Visual Impairment Awareness

Stream C Dynamic Destroyer

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Project Brief

In a time when cities are incorporating technology into everyday experiences, a large part of the community is still left behind. Stevens et al. (2013) reports that 32.4 million people worldwide were blind in 2010 with 191 million having some form of visual impairment. As visual impairment primarily occurs in older adults over 50 years old, this number will only increase as the population ages.

People with visual impairment are not benefited by many of the visual experiences that dominate the smart city, and as such the general public lacks understanding of how to approach and help those with visual impairment. Many inventions such as Braille readers, the white cane and voice GPS navigation have allowed people to retain their place in the urban environment. However, as cities become more technologically advanced, the gap in the perceptions towards the visually impaired continues to grow.

We aim to devise an interactive way to improve attitudes towards people with visual impairment within the community, while considering their abilities for greater inclusivity.

Background Research

Mental health of people living with disabilities

People with disabilities go through many issues including physical limitation, miscommunication, mental health problems and other problems like isolation from mainstream community, financial difficulty due to lack of job availability. Therefore, it is important to understand what they are going through in order to solve any problems that they have.

According to Gallagher, Hart, O'Brien, Stevenson, & Jackson (2011), visually impaired people not only lose their vision, but also their independence since visual function is such an important part of a person's daily life (Bláithín et al., 2011). Losing independence can ultimately cause the isolation, lack of confidence and social skills.

Datta & Talukdar (2015) have reported that visually impaired students in South Australia have showed low score on their self-concept, which has six dimensions: self-concept, physical, moral, personal, family, social, and academic achievement (Datta & Talukdar 2015). It means their self-esteem, confidence, self-image, social relationship behaviour is more negative or lower than others who have no vision impairment. This research has found that "students with vision impairment often feared rejection by their sighted peers and so preferred to remain secluded and isolated" (Datta & Talukdar, 2015, p.668) and visually impaired students often have a hard time understanding "subtle social nuances and social feedback and need support to interpret and understand the social environments surrounding them"(Datta & Talukdar, 2015, p.668).

Disabled does not feel included in their community because of their low self-esteem.

Disabled people have reported that they have low and negative self-concept "when compared to the standard norms, as they perceived themselves to be different from their peers" (Datta & Talukdar, 2015, p.668). Theoretically, self-concept is commonly formed by the environment around them (Datta & Talukdar, 2015). "People with disabilities living in the community will make comparisons with other non-disabled groups and it is likely that their self-concept will decrease because of the effects of negative frames of reference" (Datta & Talukdar, 2015). The research shows that visually impaired people show lack of confidence, social skills, self-concept and they are inevitably comparing themselves to people who have no disability, which leads them to more negativity.

However, it does not mean that they feel pity for themselves. David O'Driscoll, a psychotherapist, has published an article, We do not want your pity. O'Driscoll (2016), describes excessive help from the general public is not based on respect, but pity. Perhaps, humans instinctively want to compare themselves to others as the previous research theoretically stated, especially with those who are weaker to justify how great they are. At the same time, the pity for the disabled can be the by-product of proving how better they are than the disabled (Datta & Talukdar 2015). It is important to find the right balance between helping them and living with them in the same community together.

Most visually impaired people expressed that the reason why they are not helped properly is because the general public have a "lack of awareness and understanding of the needs of people with vision impairment" (Bláithín et al., 2011). Indeed, most of the public's attitude towards disabled can make them feel more uncomfortable, isolated and making invisible and subtle hierarchy. Therefore, it is crucial to educate both the general public and visually impaired people the right information and correct the misperceptions (Janiszewski., 2006).

It is important for people with disability to understand and acknowledge their physical condition and learn how they can overcome what they are going through, which will eventually help them to maintain healthier mental states. Since they score lowly on most of self-concept dimensions, their social engagement can be a solution to make them live better. For the general public, it is recommended to learn what people with disability go through to understand how to interact with them and raise their awareness of vision impairment.

Effect of vision loss in everyday function

The loss of one's vision severely impacts those who are experiencing it first hand and those around them. Along with significant financial costs, vision loss affects the quality of life, ability to travel, and sense of independence. Vision impairment affects tasks such as reading, socialising, and pursuing leisure activities as well as basic daily activities (Brown et al. 2014).

Brown (2014) categorised the functional complaints of 819 vision-impaired people seeking low-vision rehabilitation appointments across the United States between 25 April 2008 and 2 May 2011. Ages ranged from 18 to 110 with the median age being 77 years old. There were 525 women (66.4%) and 271 men (33.6%). The most common request for assistance was for reading (66.4%), followed by driving (27.8%), and the use of assistive devices (17.5%). Other complaints included in-home activities (15.1%), lighting-related activities (11.7%), recognising faces or interacting socially (10.3%). Difficulties with walking, performing hobbies, using technology, watching television, doing out-of-home activities, and work or school related activities consisted of less than 10% of the complaints.

