PORTFOLIO

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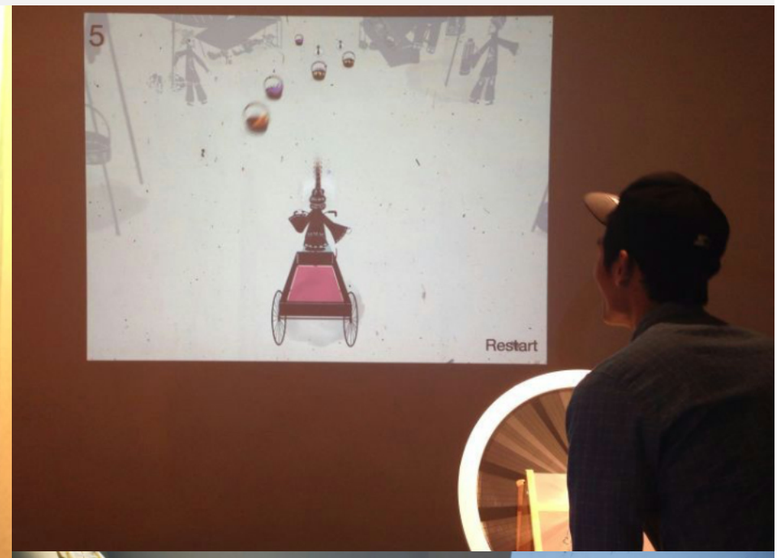
Major Project Stories

1 Shadow Play

A game console that brings seniors joy

Shadow Play is among the most interesting projects I have done. It is a device that addresses elderly loneliness and social isolation by turning their daily exercise into a social game. Designing for seniors is often challenging as they tend to be less technically literate and the interaction has to be tangible and straightforward. To make sure seniors could have fun and socialize without the need to learn or adapt, my teammates and I built a set of game controllers that mimic their exercise equipment. In the end of the project, we were even invited by our partnering organization to install the device in their eldercare center, where it became a popular recreational facility in the exhibition period.



We adopted the principles of Design Thinking throughout the project.

Empathizing

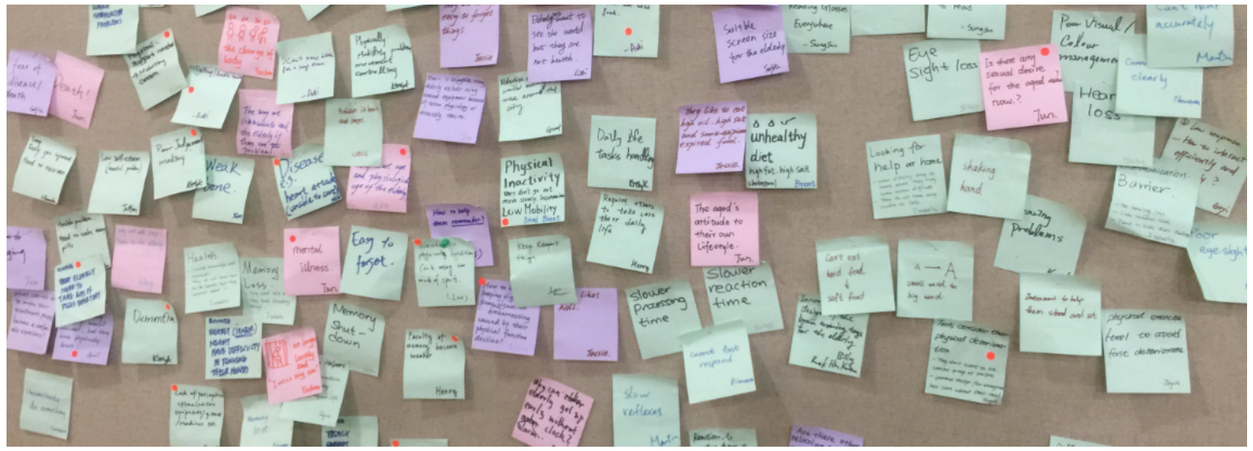
After talking to over twenty elders in Hong Kong and Hangzhou, we found that they often spend time alone, especially during the daytime. Most of them expressed loneliness because they lack interesting activities to do, and their children are either busy at work or living in different places. They could not socialize online due to their unfamiliarity with mobile technology. We also studied their daily routines and found that they visit public parks and elderly centers every day for light exercises.

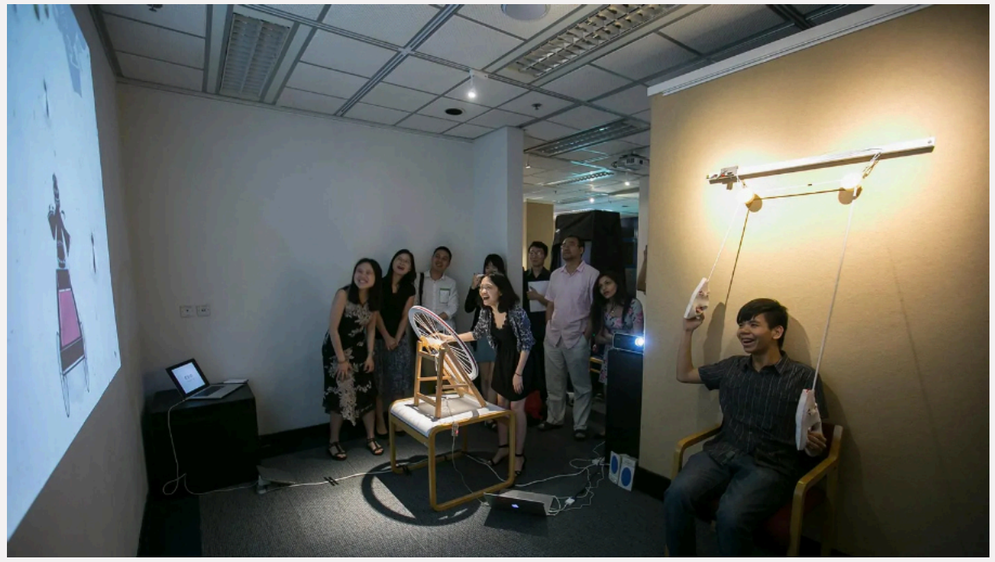
Defining

With the user journey and insights that we gathered, we went on to define the problem statement as ‘How might we reduce elderly loneliness without changing their living style?’.

Ideating

After a series of brainstorming, we selected the idea of turning their daily exercise into a social game. With an interface that they are already familiar with, they can enjoy the game without the need to learn or adapt. The movement of the game character relies on the coordinated control of two players. As a result, they are indirectly encouraged to socialize and play together with their friends and grandkids.



