POSITIVE EXPERIENCE WITH FRIENDS AND FELLOW FISHERMEN, I DONT DOUBT SEE BUOYS MARKET WILL GROW.

CONTEXTUAL DIAGRAM

After I had established See Buoys specifics, I created a contextual diagram to help me visualise where the product would feature. The visual pulled together feedback from fishermen and industry professionals, Angus Young and ferry captain Richard Littlefield. Specifically it allowed me to highlight the areas in Scotland where See Buoy would perform best.

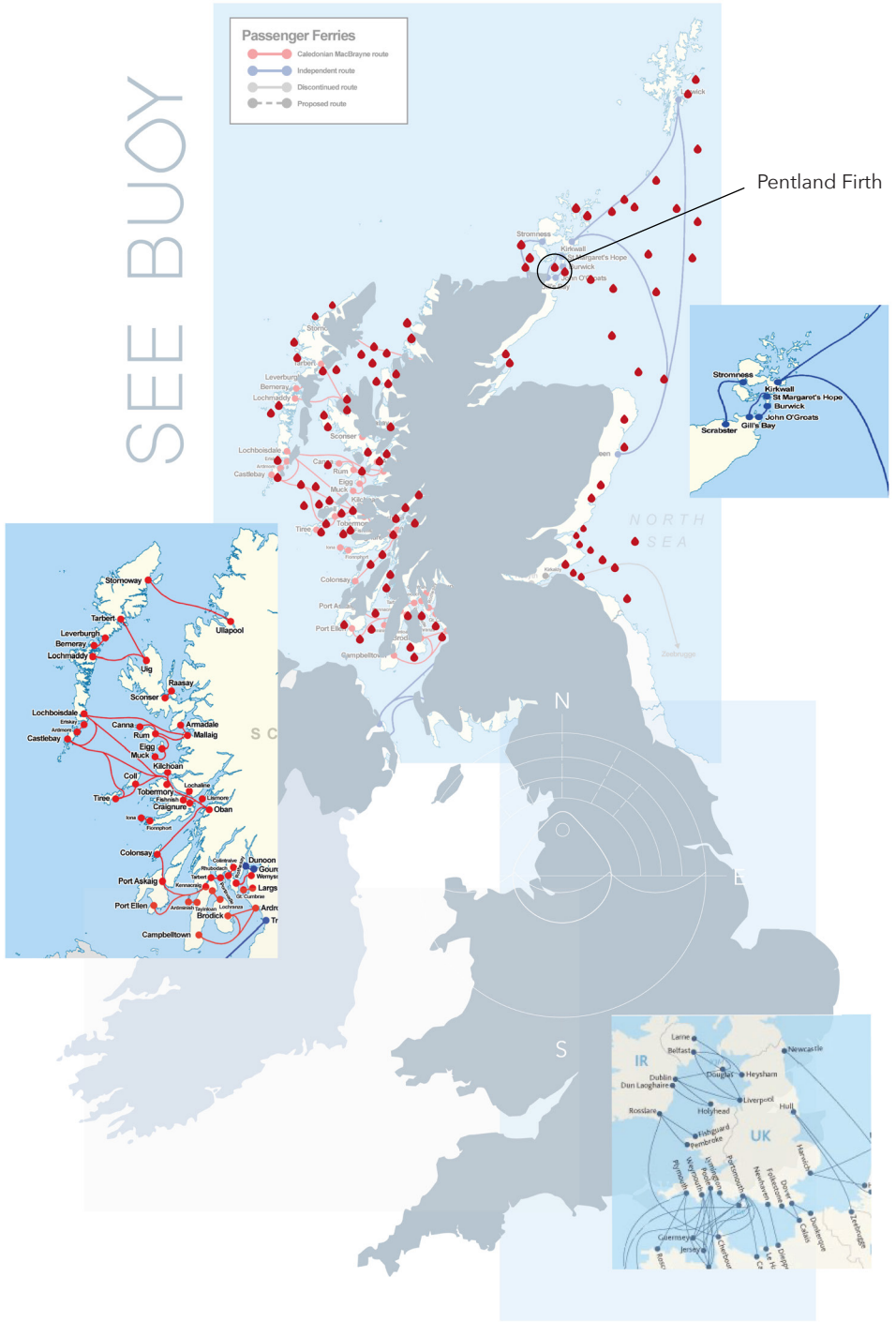
Targeting Scotlands complex geography and tides See Buoy has been designed to feature inland between lochs, nooks and crannies where ferries, leisure and tourism activities often damage poorly visable buoys.