The most common request for low-vision rehabilitation (LVR) was for reading which varied from sustained kinds of reading such as books or magazines to short-form or spot reading such as medicine bottles, bills and food labels. Sustained reading is much more affected than spot reading tasks with certain types of visual impairments (Ramulu et al., as cited in Brown, 2014).

Second most common complaint was for driving. Visually impaired drivers tend to navigate in familiar environments and restrict their time behind the wheel, limiting the need to do more difficult tasks such as reading road signs, maps and GPS devices. (Massof, Deremeik, Park, & Grover, as cited in Brown, 2014). Younger people requiring transportation to meet the demands of everyday responsibilities such as school, work or family were more likely to seek LVR for driving.

Mobility complaints included walking and out-of-home activities. Visual impairment increase the risk of falls. Mobility loss is greater in people with peripheral vision loss than those with central loss (Willis, Vitale, Agrawal, & Ramulu, as cited by Brown, 2014).

People afflicted with visual impairment are forced to function in a world that is primarily not built for them.

A study of 508 participants of a sample of nine areas in Melbourne and four areas in rural Victoria were interviewed and examined as part of the Visual Impairment Project (Weih, McCarty, & Taylor, 2001). Mean age was 65 and 276 were women (54%). Participants had to complete the VF-14 questionnaire, which identifies difficulties a person has in doing everyday vision-based activities. The questions were answered on a 0-4 point scale, 0 being 'unable to do this activity'. The activities that were assessed included reading across various mediums, watching television, cooking, driving, identifying a ten cent coin or faces, among others. It was found that the participants in this study found it hardest to read small print, read street or store signs, drive at night and play sports.

Navigating through the city with low-vision

Maplesden (2012) explains that there are many skills used by vision-impaired pedestrians to travel. In an Australian survey in 2009, it was estimated that 575,000 people over the age of 40 have a vision impairment, defined as less than 6/12 in both eyes (Vision Australia, as cited in Maplesden, 2012). This level of acuity disqualifies them from driving as it typically requires 6/12 in the better eye. If a person with low-vision cannot drive or ride a bicycle safely, they have to walk by themselves to avoid being a dependent.

A long white cane is used by the visually impaired to check the ground surface ahead and provide warning for every step. Those who don't use white canes say they don't want to be pitied or signal their disability. New drivers are given minimal information about the needs of visually impaired people and can interact wrongly when encountering them on the road. Seeing eye dogs cannot interpret traffic lights and have to wait for the owner to proceed.

People with low-vision learn to work around their particular type of impairments. Reduced central acuity can be compensated for by looking upwards or to the side. The concept of 'facial vision' refers to listening to the reflection of a sound off of a nearby object. Keeping a straight line while walking is aided by maintaining a constant position of sunlight on exposed skin. Using a 'talking watch' and facing the sun can deduce the north compass direction. Ipads can photograph an object and enlarge the photo with in-built software.

Visually impaired persons use a range of techniques to navigate their environment using their hearing. Listening for particular engine noises can help determine if a vehicle is accelerating, slowing down or stopping. These changes in sound can help a visually-impaired pedestrian deduce when it's safe to cross. Roundabouts prove particularly dangerous for pedestrians with low-vision as there is no way to communicate with the driver.

Tactile Ground Surface Indicators indicate that there will be a change in the ground surface. White canes are unable to warn of hazards that are above waist level. A slight step for ramps can be used to anchor one's white cane and indicate that the user is about to step onto a road. Flat streets where road and footpath merge are hard for low-vision people to navigate.

Market Analysis

Existing Solutions

By analysing existing solutions on the market that tackle vision impairment, we can generate more awareness amongst the general public help create communities that are inclusive, and help sufferers of visual impairment live with a better quality of life and reduce isolation.

An experiment conducted by Henry, Brown, Tang & Hanneghan (2015) was used to evaluate the effectiveness of game technology and simulation as a tool to promote awareness for individuals that suffer from partial-sightedness and blindness. Scenarios of the difficulties faced by victims of visual impairment conditions were created to allow normal sighted individuals to experience the effects of visual impairment in a safe environment. One simulation put the user at a road crossing scenario which required the user to rely solely on auditory cues to get from point A to point B. This was proven challenging to the participants as they had to process the limited information about the environment. 15 of 17 participants said that they would be inclined to help a blind individual indicating empathy towards those who are vision impaired.

Researchers from the University of London ("Using VR to raise awareness of vision loss and eye disease", 2018) have developed a virtual reality experience which can simulate sight loss in an immersive, interactive and intuitive way. In accompaniment with a smartphone app, it not only raises awareness for the vision impaired but also encourages and delivers eye tests to people who need them.

