IDEA 9101 LAB

Leaf on the lawn

IDEA Studio Responsive Environment Technical Implementation

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Design Process

DESIGN BRIEF

Botany lawn is one of the most distinct areas at University of Sydney. It faces the main campus entrance, Fisher Library and is right next to the Quadrangle - one of the most iconic buildings in Sydney. In view of its unique location, we decided to juxtaposition the students' experience with the local community surrounding the campus and find ways of improving the area for all to benefit from. Although Botany Lawn is often occupied during daytime, it is very rare to see people remain in the area at night with the darkness enthralling the site. Therefore, this research aims at redefining the current experience to one bettered, with the inclusion of digital technologies.

"How can we make the experience better at night at Botany lawn?"

PROBLEM STATEMENT

In general, people are satisfied with Botany Lawn, however, the number of visitors decreases whenever the daytime shifts to night due to poor facilities such as: lack of water fountains, comfortable benches, no power sockets, the insufficient lightning and no shelter to protect them from rain and sun.

Our group made an attempt at focusing on improving the poor facilities and solving the lower attendance at night. One of the main issues that we featured, abbreviated and showcased: the insufficient lighting, prevents people from staying on site as they are not able to perform much without external light sources. Due to this, we reformulated the design challenge and so, we are dedicated to delivering a coherent, cohesive and appropriate solution for Botany Lawn, one that is non-invasive, appealing and addressing the key user needs the were featured and brought out by the completion of our User Study.

Botany lawn experiences low attendance due to poor facilities on site after hours. By the use of digital technologies, we intend on reinvigorating the precinct.

PERSONAS

*We used these personas to get to this stage and it's derived from the Studio Assignment 1

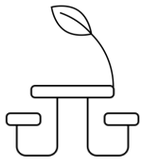
	Student	Staff	Local community	Visitor
Bio	 **Mark** Male, 24 Student Lives in Eastern Suburbs Australian	 **Irin** Female, 29 University of Sydney tutors Live in Baulkham Hills, NSW, Australian	 **Sam** Male, 33 Designer Lives in Newtown Australian	 **Jack** Male, 22 Student of University of Queensland Lives in Brisbane, Australia
Scenario	Mark studies part-time International Relations on a Master's level and works full-time in an office in the city. He rarely has time for himself and lives in an everlasting hurry. He values nature and history, although picks up on knowledge when he takes time off and travels. However, considering he doesn't have enough of either, he seeks desperately for places where he can commit to work: open, quiet spaces with a plethora of nature surrounding. He would like to see a change in his life, make it balanced and way more rewarding.	She is a 29-years old woman with great passion for communicating with friends and exercising. She lives in Northwest Sydney with her boyfriend and works as a tutor for the University of Sydney. She works throughout the week and takes short lunch breaks. It's just 3 minutes walk to Botany lawn from her office. Everyday she has lunch on a traditional bench at Botany lawn. She enjoys flowers, plants and the atmosphere at the site but she is not satisfied with the noise coming from Parramatta Rd. & mosquitos in the evening.	Sam is a designer, single, lives around the campus of the University of Sydney. Since the sports centre at the university is the closest to where he lives, he visits the campus to attend swim school once or twice a week. He likes the atmosphere of the campus, so he will take a walk at times and have a rest in several areas of the campus, especially on the weekends when campus is quieter. Also, he comes at times to the university library to read some books or finish his work in a quiet place.	Jack is an international student of University of Queensland. He is currently majoring in Master of Tourism, Hotel and Event Management. Due to professional habit he always takes breaks to travel around. During this Easter holiday he visited University of Sydney. Before he arrived, he used to hear about the campus of USYD: of how much more beautiful it is than that of UQ. Thus Jack walked around and observed but he found this university too touristy and therefore crowed. He preferred quieter, yet pleasant places around campus for taking rests.
Goals	• The feel of accomplishment • Specialising in a new field • Wishes to become an expert in current field • Having more time for himself • Combining relaxation with work	• Lunch at a quiet place • Sitting in a beautiful environment • Saving time and not moving long distances • Have a quick lunch	• Keep a balance between work and life • Lead a healthy lifestyle • Find a good place to take walks and rest • Enjoy the atmosphere of the campus	• Needs a quiet place to take rests • An area with sufficient facilities: shaded seats, water fountains, power supply • Prefers places that are entertaining in a way, refrains from dull spaces
Motivations	• Feels his work can be meaningful • Cities changing and progressing • New challenges creating opportunities	• She likes the flowers and plants • She enjoys the atmosphere at botany lawn • She prefers traditional bench seats	• Get in better shape by attending the gym • Visit the library to study and get better marks • Nourish the atmosphere of the campus	• Looking forward to taking refreshing rests • Seize the time to explore the campus • Enjoy the stay on USYD campus
Frustrations	• Working seasonally in an office imposes too much stress & health problems • Can't find a nice, quiet place in the city • Can't find relief from work • Trouble with making effective use of the time • There are no spaces that stimulate senses and the current ones have shortcomings	• She can't stay a long time at Botany lawn • Time constraints • She dislikes the Mosquitos • She is not satisfied with noise from Parramatta road	• Botany lawn is not on his regular route to the gym but he really likes the area • Can't see the cityscape from Botany Lawn • Lack of space at Fisher's Library, especially during the exam period	• Botany lawn is not easy to find • There is a limited vacancy on this site especially throughout lunchtime • The noise from off-campus street is bad • The lawn lacks entertainment facilities • No hydration, power supply on this site • No shade-providing shelter above benches

PERSONA BASED WALKTHROUGH

*We used these personas to get to this stage and it's derived from the Studio Assignment 1

	Student	Staff	Local community	Visitor
Bio	 **Mark** Male, 24 Student Lives in Eastern Suburbs Australian	 **Irin** Female, 29 University of Sydney tutors Live in Baulkham Hills, NSW, Australian	 **Sam** Male, 33 Designer Lives in Newtown Australian	 **Jack** Male, 22 Student of University of Queensland Lives in Brisbane, Australia
Scenario	Mark wakes up and starts the day by heading towards the university as his classes start on Mondays at 8 am. He finishes at 10 but he realised that it just started to rain. Today his work starts afternoon, therefore he has a bit of time to eat lunch and catch up with all the material that he had to go through. On the way from Holme Building to Eastern Avenue, he noticed that there are some leafs covering the tables on Botany Lawn, which seem to cover them well despite the weather getting worse. He picks up lunch at Taste cafe and then decides to get back to Botany Lawn, as it is one of the areas in Sydney, that he knows to provide a soothing atmosphere and where he can work efficiently, effectively and also wind down. Considering that the weather conditions are quite dire, there are not that many people at the area now, so he takes a seat under the leaf and proceeds to unpack his laptop on which he stores his work-related materials. However, his device is running out of battery. Mark notices, that the leaf includes a power plug. He checks whether it works and once confident that he'll be able to continue working without any power-related interruptions, he launches research materials and starts studying them for the following two hours. The time spent here proves beneficial, as the raindrops create an ambience of its own and benefit to the pleasant environment that Botany Lawn already provides. After two hours of productive study he travels to his workplace. Once he arrives, a meeting is called, where the research material is about to be discussed. Mark smiles, as he has just had them covered.	Irin rushes to the University, as the alarm didn't wake her up in time due to extensive marking that kept her up 'till late hours. She is teaching today from 9 to 5 and considering she might need to pick a few larger things up along the way home, she'll drive her car to the uni today. She proceeds with the normal daily schedule and after she is finished at 5, she decides to drive home and perhaps pick up the furniture she ordered a while back without the opportunity to find time to do so. While she is trying to drive out of the campus, she wanders into the dead-end road between the Quadrangle and Botany Lawn. At this point, she notices the slowly glowing leafs, that were not there before. She knows this place, as she frequently eats lunch here. She decides to park her car and investigate the new, upon which the leaf starts glowing in a slightly more dynamic and brighter colours. At this point another idea struck her mind, perhaps she could continue to do the marking here? She returns to her car, picks up the material that is yet to be marked, approaches one of the tables with a leaf providing light and takes a seat, upon which the light shifts to a natural sun-imitating colour, suitable for reading materials. She dwells for a moment, as the usual noise from Parramatta Rd. doesn't seem to bother her, as there is some ambient nature sounds in the background being played. The environment aids in putting her in the state of flow and in merely 3 hours, she manages to finish up all the remaining marking that she had scheduled and heads home at 9 pm.	Sam is heading for the Design Thinking lecture and tutorial today in the evening. He has plans to spend the following hours afterwards at the University due to an upcoming assignment that is due, unexpectedly, at 2 am the following day. After having attended the lecture and worked with his peers throughout the tutorial, during which he has learned that a few other students are about to do the same. They have learned of this one area that just became redesigned lately and so they're looking forward to working there. Sam decides to tag along with them, although after he spends time at Fisher's Library, as it is his favourite place to study. Once he reaches it, he finds the building to be at full capacity, noisy and to his disgust, even messy. At this point he decides to leave and follow his peers who have already gone to Botany Lawn. He notices that a few friends are sitting by the benches, with peculiar leafs suspended above them, lighting up the tables and introducing a welcoming ambience, prompting him to join. He joins two of his peers by one table and proceeds to work. He consults them every now and then, but the work is going well for the coming hours, as the environment is really nice and quiet with nature sounds augmenting the overall feel and immersion with the work. At some point the leaf shifted colour, some of his peers managed to send a signal from the other bench, which made Sam investigate and do the same to the other bench. After having exchanged a few light shifts, they went back to work until the preset deadline at 2 AM, when they submitted the assignments, feeling happy.	Jack is travelling to Sydney for around a week to spend his study break. He enjoys his campus but he also heard tales of how beautiful University of Sydney, therefore he decided to seize the opportunity and take the trip. Once he arrives, he notices the gorgeous Quadrangle, an iconic building that was being built for over a century. He asks some students around about it, but they don't seem to notice it or appreciate it as much as he is at the time. He takes a look inside-out, takes a spin from the sides and one of them drew his attention the most: Botany Lawn, of how secluded it feels from all the other areas encompassing the Quadrangle. It feels quite minimal, very comfortable with plenty of nature embedded, but also quite occupied as it is lunchtime. Jack decides to take a look elsewhere for sometime, exploring what the campus has to offer, popping up in random lecture rooms etc. Around 3, he decided to get back to Botany Lawn and experience this mysterious space. He takes a seat by one of the benches with the leaf installed, as it provides shade and the sun is quite strong on this day. He starts feeling bored, so he brings out his laptop to charge it and explore some stuff on the internet. Although on second thought, there are some interesting nature sounds being voices in the background, although he's unsure where they're coming from After 2 hours, he notices that the leaf has lit up: 'How cool!' - he thought out loud. After having spent some extra time, he decides to go back to where he was staying for the week in Sydney.

