WHIRLPOOL

JTOW5239 | VTRA7777 | JCAP4996 | HPEN9134 | XGAO2191

DECO3200

INTERACTIVE PRODUCT DESIGN STUDIO

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INTRODUCTION& RATIONALE

In today's fast-moving world, where we are all constantly connected to the internet and digital devices, we are now living in an instant gratification society with the prioritisation of freedom and choice. This is termed as the **Millenium Revolution** [3], which became the foundation of inspiration for our project; particularly, as our young target group (school children, aged between 6 - 14) have prominent characteristics that reflect this theory. However, our infrastructures around us have yet to adapt to this new wave of needs, as evident with the existing crossing infrastructures that remain static and therefore unappealing. The effect from this constitutes a **crossing experience that is more due to necessity**, rather than the inclination to want to experience and explore for the purpose of enjoyment and choice.

As a result, neglect is often the usability issue of a product. In the case of a school crossing, this neglect has seen the ongoing exercise of risky crossing behaviours, such as **jaywalking** for school students [1].

With road traffic injuries currently being the leading cause of death for young Australians aged between 1 and 14 [1], there is a much-needed market for a mainstream solution to increase the use of crossing infrastructures and thereby, promote safe crossing behaviours. The **static assumption and perception** of school crossings were identified to be a major concern in school zone environments, where the active school environment overemphasised this problem.

Therefore, our goal was to find a **dynamic** way to engage school students in their crossing experience that met the needs of **instant gratification**, without overstimulating an experience of necessity and forced actions.

SELF-DIRECTED PLAY

Making an Intuitive Design

Often for children, self-directed play is the core foundation for **learning and adaptation**, where it allows the development of a child's relationship with the world [6]. Giving them self-direction creates **intrinsic value** in our product instead of external value [6]. Hence, the key to Whirlpool in increasing crossing usability lies in allowing the child to feel in control and self-inclined to pursue a set of actions, resulting in increased acceptability and engagement. As a result, the foundation of Whirlpool's interaction design is heavily reliant on the users' movements for **instant gratification,** which is achieved using an **ultrasonic sensor** to drive the feedback of the product. This allows for the product experience to be both **publicly shared whilst feeling personalised** to achieve the self-directed play principle.

ENTRY POINT

Invitation to Play

The design principle, Entry Point, is used as the foundation of our concept's structure and purpose. Our design provides **progressive lures** (lights and audio cues) to entice users to approach it [5], drawing them to use the designated children's crossing. The physical location of the poll (centre of the footpath at both ends of a crossing) plays a role in it being a point of prospect for users, enabling them to both **easily locate the crossing**, whilst also not obstructing a roadside area.

This allows for students to still observe the road for the safest time to cross. The invitation to play is aimed to **captivate the students to cross** at the crossing rather than jaywalking. The design also prompts the student to cross rather than loiter for long periods of time at a zebra crossing. Through an audio cue, the user gets a sense of **accomplishment** when crossing in the right area, reinforcing their desire to do it again.

UNIVERSAL DESIGN

Making it Accessible to the User

Designing for young children requires attention to their **limited cognitive skills**, due to their lack of world-experience [4]. Therefore, the principles of universal design are able to address this. To achieve this, Whirlpool's functionality and aesthetics are created using **visual cues** that are adaptive to maintain our goal of creating a dynamic crossing experience, rather than utilising verbal or written cues that are limited in their understanding to some children. As a result, the use of **lights and water** became Whirlpool's main features, which are designed to be incremented based on the child's positioning to the product.

This allows for the ability to be used by a **wider variety of people** to further encourage more safe crossing behaviours. Additionally, this saw Whirlpool incorporating simplicity to reduce the user's workload. This is achieved from our intuitive design foundation from the sensors, making it simple enough to engage children whilst not being a distraction for cars and other pedestrians.