Canetroller is a haptic cane controller that simulates white cane interactions enabling people with and without vision impairment to navigate a virtual environment by transferring their cane skills into the virtual world (Zhao et al., n.d.). Not only does it aid visually impaired participants to navigate different virtual spaces but is a good outreach for blindness awareness to normal sighted people by simulating blindness

in Virtual Reality.
Touch Graphics Inc, (2014) designed and fabricated a series of touch responsive, talking kiosk for visually impaired travellers. Each kiosk displays a spatial layout of its surroundings in a multi-sensory format that is usable by everyone with a particular emphasis on the needs of the blind. Interactive maps are tactile, visual and they describe themselves through spoken language, large print captions and refreshable braille. Sound effects are embedded in the map to capture environmental sounds like fountains or bells. Ensuring that critical information for us is easily perceived may help vision impaired people recognise landmarks they may encounter when travelling through the environment.

Technologies for public awareness

Technologies over time have allowed people with visual impairment to have the ability to identify, navigate and learn about the world. These include Braille readers, screen readers, GPS voice navigation like Blindsquare along with the use of the white cane and trained guide dogs. Despite this, they still face a growing number of challenges to keep up with the fast-paced technological world today (Manzoor & Vimarlund, 2018, p.377). While digital technology has been seen as a promoter of accessibility and social inclusion, there is limited use of technology for public awareness of visual impairment that actually encourage inclusivity. Spreading awareness using digital technologies has commonly been done through digital media such as blogs, social media and websites. While this is effective as a broadcasting platform (Zayer & Gunes, 2018), it lacks interactivity and is largely information-based, centred around organisations and day events such as World Sight Day.

Technology has the unused potential to enable social inclusion of disabled people.

Interactive public displays are also effective for engaging audiences in awareness campaigns. They often require a need to engage passerby attention, realisation of interactivity, a trigger for public interaction and finally for users to reach a goal e.g. going on a website (Parra, Klerkx & Duval, 2014, p.180). While these displays do capture user interest, this depends on the type of interaction, the social and physical context, and the cost for the user to interact with it such as time, technical and cognitive load. In general, users engage with the product but do not continue to the final stage of interaction and are more comfortable at interacting with displays at a distance (p.184-185). Therefore, the use of the displays is useful to gather attention though could be more effective with shorter, simplified interactions capable of delivering the key message across stages of interaction.

Interactive technology needs to consider how to engage people and deliver key messages.

As raising awareness about the reality of disability implies changing people's attitudes, we also looked into persuasive design, a field describing how to influence the behaviours of users. While used mainly for app onboarding and marketing purposes, it can be used in affecting attitudes for increased awareness of an issue. This was used in an experimental research to increase health habit awareness in a wearable band for children (Ananthanarayan & Siek, 2010). This involved the research of novel ways to engage and motivate through vibro-tactile feedback and audio-visual communication. It is key to note that there needed to be a "balance between user input and automation" in the device (p.403), therefore a series of steps required would lead to considerable effort from the user. Alternatively, full automation results in decreased awareness and a lack of self-reflection for the desired result. In order to utilise techniques from persuasive technology to enhance attitudes towards people with disability, it is important to have an understanding of what is required for the user to interact with it that would result in a thoughtful impact.

Summary

Visual impairment causes isolation, reduced confidence and loss of independence. The inability to detect visual social cues discourages them from participating in community and leaves them feeling isolated. Apart from the effects on mental health, the ability to read, travel, pursue hobbies, and carry out everyday tasks are also affected. Although some city planners implement Tactile Ground Surface Indicators to indicate a change in surface for the visually impaired, others tend to forget to accommodate for them, leaving them to feel excluded in urban communities.

From what we've found, current technologies have not been utilised to encourage public awareness and social inclusion for those with low-vision. Previous solutions primarily use virtual reality headsets to immerse the user and evoke empathy toward the blind but this is not ideal for a public display or community engagement. There needs to be a way to raise awareness for the visually impaired through short and simple interactions in multi-sensory formats that also prompt users to reflect on the experiences of people with low-vision.

Concept 1

CONCEPT TITLE:

Touch To See-Haptic Tile Navigation Awareness

CONCEPT DESCRIPTION

In this concept, users are invited to place their hands on tiles to get directions to a location without relying on sight. A monitor screens a map display in front of the user but its details are hard to discern to simulate the lens of a person with visual disability. Instead, directions are given through audio and haptic feedback from the stereo speakers and the tiles which vibrate by mapping directions to areas of the hands. As research suggests, this can induce empathy towards people with vision impairment but also brings awareness to a more accessible way of navigation through the vibration and voice navigation. Since the directions are accessible to both those that can see and cannot, the utilisation of other senses reduces negativity in sight impairment and the idea that without sight, there is no way to independently move around.

HOW DOES IT DIFFER FROM OTHER SOLUTIONS?

Interaction with this is fairly simple compared to other technologies used for awareness of visual impairment. It simply requires users to place your hands on the tiles and listen for feedback, as opposed to reading lengthy texts or being immersed in the interface. It also gives you an idea of new technologies for navigation and useful directions to takeaway.

