THE PEDESTRIAN EXPERIENCE

CONCEPT PROPOSAL

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CONTENTS

PROJECT BRIEF

In order to reach a certain destination within the city, pedestrians must engage with tedious infrastructure in order to navigate human and vehicular traffic. Our primary and secondary research concludes that pedestrians find commuting by foot boring, frustrating, stressful and anxiety inducing. They have scarce engagement with their surroundings, and have a low sense of connectedness and community, meaning that being a pedestrian is a forgettable and mundane experience. As a result, pedestrians often look to their phones for alternative entertainment whilst commuting, which reduces their level of self awareness and can manifest into dangerous behaviour.

It is no wonder pedestrians are constantly engaging with their mobile devices instead of their surroundings, considering that infrastructure in place for pedestrians, such as crossings, tunnels and bridges are unengaging. The issue a lack of engaging spaces for pedestrians is extremely important to address, as disconnectedness from one's world not only presents enormous physical danger to pedestrians, it removes and isolates them from their environment and each other.

Ultimately, we aim to solve the issue of pedestrian disconnect by implementing engaging, fun and interactive systems to make a currently forgettable experience more memorable.

Although being a pedestrian is a necessary part of most people's lives, this does not mean it has to be isolating and mundane.

We aim to transform negative attitudes found in primary and secondary research by implementing interactive systems to provide a seamlessly integrated, yet captivating experience that will engage the user, to facilitate their connection to the world.

The problem area addresses the Stream B brief by providing a system that allows pedestrians to connect to their environment in a way that promotes wellbeing and sociability through interactive experiences. Additionally, the concepts discussed will encourage pedestrians to engage with their surroundings, ultimately reducing risk taking behaviour that stems from impatience and frustration.

Although there are certain elements of the pedestrian experience that cannot be easily changed (such as the width of footpaths and increasing the number of bike lanes), our system aims to seamlessly integrate into the user's everyday surroundings so as not to disrupt them, but rather, to add a part of commuting that makes it more interesting.

MARKET ANALYSIS + BACKGROUND RESEARCH

The pedestrian experience has been described as isolating and mundane in our primary research, and this is in part due to a lack of interactive technologies that engage pedestrians. A series of academic sources were analysed to gain broader perspectives about relevant new and existing technologies that are in place to enhance the pedestrian experience through the use of interactive technologies.

Firstly, it is important to grasp the current state of the pedestrian experience within cities locally through primary research. This was carried out in the form of a survey, which received over 50 responses. These respondents were aged between 18 and 70 years old, and provided their opinions about the pedestrian experience through comment boxes on the online survey. Respondents rated the overall pedestrian experience a 3.3 out of 5, and, on a scale out of 100, rated their feeling of safety at 69. Common emotional words associated with the pedestrian experience include "fear, stress, anger, irritation, bored and neutral" More negative emotions were reported than positive ones, which explains the issues reported surrounding urban infrastructure.

When asked what good urban infrastructure is comprised of, respondents stated; well maintained foot paths, more nature/trees, wide paths away from traffic, seating, integration with public transport. Respondents were disappointed with the amount of road works, including the construction of the light rail, and lack of accessibility.

