

2019

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What

AQUApod is a modern and low maintenance alternative to a waiting room aquarium. The kinetic aquarium system, populated by biomimetic magnetic fish has been designed to improve the physical and mental well-being of A+E users.

Who

Everyone! Offering one AQUApod specifically for active interaction and another for purely passive interaction enables users to chose how they would like to engage with the product. The modularity allows for a range of configurations. Each module can be placed at any desired height, angle, wall location to best suit the environment and accommodate all users.

Where

The application of AQUApod stretches far beyond A+E waiting rooms, with long waits and stressful experiences occurring in many situations. From public transport to mental health institutions, any environment with adequate wall space is suitable.

Why

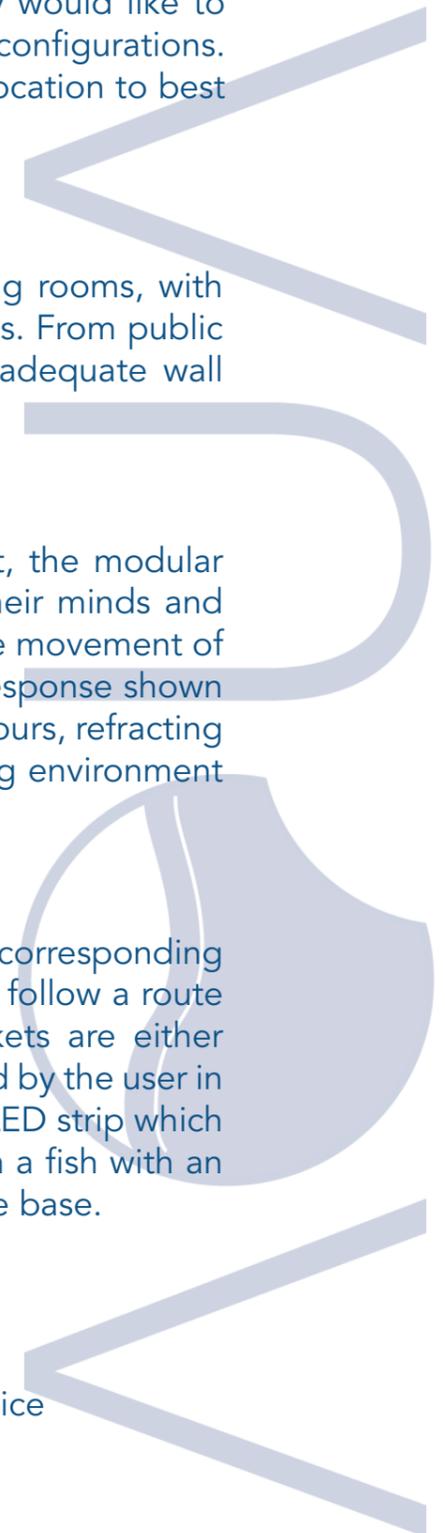
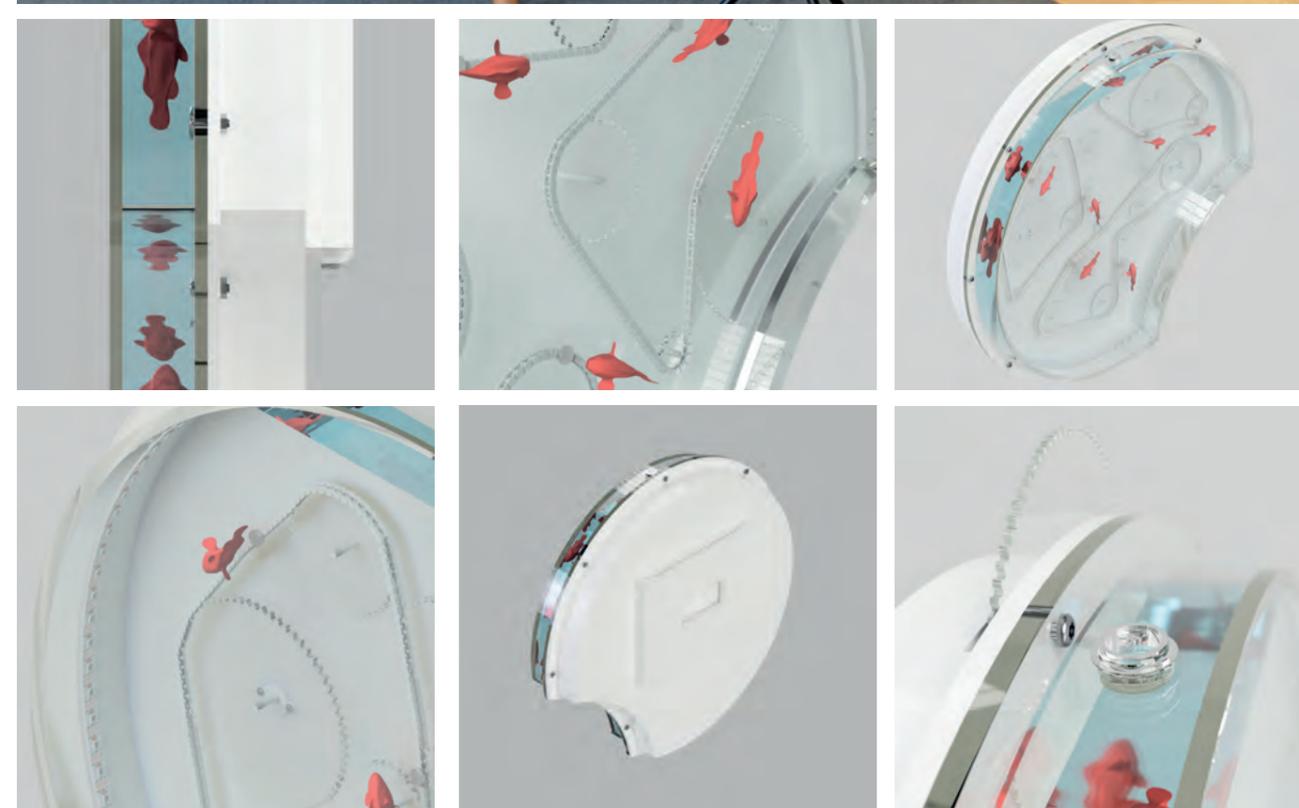
By bringing an element of nature inside the A+E environment, the modular system engages patients passively or actively, by occupying their minds and positively distracting them while waiting. Passively observing the movement of the fish through water, like real aquariums induces a biophilic response shown to reduce heart rate and blood pressure. The subtle relaxing colours, refracting through the water from the RGBW LED strip, promote a calming environment to negate user stresses.

How

The magnetic fish circulate around the tank by connecting with a corresponding magnet within the base. These magnets, attached to the chain, follow a route defined by the chain and sprocket mechanism. These sprockets are either electronically driven in the passive AQUApod or manually rotated by the user in the interactive AQUApod. The passive pod contains an RGBW LED strip which is controlled by an RFID system. The light changes colour when a fish with an RFID tag inside is detected by the RFID reader hidden within the base.

Acknowledgements

The PDE staff, especially Nick for his guidance
 The workshop staff, particularly Alan for his expert technical advice
 GU advisor, Alessandro Casaburi
 The GU68 Engineers Trust
 My fellow peers for emotional support every step of the way
 Everyone I spoke to regarding their experience of A+E

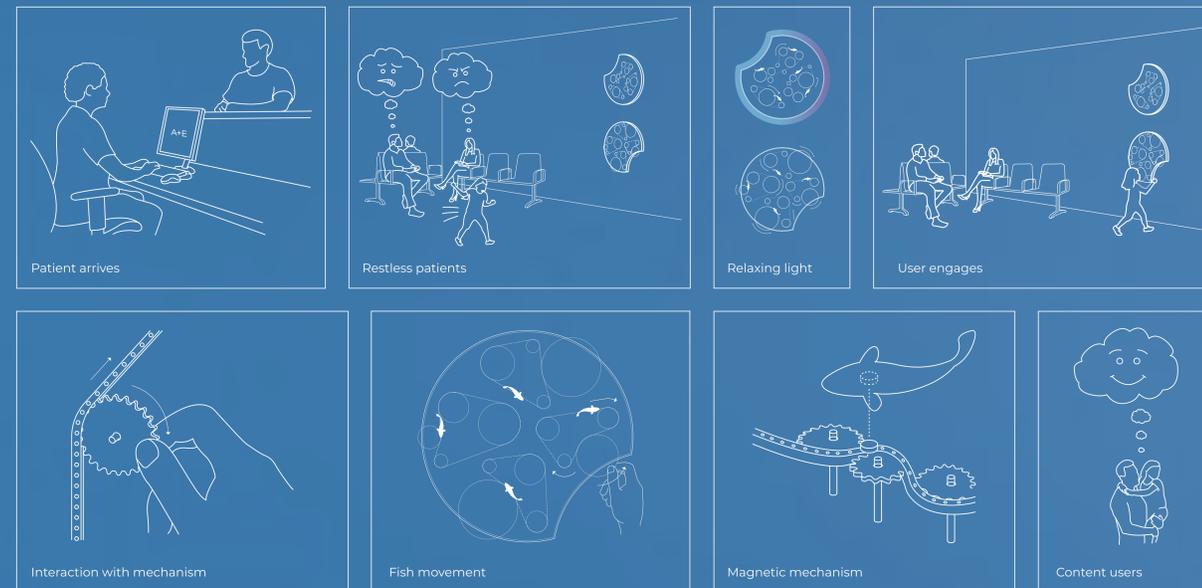




AQUApod

On average 4,400 people visit Scotland's A+E departments every day, with 25% of A+E patients in Glasgow waiting more than 4 hours for care. As each hour passes waiting in A+E, patients become stressed, restless, bored, anxious and frustrated with very little to occupy their minds.