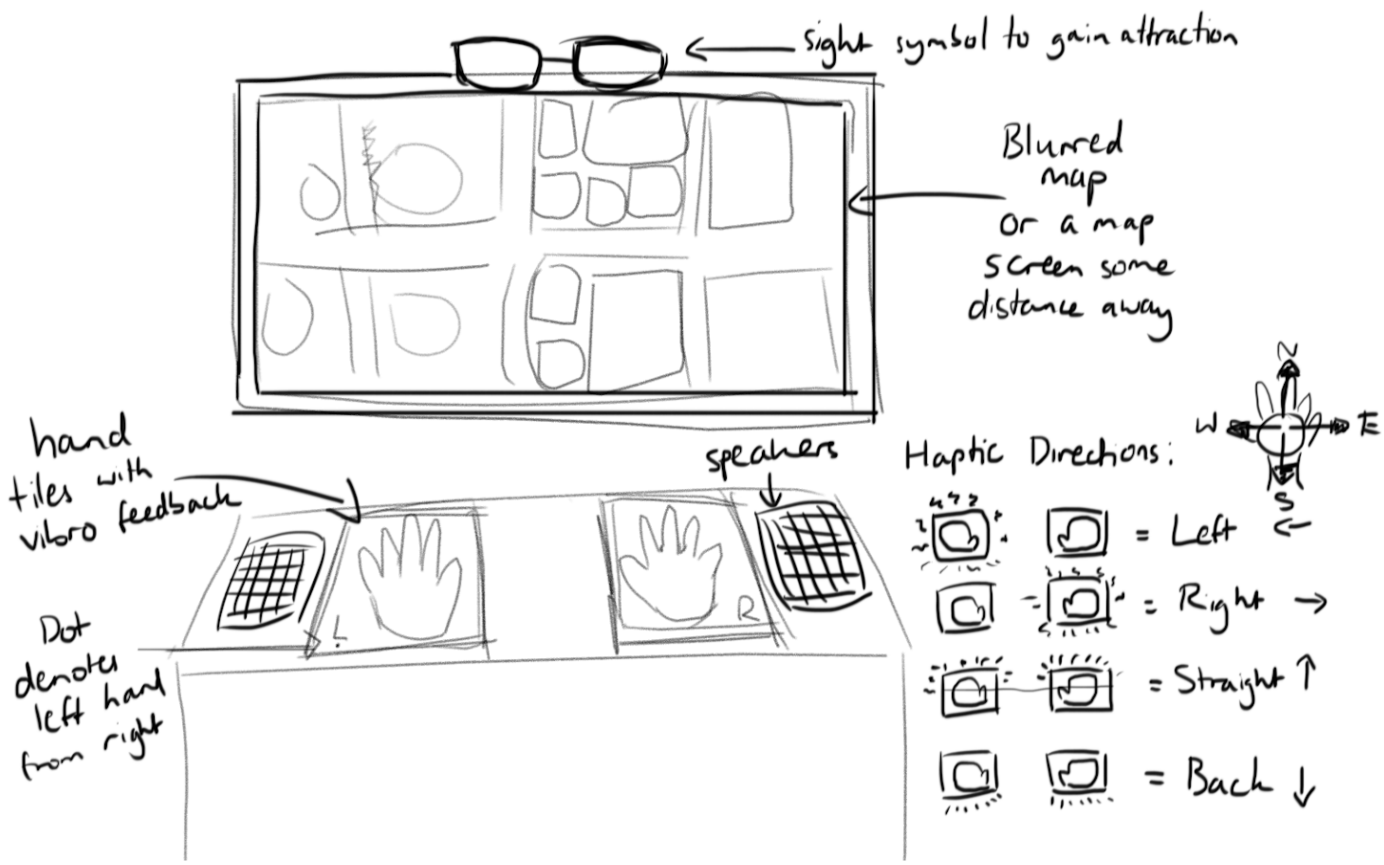
HARDWARE REQUIREMENT

Screen, Touch Sensors, Arduino, Vibration Motor, Speakrs

SOFTWARE REQUIREMENT

C/C++, Processing or JavaScript for map interface

CONCEPT ART



Concept 2

CONCEPT TITLE:

Where is There? – Direction Game

CONCEPT DESCRIPTION

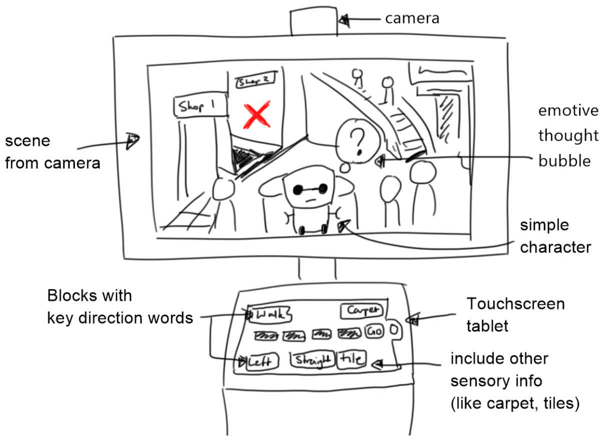
People use sight to navigate by estimating distances, noticing landmarks and orienting themselves around objects. But without sight, this is delegated to the other senses by recognising sounds, textures and even the feeling of sunlight. But it begs the question, “where is there” when you are communicating directions to a person who cannot see?