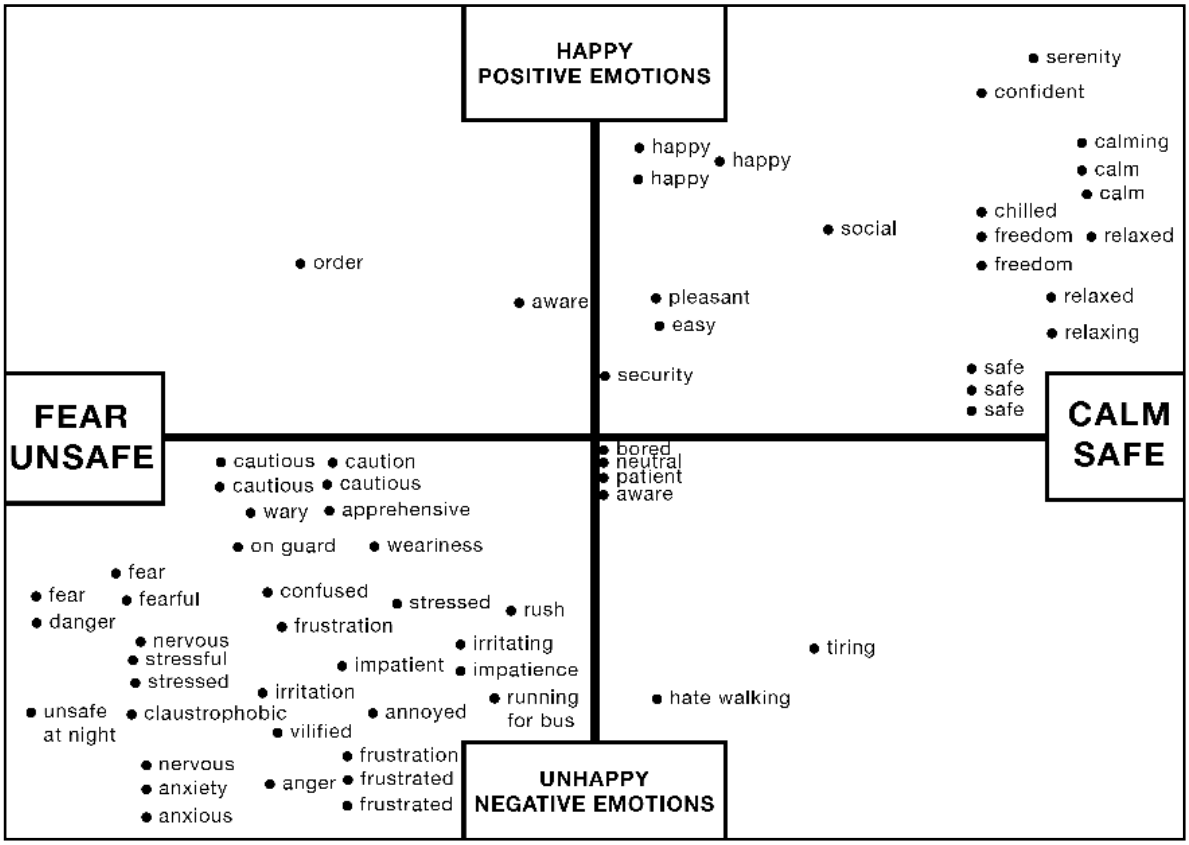

Figure 1: User Satisfaction Map, displaying the reocurrence of negative responses towards the pedestrian experience.

MARKET ANALYSIS + BACKGROUND RESEARCH

Respondents were also asked what activities they were doing whilst being a pedestrian. The most common response was looking at maps, and the second most common response was listening to music. Respondents also were reading texts/talking on the phone, looking at social media, playing games, or not looking at their phone at all. As demonstrated in Figure 1, the survey results have demonstrated that pedestrians are generally unimpressed with the pedestrian experience, and, because of their negative, bored emotional state, feel the need to use their mobile phones as a means of staying entertained and engaged. Additionally, a lack of adequate infrastructure to support pedestrians being engaged and staying safe adds to this dissatisfaction.

The primary research was useful in determining pedestrian sentiment locally and in detail, however secondary sources were also analysed to gain more qualitative and quantitative data.

Current technologies in place that aim to engage pedestrians through the use of interactive technologies include 'shadowing' streetlights that were installed for two months in Bristol in 2014.

The streetlights used an infrared light and projector to display the 'shadow' of the person that walked before them on the ground next to the current user. Creator Matthew Rosier explained that "shadowing offers an exploration of the disconnectedness that technology can create between strangers... and the unseen data layers and surveillance culture that pervades our contemporary urban spaces" (Johnson, 2015).

In a study similar to our own, Colin Ellard conducted a study in 2011 to observe the psychological state of pedestrians in different urban environments.

To measure their response, he asked them to reflect on their emotional state on their smartphones in each location. He also had them wear smart bracelets that recorded the respondents skin conductance, a simple indicator of their alertness and arousal. Ellard described the locations in the observations as "nothing but empty sidewalk…a long bank of frosted glass on one side, and a steady stream of honking taxicabs on the other…", to a "lively strip of restaurants and stores with lots of open doors and windows, a happy hubbub of eating and drinking and a pleasantly meandering mob of pedestrians..".

His findings were adjacent to our own, that people in mundane urban settings are disengaged. In locations that were blank with nothing for the subjects to engage with, words such as "bland, monotonous and passionless" were the common theme. Their devices showed their alertness and arousal was "bottoming out".

Their stature was "quiet, stooped and passive". As expected, the contrasting location allowed subjects to feel far more at ease and happy. In their descriptions they used words such as "mixed, lively, busy, socialising and eating". This study recorded the dramatic emotional differences between an engaging environment and a mundane and boring environment.

MARKET ANALYSIS + BACKGROUND RESEARCH

Boredom and disengagement have far reaching and extensive impacts on our lives than one might expect. In fact, it has become obvious that boring experiences actually change the brain and body's chemistry in a way which generates stress.

It was found that even small doses of environmental deprivation generate "stress, Impulsivity, lower levels of positive affect, and risky behaviour" (Ellard, 2011). Furthermore, a study by Merrifield and Dankert found that after watching scenes considered boring, the subject's saliva samples contained higher levels of cortisol, the hormone that is indicative of stress.