AQUApod is a kinetic aquarium system, populated by biomimetic magnetic fish, designed to improve the physical and mental well-being of A+E users. By bringing an element of nature inside the A+E environment, the modular system engages patients passively or actively, by occupying their minds and positively distracting them while waiting.



IMPROVES USER WELL-BEING

Observing fish movement induces a biophilic response and positively distracts users whilst subtle relaxing colours reduces stress.



ACCOMODATES ALL USERS

Mountable modular pods engage users passively or interactively.



HASSLE FREE

Magnetic fish don't require regular cleaning or maintenance. You simply 'Plug in and play'.



AQUA_{pod}

AQUApod is a **kinetic aquarium system**, populated by biomimetic magnetic fish, designed to **improve the physical and mental well-being of A+E users**. By bringing an element of nature inside the A+E environment, the modular system **engages patients passively or actively**, by **occupying their minds and positively distracting** them while waiting.

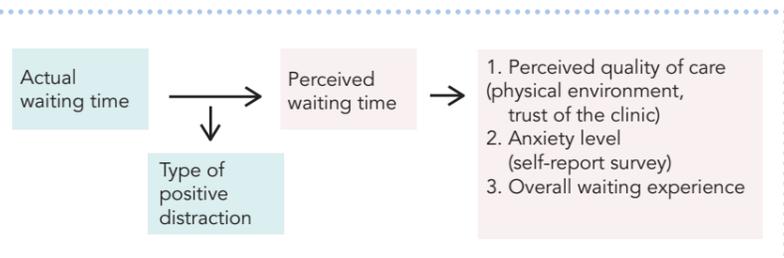
Research

Improving user experience in adult Accident + Emergency

On average 4,400 people visit Scotland's A+E Departments every day, with **25% of A+E patients in Glasgow waiting more than 4 hours for care.** As each hour passes waiting in A+E, patients become stressed, restless, bored, anxious and frustrated with very little to occupy their minds.

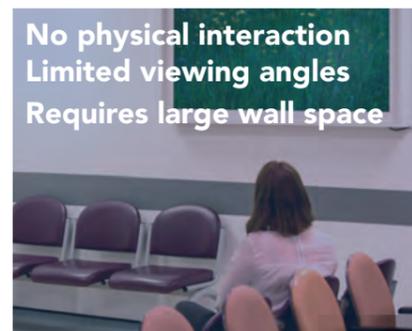
Although reducing waiting time before treatment is important, it is nearly impossible to achieve a zero wait time within the current NHS medical system, thus improving the waiting experience is more likely to have an impact on patient stress levels.

Positive distraction helps shift an individual's attention from negative stimuli to more positive and restorative stimuli, thereby helping patients divert attention from the unpleasant fact of waiting for medical treatment, to an experience that can occupy their attention in a pleasant way.



Existing Solutions

Current positive distraction methods include TV screens, toys, magazines and digital art.



No physical interaction
Limited viewing angles
Requires large wall space



Engages children
Not appealing to adults
Limited interaction height

Design opportunity:
Can we redefine adult A+E by taking inspiration from children waiting rooms?

Expert Insights



'Whilst our priority is treating patients, occupying them while they wait is just as important as this takes a huge strain off our nurses frequently being asked for updates and dealing with worried and frustrated family members.' *Dr Jude Stenhouse, Consultant Emergency Medicine at QUEH.*



'any NHS product must consider hygiene, cost, and be designed with everyone in mind.' *Dr Rodney Mountain, ENT surgeon and lead for Design and Innovation Healthcare.*

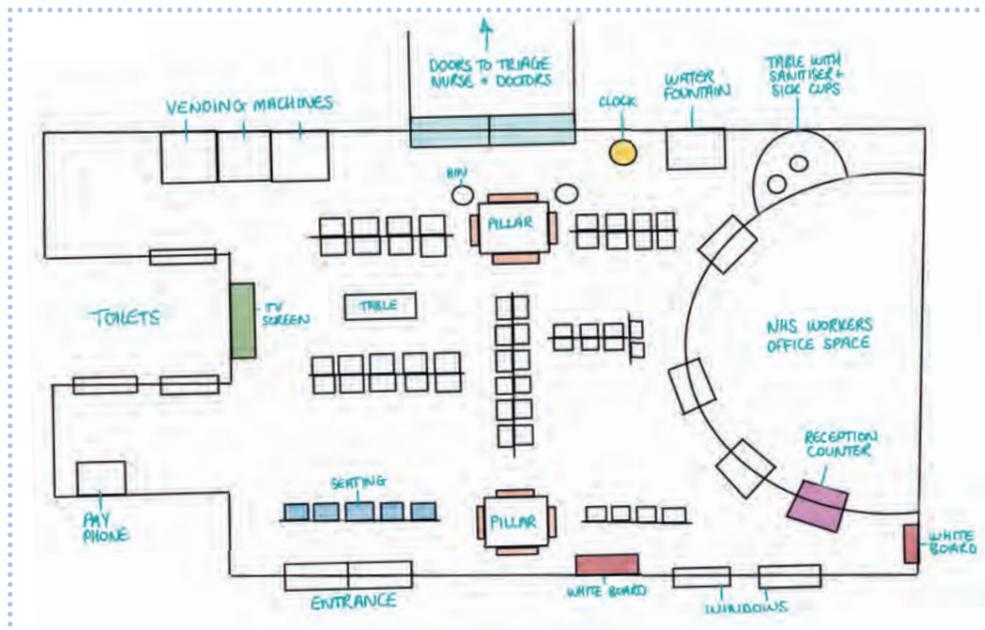


'Regardless of the amount of resources we have or how hard we work, it's very difficult to reduce waiting times. A+E is unpredictable, critical patients must be prioritised, sadly leaving others waiting.' *Julie Davies, NHS Forth Valley Senior Triage Nurse.*



Dr Graham Bell, Consultant at Royal Hospital for Sick Children, praised how effective the range of toys/games available is at distracting and calming down children.

A+E Visits



Identified design constraints:

- Every waiting room is a different size and set up, with limited floor space
- Vast range of users - different ages, sizes, physical and mental abilities, nationalities etc.
- Non disruptive - conscious of other users waiting

User Insights

long waits

'out of the loop'