Where is There? Is an interactive experience which questions how you would get a small on-screen robot to walk to a random “there” in your periphery without using the word “there”. A camera views the scene in front of the user and marks an “x” in a random spot. The user is then given a set of keyword blocks for directions plus visual and textural landmarks which users can drag and drop into spaces on a touchscreen. The user-built directions will then either be carried out to see if the robot can get to the mark or it will express confusion over the words.

This approach is suitable for all ages and provides awareness not only in communicating directions to people with visual impairment but also direction communication in general through the use of coding concepts. Having to guide the robot through words rather than moving it on-screen also conveys the capability people with visual impairment have in navigating by themselves.

HOW DOES IT DIFFER FROM OTHER SOLUTIONS?

The concept not only simulates giving directions to the blind, but is an educational and novel interaction. Rather than being given information over how you should be giving directions and why blind people need them, users can gain an understanding of direction clarity through testing it out. Use of the coding block further allows kids and adults to understand the order of directions and makes the solution more engaging by testing directions mapped to a real scene.



HARDWARE REQUIREMENT

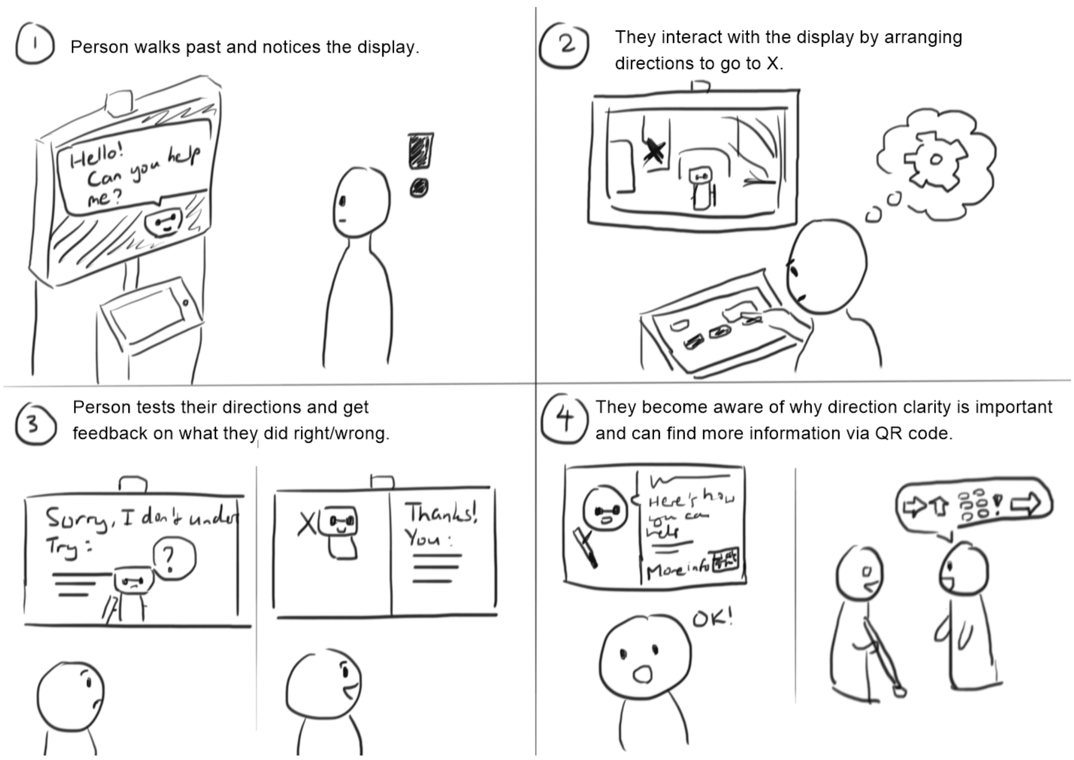
Screen with back camera or webcam, Touchscreen tablet

SOFTWARE REQUIREMENT

Unity (C#),
JavaScript,
Image analysis and recognition
(e.g. Processing)

CONCEPT ART

AND STORYBOARD



Concept 3

CONCEPT TITLE:

Community Scavenger Hunt

HOW WOULD IT SOLVE THE PROBLEM?

This concept playfully invites the community to get a glimpse of the struggles that low-vision people face in their everyday lives. It seeks to raise awareness through empathy and in that way improve attitudes towards visually-impaired people.

HOW DOES IT COMPARE TO OTHER SOLUTIONS ALREADY ON THE MARKET?