Disengagement with our surrounds as a pedestrian can be compared to environmental deprivation. There is a lot happening, but it is not engaging in a way that grabs our attention and makes us feel engaged or switched on. A study by Ghel, 2006, revealed that people, on average, walk faster in blank and dull locations, compared to open and lively locations. With nothing to focus on, they seemingly grit their teeth and bear it, rarely turning their heads and subconsciously try to reach their destination faster. This further supports the study

Cities are characterised by busy, over-populated streets with loud road noises and an ambience of hustle and bustle. It seems illogical to call this "environmental deprivation" as described earlier. This counter intuitive link was explored by Dr Adli, in his TED talk entitled Stress in the City. Dr. Adli puts forward his theory of 'city specific stress' which is "the combination of social density [and] social isolation which combines to a city specific social stress" (TEDx Talks, 2013). This 'city specific stress' explains why "depression carries a 40% higher risk in cities… anxiety disorders have a 20% higher risk" (TEDx Talks, 2013). Disturbingly, Adli's research also showed that "the risk for schizophrenia is twice as high in cities than in rural environments" (TEDx Talks, 2013).

These alarming statistics demonstrate the need for cities to somehow become a less stressful environment in the interest of public health. The solution to this city specific stress, Adli believes is education - "we should inform city dwellers of the negative effects of stress, just as we do for smoking" (TEDx Talks, 2013).

According to the World Health Organisation (WHO), stress has been described as "the worst health epidemic of the 21st century" (Meyers, 2018). The strong correlation between stress and city living demands a solution that engages pedestrians to momentarily escape from stressors.

In analysing urban planning, Ellard explained that transforming the bottom 3 metres of a building's exterior by introducing more visually appealing details will dramatically change the way pedestrians interact in the space. Pedestrians who engaged with the more interesting facade were far more likely to "pause, look around and absorb their surroundings" and were deamed to be in "a pleasant state of positive affect" (Ellard, 2013) and were far more attentive to their space and eachother. This simple change in aesthetic impacts the pedestrian experience dramatically.

MARKET ANALYSIS + BACKGROUND RESEARCH

The negative emotions and behaviors such as boredom, stress and discomfort associated with being a pedestrian has far reaching consequences. Though it may be in small doses, boredom and stress is emphasised across many studies as being dangerous to our health, and our safety. The pedestrian experience, though part of many people's quotidian experience is making us more anxious, bored and rushed We believe this is largely due to the outdated and unengaging infrastructure that helps our society function. The introduction of emerging technologies on our walkways has the potential to bring greater happiness, fun and engagement which would in turn reduce stress and immerse us more in our surrounds.

Shadowing is not only an interactive, engaging technology that encourages the user to reconsider the spaces around them, it also brings strangers closer together through a visualisation of the people who have walked the same path. Shadowing has the potential to reduce common feelings of social isolation in pedestrians by encouraging them to look up from their devices and be aware not only of their immediate surroundings, but the types of people that have walked there before.

Limitations of Shadowing are that it may be engaging and connect strangers in a way, but there is no direct social contact with others, and may contribute to the reduction of stress and overwhelm in users.

One approach that was developed in South Korea to combat what they have come to know as "Smombies" a conjunction of smartphones and zombies the epidemic of people being glued to their device and the dangerous consequences of not paying attention while commuting. "Increasing number of smombie accidents have occurred in pedestrian crossings, so these zombie lights are essential to prevent these pedestrian accidents," (South Korea "Smombies", 2019) explained Kim Jong-hoon. Trialling blinking lights and laser beams at to encourage and remind pedestrians to look up from their phones while crossing the road and reduce the number of smombie accidents.

Another approach that was developed in Suqian, Jiangsu Province a smart zebra crossing where embedded lights in the road flash to signify that pedestrians have right of way and signage lights up stating "yield to pedestrians". This method is a simple solution that addresses this issue local police stated that the majority of drivers at night struggle to see zebra crossing as they blend into the road easily later at night. They also attempted to improve this during the pilot period by painting high reflective iconic 3D animated characters to draw the attention of drivers.

Finally, Line of Sight is a system developed by Mettle Studio that displays strips on either side of the zebra crossing that glow red to warn cars that someone has stepped onto the crossing. In a bid to slash accident rates due to restricted vision and monitor pedestrians, the electronic strips are able to detect when a pedestrian is approaching and can signal this feedback to oncoming vehicles. Once the pedestrian has successfully and safely crossed the road, a broken light will flash to notify the driver that they will soon be able to proceed.

MARKET ANALYSIS + BACKGROUND RESEARCH

IN SUMMARY:

Primary and secondary background research has revealed high levels of pedestrian dissatisfaction due to infrastructure that discounts their needs. The user can therefore be understood to require an engaging and interactive system in place that not only helps them to make safer choices, but makes them more comfortable, connected and less stressed within the urban environment.