A specific example of a body of water that would benefit from See Buoys unique risen form and light, is the Pentland Firth. This was highlighted to me by ferry captain Richard. The body of water between Orkney and the mainland is a prime fishing ground. However, the stretch of water is amongst the worst in the world, with 6 tides and 13 wind directions. As a result buoys become submerged and visability decreases further.

'You won't see them until the last minute because they are semi submerged' - Richard Littlefield, Ferry Captain

Connecting Scotlands coastlines, we are surrounded by ferry routes which restrict fishing grounds. Fishermen are forced to edge closer to ferry paths are these are unfished. Frequently in the hours of dark,
collision between ferries and buoys occurs, resulting in snapped lines and lost equipment.

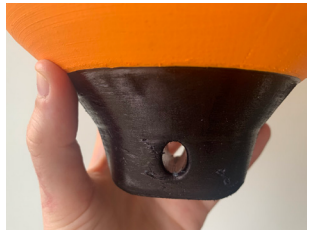
See Buoy aims to provide to a tool for fishermen, fishing in close proximity to ferry paths and complex coastlines, by preventing accidental damage of fishing equiptment.



FINAL PHYSICAL MODEL

With limited materials and and no workshop space to create a well resolved ‘wizard of oz prototype’, I finalised a final physical prototype of See Buoy to the best of my ability.

Living close to the sea, I was able to capture the physical model of See Buoy within its environment. I used my one form of excercise a day to get out on a kayak and create a contextual image of the prototype. (Protoype not to scale).

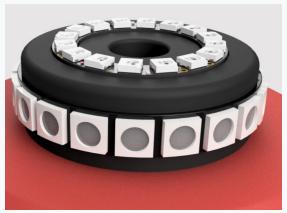


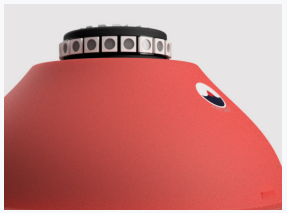
EXPLODED VIEW

WHAT IS INSIDE SEE BUOY?

PARTS LIST				
PART NO.	QTY	PART NAME	DESCRIPTION	MATERIAL
1	2	HIGH INTENSITY LED'S	LIGHT TO EMIT	PRE-FABRRICATED
2	1	LIGHT CASING	PROTECTS AND SOFTENS LIGHT	HIGH IMPACT POLYSTYRENE
3	1	SEE BUOY LOGO	PRODUCT BRANDING	POLYPROPYLENE
4	1	LIGHT HOLDER	PROTECTS TECH	POLYPROPYLENE VINYL
5	2	GENERATOR	TRACK FOR MAGNET	RECYCLED POLYETHYLENE
6	1	MAGNET	GENERATES ELECTRONS	PRE-FABRRICATED
7	2	COPPER WIRE	CONDUCTIVE PATH	DRAWN COPPER
8	1	TOP OF BUOY	UNIQUE SHAPE TO SIT HIGH IN WATER	RECYCLED POLYETHYLENE
9	1	BASE OF BUOY	HOLDS COMPONENTS	RECYCLED POLYETHYLENE
10	2	RUBBER SEAL	ENSURES BUOY IS WATERTIGHT	NEOPRENE
11	2	CLIP ATTACHMENT	DISMANTLE BUOY	NYLON
12	1	ENERGY HARVESTER	STORES ENERGY	PRE-FABRRICATED
13	1	BATTERY HOLDER	SECURES BATTERY	POLYPROPYLENE
14	1	ROPE HOLDER	ATTATCH TO ROPE	NYLON
15	1	POWER BUTTON	TURN ON/OFF LIGHT	PRE-FABRRICATED