Other solutions or experiments to raise awareness that we've researched heavily relies on the use of virtual reality to place the user in a low-vision experience. While VR is great to use for immersion, it is not a good technology for use in a public space or for community engagement.

This proposed solution is a good compromise between experiential immersion and public participation.

HOW WOULD IT WORK?

There will be a projection or big screen that initially starts off displaying all black. There will be a QR code near the screen that people can scan to interact with the display. After scanning the QR code, users will see a small version of the display on their phone. They will find that the screen is divided into multiple tiles that they can tap on.

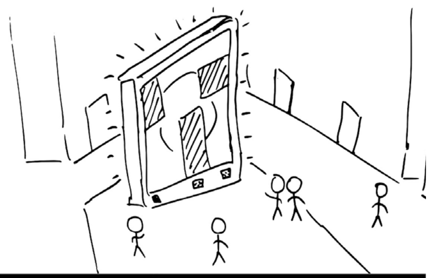
Tapping on one of the cells will present a photo of an object that is blurred or obscured in some way. The kind of obscurity represents the various types of vision-impairment. The object will be taken from the surrounding environment. Users will need to look around if they cannot guess it straight away. Clues can be given to the user by vibration or sound through the phone.

When the user knows what the object is they will type it's name into their phones. When an object is correctly identified, the tile will flip and reveal part of the larger image hiding behind.

The cleared image will be the face of a visually-impaired person. After the image is revealed, statistics visually-impaired people will appear on the image. The game will reset after a certain amount of time.

HARDWARE REQUIREMENT

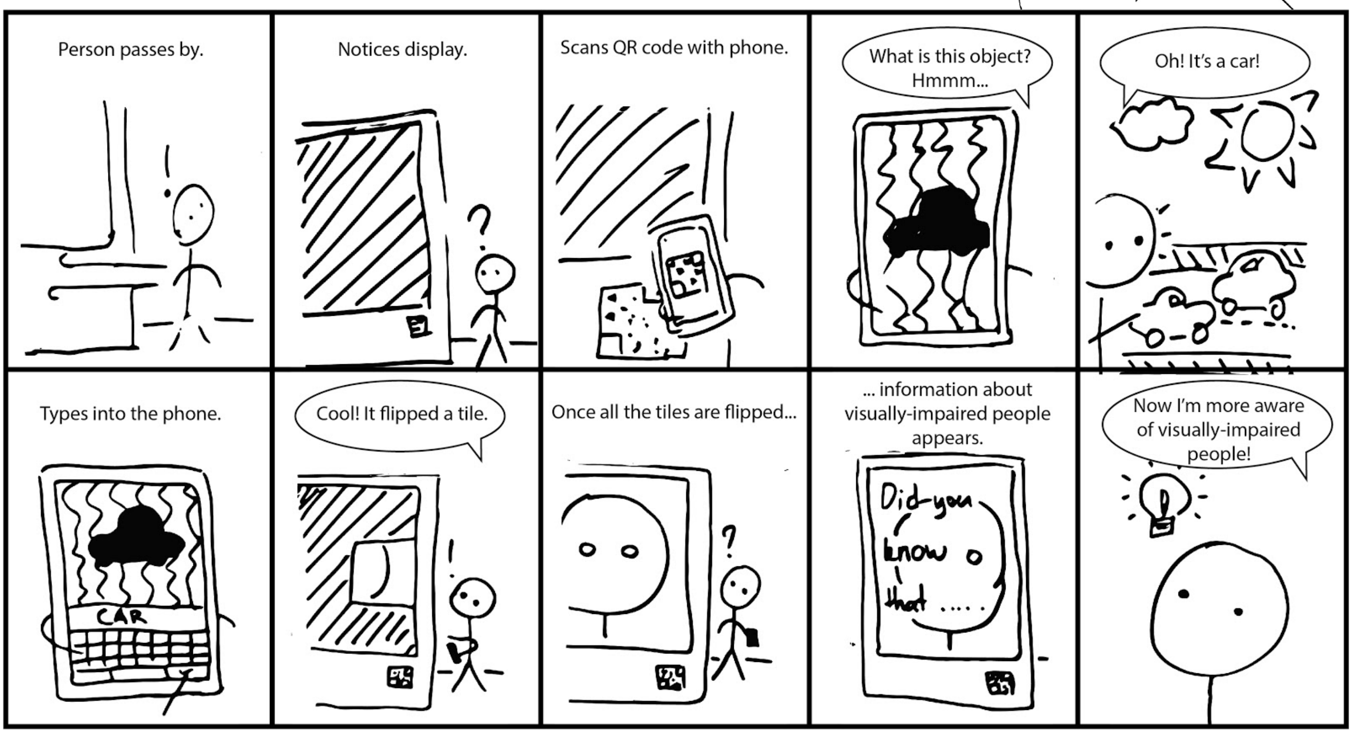
Server (either web hosted or Raspbery Pi), Screen or projector, Housing for the display



SOFTWARE REQUIREMENT

Adobe Suite, QR code generator, Unity (C#), Node.js (Javascript)

CONCEPT ART AND STORYBOARD



Concept 4

CONCEPT TITLE:

Shopping Mall Kiosk Campaign

HOW WOULD IT SOLVE THE PROBLEM?