Although current technologies such as Shadowing, Line of Sight and safer crossings for 'Swombies' are in place, they can be improved upon by adding interactive and more engaging elements to make the pedestrian more aware of, and connected to, their surroundings. Alternatively these technologies have limited opportunity to increase sociability within cities. Equipped with this research, we have created 4 concepts that address these common issues for pedestrians in a unique way that incorporates the needs of all stakeholders.

CONCEPT 1: BIOSIMULATOR

BioSimulator is a system designed for use in areas of high pedestrian density that utilises meditation, and the restorative effects of nature to relieve stress in an interactive and engaging way. BioSimulator is comprised of a series of simulated natural elements, such as foliage and nature sounds, as well as a guided breathing visualisation, which momentarily relieves the user of stress, and increases their self awareness.

As demonstrated through background research, stress is a prominent issue that continues to grow as urbanisation and social density does, therefore implementing measures to combat stress in an interactive, engaging manner is a growing necessity in our cities.

BioSimulator alleviates the negative effects of stress on the body through simulations of nature. Seeing as "numerous studies have demonstrated that contact with natural environments offers a relatively effective way of obtaining restoration from stress and mental fatigue compared to ordinary outdoor urban environments" (Van den Berg, Hartig & Staats, 2007), BioSimulator will leave a positive, lasting impact on the user that will not only help to alleviate feelings of stress, it will provide them with a sense of connectedness and awareness of the world around them.

Although busy pedestrians may not have the time to stop and immerse themselves in BioSimulator, "when moving through the environment from one place to another, passage through a natural setting may provide a respite that, although brief, nonetheless interrupts a process of resource depletion" (Beatley, 2011, p.5).

Therefore, BioSimulator will still be effective and has the potential to relieve feelings of stress even with limited interaction.

Existing solutions to relieve stress and strengthen connection to the users surroundings within urban environments mainly arise from the field of biophilia. The term biophilia was popularised by biologist Edward O Wilson in the 1980's, when he "observed how increasing rates of urbanisation were leading to a disconnection with the natural world" (Heath, 2019). Biophilic design in urban environments is on the rise because it can "reduce stress, enhance human creativity and clarity of thought, improve human wellbeing and expedite healing" (Browning, Ryan & Clancy, 2019).

An example of biophilic design that aims to deepen connections with ones' surroundings is the Toledo metro station in Naples, Italy. Most people's perceptions of metro stations are that they are cramped, crowded and unengaging, however the Toledo metro station utilises biophilic design to connect the user to themes of water and light depicted through mosaic artwork inside the station.

The station also has a hexagonal skylight, which allows sunlight to reach the platforms. Toledo metro station transforms conventions of a dark and dingy cave, as "instead of tired eyes gazing wearily at the evening paper, people are given an aesthetically complex environment to interact and engage with - all for the small price of a metro ticket" (Downton et. al, p.92).

CONCEPT 1: BIOSIMULATOR

Figure 2: Interior of the Toledo Metro Station, Naples, Italy

Figure 3: The LowLine Lab, New York City

An additional example of biophilic design in urban environments is the 'LowLine Lab' which was on display in New York City between 2015 and 2017. The site of the lab was an underground abandoned market. Multiple different species of plants were kept alive, and even thrived underground thanks to a complex system of solar technologies that tracked the sun's movements and reflected the sunlight indoors. The lab was only open on weekends, and attracted over 100,000 visitors (Lowline Lab, 2019), demonstrating the public's interest in biophilic design.

These examples of biophilic design are quite different in terms of execution, yet still engage pedestrians by seamlessly integrating natural themes to evoke a sense of calm and serenity in densely populated cities. BioSimulator adopts the benefits of biophilic design on a smaller and less complex level that doesn't involve drastically changing infrastructure, yet still has similar beneficial outcomes. It also adds an interactive element that the examples lack through the motion sensors, making the experience more personal. Additionally, the guided breathing visualisation provides a real time, engaging experience that relieves stress.

BioSimulator is interactive as it uses motion sensors to detect the presence of a pedestrian and appeals to their senses to create an authentic nature simulation. When a pedestrian is detected, the simulation subtly 'switches on'. This simulation is comprised of a discrete rotating fan to emulate a breeze, sun lamps to emulate heat, natural sounds via a speaker and the visual presence of foliage. Artificial foliage is used in the interest of reducing the need for maintenance and withstanding the elements, and all parts of BioSimulator are waterproof where possible. The guided breathing visualisation is displayed through circular LED light strips, with a small circle in the center expanding and contracting to emulate breathing, and a textual indicator (inhale or exhale).

Limitations of BioSimulator arise from non-users, who could vandalise it, or steal components. For that reason, components will be secured as well as possible to the site and items of value (fans and speakers) will be seamlessly and subtly integrated into the site (e.g. installed in the wall and out of sight where possible).