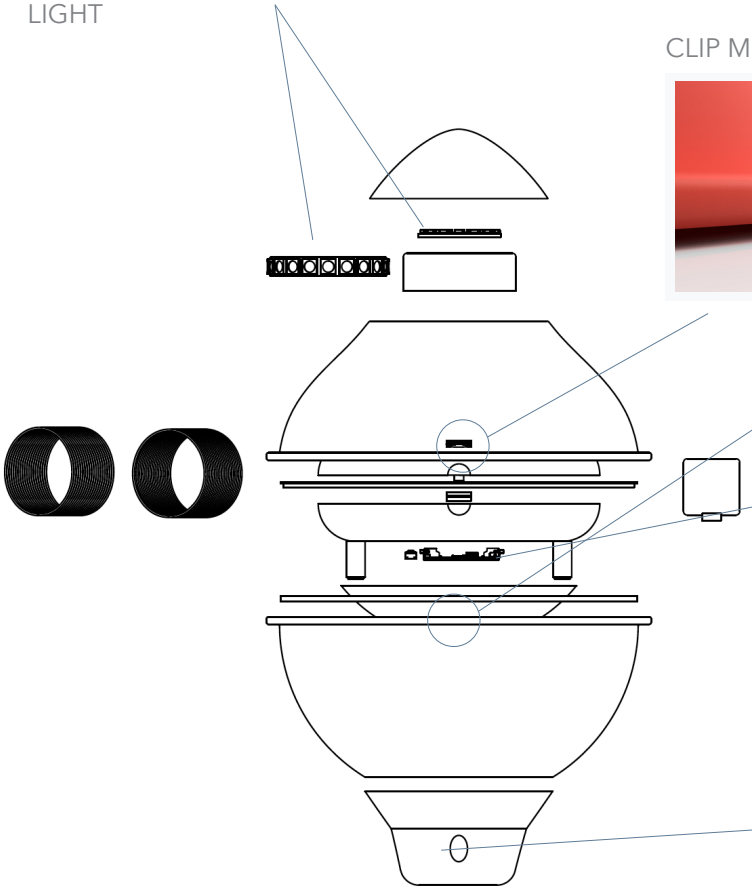
SEE BUOYS COMPONENTS





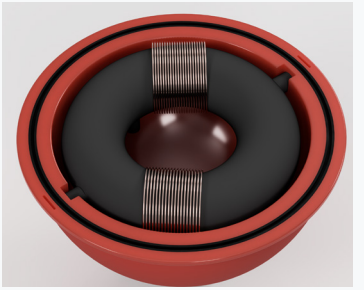
The 360° high intensity flashing light, located on the top peak of See Buoys unique shape, ensures that light emitts from every direction of the buoy.

LIGHT



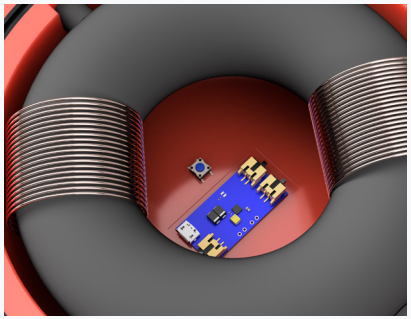
CLIP MECHANISM

I established through digital 3D modelling and sketching that a combination of a rubber seal, connecting where the two halves meet, and a clip mechanism would ensure the buoy was secure and water tight. I added grip detail above the push points of the clips to highlight the interaction of opening the buoy, splitting it in half.



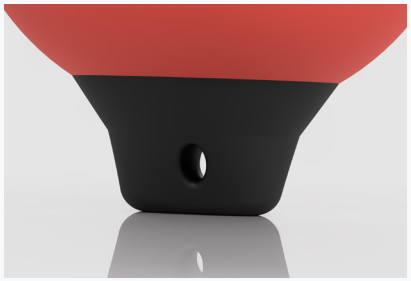
RUBBER SEAL

BATTERY



As the generator inside the buoy will be running constantly, powered by the movement of waves. This means that the light will also be running constantly day and night to ensure safety of equipment. The power generated will be stored in a battery. This will ensure that the light is always lit. There will of course be peak times for the generator to develop more power, ie. if the sea is has more movement due to wind, tide or swell.

The battery I have chose to use in the buoy is a Piezoelectric Energy Harvester This battery will sit in the base of the buoy in a holder to ensure it is secure despite the movement of the buoy.