USER CASE SCENARIO

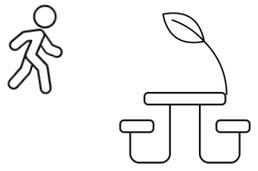


When there is nobody

LED strip lights under leaf glows slowly, progressively and regressively when nobody is in the vicinity of Botany Lawn

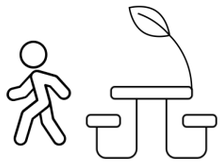
When there is a person passing by

Whenever someone passes by Science Road, a motion detection sensor connected with an Arduino sends a signal prompting the LED strip to shift its lightning patterns to a more enticing form, hastening its glowing pattern



When a person is up to 2.5 meters away from the Leaf

The ultrasonic sensor connected to the Arduino recognise their position and increases the speed of blinking LED strip lights to a form... At the same time sound will be play by Arduino and people can listen to natural sounds from Bluetooth speakers.



When the person is leaving the leaf

When a person leaving the bench (sensing area), force sensitive resistors transit by Arduino with 5 second delay to reset all actions to the empty mode for slowly blinking LED strip lights again.

When there is person sitting there

Upon a person sitting on the bench (sensing area), a force sensitive resistor will transit by Arduino to the LED strip lights strength into an appropriate luminosity level as to provide sufficient light conditions for using non-electronic devices such as reading a book and etc. Also an android device that connected to Arduino by Bluetooth will be available for changing opacity of LED strip lights and switching natural sounds that played from speakers or stop it.

INTERACTION MODES

1

Empty mode

When nobody is sitting at the table

The light glows smoothly and regularly to attract attention of anyone passing by or looking for a place to spend their time

2

Access mode

Upon approaching the leaf

The light increases its speed and brightness accordingly to how far the people are located. If the ultrasonic or motion sensors do not detect anyone, the mode remains at empty mode

3

Occupied mode

Upon sitting at the table

The light source's brightness becomes maximised and maintains its level regardless of the ultrasonic and motion sensors. The brightness may be changed and sounds activated upon downloading the app

4

Left mode

Upon leaving the table

After 5 seconds, the mode is changed to the ‘Empty mode’

FINAL CONCEPT

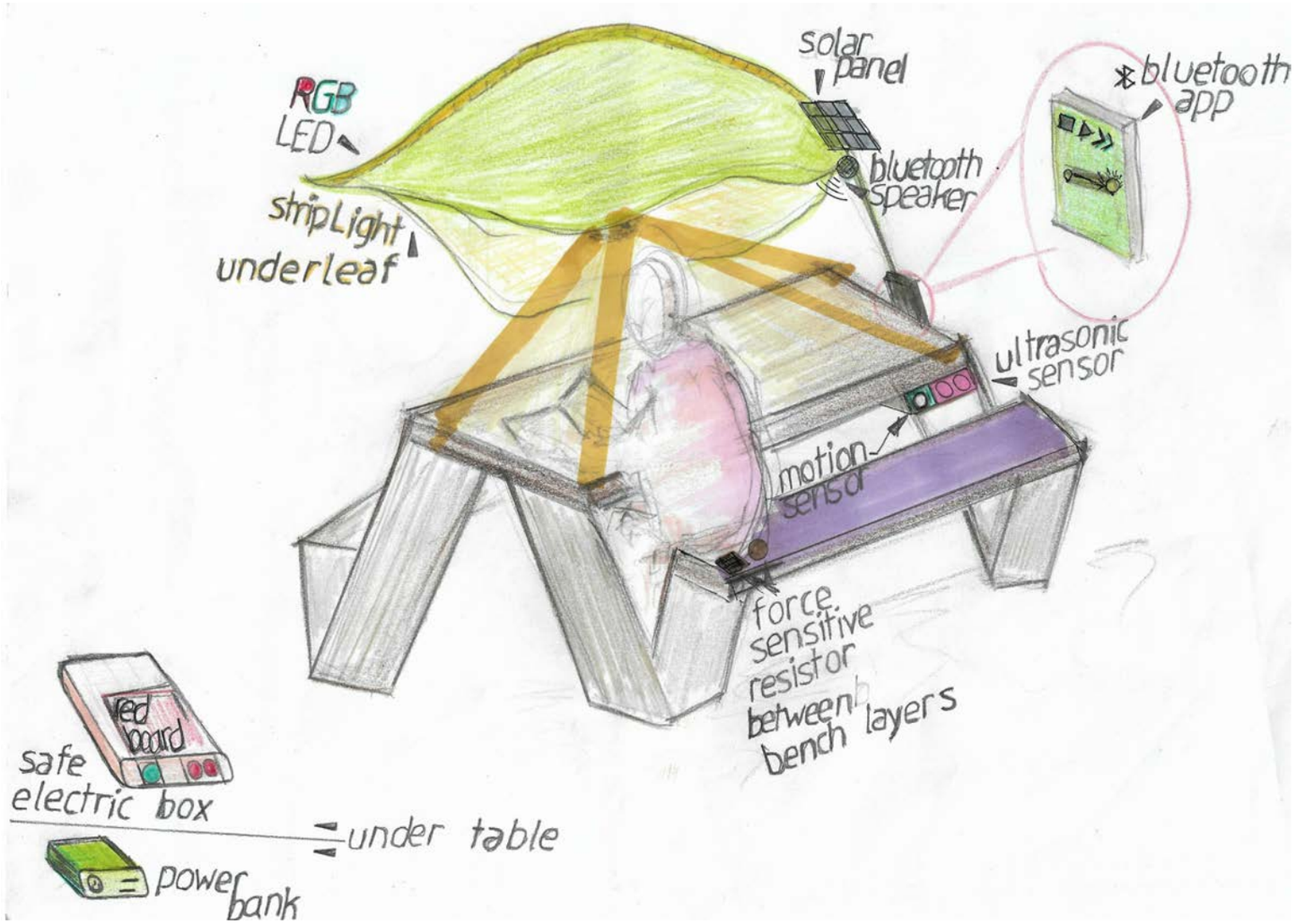
The final concept designed for Botany Lawn introduced an entirely reimagined experience constructed by following interaction design principles. The Leaf is designed to attract the attention of people passing by. Once the potential users notice our subject, they are thought to make their way towards the calmly glowing light source. Depending on the users' position and upon approach, the leaf will begin to increase its speed gradually.

It provides shelter matching the surrounding area of Botany lawn. Academic Staff and Students can spend their time wonderfully, enjoying a meal or holding conversations. However, whenever the weather goes bad, the experience loses its attractiveness. This leaf may address many user needs, it plays a role in the provision of shelter when it rains, as well as a shade during sunny days. This concept is expected to meet the user needs of a shelter during day and night, affording us to gather, learn and study.

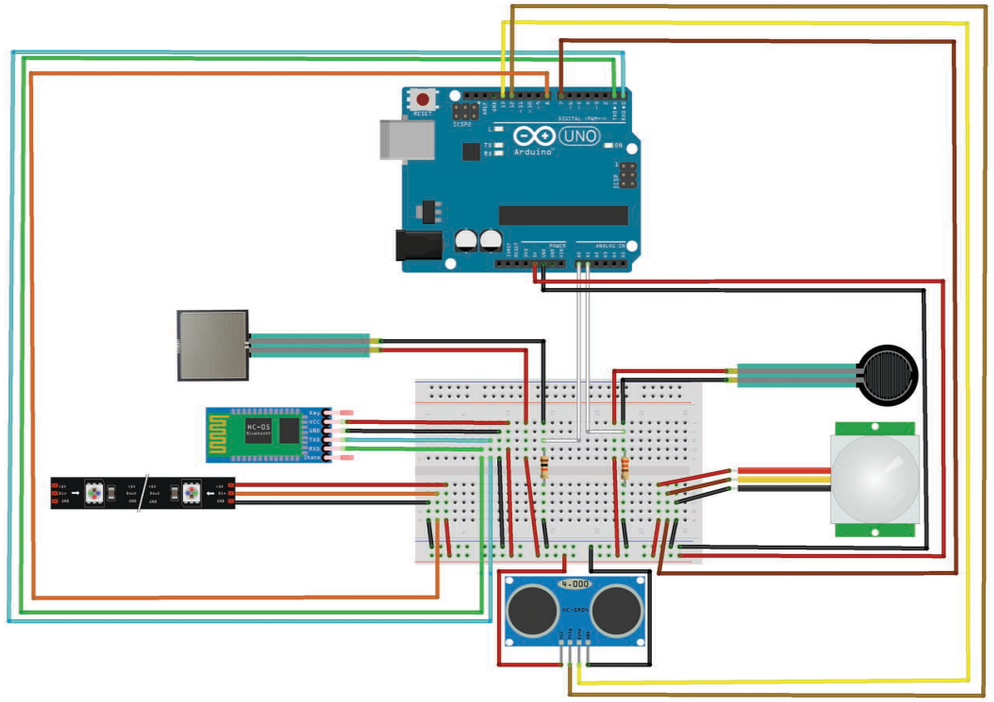
Based on our subject's curiosity and explorative needs, considering a bench affords to be sit on, we expect our potential users to take a seat and enjoy the surrounding environment.

Once they take a sit at the table, the final reaction will take place as the brightness will reach its peak. If the user is willing to change the qualities of the environment, they will be prompted by a sign to download an application by the use of which they will hear nature sounds, protecting them from the sound pollution that comes from the Parramatta road.

The application requires bluetooth connectivity and in turn provides with a variety of options to change the sounds, turn them off or change the brightness level, along with turning them off. The concept was created for the betterment of Botany Lawn identified in the research and ideation phases.