CONCEPT 1: BIOSIMULATOR

The numbers within the concept art correlate to the following elements:

1. Sun Lamps
2. Artificial Foliage
3. Rotating fans to emulate a breeze
4. LED Lights guiding breathing visualisation with inhale/exhale cues below. The circles expand and contract according to breathing cues.
5. Motion sensor to detect pedestrians.
6. Speaker plays nature sounds

Figure 4: BioSimulator Concept Art in busy underground location

Figure 5: BioSimulator Concept Art in outdoors urban environment

CONCEPT 2: SYNCROSSITY

Syncrossity is a system whereby through audio and visual cues it encourages pedestrians to cross the road at a set of lights in a way that is fun and reduces the occurrence of pedestrians jaywalking, seen to be a prevalent issue in the contextual research. In this contextual research we found that at pedestrian crossings with lights, as the group of pedestrians waiting grew and got to a certain capacity the amount of pedestrians choosing to jay walk across the street grew exponentially. In light of this, Crossing Climax would be best suited at pedestrian crossings that have a large volume of foot traffic going across them.

The system is initiated once the pedestrian presses a button on a touch display, or the button may be physical with display accompanying, that is positioned where the standard crossing button would usually be, alerting the system at least one person is waiting to cross. In preparation for the crossing the display will have text that instructs the pedestrians to walk within the the two marked crossing lines ,this will also be spoken through the speakers. Under this text will also be a countdown timer alerting the pedestrian to prepare for the crossing. As the pedestrians cross a sound effect will be initiated over the speaker system to the effect of a crowd cheering from a low pitch to a higher pitch in crescendo, similar to the mexican wave phenomenon seen at sporting events, the duration and speed of the crescendo will also indicate to the pedestrians how long its estimated they should take to cross.

Through the use of sensors placed in line with both marked crossing lines, the system will be able to detect when any pedestrian has strayed outside the markings. If the sensors detect someone has jaywalked the crescendo will cut out and an audio cue expressing disappointment will be played instead. If however every pedestrian participates and crosses the road successfully without straying from the designated crossing section the speakers will play a cheering sound acting as a climax to the crescendo indicating that every pedestrian crossed within the markings. Grabbing that initial attention through loud sounds and then holding it through a collaborative group exercise will ensure increased awareness of surroundings for all users involved and participating. Syncrossity turns safe crossing habits into a challenge and social incentive passively demand participation from every person intending to cross.