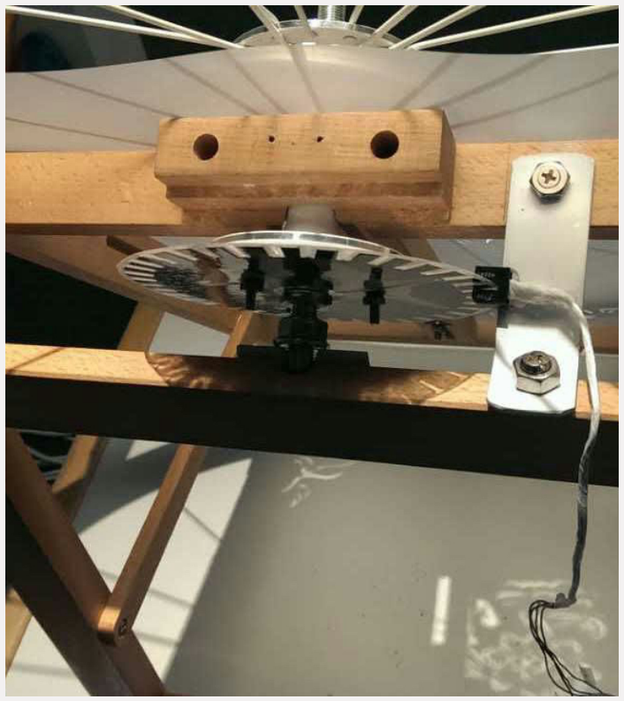


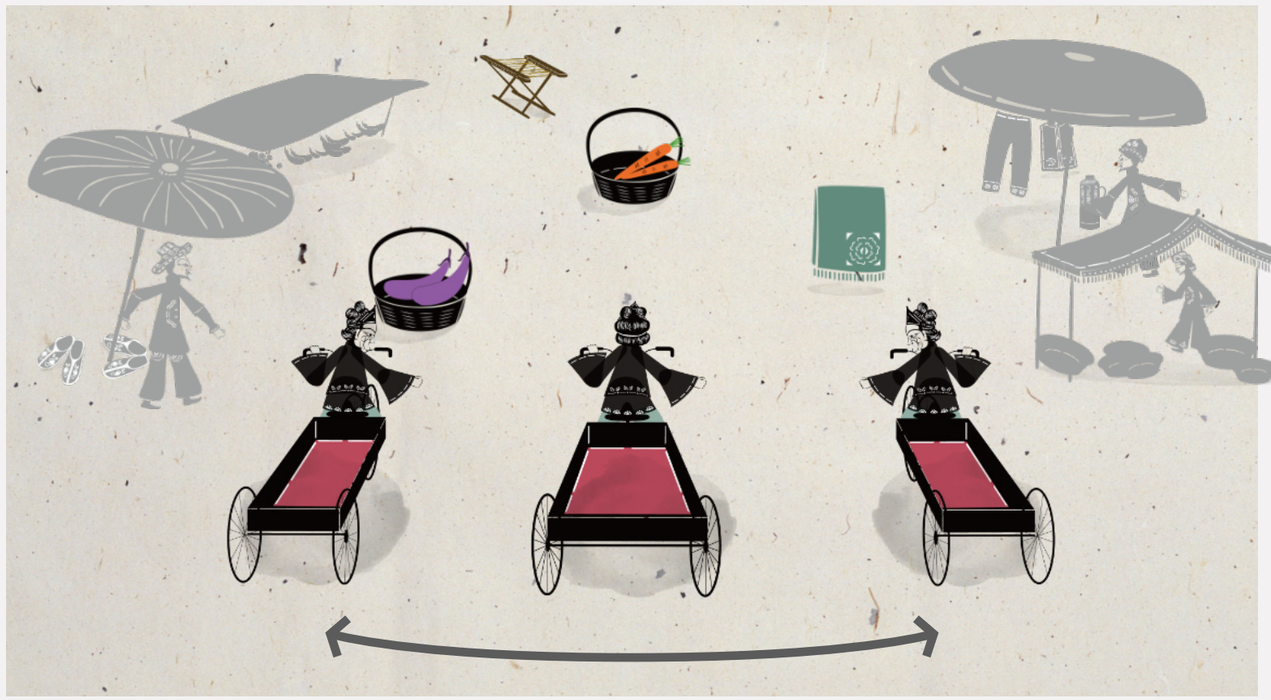
Prototyping

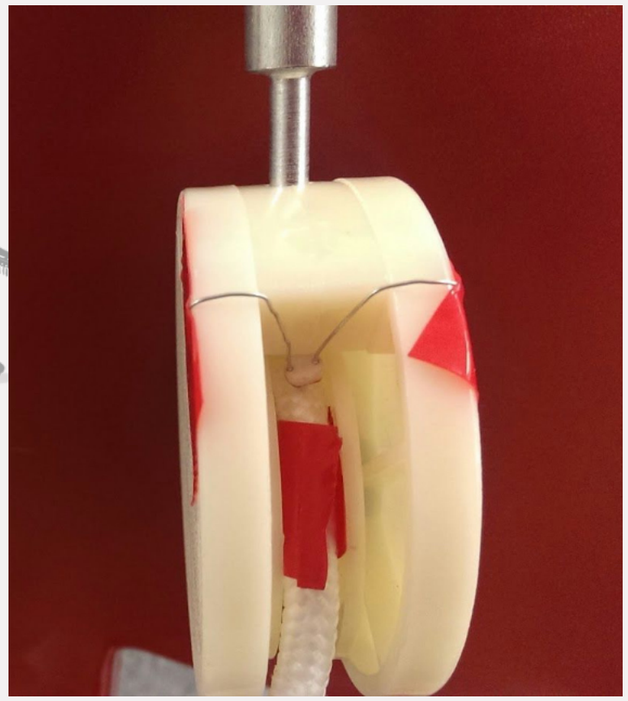
To realize the idea, we identified two common types of exercise equipment used by seniors in the elderly centers - wheel and slider. We designed Arduino-powered versions of them with embedded sensors to track the movement for controlling the gameplay. In the game, the character moves across three lanes to pick up the most items within a time limit.

An optical rotary encoder senses the rotation speed of the wheel, which in turn controls the speed of the character. The faster it rotates, the faster the game progresses but the harder it is to maneuver.

A light sensor detects the marks on the string, which in turn determine the positions of the character - left, center and right. The character can only pick up items when it is in the correct lane.