TECHNICAL COMPONENTS



Fritzing Diagram showcasing all the modules used for Arduino

Arduino Setup

- Sparkfun Redboard (KIT-13969)
- Breadboard (came with the kit)
- Ultrasonic Sensor (HC-SR04)
- Digital RGB LED Strip (WS2811) – 60 LEDs
- Cables (Possibly a lot)
- MakeBlock Bluetooth Module for mBot
- FlexiForce Pressure Sensor (ZFLEX A401-25) / (SF-SEN-11207)
- Force Sensitive Resistor (SF-SEN-09376)
- Motion Detection (PIR) Sensor (XC4444)
- USB-miniUSB (for uploading the code and powering up Arduino)

Processing Setup

- Android-based waterproof Phone (Samsung Galaxy S7)
- Processing 3.3.7
    - Permission enabled:
        - BLUETOOTH
        - BLUETOOTH_ADMIN
        - BLUETOOTH_PRIVALAGED
- Android SDK (stable version installed automatically via processing)
- USB-microUSB (for compiling, uploading, installing the Processing sketch and powering the phone)

KEY LIBRARIES

Libraries for Arduino

- Ultrasonic Sensor Library (<NewPing.h>), Arduino library search
- FastLED Library (“FastLED.h”), Arduino library search

Libraries for Processing

- Android libraries
  - Import.android.content.Intent;
  - Import.android.os.Bundle;
- Ketai Libraries
  - Import. Ketai.net.bluetooth.*;
  - Import ketai.ui*;
  - Import ketai.net.*;
- Cassette Library
  - Import cassette.audiofiles.SoundFile;

Redundant Libraries used for testing purposes

- Makeblock library (<MeMCore.h>), libraries hosted on GitHub
  - Although it might be the case that it is needed to compile the code, considering the issues with running the module anything could quite be possible
- Load Sensor Amplifier module library (“HX711.h”), libraries available on Arduino library search, although the ones used in the project were downloaded via GitHub

REFERENCES AND SOFTWARES

Reference Code Used

- Professor Takaya blinking LED code (Arduino + Android)
- IDEA 9102 Studios
    - Day 4 — Fastled LED (data cable programming)
    - Code for Lab's Assignment 1 based on code developed for Interactive Product Design Course DECO3200 (keto project)
    - Arduino: originally Bluetooth logic, highly optimized in Assessment 1
    - Processing Application: primarily used the Bluetooth logic, counter system and syntax referencing, highly optimized in Assessment 1
- Kfrajer's solution with case breaks to play music via Cassette library
- Force Sensitive Resistor Hookup Guide on sparkfun
- Minor fixes sought out on Arduino, Processing, Stackoverflow discussion boards

Software Used

- Arduino 1.8.5
- Processing 3.3.7
- Apple Keynote
- Adobe Photoshop CC 2018
- Adobe Illustrator CC 2018
- Adobe Premiere CC 2018
- Adobe After Effects CC 2018
- Adobe XD CC 2018
- Microsoft Word via Office 365
- Visual Studio 2017
- Sketch app
- Audacity

Additional Hardware

- Powerbank
- Isolation Tape
- Atlasssian Bluetooth Speaker
- Potentially a waterproof version needed
- Phone Holder

Overview

In order to visualise how Leaf would conceptually look like in real life, we looked into developing an environment for the purpose of running it in Virtual Reality on Google Cardboard. Eventually, considering the scale of the project, we decided to put the project to a halt with potential to pursue it further at a later stage.

Software

- Unity3D 2018.1
- Adobe Photoshop CC 2018

Future Components and Techniques considered:

- 3DS Max
- Rhino 5
- Photogrammetry workflow for Unity
- Adobe Illustrator
- Visual Studio
- Javascript (& C#)

Rationale

A virtual version could have aided us in seeing the affordances of the area as well as how would the Leaf present itself in consideration of the environment.

Furthermore, it would have opened up the possibility to user-test our concept with participants who would have not been able to reach us throughout the scheduled times for user-testing.

Notwithstanding, the project could also provide with the possibility to experience, explore and expand our idea even after the scheduled presentation took place, along with many experimental functionalities that we have conceptualised at development stages.

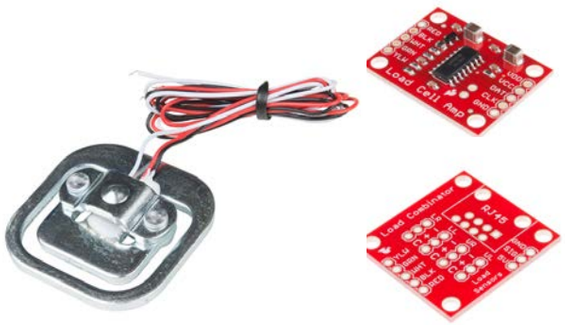
Screenshot taken during the environment development

4 Stages of rendered environmental evolution visualised

Physical Presence

TRIED

Load Cells

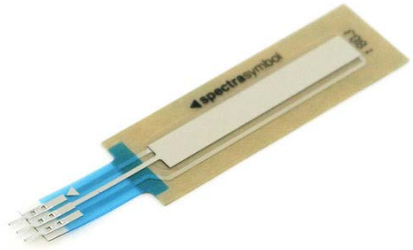


+ Already in possession of (attempted scale)
+ Great measuring capacity (up to 200 kg!)

- Extremely volatile and difficult to run
- Engineered to cover a relatively small area
- Very susceptible to aberrations if fiddled with

TRIED

Softpot Potentiometer



+ Already in possession of (SparkFun kit)
+ Great for early prototyping purposes
+ Access to a number of these modules

- Highly inaccurate readings
- The values may be maximise easily

SELECTED

Pressure Sensors

+ Decent Potential Capacity (of up to 10kg)
+ In theory, highly accurate readings
+ Very easy to setup and ready to use

- 10 kg limits potential functionalities
- Relatively expensive

Light

TRIED

RGB LED

+ Many available with our Sparkfun kits
+ Very easy to use and program

- Extremely difficult to map a number of them
- Potentially requires a very elaborate setup inclusive of wires and isolation (fragile!)

CONSIDERED

NeoPixel Ring WS2812

+ Provides highly accurate, directional light
+ Potentially easy assembly and use

- Relatively expensive
- May not fit the structure of our leaf well

SELECTED

WS2811 Digital RGB LED Strip

+ Provided to us during our course
+ Ample brightness provided by 60 LEDs
+ Waterproof!
+ Already have a functional code working

- May require an additional power source

Charging

TRIED
Computer via USB

+ Cables of varying lengths available
+ Affords to reprogram Arduino if need be

- May reduce the project's fidelity outlook

CONSIDERED
Battery Pack

+ Very easily replaceable if need be
+ May be used in parallel to USB charging

- Limited capacity (~1.5h for 8.4V, 200mA)
- Short-circuiting may drain its power entirely, prompting us to change the battery

CONSIDERED
Solar Panels*

+ The project becomes self-sufficient
+ Versatile, may charge a powerbank charging the Arduino, an ecosystem

- Very Expensive
- Will not work between dusk 'till dawn
- Its effectiveness remains theoretical

SELECTED
Powerbank

+ Quite reliable, great power capacity
+ Relatively small size and waterproof
+ We are in possession of a few models

- May fail to deliver power at times

User Control

TRIED
Physical Buttons

+ Many are available in our Sparkfun kits
+ Tangible objects are fun to fiddle with

- Involves a very messy cabling system
- Can be very easily harmed and damaged

CONSIDERED
Indirect User Control

+ Controlling the installation via OpenCV, Kinect or sensors elicit playfulness
+ A myriad of functionalities may be featured

- May require an additional power source, equipment and elaborate coding

SELECTED
Smartphone App

+ Anyone could download and install an app
+ Can modify anything seamlessly
+ Users unlikely to harm their devices

- Requires a great amount of coding
- May require instructions for users
- Potentially very difficult to implement

Environmental Monitoring

SELECTED

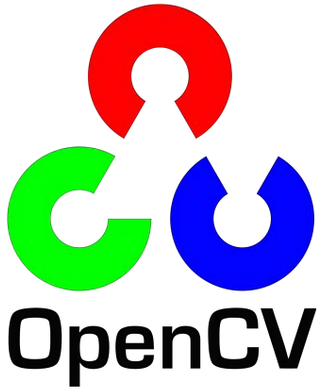
Ultrasonic Sensor

+ Low–cost and relatively effective
+ More effective models may be acquired

– Insufficient range of up to 2.5m
– Highly erratic readings between 1.5–2m
– Picks up phantom objects in distance

TRIED

OpenCV



+ Very promising software capabilities
+ Could run on anything that has a camera
+ Potentially a substantial range (10m?)

– Requires a camera, likely a laptop
– Camera noise in low–light is an issue

CONSIDERED

Kinect

+ Superior and detailed range (5m)
+ Introduces a number of possibilities

– Very Expensive, limited availability
– Requires new libraries to be learned
– Requires an external power source!

SELECTED

PIR (motion sensor)

+ Incredibly easy to use
+ Surprising range of 3–4/6–7m
+ Quite cheap and ubiquitously utilised

– Tweaking it may be an issue
– Infrared from sun affecting the device

Smart Palm

The ‘smart palm’ has been designed and developed for public beaches in Dubai, United Arab Emirates. Trees are self–sustainable by the use of solar panels embedded within the palm leaves, supporting the highly sought for shaded seating. The palms entail a variety of functions such as: a digital outdoor touch screen, battery recharging power outlet, wifi, LED lights.

The smart palm consists of seven futures:

- 1 – WiFi hotspot to provide internet access
- 2 – 360–degrees infrared CCTV camera and an emergency button
- 3 – The solar panels are specifically made to fit the shape of its leaves
- 4 – a touch screen controller and a mobile application providing information
- 5 – The digital outdoor screen for public information messages and government notices
- 6 – Relaxation points and power sockets
- 7 – Fully functional during the night as the technology is self–sustainable by the use of solar panels and green–light emitting LEDs

Development process

DEVELOPMENT PROCESS OVERVIEW

1 Ideation

Select the site and define the problem statement
Physical prototyping
Bodystorming

2 Conceptualisation

Persona based walkthrough
User case scenarios
Precedent studies
Technology overview

3 Define interactions

Bodystorming
Define 4 interactions modes based on the user case scenarios
Explore how they can be implemented in the development process

4 Technical prototyping

Test different technological components
Select the final components set
Programming based on Arduino and Processing

5 User testing

User test planning
Sound preference test
User testing 1
User testing 2
Data analysis

6 Iterations

8 different versions of prototyping
Consistent improving based on user testing feedbacks

7 Finalise the prototype

Tuning and Refinement
Cleaning the code
Final testing conducted by SuperB

8 Define future works

Technical research for the feasibility

Develop future works ideas from insights we gathered from the entire process

BODY STORMING

Overview

We have imbued bodystorming into our design process. These sessions were performed either to test specific features or the overall experience delivery by the use of our prototype at a variety of stages, ranging from lo–fi to hi–fi, but also in the different settings of time and environment altogether

1 Two students sit at a table with the leaf suspended above them, providing them with personal space and a better learning environment

2 One person grabs the controller and interacts with the light or sound provided by the leaf. He taps the slider to adjust the present experience

3 One person is attracted by the nature sounds and in turn takes a seat underneath. She grabs the controller to play with the sound

4 The leaf is suspended above the table, one person decides to sit there as it provides her with sufficient lightning conditions

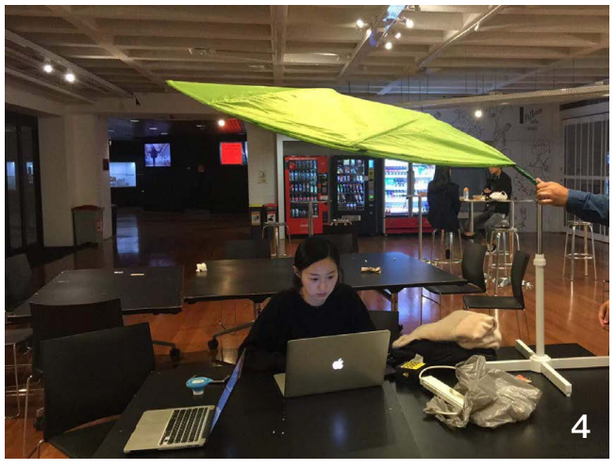
5 A group of students are sitting in a row in a classroom. After a while they begin to discuss.