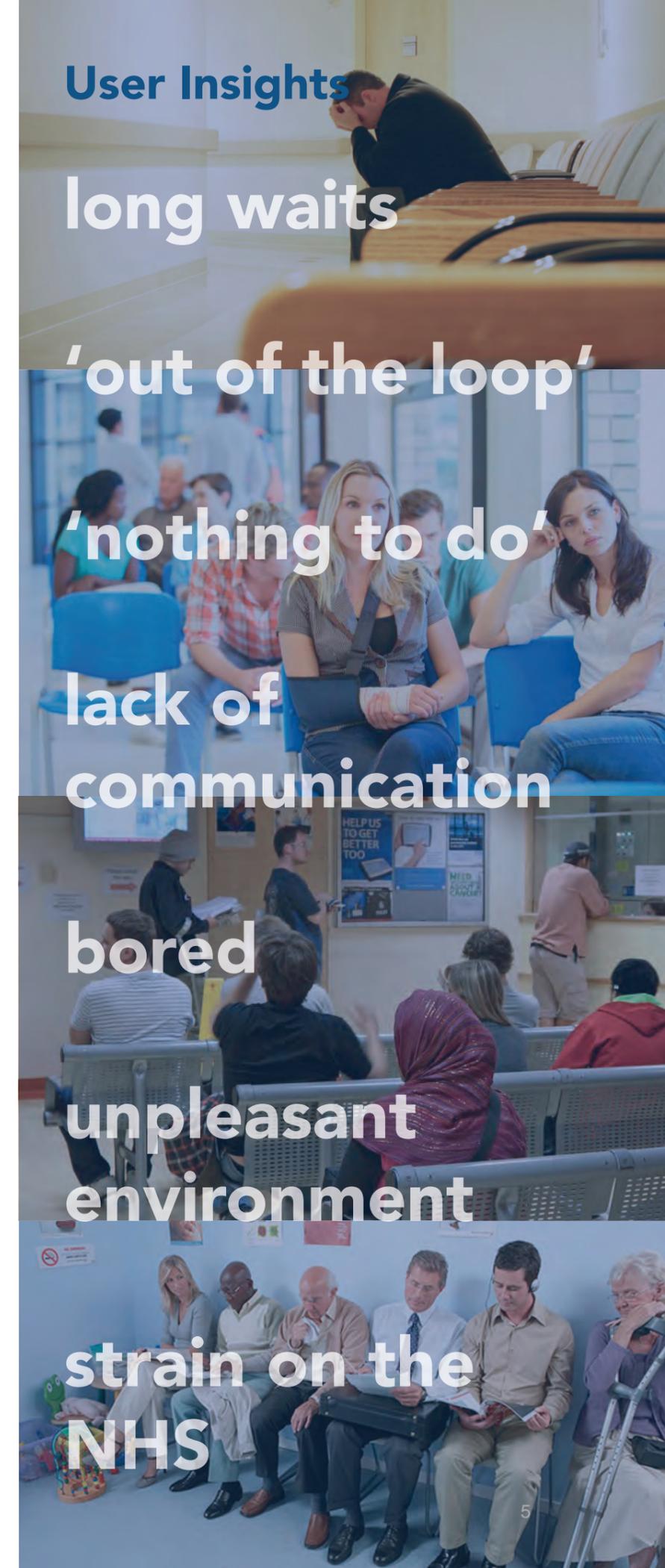
'nothing to do'

lack of communication

bored

unpleasant environment

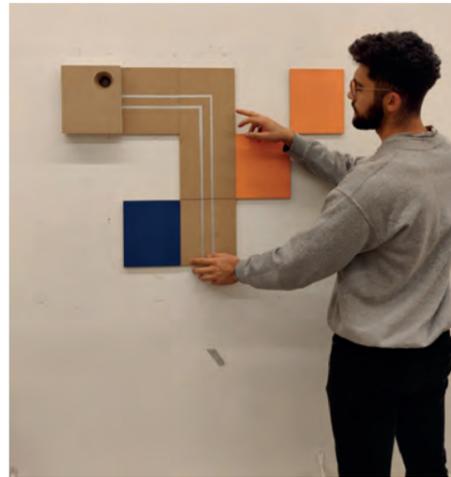
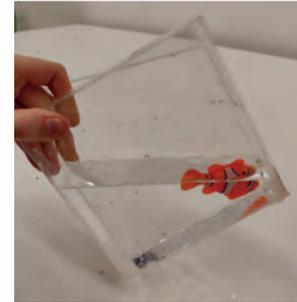
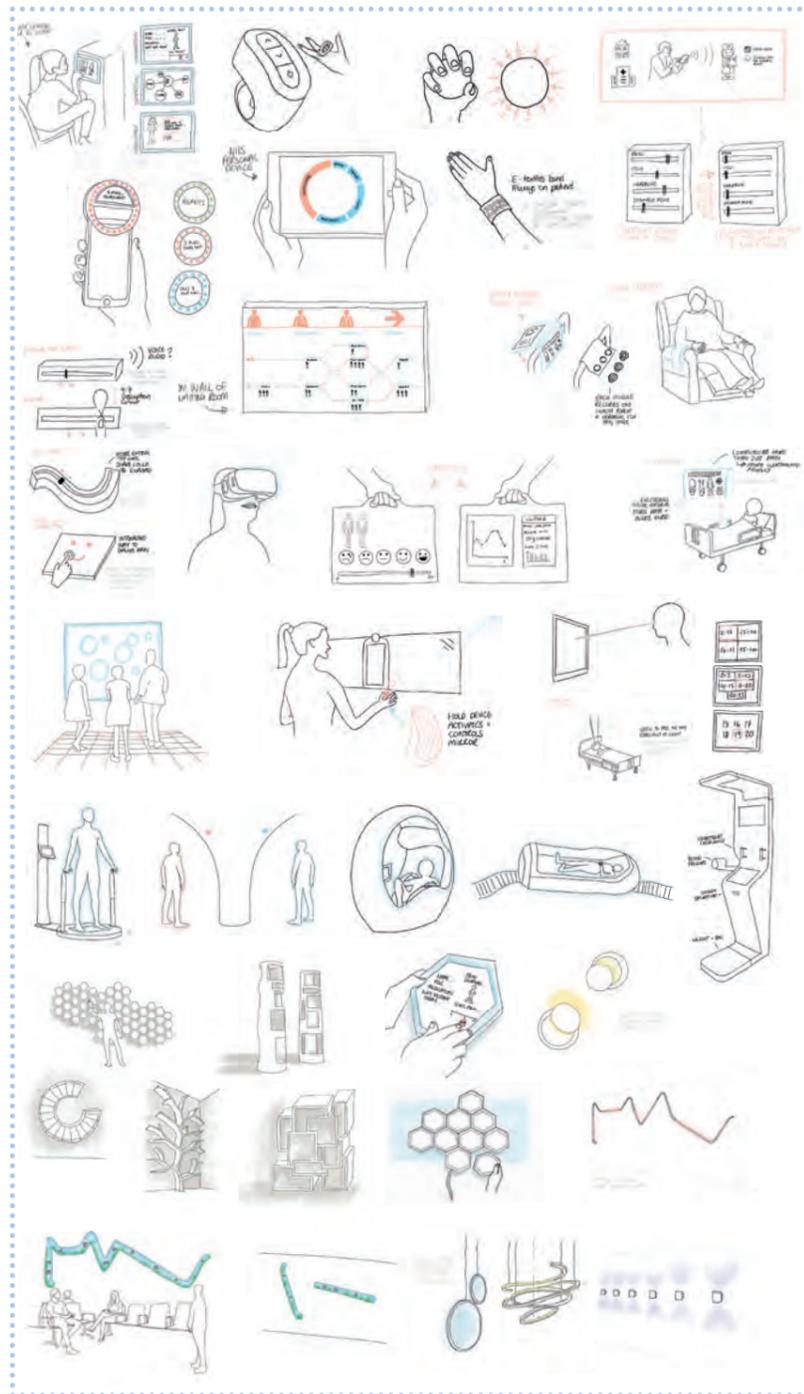
strain on the NHS



Concept Generation

2D Ideation

Due to the scope of the brief, a vast range of concepts were ideated before deciding on the chosen design direction of aquariums to bring an element of nature inside A+E. Other themes among proposed solutions to the brief included better informing patients of their A+E journey, improving efficiency of the system, monitoring and communication of pain, interactive engagement of patients and improving the environment through lighting, digital art etc.

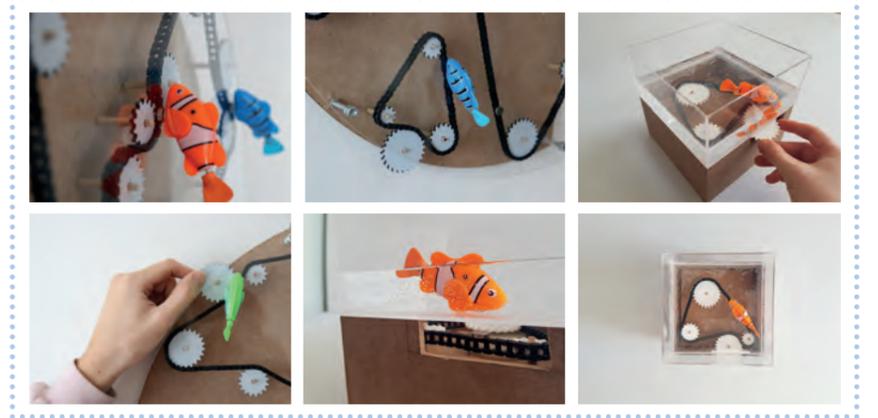
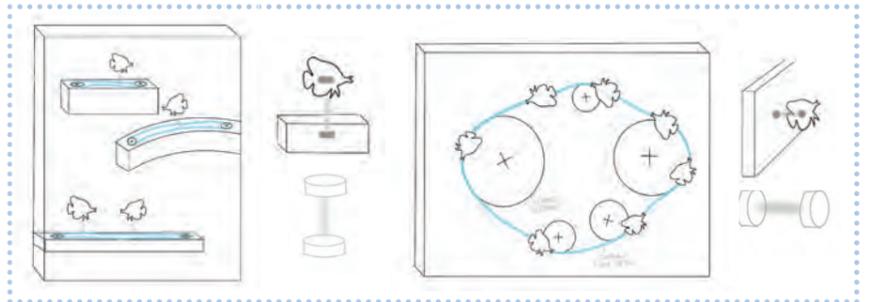


3D Exploration

Rapid prototyping was an easy way to collect informed user feedback and quickly help determine the ideas with the most potential.