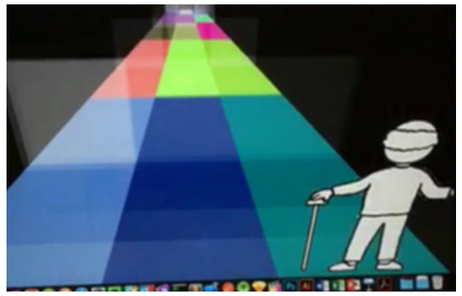


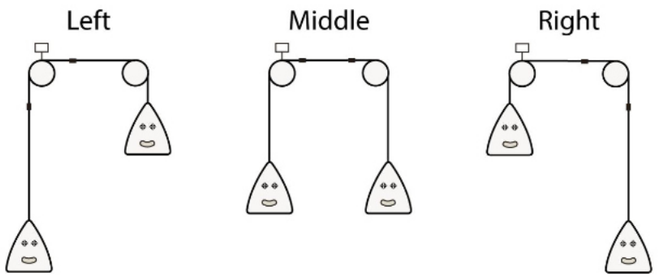


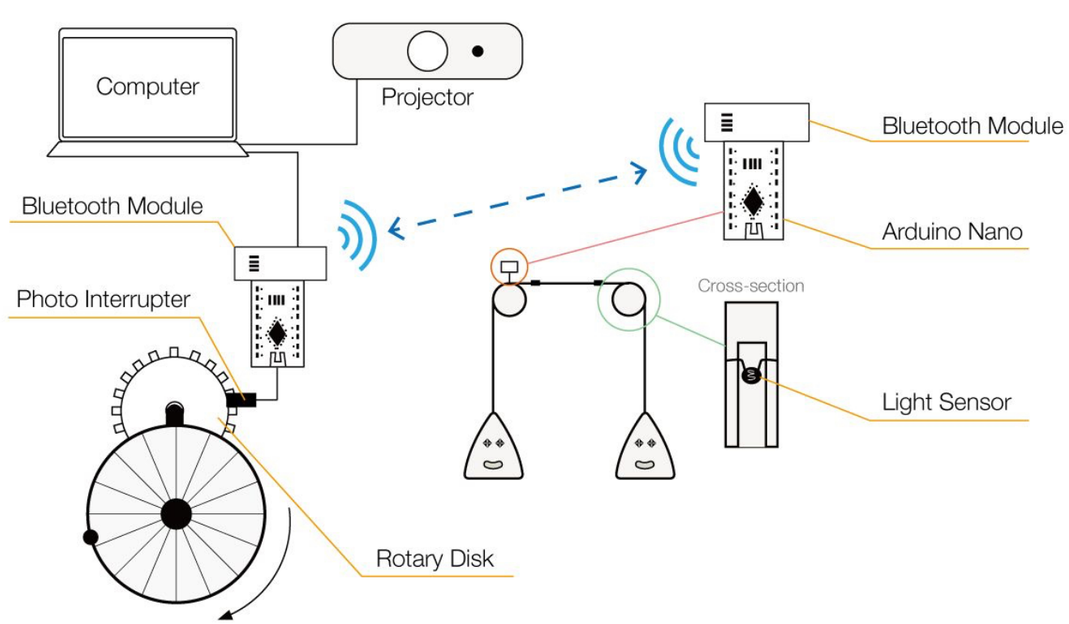


We designed the character and game scene using Adobe Illustrator in the style of the traditional Chinese puppet show, as known as Shadow Play.

The game itself is written in WebGL and rendered on browser. The input signals from the wheel and slider are transferred via Bluetooth to the computer where the browser is installed.







Testing

We invited seniors to test our device and fine-tuned our device based on their feedback. In the final round of testing, all seniors expressed satisfaction with our design and were tirelessly playing the game without wanting to leave.

Background

This project is a part of the IELM4320 Design Thinking course jointly organized by the Hong Kong University of Science and Technology and the China Academy of Art.

Date

June 2015 - July 2015

Collaborators

Avril Wang (CAA)

Wing Li (CAA)

Brandon Chau (HKUST)

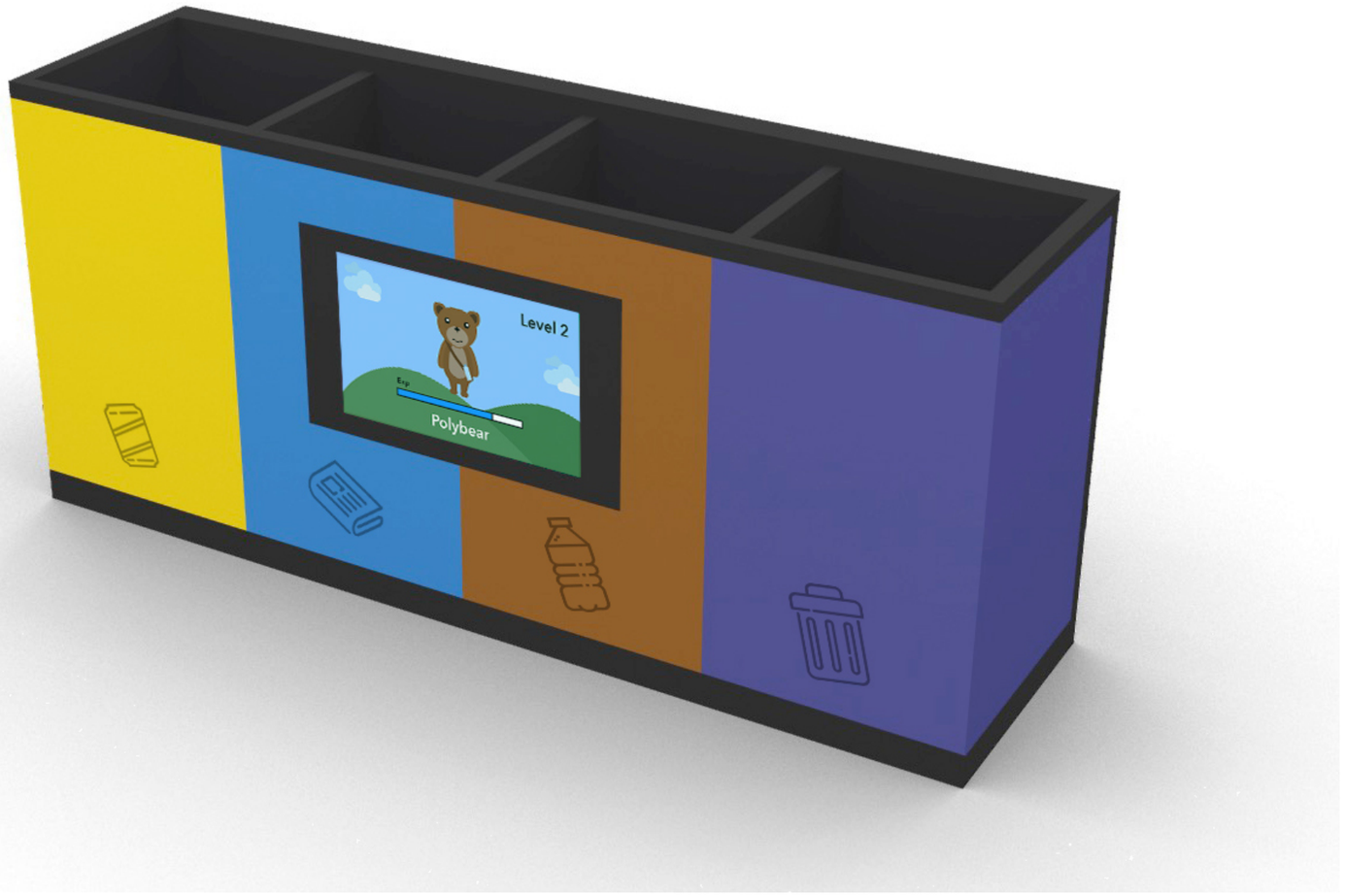
Contributions

User Research, Concept Design, Game Design and Development, Electronic Design and Development

2 SustainaBin

A gamified bin that teaches young kids recycling

If Shadow Play is my proudest design for seniors, SustainaBin is my favorite one for kids. It is an interactive recycling bin that teaches kindergarteners environmental protection. Designing for kids is almost as hard as designing for seniors because they are not interested in interacting with products that are not fun. We make use of gamification to make the process of maintaining recycling habits like a quest. With an experience bar and a few cute characters that evolve like a Pokemon, most kids who "played" SustainaBin refused to leave without being stopped by their parents. The project was awarded Audience Favorite with over 200 votes casted by entrepreneurs, investors and the public.



In the boot camp, participants with a passion for similar topics were grouped to form a team. My team consists of people who want to solve problems around waste management and recycling habits. We observed that recycling habits are more likely to persist when formed at a young age. This brought us to the intersection between education and environmental protection.

To explore more, we adopted the principles of user-centered design in this project.

Empathizing

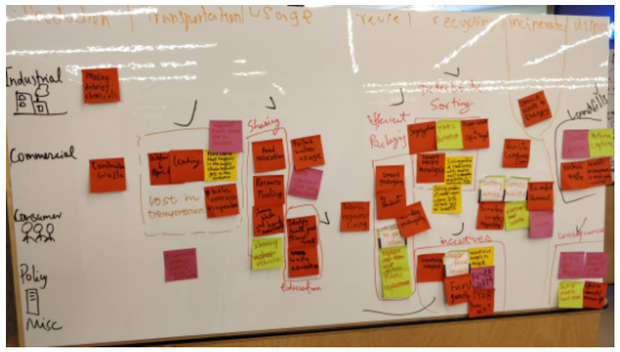
After interviewing a number of parents and their kids, we found that parents nowadays strongly prefer schools to incorporate environmental education into the curriculum of their children. Such preference is particularly popular among millennial parents. However, when they are asked about the recycling habits of their kids, most observed no or minimal behavioral change even after their kids have been taught recycling at schools. This could represent a mismatch between the expectation of parents and the educational materials at schools.