This project is a simple, but powerful way to convey to normal sighted people what vision impaired people go through when they seek navigation to a destination. A kiosk is something everyone uses at a shopping mall and the shopping mall itself is a place where everyone gos. Shopping malls are usually big and shops are complicatedly located. By nature, the reason why people use a kiosk at a shopping mall is to find out a specific store or location and when people come to the kiosk, they must feel lost and frustrated. Therefore, kiosks are one of the few options that people can rely on in the shopping mall. For vision impaired people, everywhere would feel like a giant shopping mall that everything is located complicatedly. Unfortunately, they do not have access to the kiosk system since they have limited vision. Vision impaired people could only rely on pedestrians who pass by and most of the general public has not been properly educated on how to give a clear direction to blind people.

HOW DOES IT COMPARE TO OTHER SOLUTIONS ALREADY ON THE MARKET?

The genius part of this project is that the participant who uses the kiosk is treated equally as blind people per se. The kiosk gives a vague and unclear direction to the users and they are more confused. Users try to hit the 'Explain More' button, but it gives more weird answers. When users think about when they give a direction to non-blind people, they would say such as "Go this way." Or "It is over there." by pointing a specific direction, which clearly does not make sense to the blind people. Indeed, the kiosk mimics all the uneducated general public's reaction when they were asked a specific direction. Through this activity, general public will learn how to interact with the blind people because they are physically in the blind's situation. They would understand what blind people suffers from indirectly. Moreover, because it is a shopping mall setting, the number of activity would be higher than other venues, which has higher possibility to educate more people.

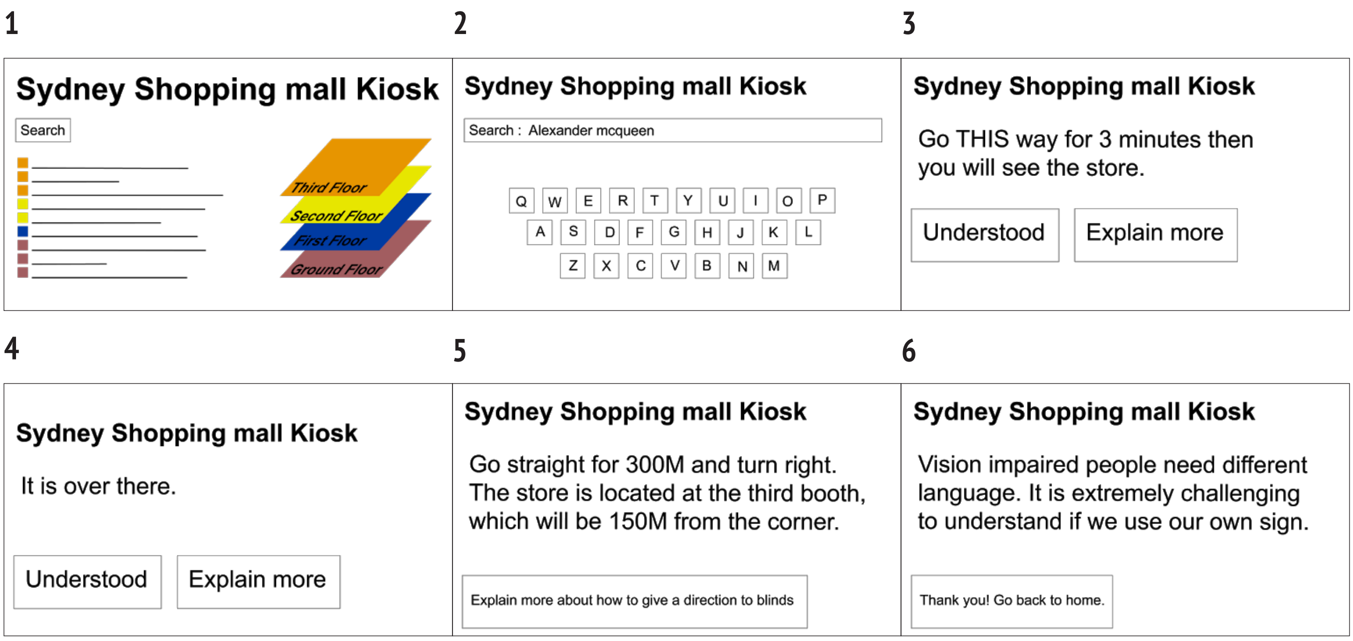
HARDWARE REQUIREMENT

Touchscreen Pad, Arduino or PI, tols and materials to build like box or stand

SOFTWARE REQUIREMENT

Javascript

CONCEPT ART AND STORYBOARD



Concept 5

CONCEPT TITLE:

Tactile Maze

CONCEPT DESCRIPTION

The Tactile Maze is an immersive and interactive simulation which requires the user to navigate a maze in virtual reality using only auditory cues and by touching an interactive tactile map which will vibrate when close to walls.