6 Everyone subconsciously gathers at the table which is equipped with the leaf as compared to other tables due to its affordances


1


2


3


4


5


6

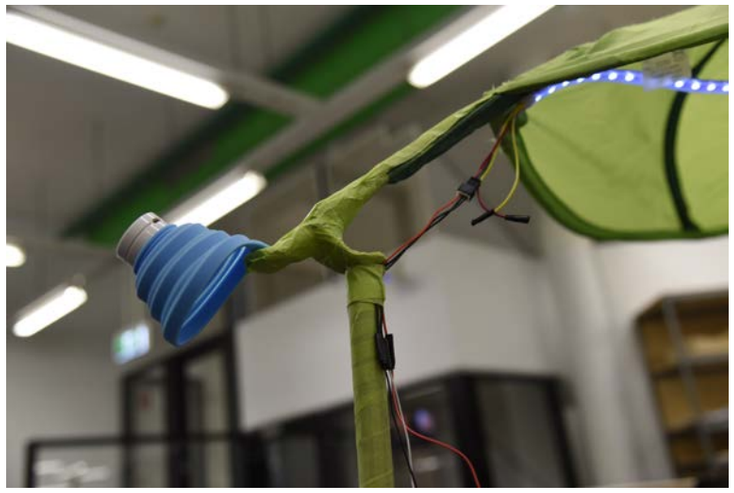
Leaf

User testing 1 | User testing 2

Phase 1 | **Phase 2** | **Phase 3**

Initially, the leaf was an installation that provided lightning and sound. The leaf detected users sitting on the bench and so the light turned on as they commenced to take a seat.

It also provided sounds such as waves, wind and birds singing, that prevented the exterior noise from coming in. This concept was expected to increase the attendance of Botany lawn at night.



After the initial physical installation, we have primarily altered some features of the leaf's features such as wrapping and covering the pole with green tape to harmonise and correspond with its natural environment.

In addition, we have changed the base from plastic to wood to increase the leaf's stability and resistance against windy condition.

Furthermore, we appropriated Tupperware in order to secure our electrical components.

After having iterated our second physical installation, we changed our previous wrapping tape with another one, due to reinforcing its waterproofness, including shielding our electrical wires. Afterwards, we found out our wooden base that we have used in our second iteration wasn't fit for bench, so we changed its size.

After having analysed our user testing findings, we found out the blinking Arduino lights on the Redboard distract our users and might suggest danger. Due to that finding, we plan on covering it with green waterproof tape, in coherence with the rest of our of Leaf's outlook.

Light

User testing 1 | User testing 2

Phase 1 | **Phase 2** | **Phase 3**

Based on the user needs we researched and analysed, we found the biggest pain point is that users are in need of a condition with lighting for studying or working after hours. Thus the most significant feature of the leaf is proving light at night for users.

For the initial prototype the lighting can work in two ways, i.e. in the case of zero attendance the light keep flickering to attract passersby; once someone sit on the bench the light stop flashing and consistently lighting up.

In the first user testing the LED strip does not work well as it keeps flickering all the time even when users sit down on the bench. In addition, it does not respond to users control sometimes and can not be turned off. The light brightness is insufficient for users studying at night as well.

After analysing the users feedback we iterate the prototype further. Firstly we make it efficiently responsive. Secondly we refine the app UI to make the controller user-friendly. Lastly we maximise the light brightness to meet users needs of study.

After iteration we test users with our final hi-fi prototype. The LED could work much better than last time. The LED could respond with user's control efficiently and properly, i.e. when users slide the leaf icon left, the light turn down while icon goes right the light turn up. As long as users sit right on the pressure sensor the lighting could stay stable and work well.

Once users stand up the pressure sensor would stop work and the light flickering start over.

Sound

User testing 1 | User testing 2

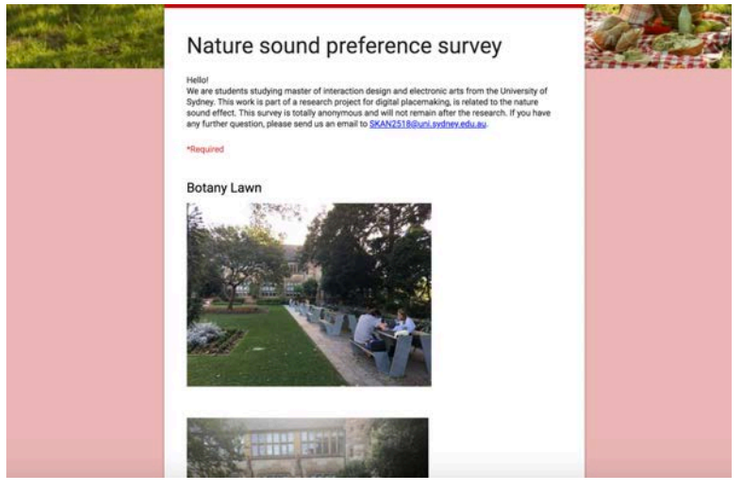
Phase 1

We found several issues based on the user-testing research that we have conducted at the early stages of our project.

One common issue is the noise coming from neighbouring Parramatta Rd that keeps interfering with the generally soothing experience the environment provides its users with, especially when they're dedicated to studying.

Thus we concluded that the users are in need of reducing the overall noise impact. In addition, we did research on sound effects related to humans psychology and found that nature sounds help people relax. In this case we came up with an idea that provides its users with nature sounds that could potentially enhance their experience on site.

Phase 2



We managed to find several samples of nature sounds and trimmed each sound to fit the appropriate size of no larger than 10 MB.

After the initial selection we designated a variety of nature sound effects ranging from bird whistling to ocean waves. Nevertheless, we cannot provide options to our users without understanding their preferences.

Therefore, after the nature sound preference online test was conducted, we decided on three nature sound files, i.e. forest sound, rain drops and creek with cicadas.

We have included these audio files within our application to be played with by our users.

Phase 3

In terms of the physical installation we installed a speaker on top of the leaf rod and connected it via bluetooth. During our initial user testing session, the sound effect was criticised on its low volume and unchangeable recurring mode.

Based on the users' feedback we refined the prototype to set its proper volume and add a turning on/off button. After our last user testing session, we received overwhelmingly positive comments on the sound feature, yet still with a few issues remaining.

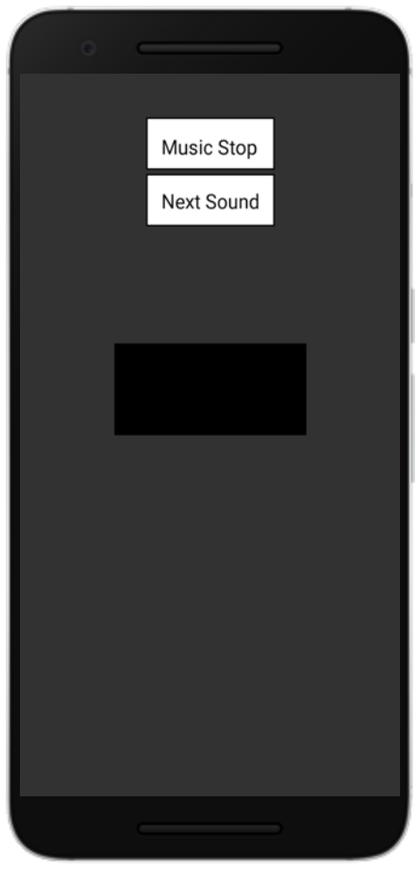
Afterwards, we iterated this set of features, simplifying the User Interface including the on/off button, although we were not able to program volume control due to library restrictions.

User Interface

User testing 1

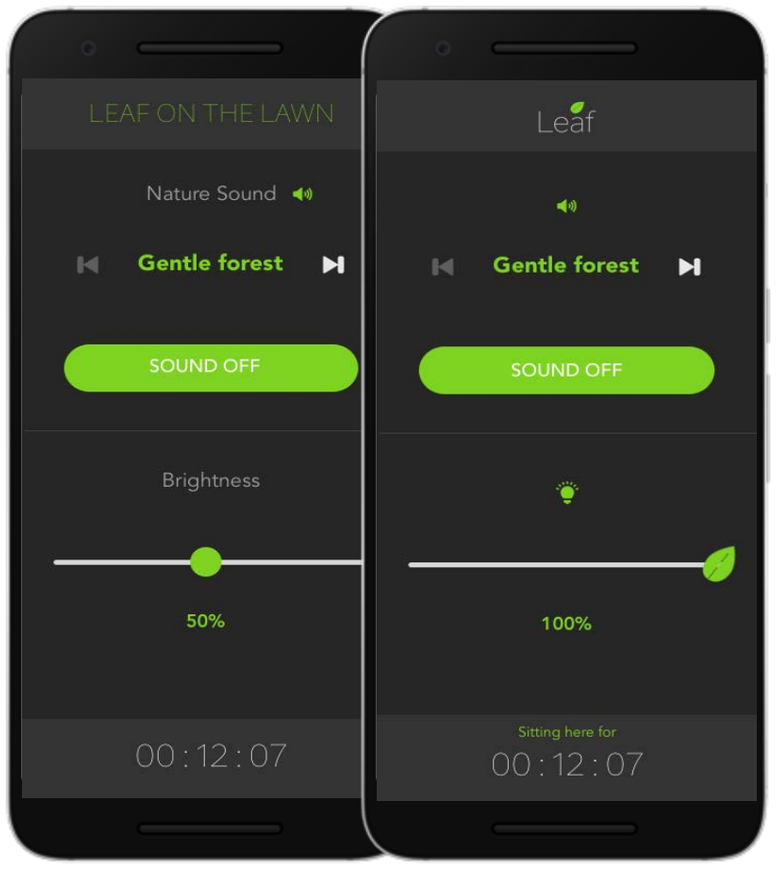
User testing 2

Phase 1



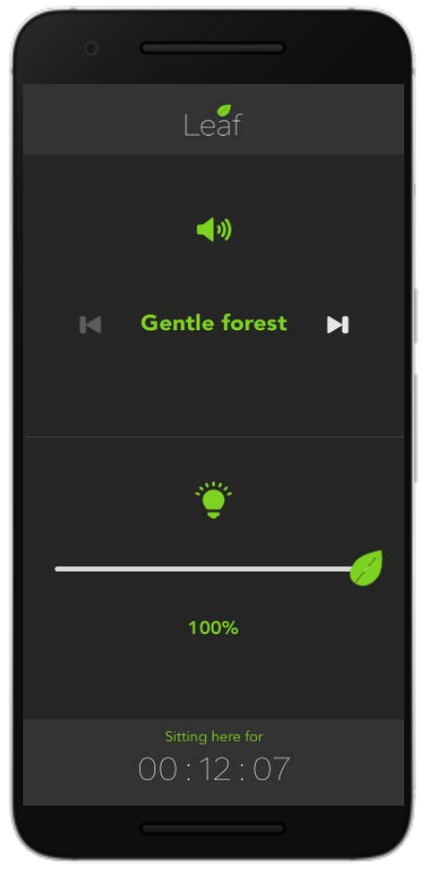
Our initial application was literally just a skeleton, a technical implementation with the sole purpose of testing out specific features and communication. It provided a very basic user interface. The white box in the middle was a slider, controlling the level of the brightness and the next button was intended for skipping sounds from one to the next