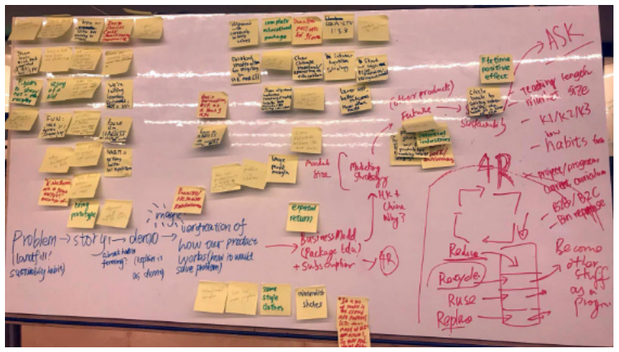
Defining

With the gathered insights, we defined the problem statement as ‘How might we encourage young kids to form long-lasting recycling habits?’.

Ideating

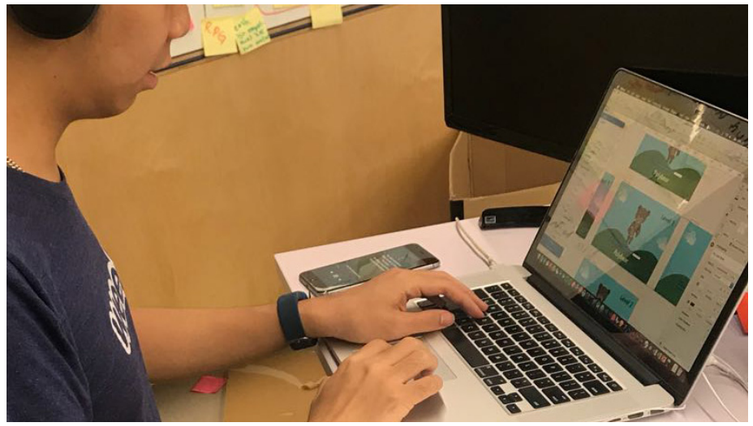
After a series of brainstorming, we selected the idea of building an interactive recycling bin that feels like a game to kids. We think the classroom is the best place where kids interact with the products. As the rewards and penalties in the game are also seen by their peers, it forms a kind of social pressure to reinforce the recycling habits in addition to the score in the game.

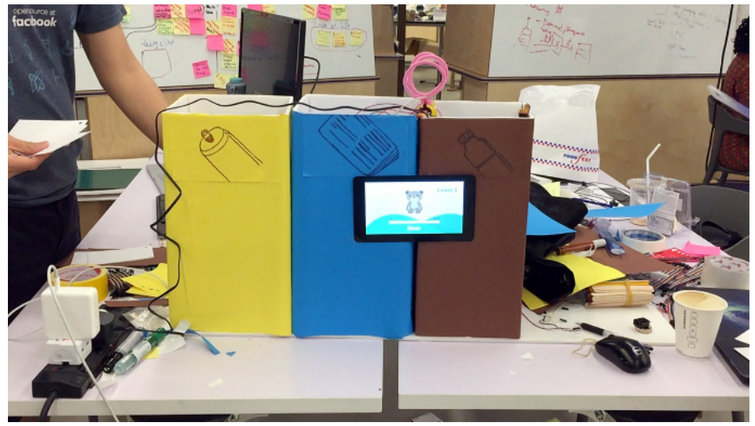




Prototyping

We built a recycling bin with four compartments using styrofoam. At the center of the bin, there is an LCD display connected to a Raspberry Pi, which analyzes the images sent from a camera module that takes pictures of the objects that fall into the bin. The game itself is running on a browser. Depending on the image recognition result, a score is sent to the browser and the character reacts based on the score. Unfortunately, we did not manage to get the image recognition working due to time constraints.





Much like Pokemon, the character levels up and evolves after a number of correct disposals of trash. It also reacts to incorrect throws with particular emotions.

Testing

We invited the staff in the MIT Innovation Node to bring their kids to test our prototype and simplified the user interface to avoid some of the confusions observed during their game play.

Background

This project was created in the MIT Entrepreneurship and Maker Skills Integrator (MEMSI) Program organized by MIT Hong Kong Innovation Node.

Date

May 2018 - June 2018

Collaborators

Banti Gheneti (MIT)

Jordan Wick (MIT)

Kirsten Qin (PolyU)

Shivangi Das (HKU)

Michelle Ong (HKU)