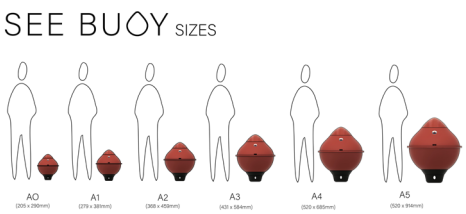


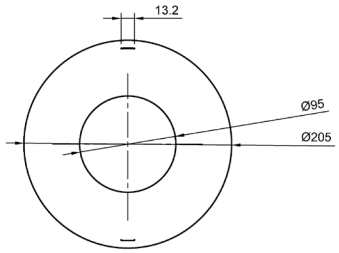
ROPE HOLD

ORTHOGRAPHIC DRAWING

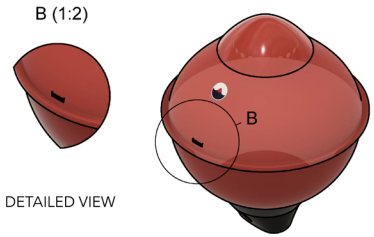
I decided to create an orthographic drawing to show the relevant sizing, fittings of the components and parts through hidden detail and a section view. Due to the highly technical nature of the buoy, I felt users may wish to see exactly what makes See Buoy function.

See Buoy is available in various sizes to ensure the product is useful across a variety of maritime sectors.

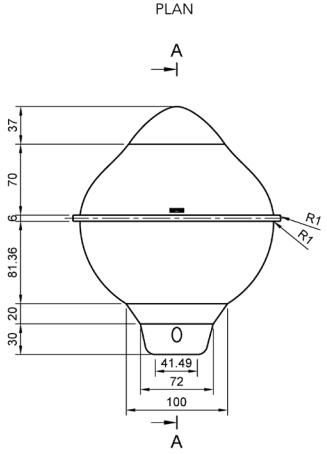




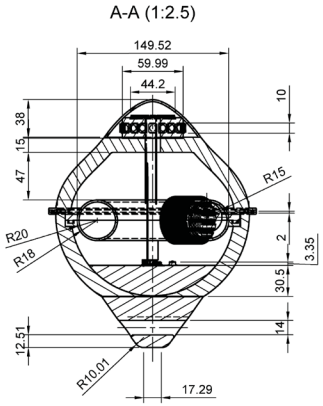
PLAN



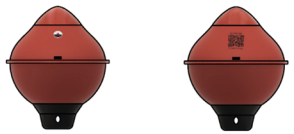
DETAILED VIEW



ELEVATION



SECTION



FRONT BACK

KIM BURKE	THIRD ANGLE PROJECTION
25/04/2020	HONOURS PROJECT
SCALE : 1:2	UNIT: MM

SEE BUOY

WHAT IS SEE BUOY MADE FROM?

Unlike existing products on the market, See Buoy uses recycled Polyethylene. This expands the products efforts to protect our environment for future generations through limiting plastic production, using recycled buoys and various other Polyethylene products. Light weight, strong and versatile, Polyethylene is the perfect material for See Buoy. Its ability to withstand harsh marine climates, weathering and UV exposure are additional reasons why I have chosen this material for the shell of the product. Many pigments are used within Polyethylene products, including heavy metals suchas Lead, Cadmium and Chromium whihc are toxic to humans and our environment. Despite no legal regulations restricting the use of heavy metal pigments in material manufacture, See Buoy is made from only material free from heavy metal and toxic chemicals that could pose further harm to our environment.

As a service to the products customers, specific buoys can be returned to See Buoy for safe and responsible recycling. Customers in turn can trade in their pre-existing buoys and receive money off their future purchases.

HOW IS SEE BUOY MADE?

Due to the complexity of See Buoys internal form, the casing of the buoy has been injection moulded. The benefit of this process is that it provides extremely high accuracy for the fitting of internal components. It also allows for various material combinations. This ensures the rope hold can be securely moulded onto the base of See Buoy. Above all else; Injection moulding ensures that the mould can be re-used, reducing manufacturing costs, contributing to making See Buoy affordable for fishermen.