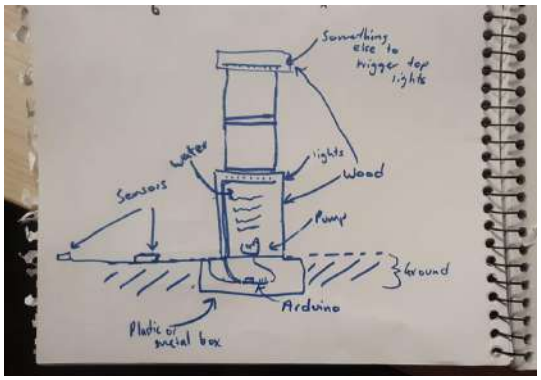
OUR DESIGN PROCESS

Timeline

Team Work Makes The Dream Work

STEP 01

Our team splits off with different roles to ensure it is build on time. We split the work into 3 teams - Building Team, Coding Team & Video/Report Team



Buying Materials

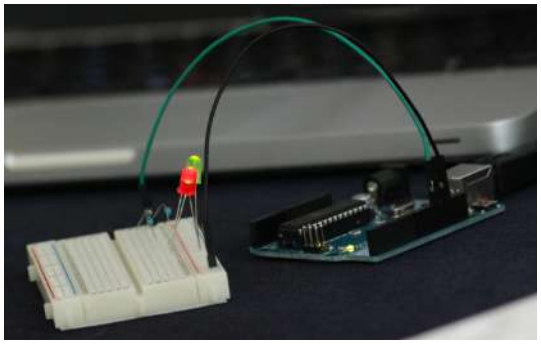
STEP 02

The teams buy the materials for the first high fidelity version. We buy the Hardware and raw materials needs to test the functionality and interaction for our user evalutation

Hi-Fi 1.0 model

STEP 03

First physical skeleton of the overall product is made, using off-shelf materials including clear plastic containers, pump and water bucket. We hot glued for waterproofing the pumps cable and tested the whirlpool function to ensure the drainage hole was the correct size.



The Primitive Code

STEP 04

Here we coded and tested the motion sensor with 2 piranha led lights using the Arduino with a shield. We had wiring issues which caused us to only be able to turn the pump on/off manually, limiting its functionality testing to be done without the sensors' reading.

User Evaluation 1

STEP 05

Our evaluation protocol saw us consistently referring & evaluating our product with 4 participants, ages 8 - 14. Using observations & think-aloud, our evaluation goals were:
- Motion sensor effectiveness
- Light & water feedback effectiveness
- Structure/shape likeability

Evaluation Results

The key takeaway was the motion sensor's sensitivity, making it very unreliable regarding the product's functionality. Other findings were:
- The speed of whirlpool rising was a bit slow
- Lighting needed to be more dynamic in changes

Coding changes:

We upgraded to individually programmable RGB LED strips, integrating it with an ultrasonic sensor rather than the motion sensor. This allowed for a more accurate reading on a user's motion and interaction. The new LED strips provided the capability to make more dynamic and interesting lighting displays. The change in brightness was significantly more visible which is necessary for a product operating in the day. To fix the pump's issue we added a relay and an external power source, enabling it to automatically switch on and off when ultrasonic is interacted with.

Hi-Fi 3.0 model

We tracked down a new tube to use. We decided to use a beer tower tube as it was leaner and taller, which would show a clearer feedback for the user and would be more accurate to the real world scale. We also bought a second pump to address the whirlpool formation issue, and some plumbing pipe joiners to create our top, cover our bucket lid, and conceal wires.

STEP 06

STEP 07

Hi-Fi 2.0 model

Another plastic container was added to the top of our previous skeleton to add more appeal and visibility to the whirlpool and product itself.

STEP 08

User Evaluation 2

Using observations & think-aloud, our evaluation goals were:
- Ultrasonic sensor effectiveness
- Light & water feedback effectiveness
- User likeability & committment

Evaluation Results

The ultrasonic sensor was a success in its accuracy, and the users enjoyed the new dynamic lighting from the LED strips.
Key issues to address are:
- Water pump failed to create the whirlpool and fill the container to an acceptable height.
_ Users wanted more stages in the lighting display.
_ Users wanted a taller and more visible tube for better engagement.