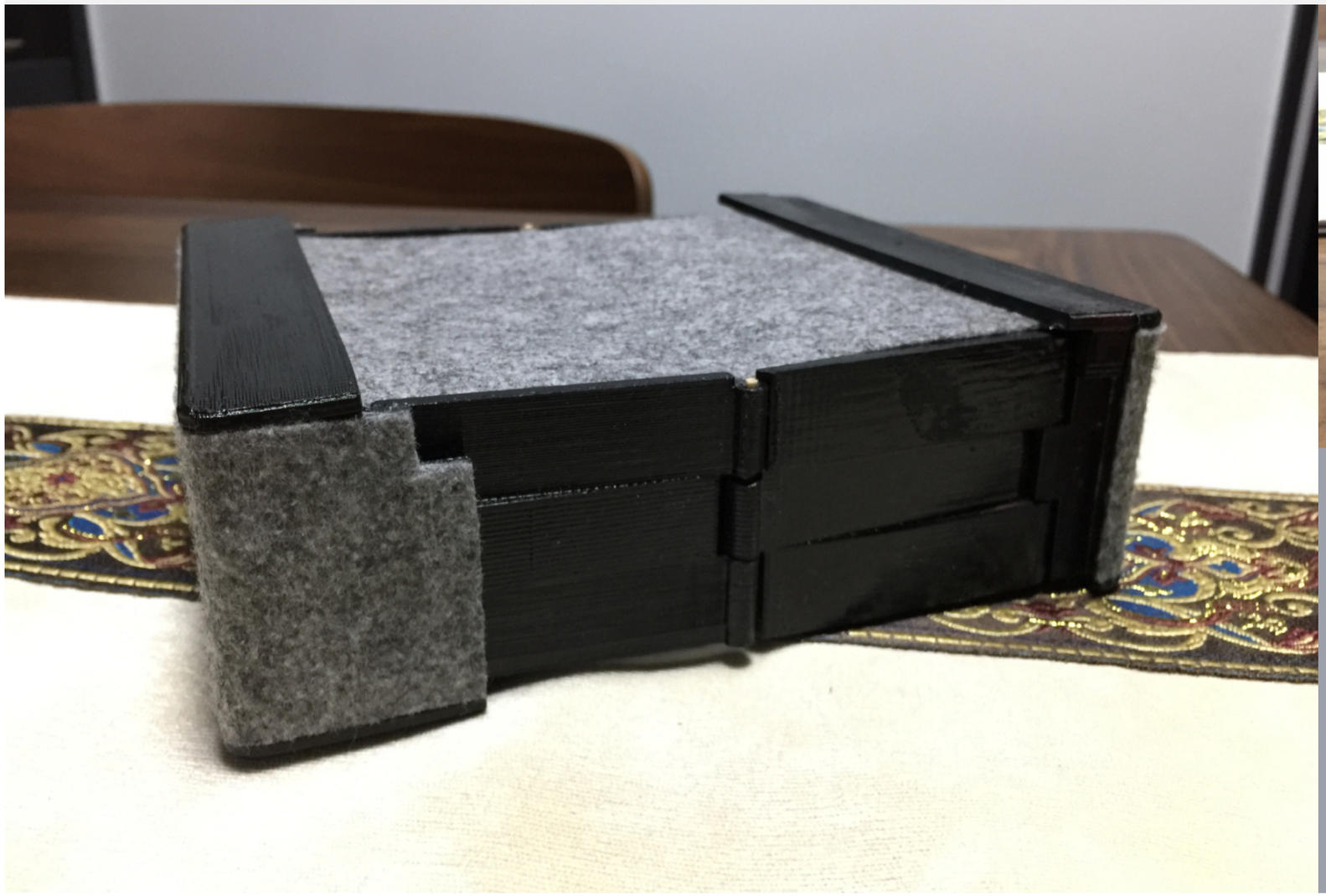
Contributions

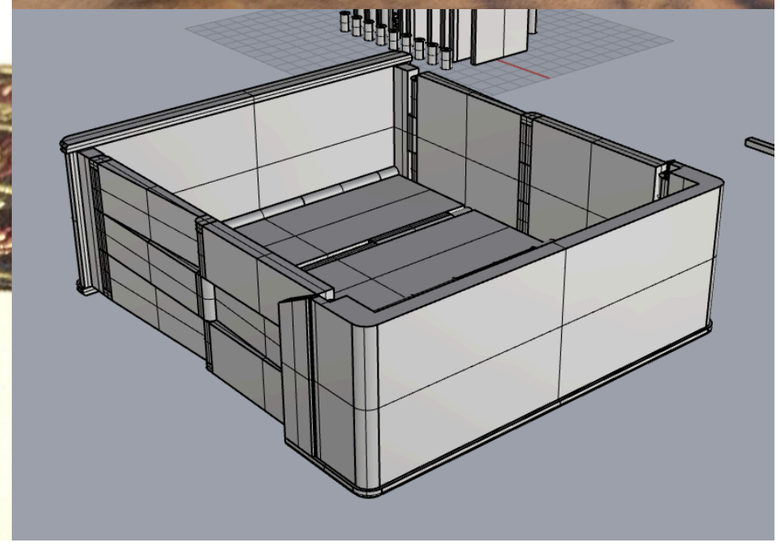
User Research, 3D Modeling, Prototyping, Character Design, Game Design and Development

3 Rebox

A wash-free, collapsible and reusable lunchbox

Compared with the first two projects, Rebox is very experimental. It was designed both to test my 3D model design skills and to explore creative solutions to the overuse of disposable lunchbox. With a piece of biodegradable greaseproof paper that separates the food from the container, users do not need to wash their box after each use. It is a mechanical lunchbox consisting of many 3D-printed movable parts. I needed to carefully design the interface between them so that the clearance or interference fit works as expected. I ended up learning a lot about creating physical products in this project, especially the polish and aesthetics.





Problem

Food containers and packaging are among the major sources of wastes reaching the landfills. While governments and environmental organizations are trying hard to encourage people to use reusable lunchbox, most citizens, especially students and office workers, are still reluctant to switch away from disposable lunchbox.

In fact, there is always a battle between reusable lunchbox and disposable lunchbox. Reusable lunch box is green but occupies space and requires washing; disposable lunch box is convenient but harmful to the earth. This introduces a dilemma between environmental protection and product experience.

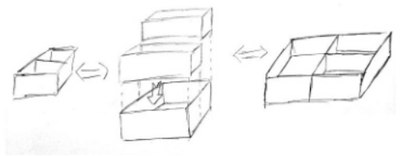
Existing Solutions

There are some existing products attempting to solve the problem. For example, some silicone box can be collapsed into half. However, its folded form is still bulky due to the large vertical cross section, making it hard to be put in most small bags, especially the handbags for female.

Concept Exploration

A number of concepts were considered in the brainstorming process. They include the recyclable, stackable, rollable, and foldable design. The foldable design was eventually selected due to its convenience, usability and expected durability. In all designs, a piece of biodegradable greaseproof paper is used as the inner layer to separate the food and the container. When the user finished their meal, they just have to throw the paper away.

The recyclable design stacks boxes on top of each other so that they can be easily transported. The boxes need to be returned by diners and washed together.