See Buoys graphics, including the logo and QR code discovery feature are permanently moulded and integrated into the polymer during this manufacture process. This ensures that the graphics maintain

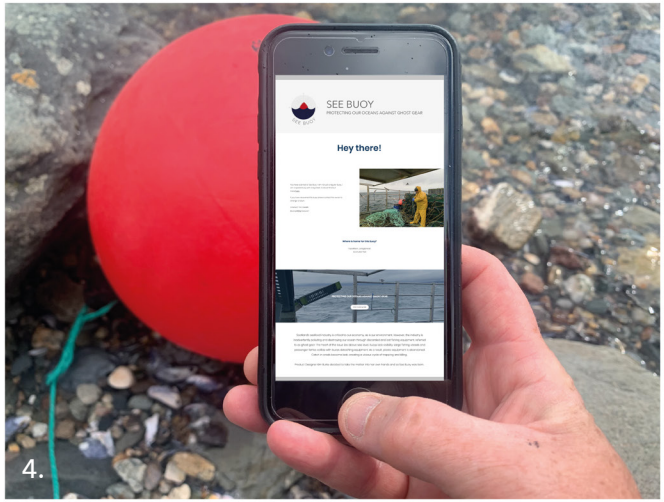
SEE BUOY

'IF LOST, SCAN TO RETURN' - QR CODE FEATURE

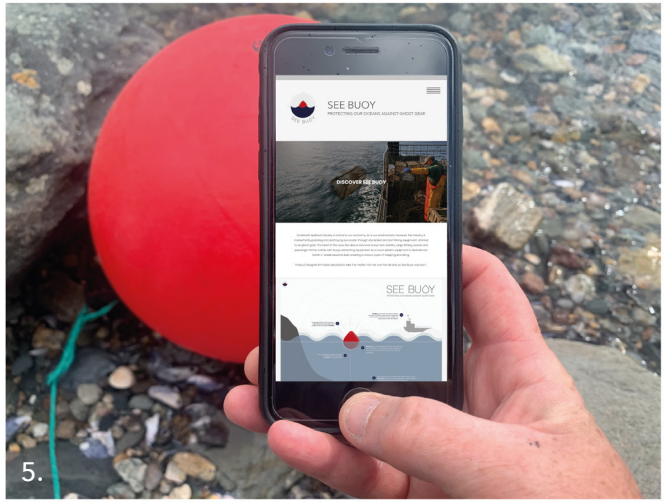
IN THE EVENT THAT SEE BUOY BECAME DETATCHED FROM ITS ROPE, FISHERMEN CAN BE ASSURED THAT THEIR BUOY IS TRACEABLE AND CAN BE RETURNED TO THEM IF FOUND ON LAND OR SEA.

PASSERS BY ARE ENCOURAGED TO SCAN THE QR CODE WITH THEIR PHONE CAMERA THORUGH A GRAPHIC THAT READS:
'IF LOST, SCAN TO RETURN.'

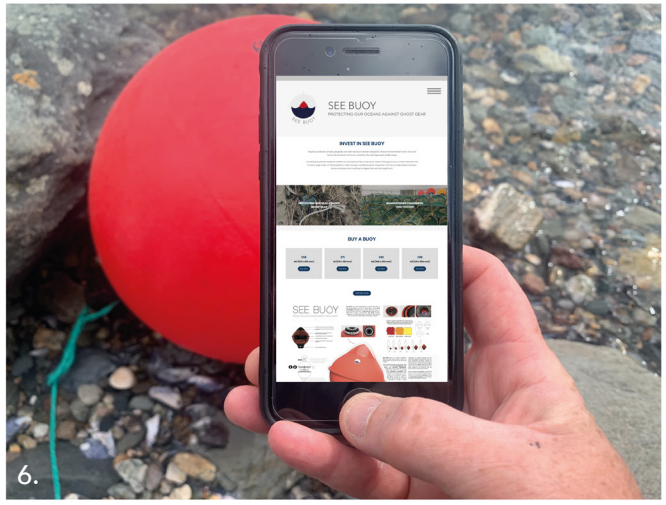
THROUGH SCANNING THE QR CODE THE INDIVIDUAL WILL BE TAKEN TO THE PRODUCTS WEBSITE "SEEBUOY.CO.UK".



THE QR CODE IS LINKED TO A HIDDEN CONTACT PAGE. DETAILS ARE PROVIDED TO CONTACT THE OWNER AND ARRANGE A RETURN. THE GOOD DEED OF RETURNING THE BUOY IS ENCOURAGED THROUGH AN EXPLANATION THE PRODUCTS ENVIRONMENTAL BENEFITS.



THE PASSER BY CAN DISCOVER MORE ABOUT THE PRODUCT THEY HAVE RECOVERED THROUGH THE WEBSITE.
INFORMATION ABOUT WHAT THE BUOY DOES, HOW IT WORKS AND WHAT IT ACHIEVES CAN BE EXPLORED.