STEP 09

STEP 10

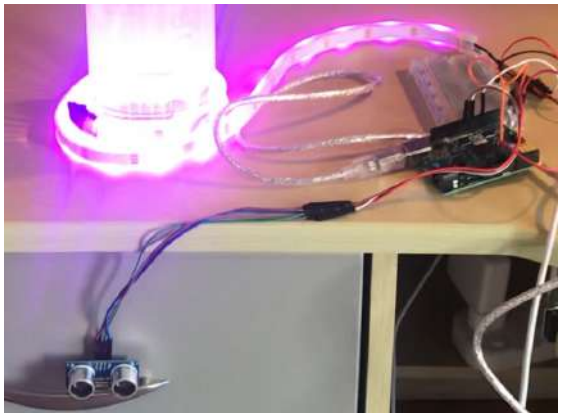
Chop Shop

We cut and rolled metal sheets to create the base that would hold the bucket for our water and conceal our electronics. We cut two holes into the tube for our 2 water pumps, and we tested the waterproofing, before committing to spray painting the base and the top.

println: Final Code

STEP 11

The LED strips were coded to have more than one pattern that would incrementally change according to the distance. The brightness and hues were experimented with and underwent many iterations. A small sound component was added to the Arduino function using a 5V speaker.



STEP 12

Final Adjustments

This process included making sure the cables fitted correctly from within the metal base, double-checking the waterproofing for electrical safety, and adding an external power bank instead of powering it from a laptop. We also had to extend some of the wires' length.

Additional Aesthetics

STEP 13

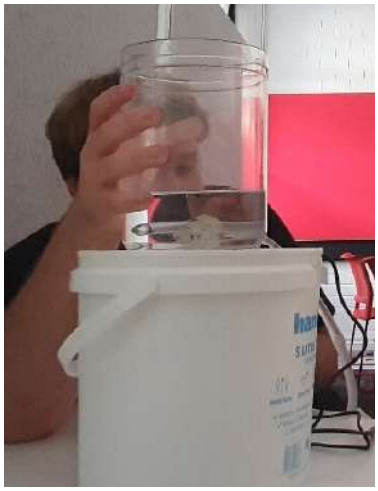
We decided to enhance the visual appearance of the water, through adding in glitter and food colouring to add more focus onto the Whirlpool. Reflective Tape was also added to enhance its contextual design (reflecting the cars' headlights), as well as to assist the light to be reflected throughout the tube.

STEP 14

Final Build

Whirlpool was put together in the exhibition space. Some issues we had were with the wiring, causing them to be replaced on the spot.

THE END



HOW TO USE WHIRLPOOL 101

CORE FUNCTIONALITY:

The interaction sits in the center of the footpath at both ends of the children's crossing. It activates through the user approaching it.

>3 METERS

Beyond this point you can only see the light ring on it slowly changing colour.

3 METERS

Once within range the pumps activate and begin to fill the tube, creating a whirlpool. A blue light flashes in a wiping pattern around the bottom of the tube, lighting the water.

2.2 METERS

The lights' colour become purple instead of blue. Patterns and pump remain the same.

1.4 METERS

The lights' colour becomes pink instead of blue. Patterns and pump remain the same.

<0.6 METERS

The light changes to a flashing rainbow effect. Water begins to reach the top.

FRONT

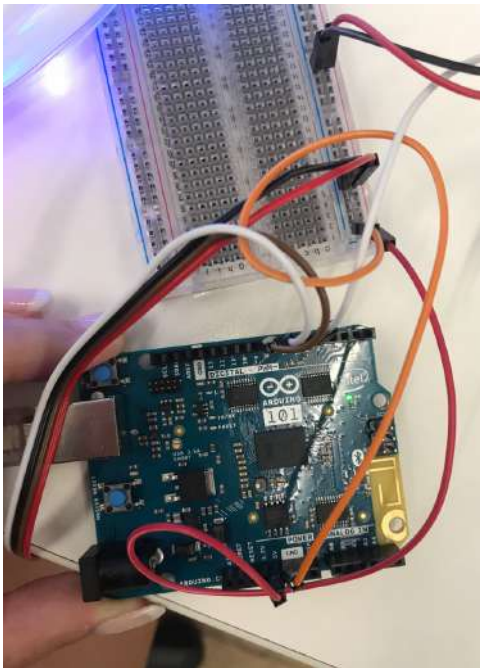
BACK

This is the Whirlpool product!