HOW WOULD IT WORK?

At the start of a session, the user is required to wear a blindfold and interactive with a tactile map by touch. The tactile map shows the spatial layout of a virtual maze. Once users get familiar with the map, they put on a virtual reality headset and are tasked with trying to figure out how to escape the maze while referring back to the tactile map using their hands for guidance. The user will lose all sense of sight and will have to rely on auditory cues and sense of touch. The tactile map is synced with the position of the user in the maze and will vibrate when users hit a wall or go the wrong direction. This is to simulate the difficulties faced by sufferers of visual impairment.

WHAT PROBLEM WOULD IT SOLVE?

Wayfinding and mobility are among the greatest challenges for visually impaired people. According to a study done in France, 56% of visually impaired people admit to facing difficulties navigating outside and 29% are not able to navigate independently (Ducasse, 2017). Visually impaired users usually exchange verbal descriptions of itineraries which may help them find their way, but do not provide them with any clues about the spatial layout of the destination environment. Maps are essentially visual and inherently inaccessible for vision impaired people. As a result, weak access to maps have drastic consequences on mobility and education, but more on personal life and can lead to social isolation. A study in Italy observed that 48% of vision impaired people don't use tactile maps (Nuzzi, R. 2018). By creating the Tactile Maze, we aim to generate awareness to communities through empathy but also encourages vision impaired users to be more comfortable when using tactile maps in public.

EXISING SOLUTIONS

A simulation created by (Henry, 2015) was used to raise awareness for vision impaired people. The simulation put the user at a cross road scenario where users had to rely on auditory cues only to get from one side of the road to another. By processing the limited information about the spatial environment, the simulation successfully highlights the hardships vision impaired people undertake in daily scenarios.

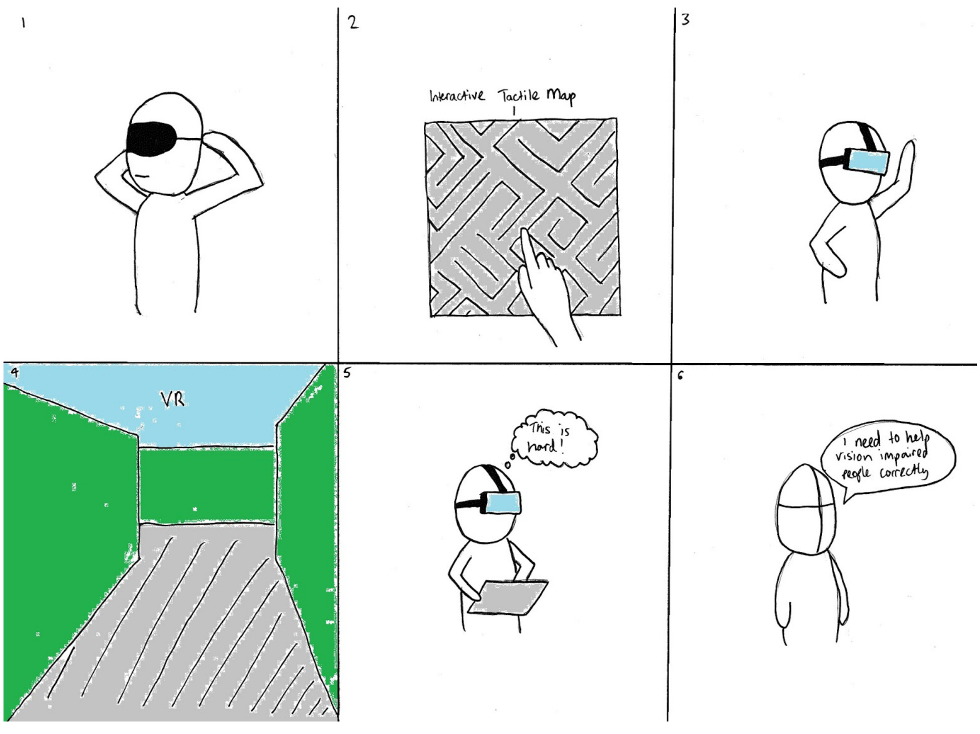
HARDWARE REQUIREMENT

Screen, Arduino, and its motion and sound sensor module, LEDS, VR headsets and system, phone, laptop

SOFTWARE REQUIREMENT

3d Modelling software, Adobe Suites, 3dS Max/ Rhinoceros 5, Unity, C#, C, C++

CONCEPT ART AND STORYBOARD



THE UNIVERSITY OF SYDNEY

Architecture, Design and Planning

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