CONCEPT 2: SYNCROSSITY

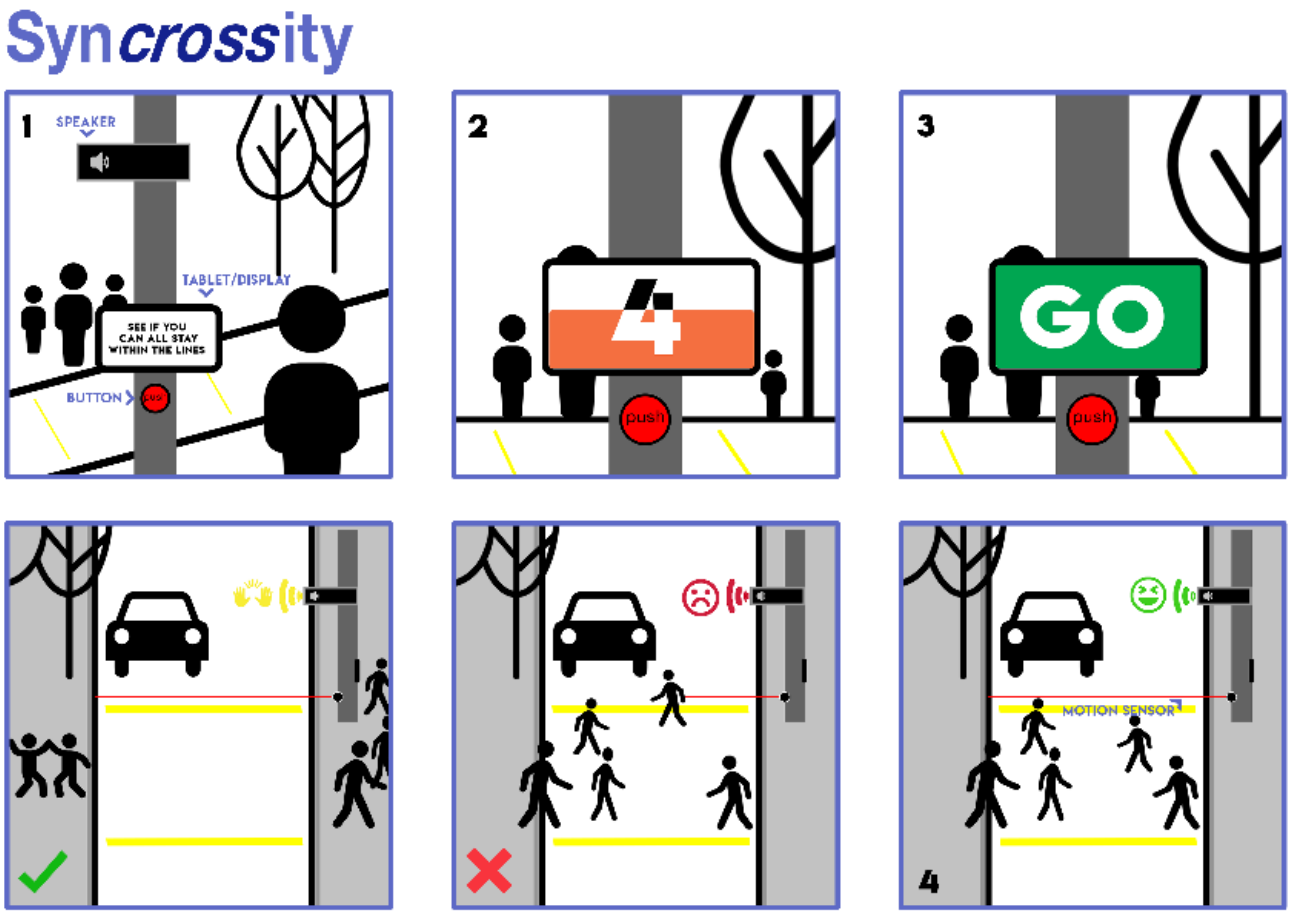

Figure 6: Syncrossity Concept Art

CONCEPT 3: CROSSING OF DOOM

The design of this concept is to encourage users to cross in the designated time frame and in the outlined crossing zones to ideally reduce the number of dangerous situations that may arise due to ignoring these parameters.

Places such as QLDs Infinity attraction and the Glass Bridge in China demonstrated how a completely artificial environment created through mirrors, lights and sound can trick the mind into believing that they are actually in this experience. By utilising these qualities, we are able to implement a similar illusion across the road to make these experiences of crossing more enjoyable and entertaining.

Within this system, the use of primarily visual cues and audio engages pedestrians in a new traffic light crossing experience. We discovered through contextual observation and research into this area that a significant number of people began crossing after the red flashing light, which signals that traffic will begin to flow soon. This simple lack of engagement with the traffic light has led to multiple people reaching half way across the intersection as traffic starts to flow. Those pedestrians concentrated on their phones more than their surroundings can result in getting themselves into serious danger or stuck among traffic. Additionaly, those rushing to cross the road to reach public transport are highly likely to run across the road even after warning signal has begun. This sense of urgency and impatience leads to disasterous consequences.

The system is activated once the button is pressed signalling a desire to cross. A text prompt is displayed on the ground that reads “Can you get across before the ground gives way?” Once the signal is clear to go, two rock like surfaces appear on each side of the crossing. This encourages a smooth flow of pedestrians and as they cross the edges around their dedicated lane, the surface appears to slowly crumble away. In addition, by crumbling sound effects over the speaker fill them with an increased sense of urgency to cross the road on time. As the lights turn flashing red to warn pedestrians that traffic will begin again, each side of the crossing begins to crumble completely away from one side to the other, encouraging those still crossing to hurry as there is limited time left. This makes those considering rushing across the road doublethink whether it’s worth jaywalking. If either side successfully crosses without anyone stepping outside the boundaries of the crumbling path, their side of the road lights up green and with a text prompt that reads “You have reached safety well done”

By using ground level projectors and sensors, the image is projected on to the path. These sensors track the pedestrian’s position to identify whether or not the user successfully made the journey across the road in the designated amount of time. Additionaly, the aid of the speaker provides crumbling sound effects to instil a more realistic impression on the participants, and make it seem as though they are part of a video game or movie.

CONCEPT 3: CROSSING OF DOOM

Figure 7: Infinity Attraction

The current market solutions available aren't quite as engaging as Crossing of Doom. The most common solution already implemented to pressure pedestrians to cross in time is a simple countdown display that shows a countdown from 10 until the lights go green and traffic begins to flow.

This particular method has shown significant results in improving the number of people choosing to go when there is only limited time left, however this method is rather simplistic in nature and doesn't engage the users in a fun and energetic way. It also fails to improve their involvement in the environment around them and sense of community. Crossing of Doom implements the time pressure of countdowns in a more engaging, fun and interactive manner, which ultimately will have a higher rate of success than its less engaging counterpart.