Phase 2



After our first user testing, we gathered feedback in relation to the interface part. Most users did not realise that they could control the light.
Our users stressed on the need to have control over sound in case they do not want to listen to it anymore. We designed our first user interface with the sound off button, the next sound icon, and the brightness controller with animation on the light icon
Also we changed our brightness controller to the leaf

Phase 3



During our second user testing we did not receive much of the negative feedback provided previously. Although, we found more ways to improve our app by observing user behaviour. Most of users clicked the speaker icon first rather than touch the sound off button. User said it is more natural to use icons, so we removed the button and provide icons to control the sound instead. Based on the references(Smashing Magazine, 2018), we increased the size of the icon more mobile-friendly

Hi-fi Prototype User Testing

SUMMARY OF USER RESEARCH

3

Phases of User testings

- Sound preference test
- User testing 1
- User testing 2

12

Participants

- 11 Students, including 2 Graduates of University of Sydney
- 4 Students researched before establishing the methodology

5

Methodologies

- Pre–study questionnaire
- Think–aloud
- Contextual interview
- Post–study interview
- Semi–structured interview

User Testing 1

Overview

Due to a wedding taking place at Botany Lawn, we were not able to conduct our user-testing on site at this time. In such case we sought alternatives.

Benches outside Wilkinson were a relative fit in consideration of the traffic outside and appropriate benches located on site.

We took the participants to Botany Lawn for them to fill the pre-questionnaire and then did the rest of the testing outside Wilkinson.

Procedure

- Pre-study questionnaire with Google form
- Think aloud
- Concurrent Probing
- Semi-structured interviews for each components
- Post-study interview
- Data analysis

Methodology

- Interviewed 5 people
- Audio recorded
- Video recorded
- Took pictures
- 360 recorded
- Observations recorded

User testing with control group nr. 1
https://1drv.ms/v/s!AsODPaqszcFrk18PzSgxJFO1stnV

User Testing with control group nr. 2
https://1drv.ms/v/s!AsODPaqszcFrk1eMrYc2XM54sQyM

USER TESTING 1

	Leaf	Light	Sound	Controller
Positive	• helpful in summer for the shades it provide • fits very well with nature environment	• attract people • light interaction is welcoming	• provide peaceful atmosphere • kind of block outside noise	• N/A
Negative	• blown away if too windy • not big enough to keep out of the rain	• the flash is a bit annoying • insufficient light for physical writing • prefer no blinking when working • prefer to remove blinking • light attract mosquitoes	• not in need if study • like background noise, can't be recognised • volume is too low • too much sound is a bit distracting • sound interaction is not noticeable	• button is dumb • not user-friendly • have difficulty to understand the controller interface • music control is not good
Suggestion	• wider or bigger • better if it's like a wing of butterfly • enable users to change the size • make it foldable • protect the device when rains • provide power supply for user's longer stay • provide electronic mosquito killer	• make it constant • put in maximum light level • prefer to change light colour • interact with lighting by waving arms	• randomly play the sound in a circle • pause between sounds • play user's own music on phone	• have some icons or indicators • not indicated of the button for volume • have a thumbnail • change light colour out of visit purpose • different buttons with different colours • have sound button to turn off • a control to stop blinking • add button to fold the leaf • add a button for party mode • connect users' own device with controller to play podcast or music

KEY FINDINGS OF USER TESTING 1

ISSUES

- After user sitting on the bench the pressure sensor did not work well which result in LED strip consistently flickering
- The lighting is not bright enough for the use of studying/working
- The motion sensor & ultrasonic sensor did not work well which result in poor light and sound interaction
- When user approach the leaf the nature sound volume is too low to be recognised
- After sitting at the table user are distracted by the sound while studying
- The controller is not eye-catching enough so that users did not notice it at first
- Users are confused about how to interact with the app interface and change the light/ sound via the app
- The leaf is not big enough to cover more than two people

FEEDBACKS

- Users said the consistently flickering is annoying and prefer no flickering when they study
- They said the lighting is insufficient for their physical writing and suggest to maximise the brightness
- Some users prefer the light colour to be changeable while others want to add other way to interact with light, e.g. waving hands
- Users said while studying they do not need sound which is distracting, in addition the sound volume is too low
- Some user suggest to have an option to turn on/off the nature sound, some other suggest to play their own music
- They said it is difficult to understand the app interface and suggest to add indicators on the interface
- They feel the leaf is useful in sunny days and it goes well with environment
- Users suggest to make the leaf bigger and have power supply

INSIGHTS

- In the user test for lo-fi prototype the negative comments are much more than positive ones
- Users' biggest pain point is about the app interface which is tricky to make sense of
- We find three main aspects of the prototype to be iterated: sound on/off, light blinking, app interface
- The current prototype seems more playful than for study use
- Based on the follow-up analysis we would refine the app interface by adding indicators to make it user-friendly; adding a button to turn on/off the nature sound; enabling user to stop light flickering
- Some of the users suggestions are not feasible but could work as future work, e.g. enlarge the leaf size and make it foldable; providing power supply; get rid of mosquitoes

User Testing 2

Overview

At the second user testing, we finally conducted on-site user testing with the improved Pre-beta version of our prototype. As opposed to the previous user testing, we tried not to lead our users to use specific part of our prototype but let them to be free to play with it. To compare the data with the previous user testing, we mainly use same questionnaire but added more questions to validate our iterations at this time.

Procedure

- Pre-study questionnaire with Google form
- Think aloud for 5 mins
- Concurrent Probing
- Contextual interview
- Post-study interview
- Data analysis

Methodology

- Interviewed 7 people
- Audio recorded
- Video recorded
- Took pictures
- 360 recorded
- Observations recorded

User-testing with one participant
https://1drv.ms/v/s!AsODPaqszcFrlHiboU02ie9Ur24R

User-testing with a group of participants
https://1drv.ms/v/s!AsODPaqszcFrlHyvKryMtfVMqkO7

USER TESTING 2

	Leaf	Light	Sound	Controller
Positive	• in line with the nature environment • give a feeling of combination of nature and technology • better than sitting on other tables • it can get out the rain • leaf is useful when it's sunny • make me feel invited	• brightness is attractive • light solve the problem of darkness • give an opportunity to stay longer at night	• sound does not distract others and relaxing	• nice to have a control the light and sound • fun to explore it • simple to understand • the default is the centre of the control bar • it's nice to give users a control • the interface is quite straightforward
Negative	• leaf get too close to tall users	• the flickering is like warning • dislike blueish tone of light • consistently flickering is a bit annoying • users confuse about the flickering when approach	• the volume of rain sound is higher than the bird sound • sound doesn't work because noise outside is still loud	• N/A
Suggestion	• increase the leaf length • make the leaf bigger • make it more stable in case of strong wind • provide a power supply	• add more LED strips	• prefer a choice of putting more sound • better to have same volume of all sound	• have a mute symbol or change the icon colour • prefer a control bar to change the volume

KEY FINDINGS OF USER TESTING 2

ISSUES

- The LED strip cannot work well sometimes which result in consistently flickering
- The nature sound volume is not loud enough to cover the noise from Parramatta Rd
- User keep listening to the rain sound because the other sound volume is too low to clearly hear
- There are only two nature sound options for users to choose
- The leaf is too short for some tall users

FEEDBACKS

- The lighting is helpful for users stay longer at night so it solve the problem of darkness
- User feel the light flickering is annoying while sitting underneath the leaf and dislike its blueish tone
- Some users think the sound does not help for they still hear outside noise
- They suggest to set the sound volume at same level
- Some prefer to have more nature sound options
- The app interface is straightforward and simple to understand
- Users feel fun to explore the app but suggest adding a control bar to adjust the volume
- The aesthetic appeal of the leaf works well for it goes well with environment

INSIGHTS

- In the test for hi-fi prototype the positive comments exceed the negative ones
- What users appreciate the most is the app's UI which used to be the biggest issue of lo-fi prototype, in this user test it gains no negative feedback at all
- Based on key findings of user test we would iterate it further by setting the sound volume in same level; adding more nature sound options
- Some of the users suggestion are not feasible but could evolve as future work, e.g. providing a volume slider on app interface; increasing the leaf's height; adding more LED strips

Iterations

‘Question!’