Once you enter the crossing the water begins to drain and the lights turn off. After a slight delay a victorious sound plays to celebrate the end of the crossing experience.

Requirements for Building

HARDWARE & SOFTWARE



Arduino IDE

code editor for Arduino - our only coding software used in this project.

Arduino genuino 101 & Wires

Microcomputer allowing us to code all the interactions. Wires enable us to connect our hardware

1 x Ultrasonic Distance sensor

Detects user's motion within a certain area - used in conjunction with pump and led light strips

Sheet metal + Plastic Piping

To encase the water bucket and conceal the hardware whilst making it more aesthetic.

2 x DC Submersible water pump

To elevate water and provide force forming whirlpool.

3.5l plastic container

To provide water source.

Water Pipe

Allows water to be pumped into the beer tower from the plastic container

Plastic Beer Tower

Contains the whirlpool once filled. is the major visible component of the design.

2 x LED Strip

To elevate water and provide force forming whirlpool.

Reflective Tape

To reflect the water and add a more aesthetic appeal to the design.

5V Speaker

Enables us to add a victorious sound effect at the end of the crossing.

How it is Built

SETUP INSTRUCTIONS

COMPONENTS

The list of the major core components that compose the final design:

1 / REFLECTIVE TOP

2 / CLEAR PERSPEX TUBE

3 / PUMP ENTRANCE & DRAINAGE HOLE

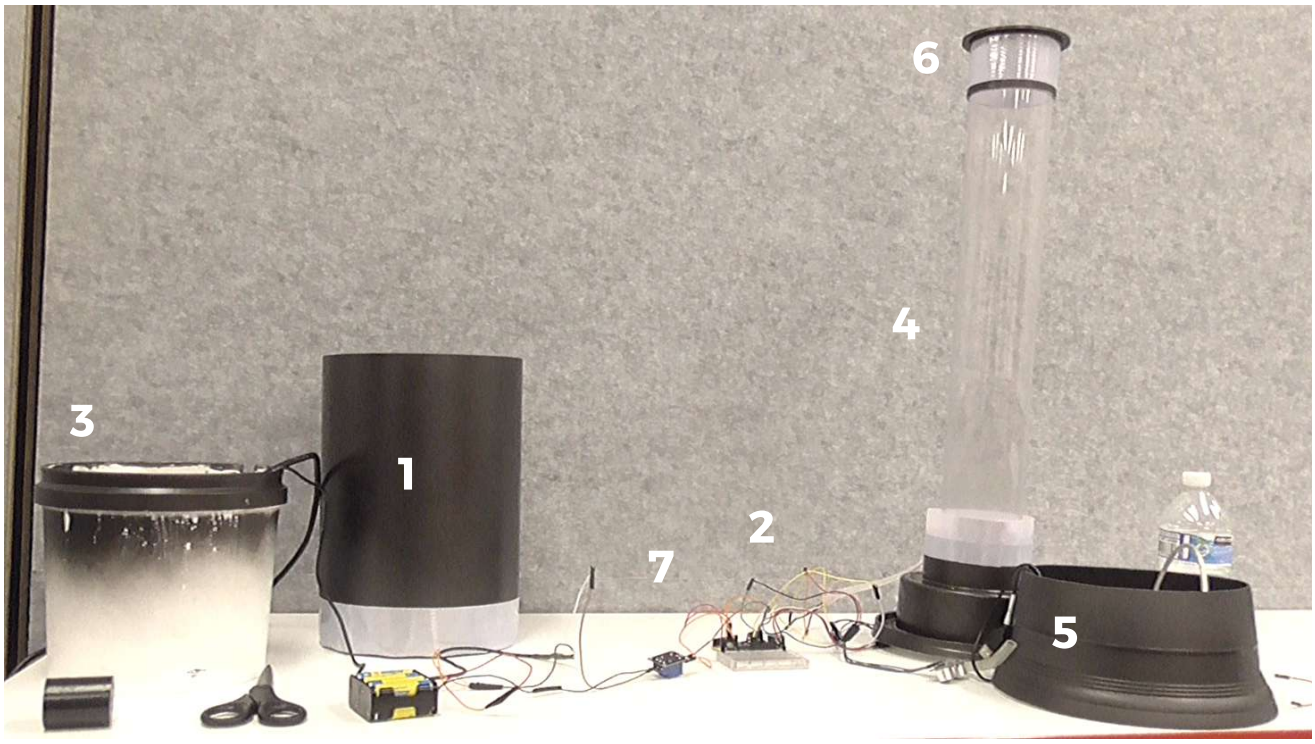
4 / LED STRIP

5 / LIGHT RING & COVER

6 / ULTRASONIC SENSOR

7 / WATER BUCKET

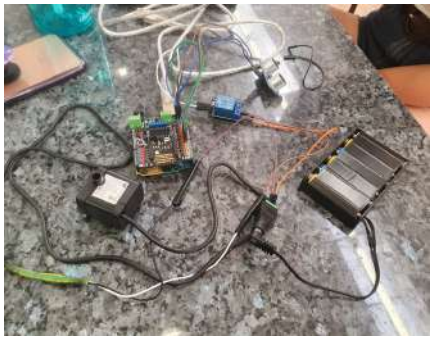
8 / HIDDEN COMPARTMENT



SETUP STAGES

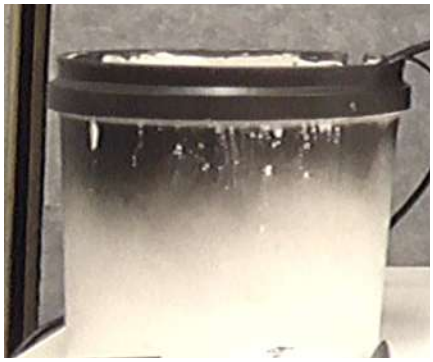
1 / METAL BASE

This hollow base holds all the electronic components and supports the bucket of water for the whirlpool effect. Place it on a solid ground.



2 / ELECTRONIC COMPONENTS