Figure 8: Glass Bridge

CONCEPT 3: CROSSING OF DOOM

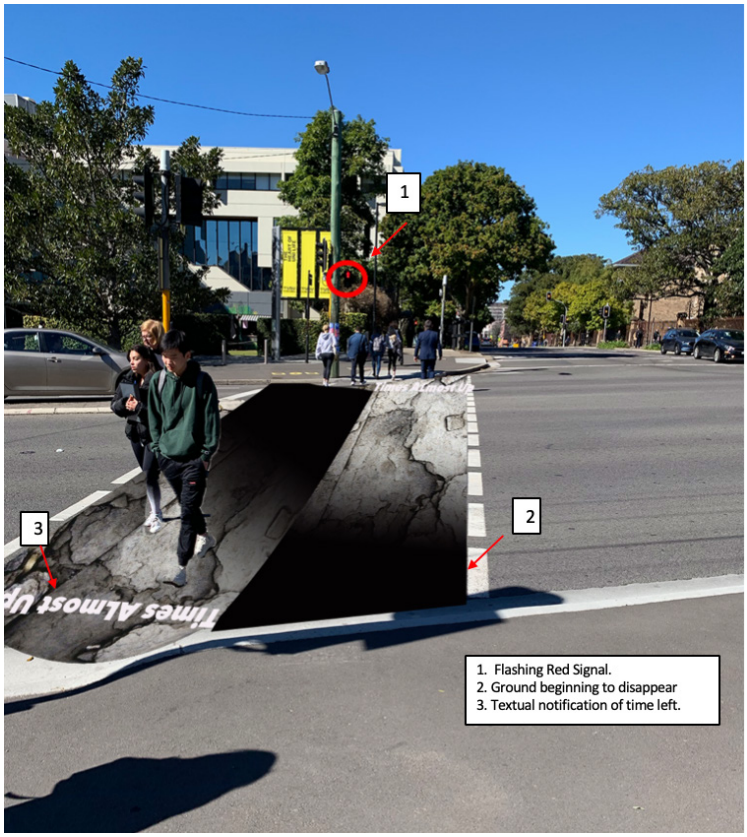

Figure 9: Crossing of Doom when the light flashes red.

Figure 10: Crossing of Doom as users cross the road.

CONCEPT 4: INTERPOLE

Interpole is a dynamic roadside feature designed to engage and enhance the experience of pedestrians at roadside crossing. Interpole is an immersive and responsive LED display that coils telephone poles on either side of pedestrian crossings to replace the static red and green man.

So how will it work?

The pole will begin coloured red as to indicate not to cross. Immediately the LED Display that surrounds the post will begin filling up with colour from the bottom up in a way that imitates a glass being filled up with water, or a mercury thermometer lifting in heat.

The time it takes to fill up will be indicative of the wait time for pedestrians until they are able to cross. As the colour creeps up the pole it changes to orange, to yellow, to green. As it creeps up the pole, a captivating and artistic display will emerge – such as an aquarium with fish, the wind through a sail, or patterns. If a pedestrian is standing by the pole, motion sensors will be reactive to movement, and they could create ripples in the display, or wind through the sails, or the fish may swim away.

In a high-fidelity version, the pattern on the emerging timer will change frequently, hourly or daily so as to provide users with new and exciting scenes to spark their curiosity. (See Figures 1-8)

Once the pole is filled to the top, and the entirety is coloured an indicative green colour, pedestrians will hear a cue to cross. In the same way as the wait time, the pole's colour will drain away, and a new pattern will emerge from the top, to let the users know how little time they have left to cross. We believe the interactivity and visibility of this design will spark interest in pedestrians and relieve stress and discourage jay walking.

Furthermore, as it is as tall as a pole (approx. 8ft), the display can be seen at any level. Non users will be able to see Interpole, and it's indications even if they are looking down at their feet, engaged in their phone, or even up into the sky at the clouds.

We believe that current green man is an outdated and monotonous experience that users place little value on. It only offers basic functionality; to cross the road or not. In our site observation, we observed a large majority of pedestrians take their phones out of their pockets when they arrive at the lights, a device far more interesting than waiting for the red man to change. Although adding a countdown to display does decrease Jaywalking and keep the pedestrians informed, it is of little improvement compared to the possibilities of interactive technology.

Limitations:
May not be weather resistant
Could distract cars, they may react to the wrong lights
Interactive art difficult to achieve on LEDs

CONCEPT 4: INTERPOLE

1

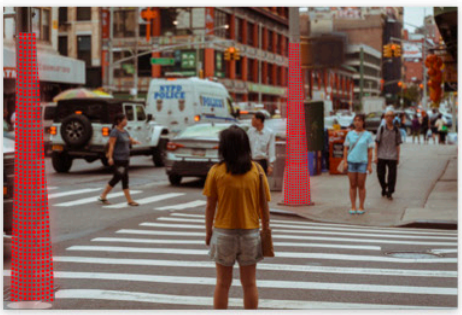

Figure 1: Pole is red for don't cross.