Overview

The primary idea behind ‘Question’ is to collect feedback in a nonthreatening, approachable way out in the open by utilising natural curiosity elicited by people passing by a specific area of interest.' – Assessment 1

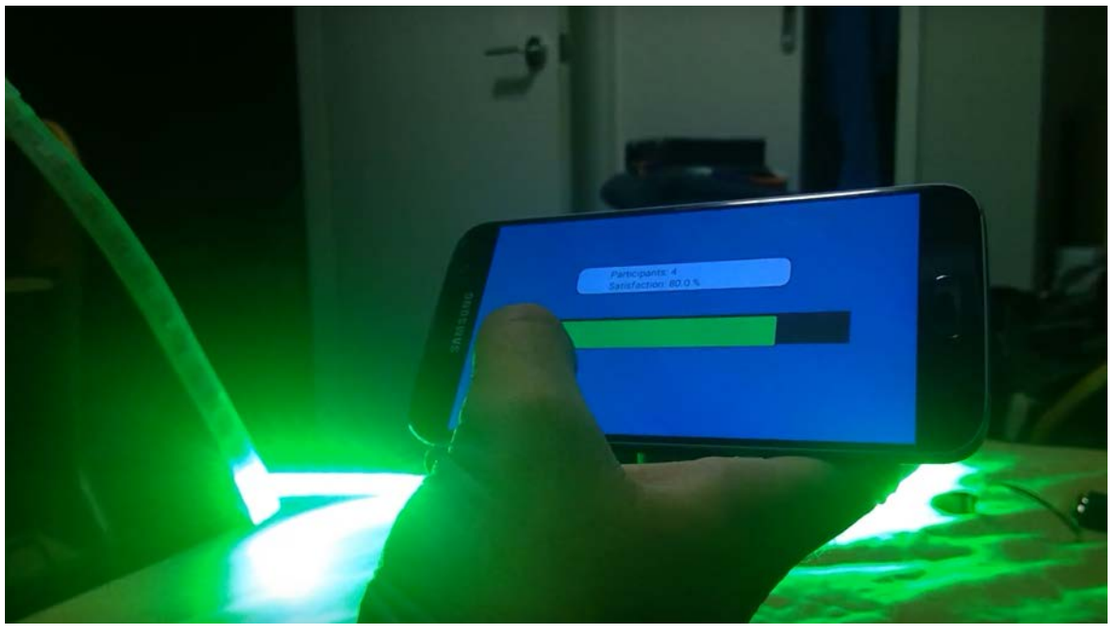
Components

- Sparkfun RedBoard (KIT-13969)
- Breadboard
- 8.4V Battery
- Ultrasonic Sensor (HC-SR04)
- RGB LED
- Digital RGB LED Strip (WS2811) - 60 LEDs
- 17 Arduino single pin cables
- MakeBlock Bluetooth Module for mBot
- USB-miniUSB (only for uploading Arduino code)
- Android-based Smartphone (Samsung Galaxy S7)
- USB-microUSB (only to upload Processing sketch)

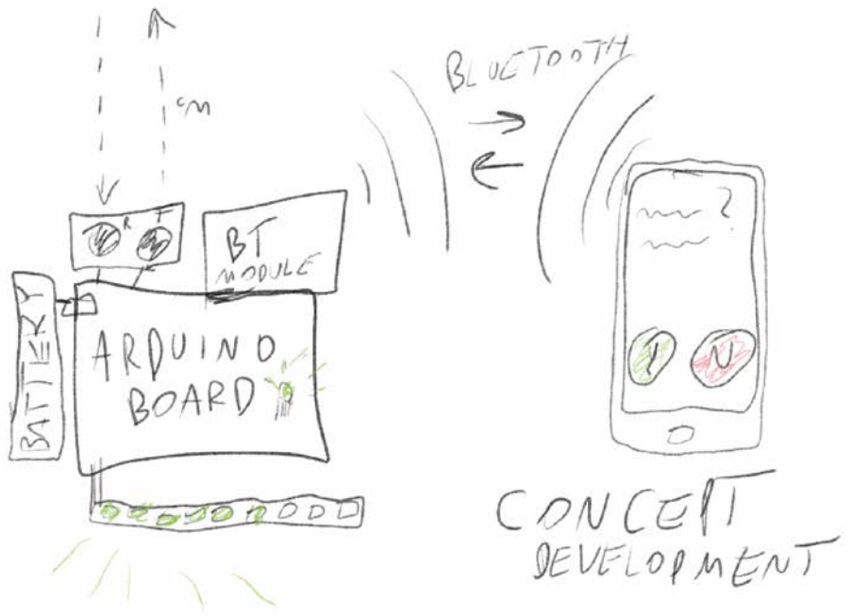
Rationale

The project was used as a base due to its advanced functionalities implemented in conjunction with its bluetooth, ultrasonic sensor and LED Strip modules.
Full 'Question!' documentation can be found here:

https://1drv.ms/u/s!AsODPaqszcFrlRY_4OMQyQmvx5jV



Final videos showcasing the 'Question!' project https://www.youtube.com/watch?v=VagJD-xlfhI



Bluetooth logic overview from 'Question!'

Planning and user control

Overview

We had to overcome several issues that were still bound with 'Question!' and explore new functionalities.

We agreed on following an idea of a responsive leaf and to execute the idea we decided to introduce glow effects. The logic involved implementing a nested for loop: one for increasing the brightness value and another to update each of the LEDs in the strip.

Cascading conditional statements were implemented and an eerie behaviour of colours shifting towards shades of gold discovered once larger brightness levels were fed to the LED Strip, which kept freezing up our code execution. Capping the values at 127 alleviated the issue.

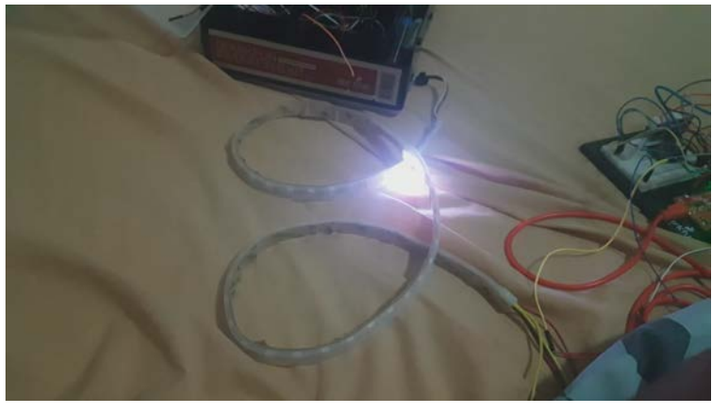
21 April

Video depicting an example lightning control feature
https://1drv.ms/v/s!Aql17gtc_ND8hNsNFQ2h_aaueeaniA

Changes

- Users may need to feel having influence over their surrounding environment, therefore the ability to introduce, change or turn off sounds was implemented
- Control over the light's colour and brightness was featured by the use of a potentiometer and 4 buttons
- We shifted from having buttons and a potentiometer towards an app controlling key features of the Leaf

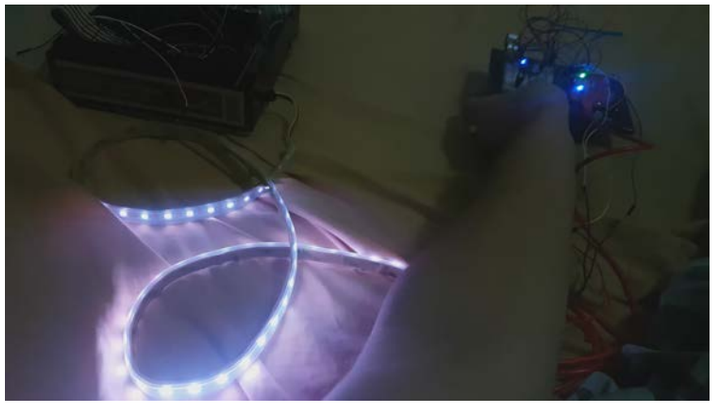
3 May



Progressive gradational glow effect test for each LED
https://1drv.ms/v/s!Aql17gtc_ND8hOB6l1FgjKBTjYTGAQ

Problems

- Bluetooth communication occurring only via Strings, heavily limits our conceptual design
- Eerie values produced by Bluetooth
- Negative values being showcased in Arduino
- Ultrasonic Sensor won't work independently from the Bluetooth module



Testing the glow effects relative to sensors' readings
https://1drv.ms/v/s!Aql17gtc_ND8hOB5Rcvse39gcyMcSg

Solutions

- Trimming Strings, parsing integers and Bytes works, parsing Bytes from floats directly will work as well
- Received data has to be read as Chars in Arduino
- Capped the broadcasted values of up to max 127
- Decrease the number of loops for the glow effect to take place (could be a library-related issue)

Arduino & App Development Process

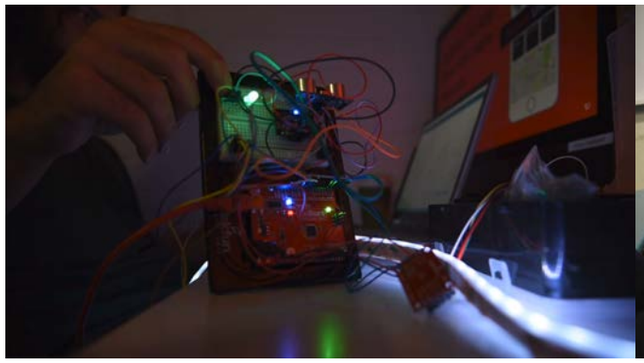
Overview

In order to make the occupied mode feasible, we decided to introduce load cells into our project. We have worked simultaneously to tweak the glow effect, ultrasonic sensor readings and make an attempt at getting the load sensors functional along with driving further developments and tweaks related directly to the handheld application.

The app was based on the logics of 'Question!' and further developed to increase its functionality. The main issue revolved around finding a working sound library for Android, Cassette was only one that worked.

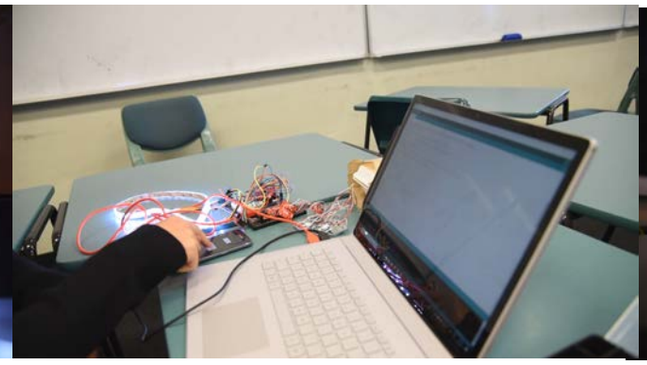
During the Interim presentation we have showcased the key components & developments of our project, and demonstrated a nearly fully functioning MVP prototype. In parts, the presentation utilised wizard of oz technique, for instance to demonstrate occupied mode.