These are all securely wired up and positioned. Place them together at the bottom of the metal base, including the battery pack. N.B. The electronic components are linked up with the ultrasonic sensor, water pump & the LED strips. Make sure these 2 parts do not go into the base by hanging them over the brim of the base.



3 / BUCKET

Grab the bucket and fill it with water. Place this on top of the metal base and the electronic components, and make sure the LED strips, water pump and ultrasonic sensor are still hanging outside the base.

SETUP STAGES (CONT.)

4 / CLEAR TUBE

The bottom of this clear tube consists of 2 hanging small water tubes to connect to the water pumps. Insert these small tubes into the water pumps, and then place them into the bucket of water.

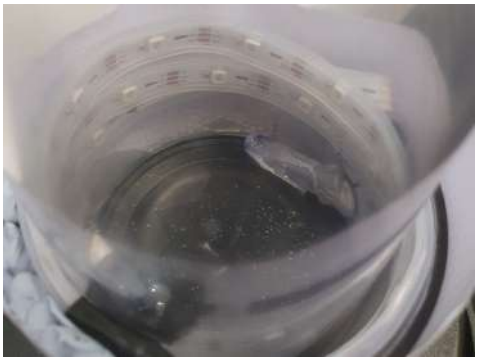
Now that the water pumps are inside the bucket, carefully lower the clear big tube down, and the base of this tube should fit perfectly as a lid on top of the bucket. Secure it down to enclose the metal base and water bucket components. It should look like the picture to the right.

5 / LIGHT RING COVER

This light ring cover is encased with LED lights around it, adding an ambient light effect to the black base. Grab this and slip it over the big tube until it sits well on the top of the base and the bottom of the tube.

6 / REFLECTIVE TOP

This sits at the very top of the tube, and consists of a reflective tape to safely mirror cars' headlights for visibility and safety awareness.



7 / ULTRASONIC & LED STRIP

Now it's time to place these two electronic parts onto the product. Place the ultrasonic sensor at the front of the product, letting it hang from the base of the light ring cover.

Wrap the LED strip inside the shown section to the left. It should sit inside perfectly, and be hidden within the base of the big tube. N.B. Make sure that the lights are facing towards the water, not away from it.