Evaluation + Refinement

After listening to user feedback and evaluating concepts against a table of weighted requirements, it was decided that a modular kinetic aquarium system which positively distracts the user whilst creating a calming environment and requiring minimal maintenance was a promising design direction. Seeking inspiration from interactive designs helped understand the range of technologies available and explore the potential form and aesthetic of the system. Through an iterative process, with consideration to engineering practicalities, a final design for the aquarium system was realised.

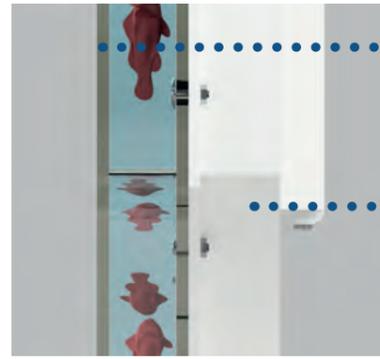


Product Overview

Passive Pod



Interactive Pod



Shatter-proof Plexiglass tank (Injection Moulded)

ABS white base, available in different colours (Injection Moulded)

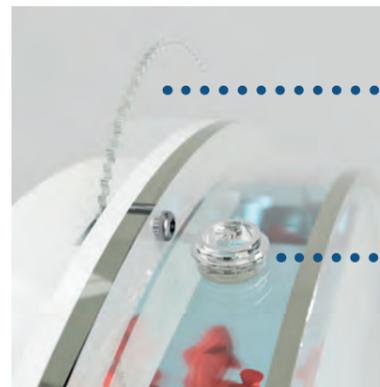


RGBW LED strip controlled by RFID System

Geared motor drives sprocket



Anti theft wall fixing



Manually rotating sprocket

Water valve



Magnetic fish

Chain + sprocket



Improves user well-being

The users mind is occupied and positively distracted during the often stressful and long wait. Passively observing the movement of the fish through water, like real aquariums induces a biophilic response shown to reduce heart rate and blood pressure. The subtle relaxing colours, refracting through the water from the RGBW LED strip, promote a calming environment to negate user stresses. Physical interaction with the sprocket mechanism directly engages users whilst creating a natural interaction zone around the AQUApod, therefore not disturbing other users.



Accommodates all users

Offering one AQUApod specifically for active interaction and another for purely passive interaction enables users to choose how they would like to engage with the product. The modularity allows for a range of configurations. Each module can be placed at any desired height, angle, wall location to best suit the environment and accommodates all users.

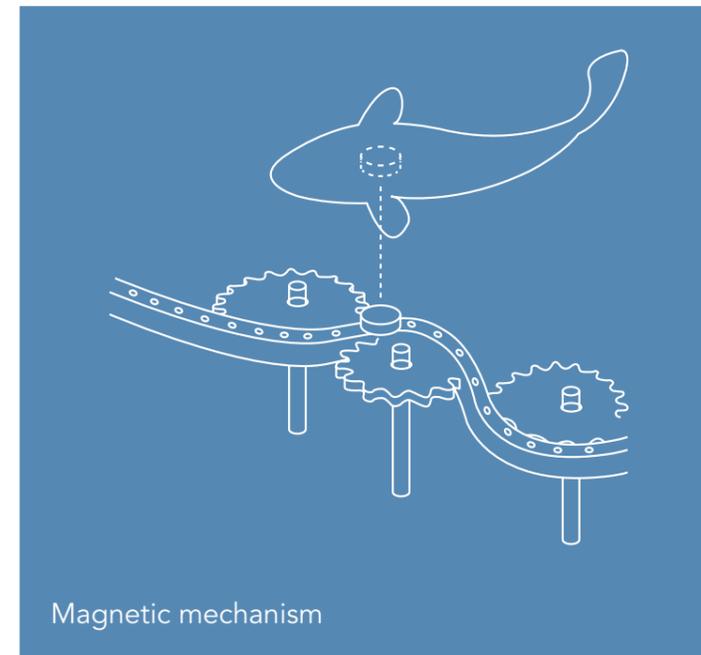
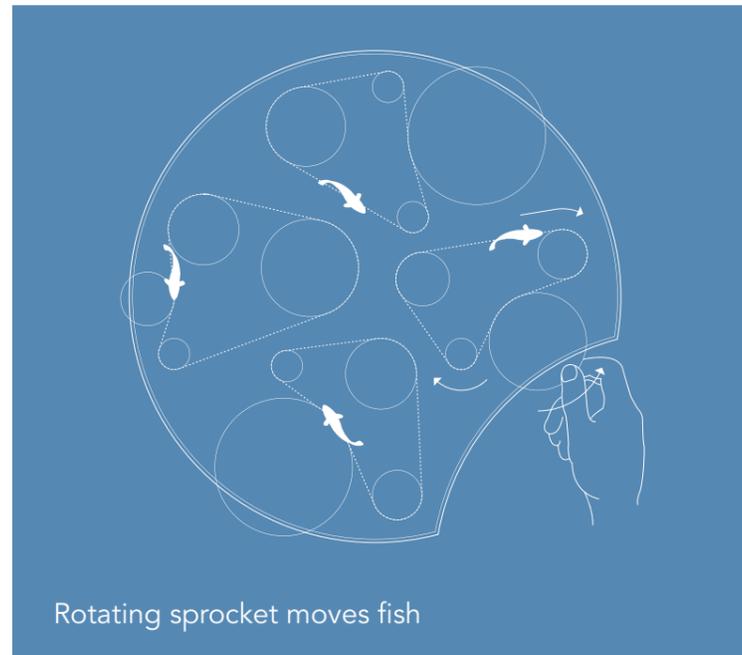
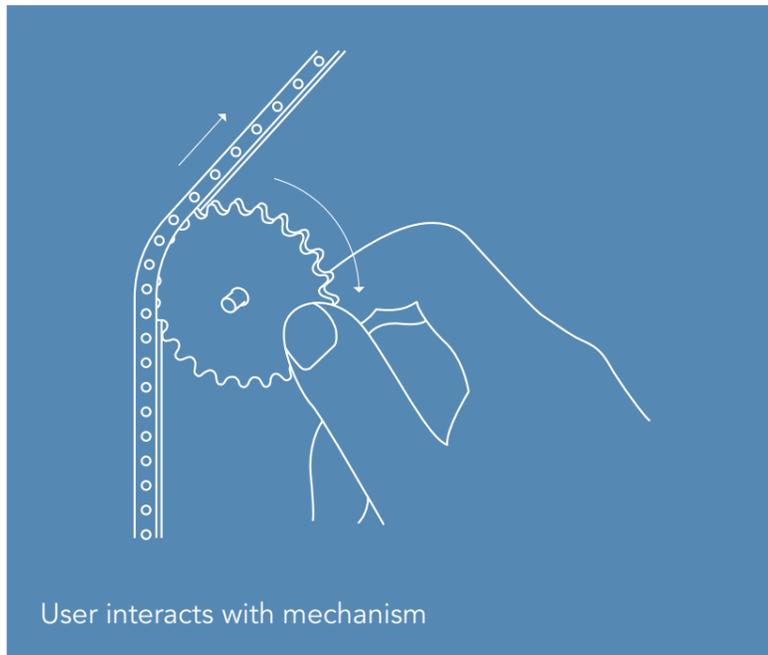
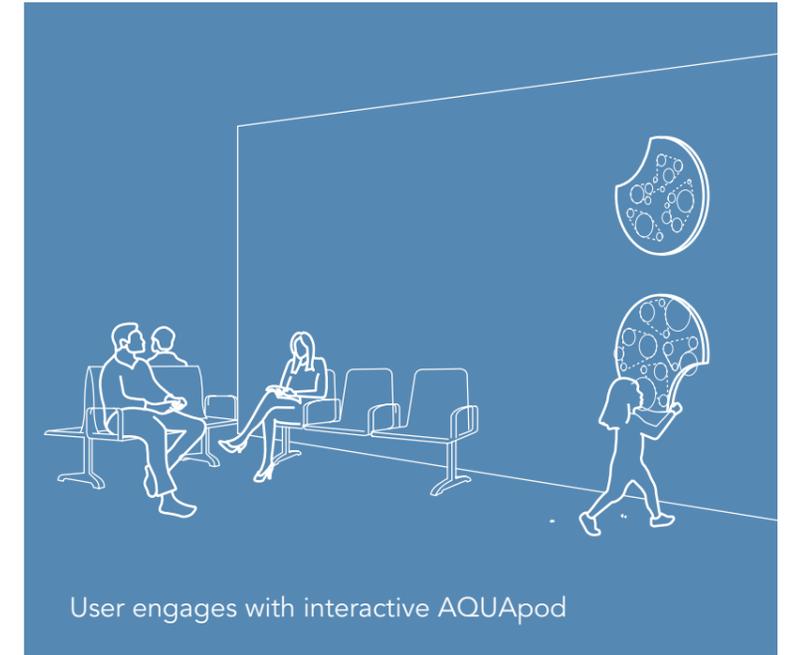
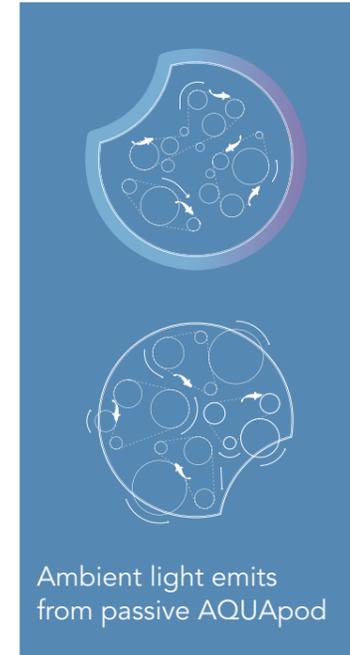
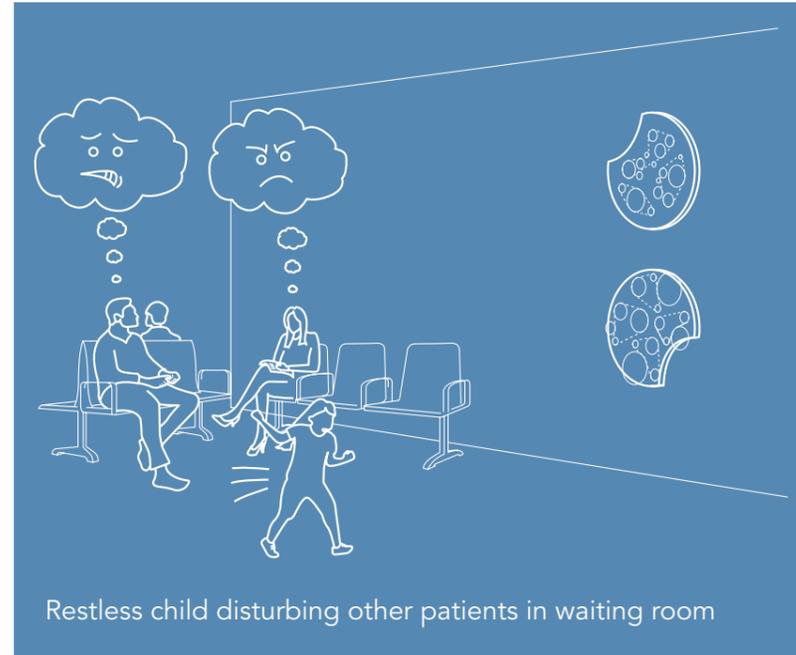