Morning
4 May



Tests of the glow effects and code debugging
https://goo.gl/JwViLZ

Afternoon
4 May



Demonstration of our MVP and power shortages
https://goo.gl/QJqyCV
https://goo.gl/Ca7oCM

Evening
4 May

Group meeting excerpts at Wilkinson
https://goo.gl/YKBHFy

Changes

- Bluetooth functionality utilised in an pilot App
- 4 Load Cells system introduced into our project
- Gradational brightness changes with a slider UI
- Playing & skipping songs functionality implemented
- Certain nature sounds extracted from a video game
- Smoothed out and differentiated glowing patterns
- Posted an issue thread on github relating to Cassette library sound loop freezing up: https://github.com/shlomihod/cassette/issues/2

Problems

- In order to play sounds, we need an MP3 Shield that takes most of Arduino's digital pins, requiring us to divert additional resources for the acquisition of new components, complicating our project
- Syntax differences between Arduino and Processing
- Load Sensors keep refusing to work (fix pending)
- Processing sound libraries do not work on Android: including Minim, Processing.sound & Apwidgets
- Cassette library stops working after 14 loops
- Duplicating Values being queued via Bluetooth
- Glowing patterns too fast and erratic
- Detailed overview of the technical part still unclear

Solutions

- Play the music via an app and provide the user the option to use it by themselves as a remote control for adjusting the light's brightness, choose particular songs or turn them off altogether
- Easily fixable: eg. null in Arduino is called NULL
- Cassette library works on Android, allowing us to feature core sound functionalities
- Delayed function execution (20ms) & data gating method implemented into the Processing application
- Implementing delays prolongs the glow duration
- Brainstormed and discussed potential solutions in relation to how we see the final concept

Load Cells, Feedback, Full Glow, Softpot

Overview

As the load sensors did not work, an approach to resolder each of the components was undertaken. In parallel, the leaf was being assembled based on a mixture of household items such as a fan stand. Unfortunately, the load sensors would still remain inoperable, therefore a second resoldering session was scheduled. In addition, we have tested how potential users feel about the leaf overall. Once resoldering of the load cells was completed, we looked into testing each of the modules with a multimeter. We have discovered that the connectivity was in order, however the cells would still refuse to work. Furthermore, a few cables have snapped in the process.

We looked into introducing a full glow functionality, as the previous states did not feel seamless. We have consulted our tutors in relation to the sounds and the leaf itself. Upon feedback received, we have further shaped a methodology to research nature sounds.

Eventually, we decided to seek alternatives such as pressure sensors. A softpot module was utilised, once the functionalities were implemented, we have showcased our core functionalities to some of our peers in order to receive additional feedback to iterate upon.

9 May

Resoldering load cells and gathering feedback

https://goo.gl/8udT7P

https://goo.gl/6u7tW6

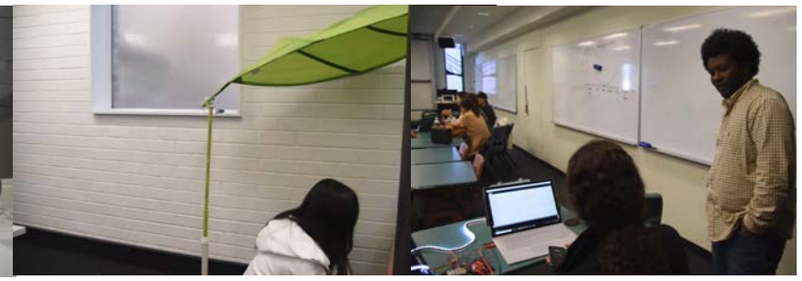
10 May

Resoldering load cells and its debugging process

https://goo.gl/bPHSn5

https://goo.gl/m2AotG

11 May



Seeking feedback from a variety of stakeholders

https://goo.gl/uxi4uq

https://goo.gl/Ss7By4

Changes

- Entirely resoldered the load sensors at DMAF
- Built the structural part of the Leaf
- Pre-tested the Leaf with our target user group
- Purchased a Multimeter from Jaycar and tested the Load Sensors' connectivity
- Installed a softpot mimicking pressure sensors

Problems

- The load sensors remain nonoperational due to issues currently beyond our understanding
- Half glows are not seen as seamless, therefore the logical structure will need to be recoded
- Softpot module is unreliable and very peevish
- Some sounds may be irritating, such as bird sounds and they may not alleviate the traffic sounds at all

Solutions

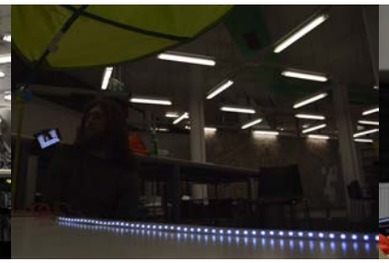
- Resoldering the Load Sensors entirely, purchasing and testing them with a multimeter to test the modules one by one and drill down on the issues or Ordering Pressure Sensors instead and trying a softpot to test the logic implemented in Arduino
- Introducing a combination of Increasing and decreasing logical loop achieves full glowing patterns
- Scheduled to borrow a flexi-pressure from Mik and potentially order an additional pressure sensor
- Test a selection of sounds with our potential users

Pressure Sensors, PIR, Code Optimisation

Overview

We worked on programming and launching the flexi-pressure sensor in parallel to developing the nature sounds questionnaire. In addition, we have tested a number of nature sounds and music genres including: Rap/Hip-Hop, Ambient Electronic and Grunge to test its effect on the environment and whether it alleviates traffic noise. The final results were mixed, although quite promising.
We moved forward with appropriating the Tupperware box in order to fix the ultrasonic and the PIR sensors within. By the use of a hacksaw and a variety of drills we managed to appropriate and build features stabilising our structure such as a wooden base. We have encoded the PIR and after assembling the box, we have secured the key components within and in proximity to the Leaf.
At this stage we worked on finishing the methodology and resolving issues revolving around the reactive behaviour. We received help with structuring the Arduino code and afterwards we coded a functional breaking logic if someone was detected during the idle loop glow. We have also scheduled the user testing and invited a few participants at this stage.

14 May



Testing the Pressure Sensors and our Speaker

https://goo.gl/LZCZeC

https://goo.gl/r42QWg

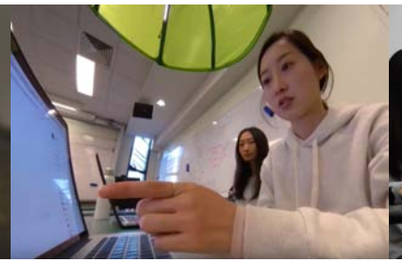
16 May

Working on all the Leaf's modules (code & structure)

https://goo.gl/BDZrGt

https://goo.gl/F2m4Ws

18 May



Timelapses showcasing our collaboration

https://goo.gl/znUDqA

https://goo.gl/j1247g

Changes

- Coded and tested the flexi-pressure Sensor
- Tested a variety of sounds and music and its effect on surrounding traffic noise
- Purchased and collected a Pressure Sensor from LittleBird (field trip to Hornsby)
- Borrowed PIR (motion sensor) from Abhiruchi
- Appropriated a Tupperware box and secured Arduino modules safely and waterproof within
- Sorted the code for increased legibility
- Introduced loop breaks to check the sensors
- Changed glow patterns for increased natural feel

Problems

- Bird Sounds were found 'very annoying'
- Music can be distracting, as people began to leave the area in which they were being played, although at the same time some sounds were found too quiet
- The PIR module seems to be triggered randomly
- Existing Leaf base remains fragile
- The idle mode needs to finish its loops (3s) before it can check for anyone approaching the leaf
- The code is illegible due to it being clustered

Solutions

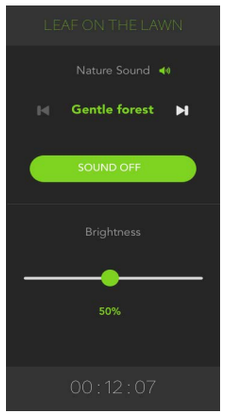
- Increasing the sound decibel levels in Audacity
- Testing the sounds further with our user group, restrict the speaker to the app (if feasible)
- Rescrew and retest the PIR sensor, if needed: buy a new sensor or continue debugging
- Building a new base withstanding elements
- Introducing breaks within the loops to check sensors and execute their glowing patterns
- Sorting the code into seperate functions and pages to increase our development efficiency

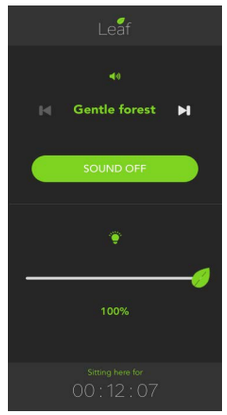
App V.2, Design & Development

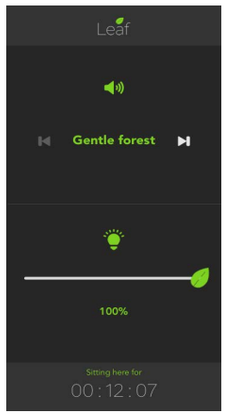
Overview

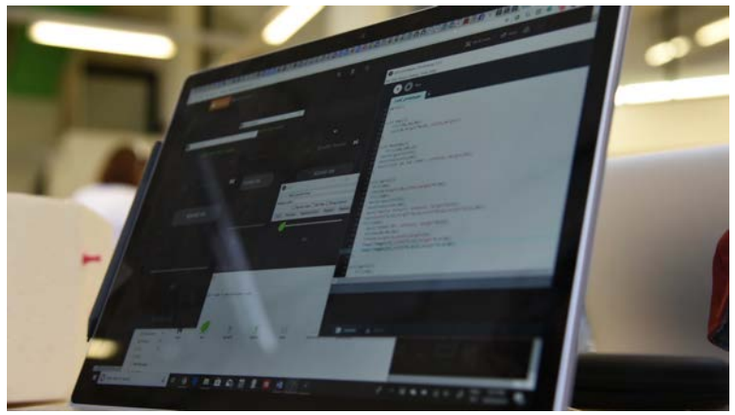
Due to negative feedback provided during the user–testing session, we decided to undertake a full app redesign and redevelopment processes by following real–world User–Centered Design and Development processes.
The creation of wireframes, mockups and the development of the app itself took place, with each part being tested and iterated upon the feedback received throughout the process.