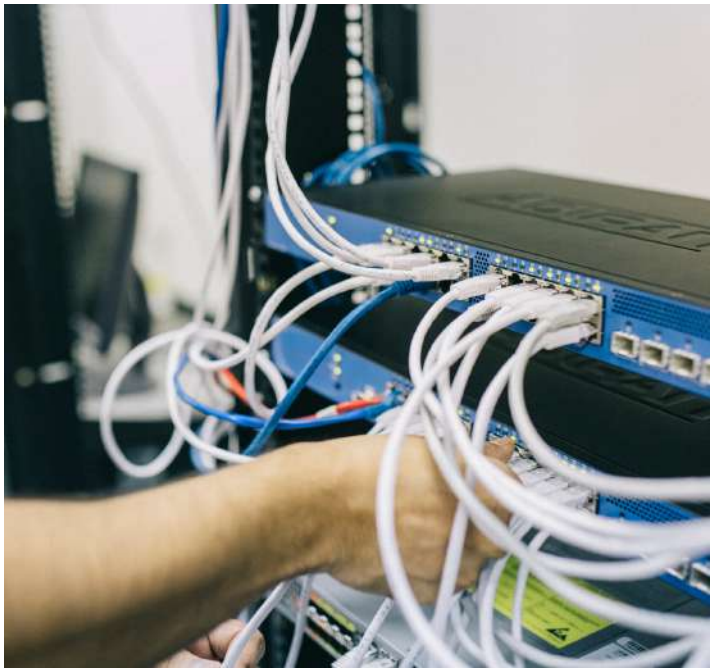
What Went & Can Go Wrong

KNOWN ISSUES

01

Aesthetics & Model Scale

We were limited in creating a completely polished look, with the exposed LED strip when viewed from the top down, as well as the back wires not properly fitting the ring light cover on the top of the base. Also, we weren't able to create Whirlpool as big as we originally wanted, due to the limitation of both budget & materials available. An example was the extremely hard to find plastic clear tube for the body of our product.



02

Accessiblity of Hardware

The current design doesn't have an easily accessible way of removing and fixing the hardware within. At the moment, to access the inside hardware, we'd have to remove the whole tube body and top, and then remove the bucket of water. Moving forward, we plan to design a small hatch on the side of the base in order to more easily access the inside electronics.

What Went & Can Go Wrong

KNOWN ISSUES

03

Whirlpool Failure

Though through testing we have had the whirlpool working perfectly on a few occasions, there is a chance that the whirlpool after consistent usage will not fully form. A better way to address this is to design a better compartment to produce a perfect hole for a better pressure on the water to form the whirlpool effect. Additionally, our water pump pipe is currently the wrong size, which may add to the weaker flow of water from the pump.

04

Lighting

Though the tube is well lit, we would need to encase the LED lights better so that it would appear more diffused, decreasing the risks of glare being an issue for pedestrian and vehicle safety.

What is Next

FUTURE VERSIONS

Acknowledgements

As a group we acknowledge the limitations we faced with building our product. Our major limitations included the time frame, the access to certain materials and our actual skill levels. Further our ultrasonic sensor is limited in the distance and angle that it can read for user interaction. For a commercial version we would have more material testing and receive professional skill sharing in areas we were lacking skills in. Further, our ultrasonic sensor may be replaced with a more advanced technology, such as a thermal sensor. This way, Whirlpool is able to register and adapt its interaction to more people, as well as becoming more accurate. That said, here are three features we would love to add:

Solar Power

Addition of solar panels to make our product more self sufficient and eco friendly. We would add solar panels to the top of the design to power all the electronics.

Self Filling

This was a concept that also draws upon the concept of being self sufficient and eco friendly. Having a way for it to capture the moisture in the air to slowly refill any precipitation would help counter the climate of Australia, especially in summer and decrease maintenance.

What is Next

FUTURE VERSIONS (CONT.)

Water Effects

Going forward, having the water display more effects, such as bubbles, would enhance user interaction and display a more dramatic and diverse feedback.

More Patterns

Having more patterns will improve the longevity of the product and the interaction of it. We want to keep it engaging and have it go through new and current animations, depending on how close the users are to the Whirlpool, to increase spontaneity.

To go with this an ability to access them via the internet to update would be ideal too.

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