2

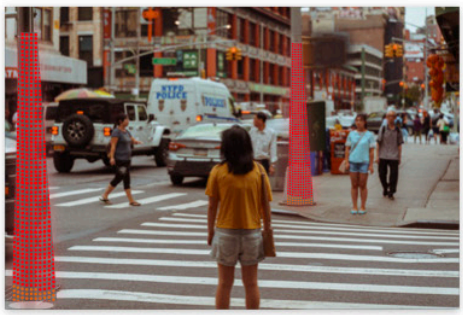

Figure 2: Color begins rising

3

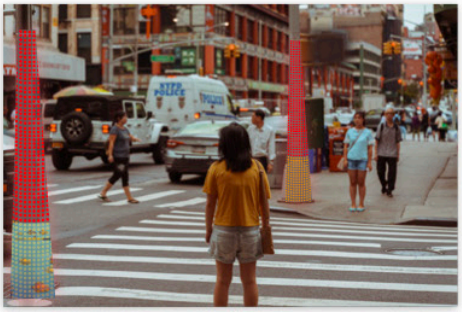

Figure 3: Continues rising, fish emerge

4

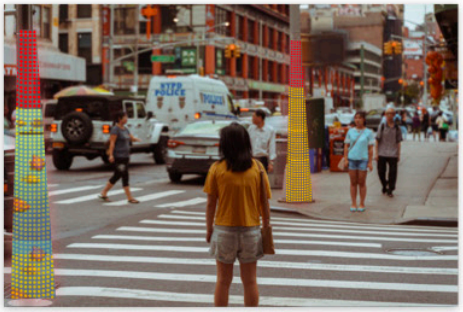

Figure 4: continue, yellow tinge.

5

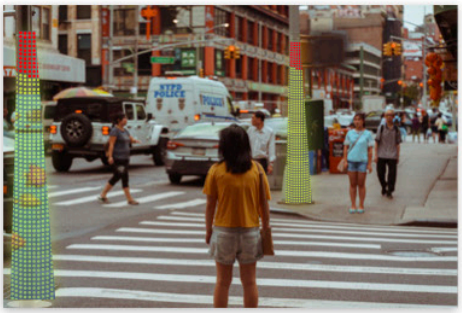

Figure 5: Begins to turn

6

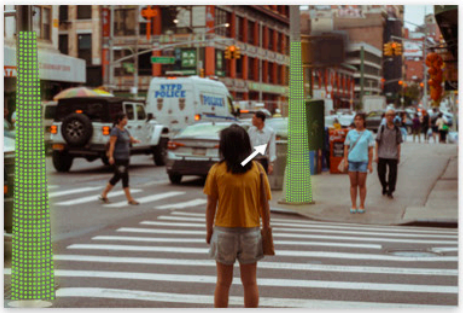

Figure 6: Pedestrian crosses

7

Figure 7: Visual countdown

8

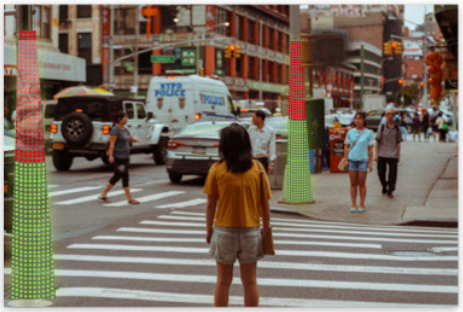

Figure 8; New Interactive art emerges

HARDWARE + SOFTWARE REQUIREMENTS

BIOSIMULATOR

In terms of material, the BioSimulator will require artificial foliage. In terms of hardware, setup will comprise of an rotating fan, speakers, LIDAR-Lite v3HP for motion sensing, heat lamps and LED light strips and text bar and it will run on Arduino Uno coded by Arduino IDE and sound effects edited on audacity.

SYNCROSSITY

In terms of hardware the Syncrossity system will require LIDAR-lite for motion sensing, speakers (loud capability), a tablet (android) with protective casing and running on Arduino Uno, software Arduino IDE and audacity.

CROSSING OF DOOM

The Crossing of Doom system will require a projector, LIDAR-lite motion sensor, and speakers (loud capability). The system will be operated from a PC running either mac or windows.

INTERPOLE

The interPOLE system requires ADAFRUIT INDUSTRIES DotStar Series, RGB LED Strip which will run on an Arduino Uno coded in Arduino IDE.

GROUP CHARTER

CHARLOTTE

Writing the project brief - comprised of taking notes during group brainstorming sessions to create the problem statements.
Summarising survey results
~2 pages of research (on the impacts of stress and the rise of stress in cities)
BioSimulator Concept
Compiling information into final report

GABRIELLE

Background Research
Interpole
Visual Diagram Sketch from descriptive primary research
Proof read

JAMES

Primary research findings
Materials, hardware and software that would be required to construct all four of the concepts.
Digitised Visual Diagram (in primary research
Helped formulate project brief

LUKE

Market Analysis
Concept: Crossing of Doom

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