Hassle Free

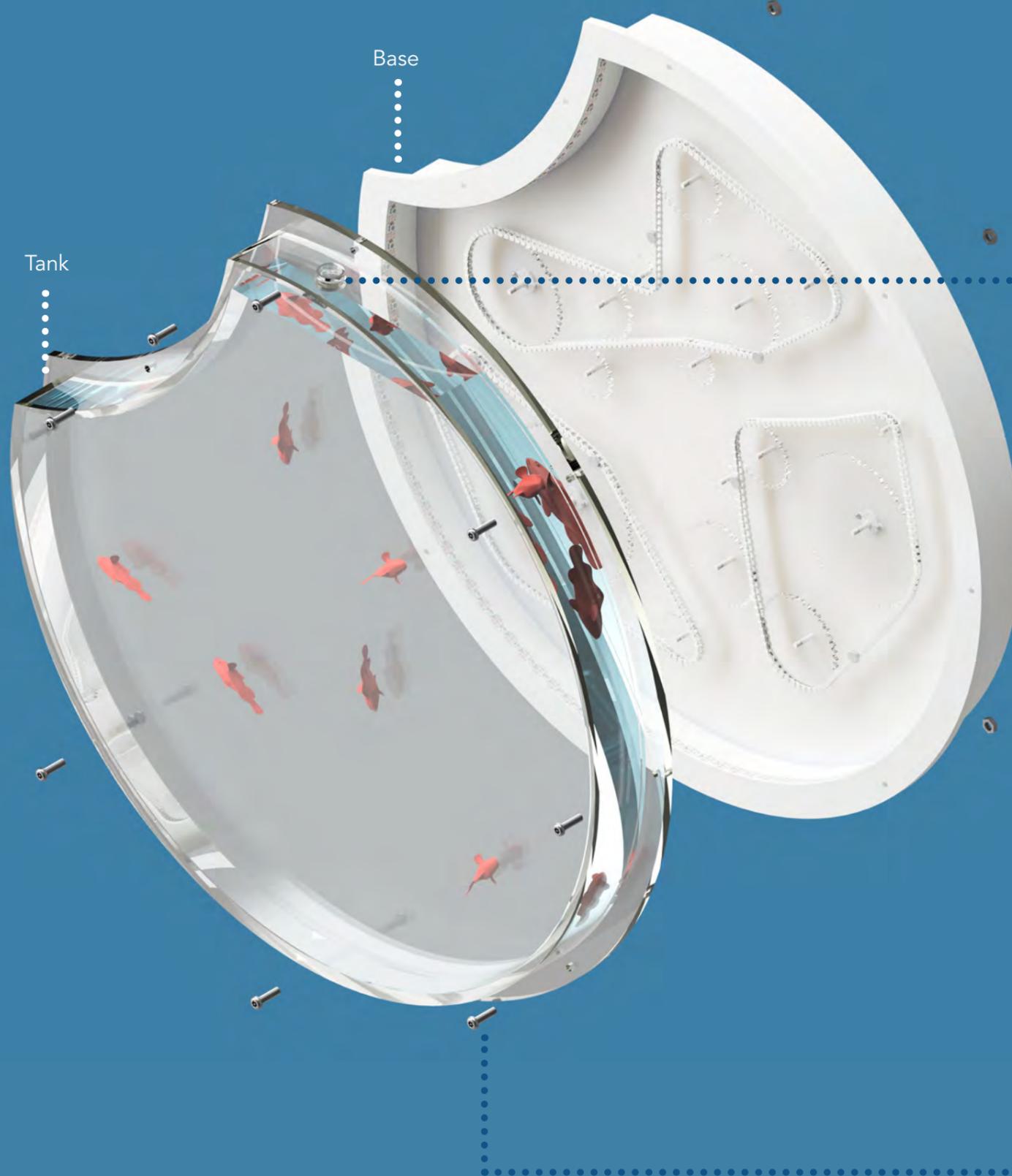
Magnetic fish don't require regular cleaning or maintenance. You simply 'Plug in and play'.

AQUApod proposes a modern alternative to a waiting room aquarium. User and expert insights revealed the importance of positive distraction while waiting and the health benefits it brings to stressed and worried users. Thus, the unique kinetic aquarium system hopes to transform negative user waiting experiences and ignite joy.

User Journey

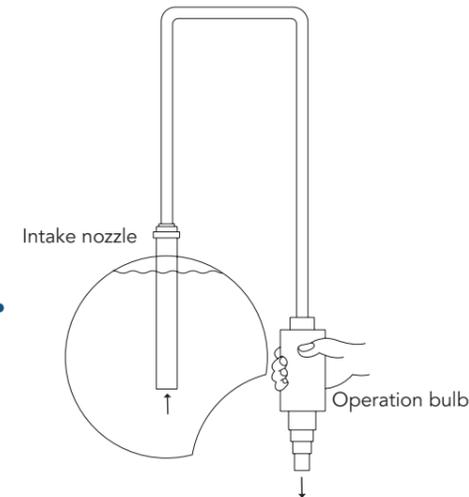


Tank



Maintenance

Using a simple mechanical pump water can be safely added and removed whilst the tank remains attached to the wall. The fish can also be removed via the water valve if desired.