CONNECTING THE BUOY DIGITALLY TO ITS ONLINE MARKETING PLATFORM WILL ALSO PROMOTE THE PRODUCT. THE INDIVIDUAL CAN ENQUIRE OR PURCHASE THE BUOY THROUGH THE ONLINE STORE.

TRY IT FOR YOURSELF

Use your phone camera, scan the QR code below and view See Buoys 'If lost, scan to return' on the product website.

DO YOU BELIEVE SEE BUOY WOULD BE OF BENEFIT TO YOUR FISHING PRACTICE?

> **I think See Buoy has incredible potential for the UK fishing industry.**
>
> - Lobster fisherman Russell, age 60

> **See Buoy would undoubtably save us thousands each year in lost equipment**
>
> - Prawn fisherman Mario, age 28

PEOPLE 40%

See Buoy was about creating a product that was built into the users working environment, to prevent the loss of fishing equipment at sea. Primary research vividly highlighted the issue fishermen faced, giving me the drive to create a product that protected sea life and livelihoods. Taking a participatory approach to gain deeper insights was crucial to the success of See Buoy. I am proud to have developed a viable product that fishermen would be glad to use.

DESIGN (35%)

Visual design was a strong focus in the branding of See Buoy. I spent a lot of time developing a logo, name and brand image for the product. This was to ensure it sat well in the market beside other products, as I took a conceptual and marketed approach to explain the product concept. The design of the buoy was heavily considered from a functiional perspective and reflected its embeded technology. The form of the buoy was influenced by the delivery of its lighting output and the need for the buoy to sit higher in the water.

TECHNOLOGY (25%)

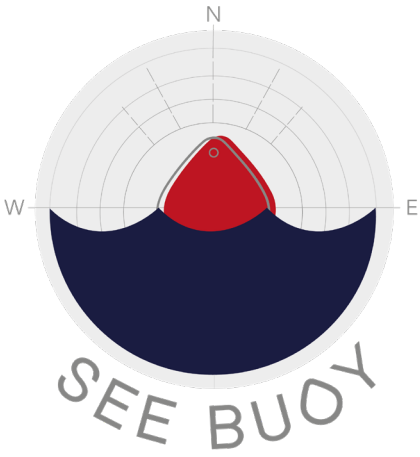
I predominatly used Arduino to test lighting sequences and the colour for See Buoy, integrating neopixels into models and conducting user testing to discover which was more visable from various distances. I used multiple 3D modelling tecniques to prototype the movement and form of the generator and tested which generated greater voltage. Whilst See Buoy is a product that is powered by unique technology, the key focus was to create a product that made a difference and slid into a fishermens working environments with ease.

WHAT IF'S?

I never anticipated 8 months ago at the beginning of my honours year project See Buoy would be my final outcome. I am proud of the product I have developed and delivered especially under the circumstances 2020 threw at us. I am especially satisfied to have produced a product that has been developed close to the products intended users and industry professionals. Stepping on a commercial fihsing boat at 3am to conduct 12 hours of research sure put me outside of my comfort zone. Various phone interviews to industry professionals has grown my confidence as a designer. I can finally say I am proud to deliver See Buoy as a representation of my ambition for cleaner seas and as a culimation of my 4 years at DJCAD.

Given the opporttunity to further develop See Buoy, I would like to see buoys ar either end of a string of creels, connected and flashing in sequence (potentially through a bluetooth module). The consideration for various models and price ranges of the buoy could also be developed, giving fishermen choice within their product price and level of performance.

Fisheries Innovation Scotland invited me to pitch See Buoy in July of 2020 at the Scottish Fishing Confrence, themed 'From Innovation to Action'. The shark tank pitch became my focus throughout the development of See Buoy and framed my final conceptual outcome. However due to COVID-19 the confrence was cancelled along with New Designers and our Degree Show. Loosing focus and sight of a final presentation was difficult. However, my passion for the topic has really pushed me to the final outcome of my honours project. I am still holding out hope that I will be pitching See Buoy next year. I look forward to the feedback I gain to develop See Buoy even further and reach my goal of a fully integrated working prototype which could be used within the fishing and maritime industries.



FIND OUT MORE AT THE PRODUCT WEBSITE: www.seebuoy.co.uk

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www.kimburkedesign.co.uk