25 May









Changes

- Redesigned the application from ground-up, following User Interface design principles and Human-Computer Interaction methodologies
- Developed a fully functional application by the use of researched set of libraries working in Processing for Android environment
- Only unduplicated values will be sent via bluetooth from now-on

Problems

- Resizing the images as a function, creates smoothing-related artifacts
- The need to manipulate image colours requires non-tinted vector images
- Enormous delays in bluetooth communication happening eventually

Solutions

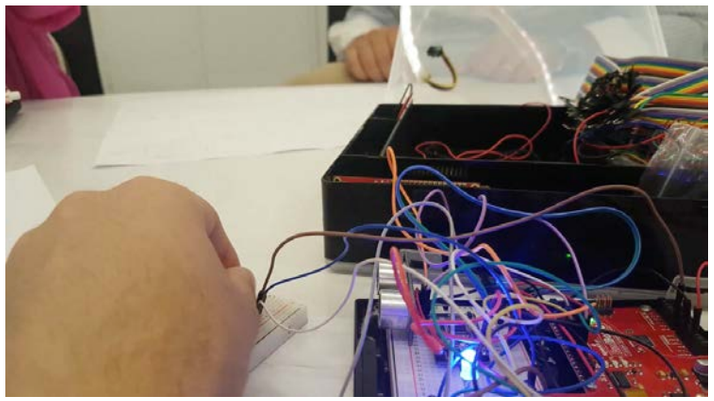
- There is a number of resizing method, the internal one works effectively
- Tint function works very efficiently once it's supplied with clean vectors
- Increased the delay for bluetooth data to flow by the use of mouseX instead of pmouseX etc., conditional statements checking gated values

Fixing Glitches – Arduino & Android

Overview

At this stage we focused on cleaning, optimising and sorting our code along with implementing changes based on the feedback from our users. We are still due to implement more effective filtering methods for our ultrasonic and PIR modules along with additional features

29 May

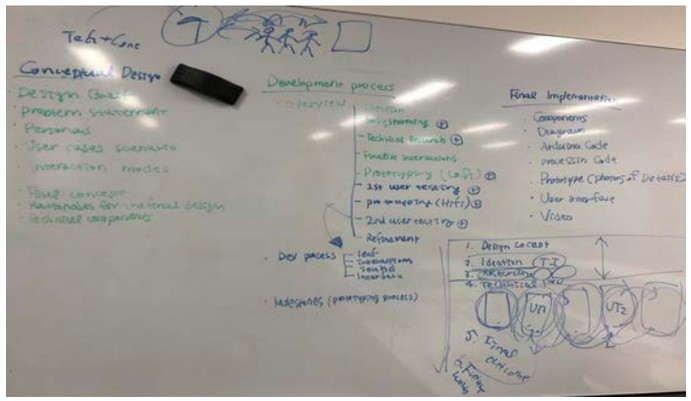


https://1drv.ms/v/s!Aql17gtc_ND8hNsNFQ2h_aaueeaniA
https://1drv.ms/v/s!Aql17gtc_ND8hOB6l1FgjKBTjYTGAQ
https://1drv.ms/v/s!Aql17gtc_ND8hOB5Rcvse39gcyMcSg

Changes

- Cleaned, Commented & Optimised Arduino code
- Fixed Ultrasonic Sensor noise via 'gating' and statistical methods (requires optimising)
- Optimised the Motion Sensor functionality by rescrewing the PIR sensor (may need optimising)
- Implemented changes based on User Feedback
- Cleaned, Commented & Optimised Processing code
- Highly tweaked button responsiveness
- Implemented changes based on User Feedback

30 May

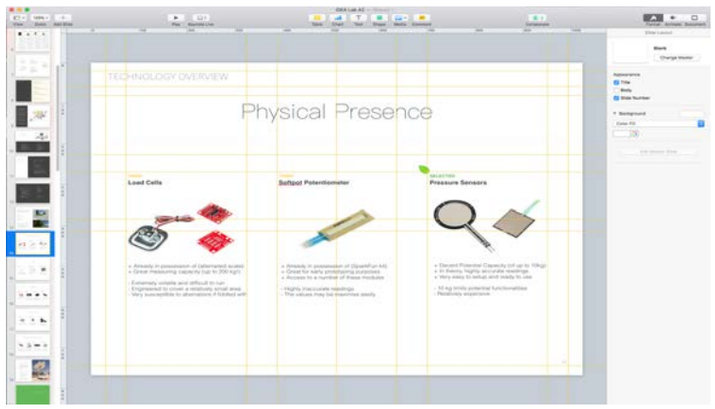


Final group meeting and Ideation for the Lab documentation

Problems

- Ultrasonic sensor still generates random noise
- Motion Sensor (PIR) generates random values
- Redundant code for statistical equations
- Misleading icons clicking which did nothing
- Sound glitches out after 14 state changes
- Inconsistent colour changes and flickering
- Icons are resized eerily and unnaturally tinted

31 May



Documentation

Solutions

- 8 different readings captured in 2ms intervals, recorded and subtracted provide an effective result
- Rescrewed the jumper within the PIR module
- Used arrays to loop through ultrasonic readings
- Carved out some of the button redundancies
- Fixed the sound glitching out (it literally fixed itself)
- Reordered logically the code structure
- Icons' aspect ratio & colour manually altered

Future works

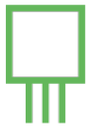
FUTURE WORKS

Although we have developed an end to end experience, there are future works that we would like to recommend for further development, testing and iteration to complement the experience.

Leaf

- We have plan to make a big man-made leaf for hung over the whole picnic bench table.
- Solar panel on top of the leaf would be a good option for sustainability and saving energy
- Add power plugin on pole for charging the electronic devices
- Add more LED strip lights under leaf for more brightness.
- Waterproof speakers with higher quality for clear powerful sound and protection from rain.
- Change the location of electric box from pole to under the table for hiding it from visitors vision.

Tech?

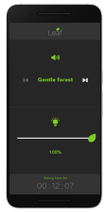


- Introduce filtering via Standard Deviation statistical method
- Test different PIR sensors
- Introduce new functionalities, such as more elaborated states
- Apply a variety of state saving functions in order to increase the flow
- Fabricate attachments for the pressure sensors to remain under
- Pursue further a variety of potential glow states
- Try introducing a progressive colour-changing algorithm based on the ultrasonic and/or PIR sensor, despite that we have tested it, the readings were too erratic, compromising the seamless structure

Sound

- As users suggested we plan to add more nature sound options to fit users wide range of preference
- To make the prototype more interactive and user-friendly we intend to add a sound volume slider on the app interface

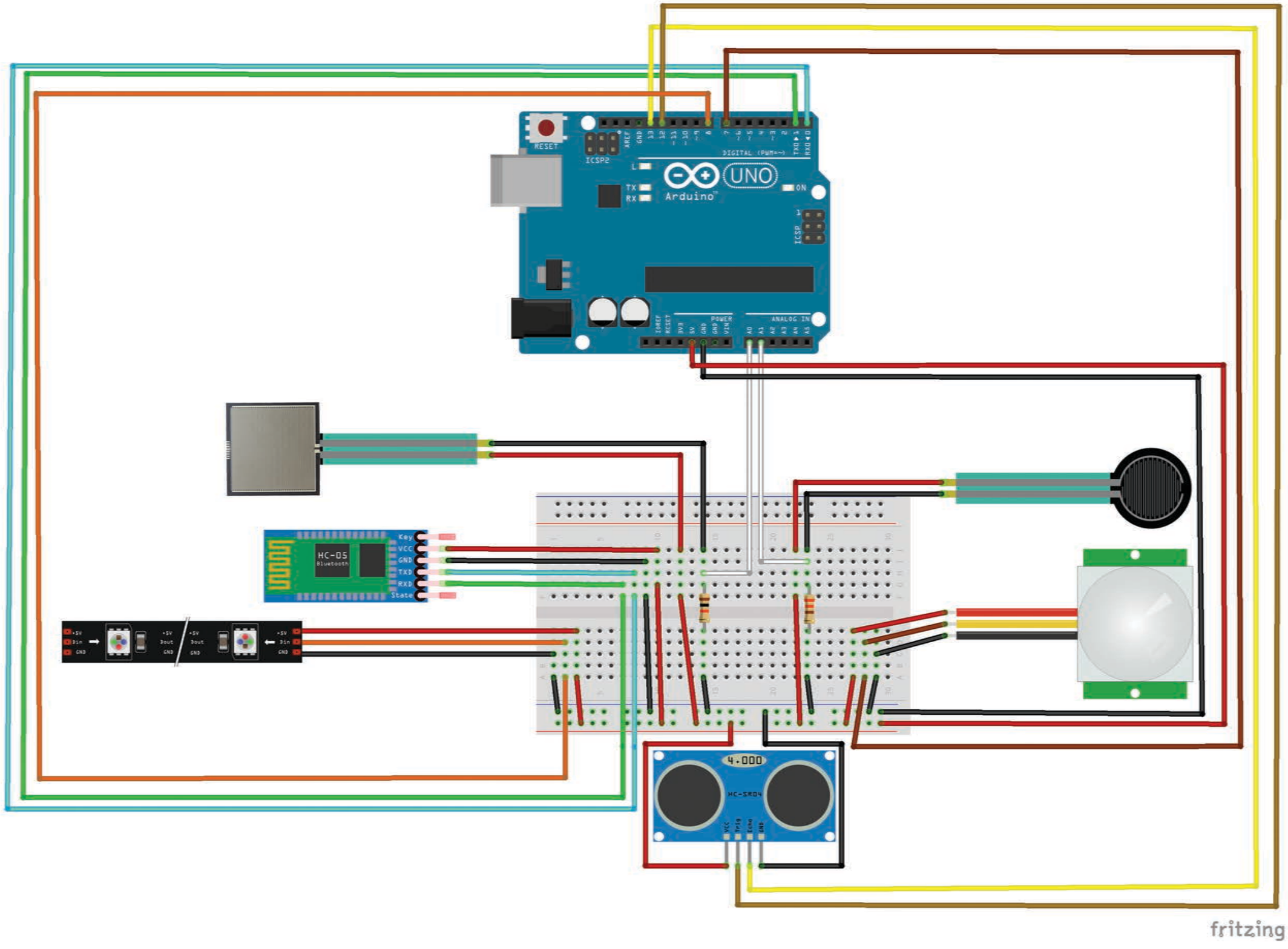
Interface



- One thing we would like to include as a future feature for the interface is ‘Pomodoro timer’ that allows user to break down work into intervals, traditionally 25 minutes in length, separated by short breaks.
- As many user suggested, we can consider to add a volume control slider as the brightness controller we currently have.
- We can add simple feedback survey and statistics to collect datas to analyse user behaviour patterns and the satisfaction level

Final Prototype

FRITZING DIAGRAM



Link to Processing files

https://github.com/Fuadex/Leaf

Link to Arduino files

https://github.com/Fuadex/Leaf

Making video

https://bit.ly/2suypvd

https://1drv.ms/f/s!AsODPaqszcFrISDxNegzPYXi_1YE

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Source Documentation

Full, Detailed Project Documentation may be found here:

https://unisydneyedu-my.sharepoint.com/:w:/g/personal/fsou4085_uni_sydney_edu_au/Efv9JhmZSXlKreKXRSI6ZvwB6g-QO4yzXDiHYii8Sbf30g?e=Oks7xx

All video recordings may be found here:

https://1drv.ms/f/s!AsODPaqszcFrkkr5o0HX7Ch1t060

All 360 video recordings (primarily interviews) may be found here:

https://1drv.ms/f/s!AsODPaqszcFrk2B2XX3wLcWakMgw

Thank you

Special Thanks To

- User-testing participants for the provision of invaluable feedback
- Laboratory/Studio (IDEA9101/IDEA9102) tutors for the provision of invaluable feedback, insightful tutorials and further help whenever needed
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