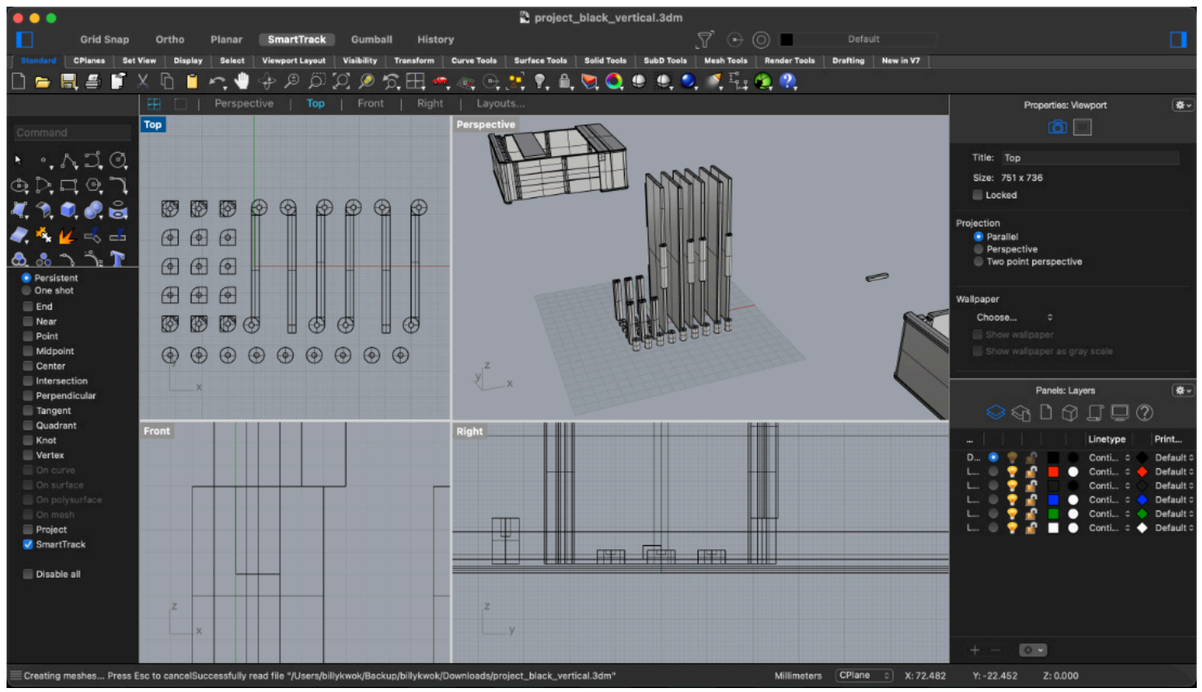


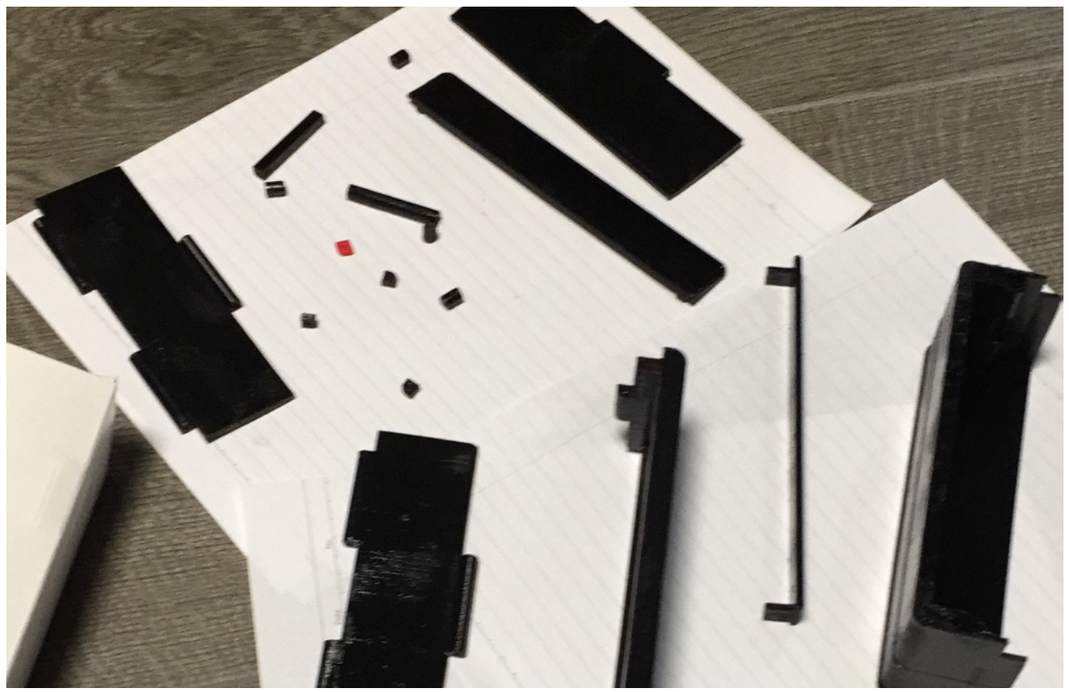
The stackable design divides the lunch box into three parts. Each part can be stacked together to reduce its size.

The foldable design folds the box into a more compact block. Its body is mostly rigid and the collapsed form is only one forth of its original size.

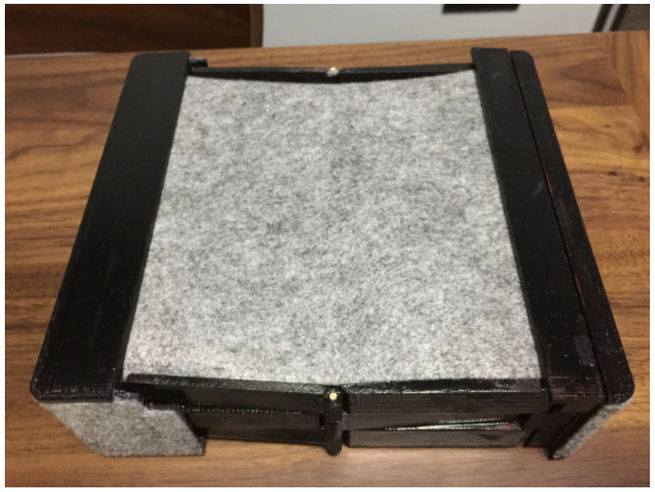
Prototyping

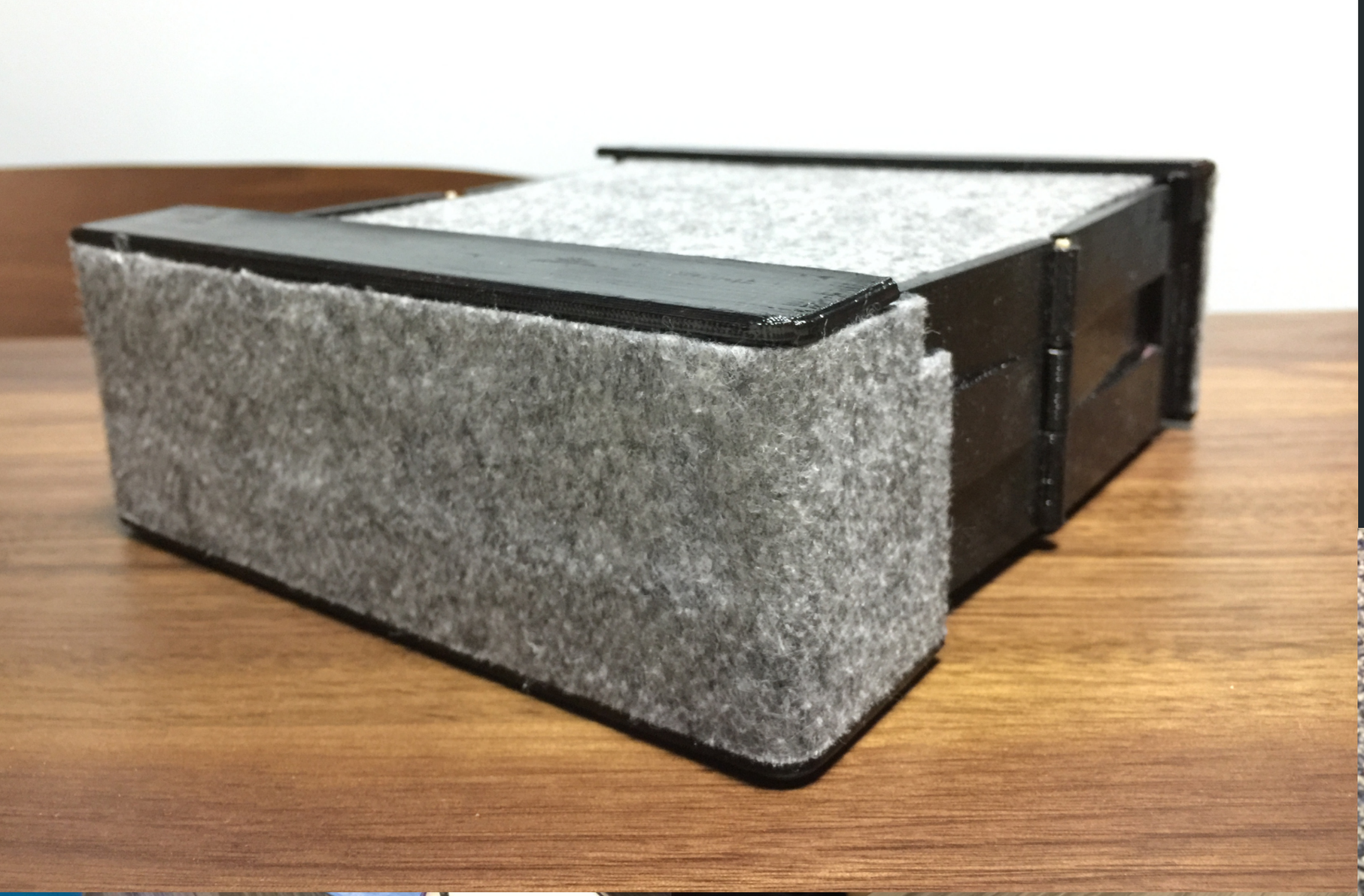
A few low-fidelity prototypes made of cardboards and papers were made to test out the ideas. They were tested for its usability and feasibility, evaluated based on factors like user interaction, affordance, usage flow, and product mechanics. After confirming that the product design is usable and feasible, a high-fidelity prototype was made to showcase the design of final product. The high-fidelity prototype was designed using Rhino and 3D printed into physical parts. The parts were polished and sprayed with black paint.





After assembling the box, a few pieces of gray fabric were added to the exterior to give it a neater look inspired by the Amazon Echo and Nest Speaker.





Background

This project is a part of the IELM2150 Product Design course at the Hong Kong University of Science and Technology.