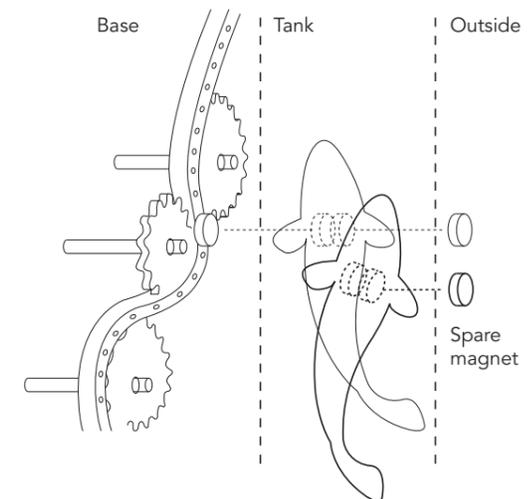


Set up:

1. Simply fill up the tank with tap water and add 2-4 drops of dish-washing detergent.

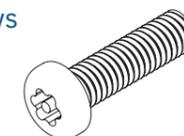
2. Using the spare magnet, align each fish with the corresponding magnet on the chain. This method can also be used to 're-track' the fish if they ever lost magnetic connection.

3. Using a cloth the plastic exterior can be easily sterile cleaned.



Security Screws

Same type of screws used by the NHS to prevent theft.



Weight

Tank (empty): 6.42kg
 Tank (95% full, 11.5litres): 21.22kg
 Base: 3.5kg

AQUApod total weight:
 25.69kg (with water)
 10.89kg (with empty tank)

The recommended manual lifting weight for one person is 25kg. The AQUApod can therefore be carried by two people when it is filled with water or by one person either in parts (base/tank) or when the tank is empty.

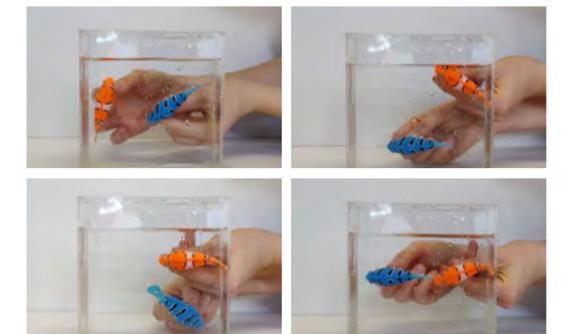
Plexiglass (PMMA)

- Lightweight
- Ability to resist cracking
- Diverse range of shaping options
- Non-yellowing

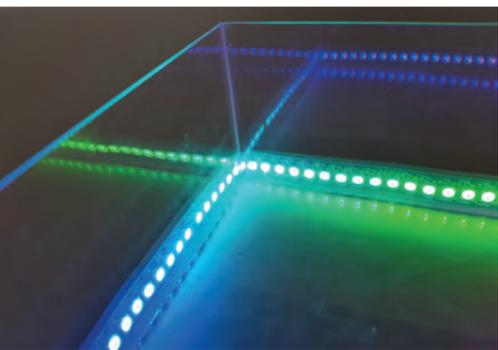
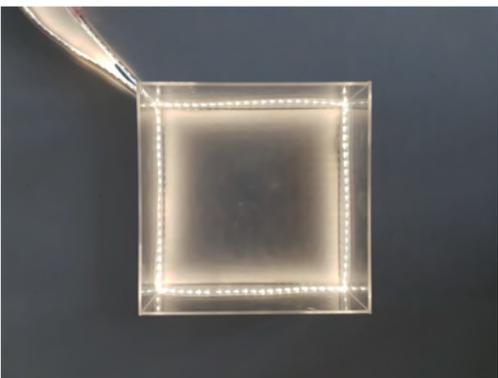
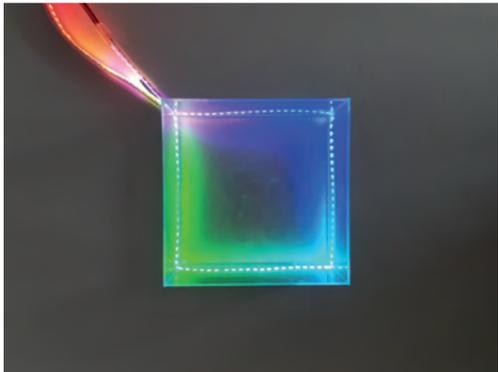
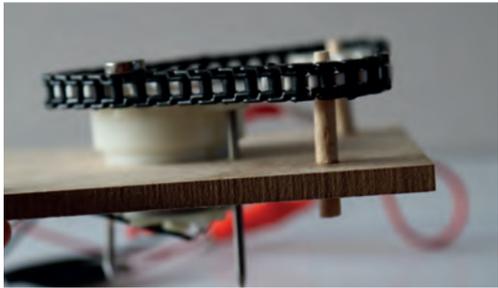
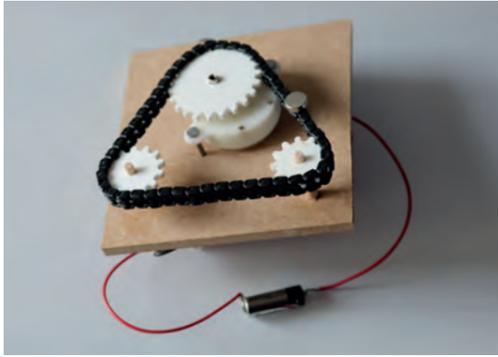
Finite Element Analysis determined the optimum thickness of Plexiglass and radius of the curved feature with the lowest maximum stress value. The chosen design avoided stress on edges to avoid any potential structural failure. Injection moulding creates a strong, lightweight tank as one seamless body, further preventing leakage.

Buoyancy

A small fish tank was prototyped to ensure the magnets were strong enough to pull the fish effectively across a vertical plane. Results showed that the fish is neutrally buoyant with the water supporting the mass of the fish. Therefore the vertical orientation will not increase the motor load appreciably since only momentum is required to be overcome when the motor is started.



Passive Mechanism



Flexible RGBW LED strip

Offers endless possibilities of patterns and colours of light. Gentle transitioning of calming colours on a loop was most appropriate for A+E environment.

Mini microcontroller

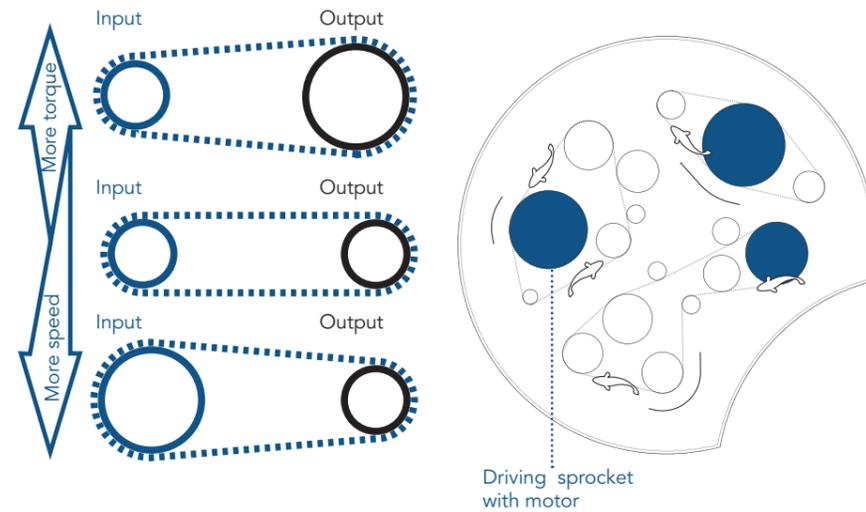
Controls the sequence and colour of each individual LED. Attaches to the base shell using plastite screws.

Passive RFID system

Tag with no internal power source (located in fish) is powered by the electromagnetic energy transmitted from the RFID reader. Low cost system and tag is available to buy as a very small sticker.