Date

October 2017 - November 2017

Collaborators

N/A

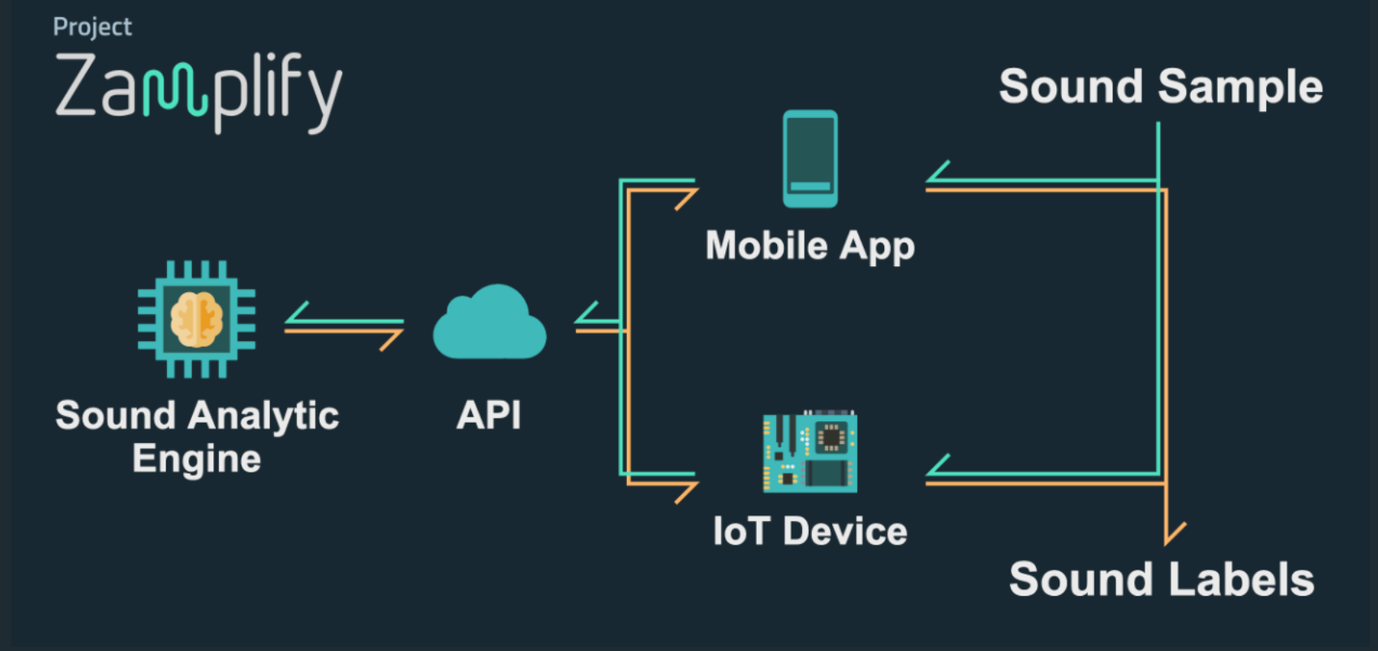
Contributions

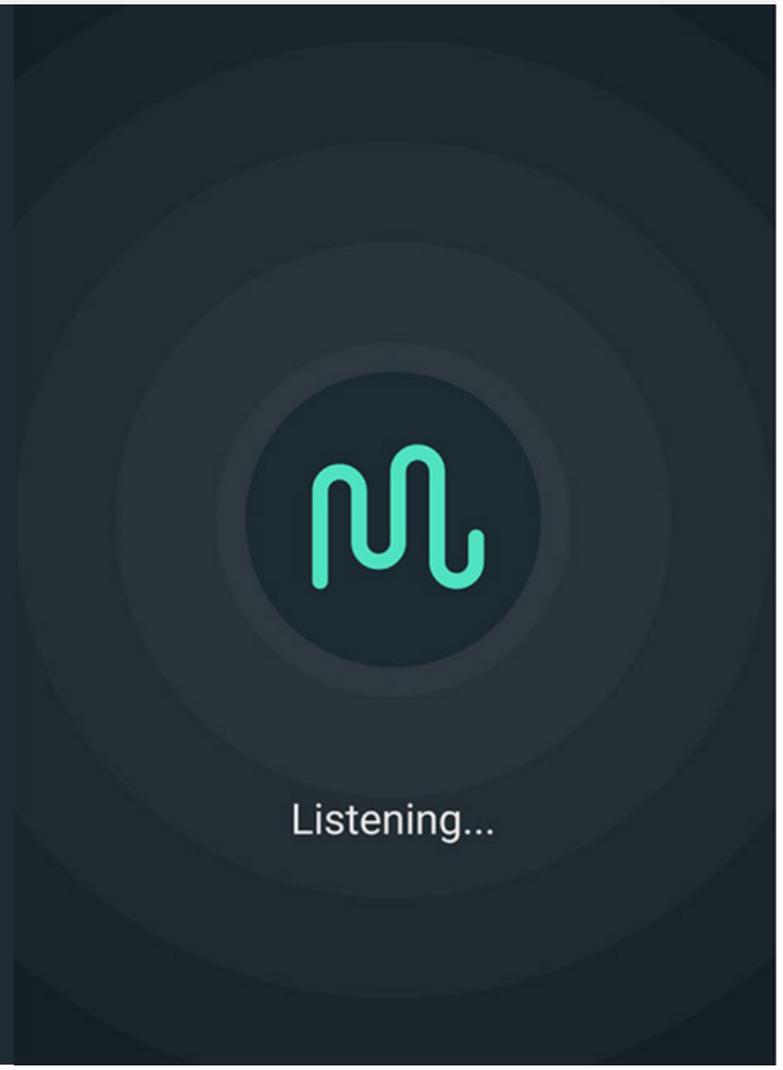
N/A

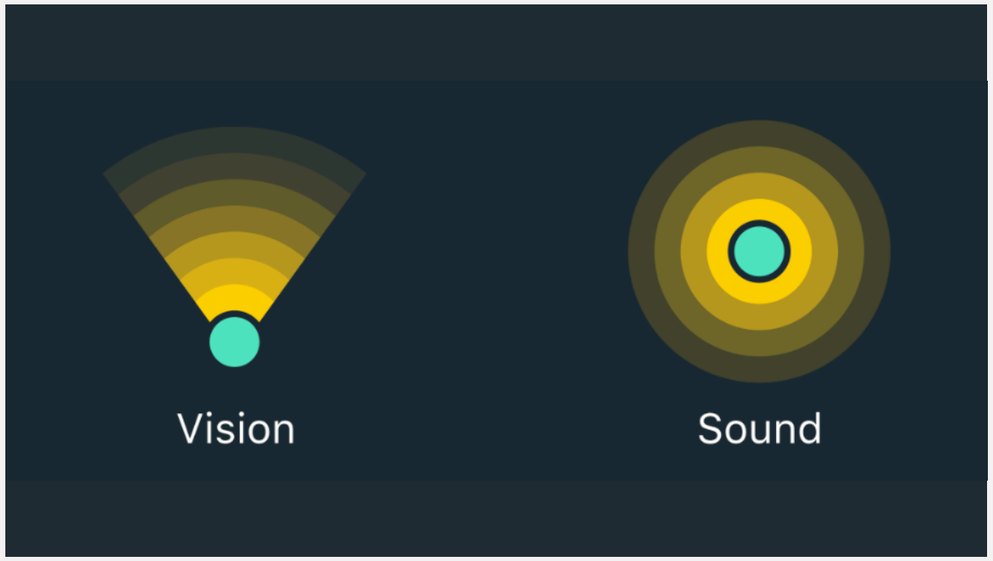
4 Zamplify

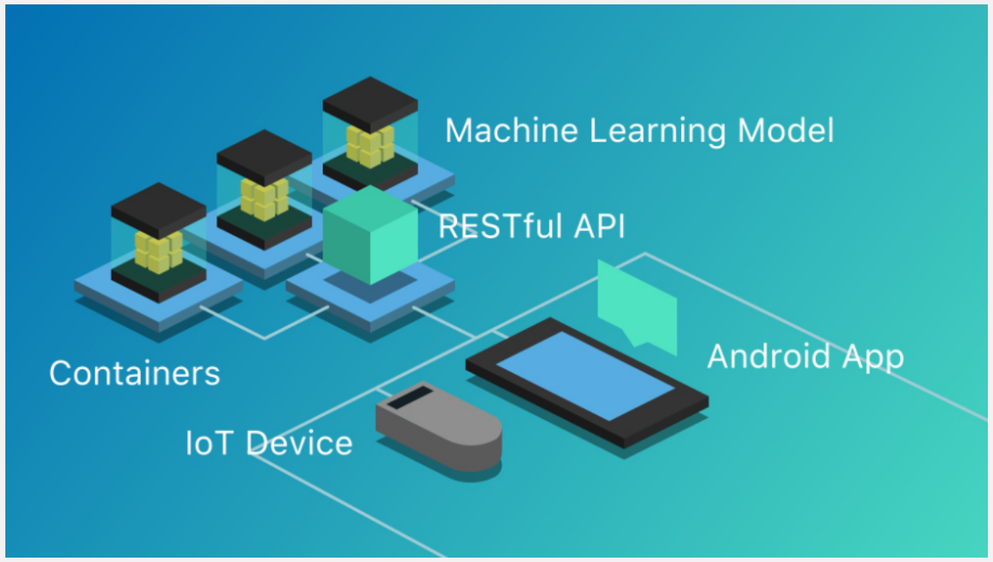
A system for audio-based context awareness

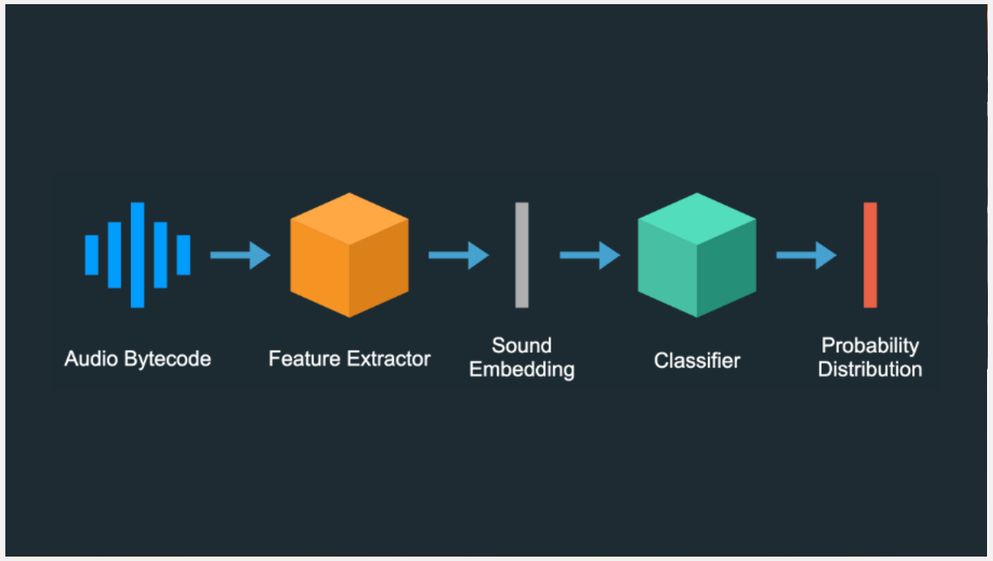
Natural sound can be an important indicator for context. With context, computers can make much smarter decisions for you. Imagine your phone automatically mutes itself when it knows that you are in a library or theatre. Zamplify is a real-time natural sound recognition system that was built on top of this interesting idea of human-computer-environment interaction. The Zamplify Android app and its complementary IoT device continuously recognize context from the surrounding sound and provide a customizable trigger-action mechanism that performs actions when a certain context is detected. This project was awarded the Best Final Year Project and funded by the FYP+ Supporting Scheme.











Background

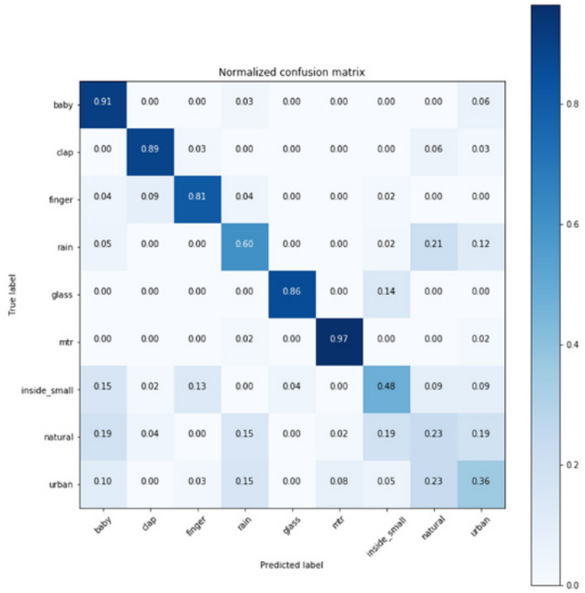
Giving computer systems a sense of the environment is not as easy as it seems. Signals like GPS, motions, proximity do not convey enough general information about the environment. Visual signals such as images and videos are hugely affected by line of sight. In contrast, the power of