Geared motors

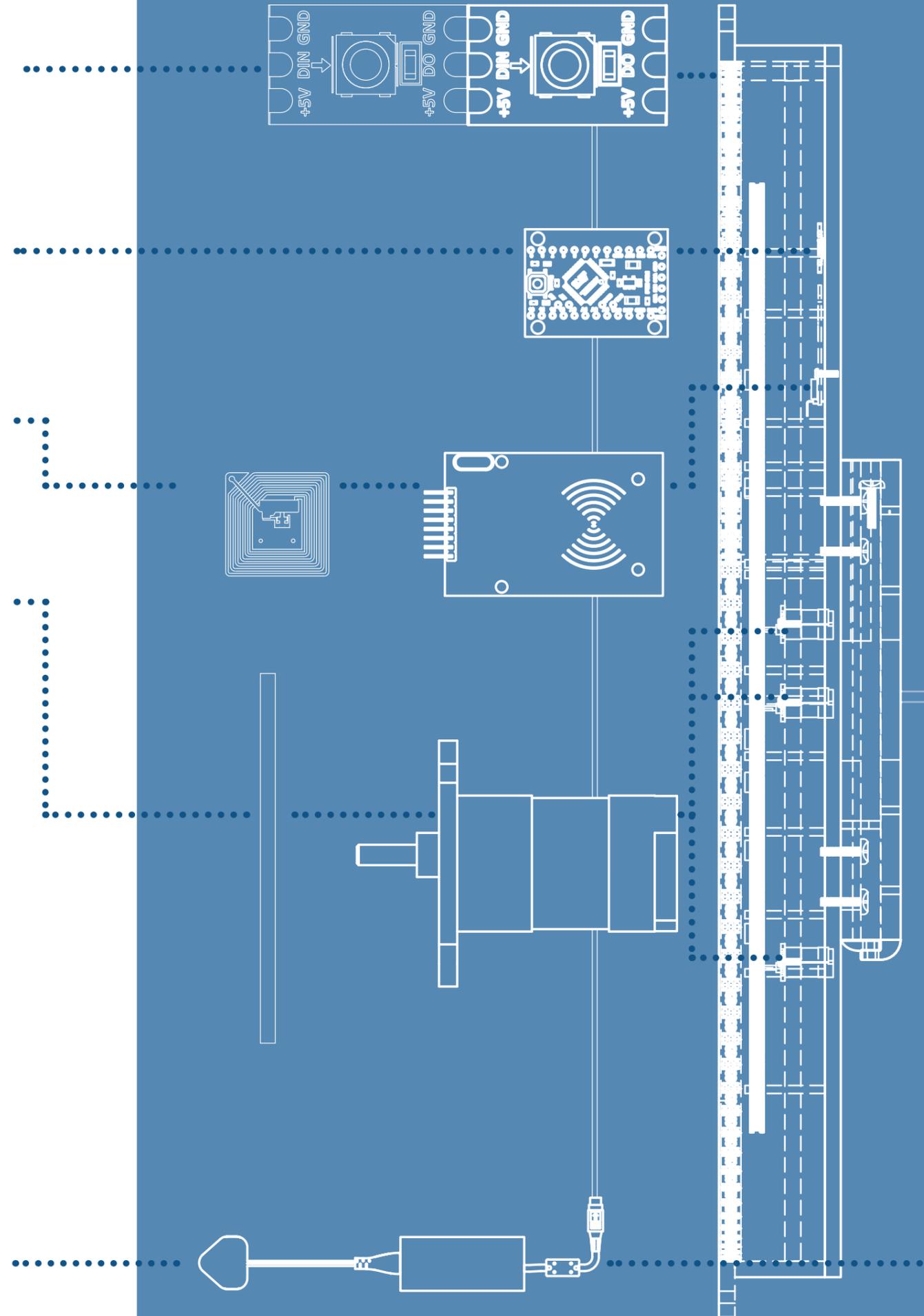
Users reported 3RPM to be the most pleasant speed for the fish movement. AQUApod powers the largest sprockets to increase speed of the chain and reduce torque.



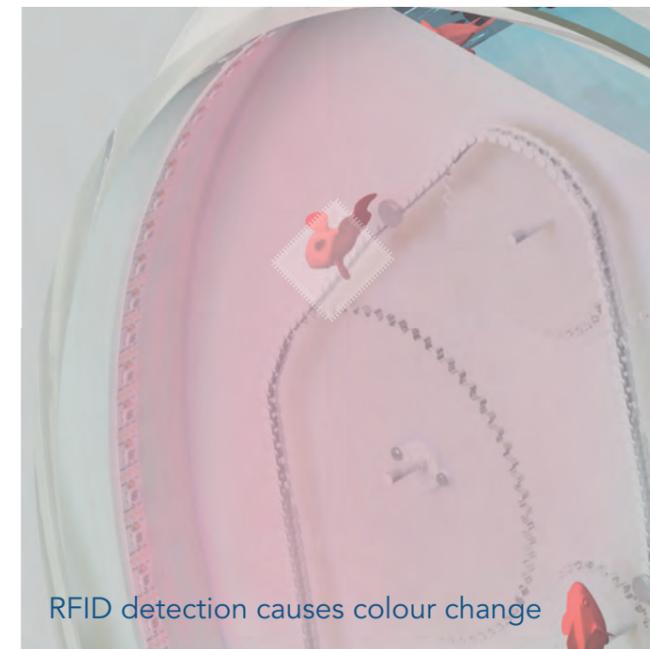
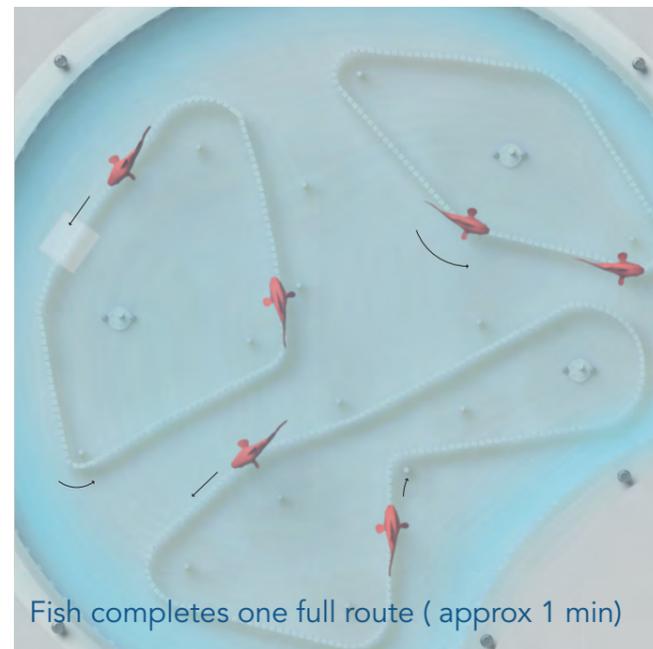
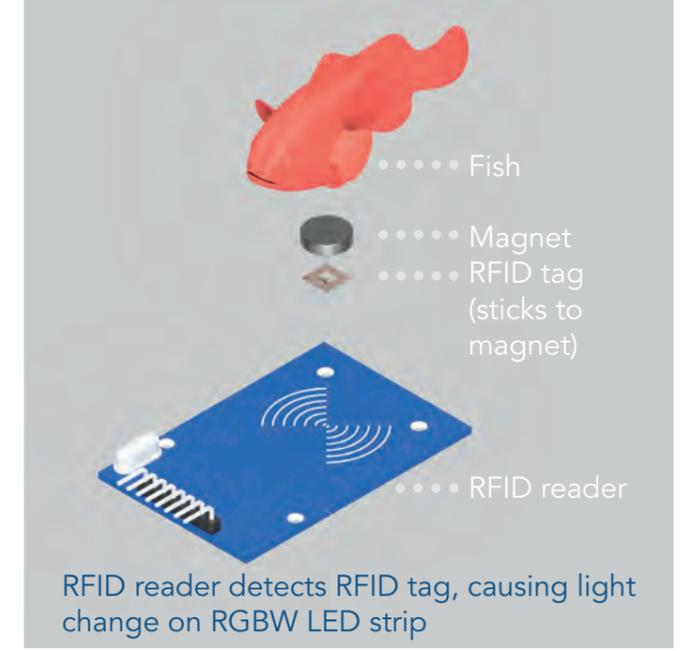
Switching power supply

Max current draw of passive AQUApod: 1.72A
12V Switching Power Supply: 3A

Mains supply was the most suitable due to AQUApod requiring a reliable and constant power source. Unlike rechargeable batteries, mains power requires minimal service requirements, is hassle free and affordable. Although cable covers are needed to conceal the wires aesthetically, the location of the product should not be restricted in A+E since drop ceilings provide an accessible power supply.



Lighting



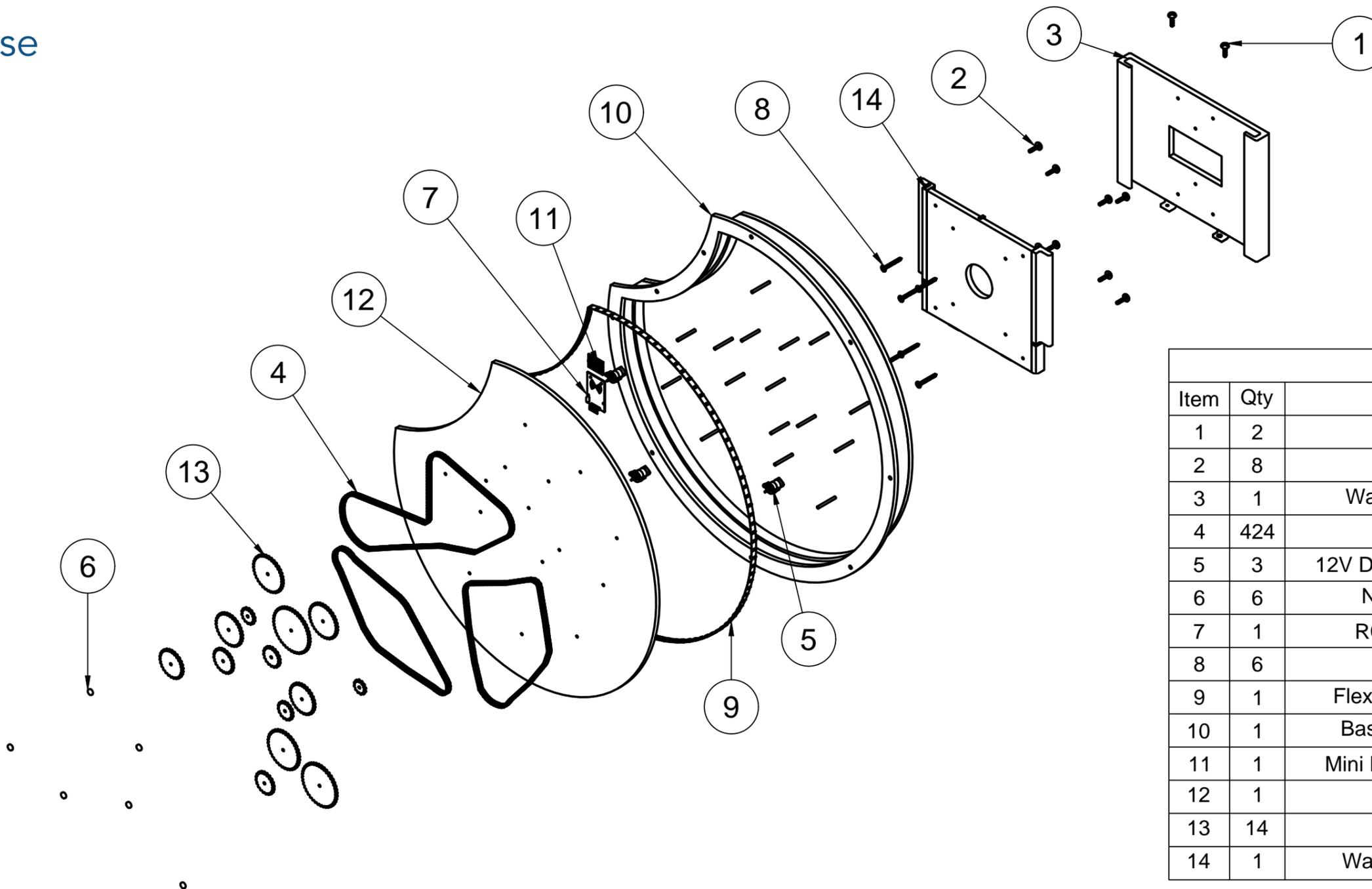
Interactive Mechanism



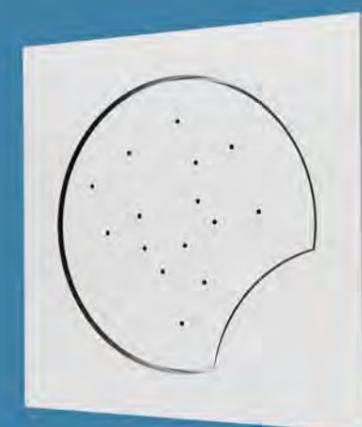
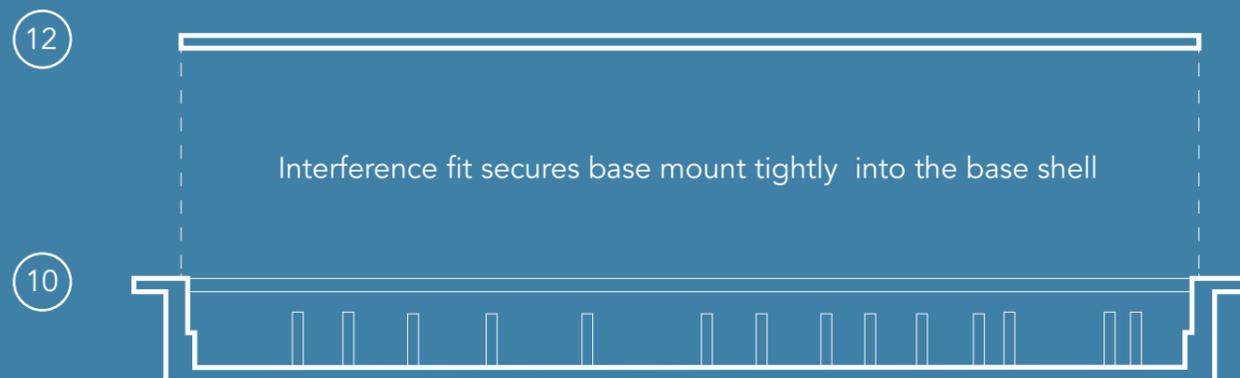
User testing determined large sprockets to be the preferred user interaction point. Some users were attracted to the organic shaped wheel but surprisingly preferred the feel and natural grip provided by the sprocket on its own. It was noted that the bigger the sprocket the better, since it provided a larger surface area for a range of users to hold on and rotate with, also NHS workers commented that this would be easier to sterile clean.



Base



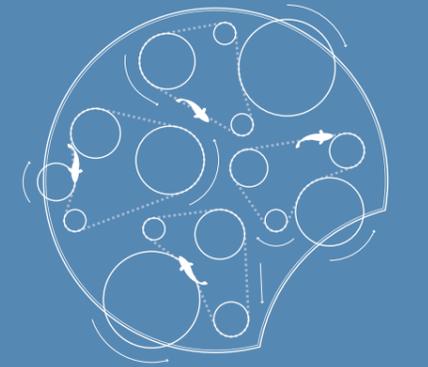
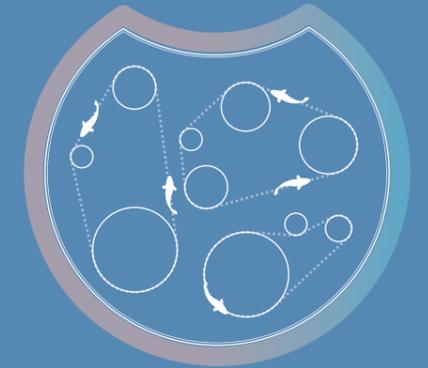
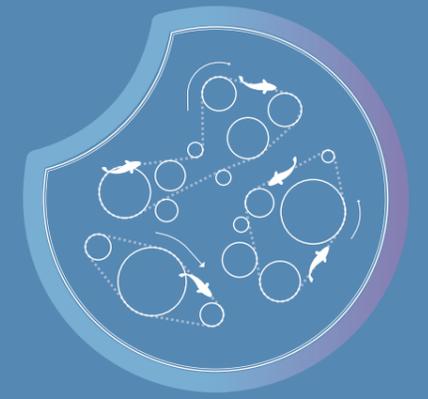
Parts List			
Item	Qty	Part Description	Material
1	2	M4 20mm Screw	Steel
2	8	M4 20mm Screw	Steel
3	1	Wall Fixing - Wall Plate	Steel
4	424	Plastic Chain	Plastic
5	3	12V DC 3RPM Geared Motor	n/a
6	6	Neodymium Magnet	Neodymium
7	1	RC522 RFID Reader	n/a
8	6	M4 40mm Screw	Steel
9	1	Flexible RGBW LED Strip	n/a
10	1	Base Shell (inc. dowels)	ABS
11	1	Mini ESP8266 Microcontroller	n/a
12	1	Base Mount	ABS
13	14	Sprocket	Acrylic
14	1	Wall Fixing - Base Plate	Steel



..... **One part injection mould for base (designed for both passive and active pods)**

Injection moulding the ABS base offers great precision, high repeatability, consistent quality and a part that requires minimal work after production. Although this process is a high initial cost for tooling it is economically viable and efficient for high production output. The base design was altered slightly by adding draft angles to ensure the ABS base part could be easily released from the mould during manufacture.

Versatility



Adaptable to a range of environments and users

The application of AQUApod stretches far beyond A+E, from public transport to mental health institutions, with long waits and stressful experiences occurring in many situations. A degree of flexibility was required to allow the modern aquarium to adapt to their users and environments. The numerous possibilities of the base colour, light settings, type of magnetic animal and its path arrangements offers opportunity for customisation and collaboration for stakeholders. Modularity provides accessibility to a range of users and empowers the stakeholder to choose the configuration best suited to their environment.