natural sound is often overlooked. In fact, an enormous amount of context-related information can be inferred just from the surrounding sound. The “noise” around us can indeed be a good indicator of context.

Overview

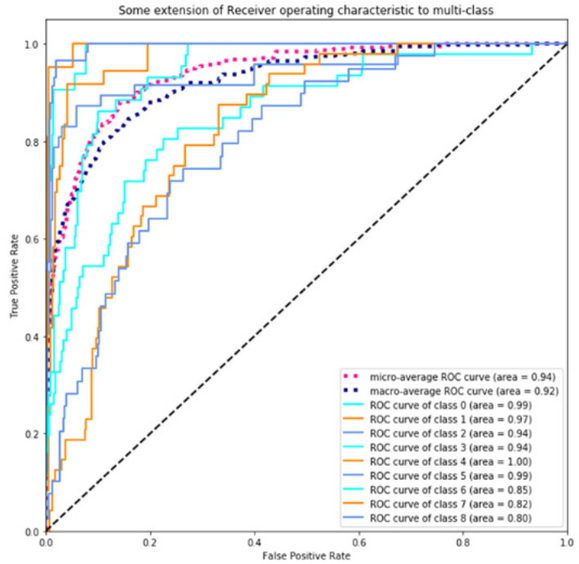
Zamplify is an integrated system consisting of three major components (picture in the middle). The core is a deep learning model that provides context awareness capability to connected applications via an API. The Android app and IoT device are peripherals built around the core API and serve as the channels for audio input and action output.

Machine Learning Model

The sound recognition model takes raw audio byte codes as input and gives a probability vector as output. As shown in the bottom diagram, it consists of two parts - feature extractor and classifier. The feature extractor is a partial reimplementation of SoundNet, a convolutional neural network from MIT. The original model was created by transferring the weights of a state-of-the-art pre-trained image recognition model to a sound recognition model, using videos as training examples. Each video is split into an image sequence and an audio clip, then fed into the transfer learning model for weight transfer. The classifier is a 26-layer LSTM model that takes the output of the feature extractor and classifies them into 9 types of sounds.



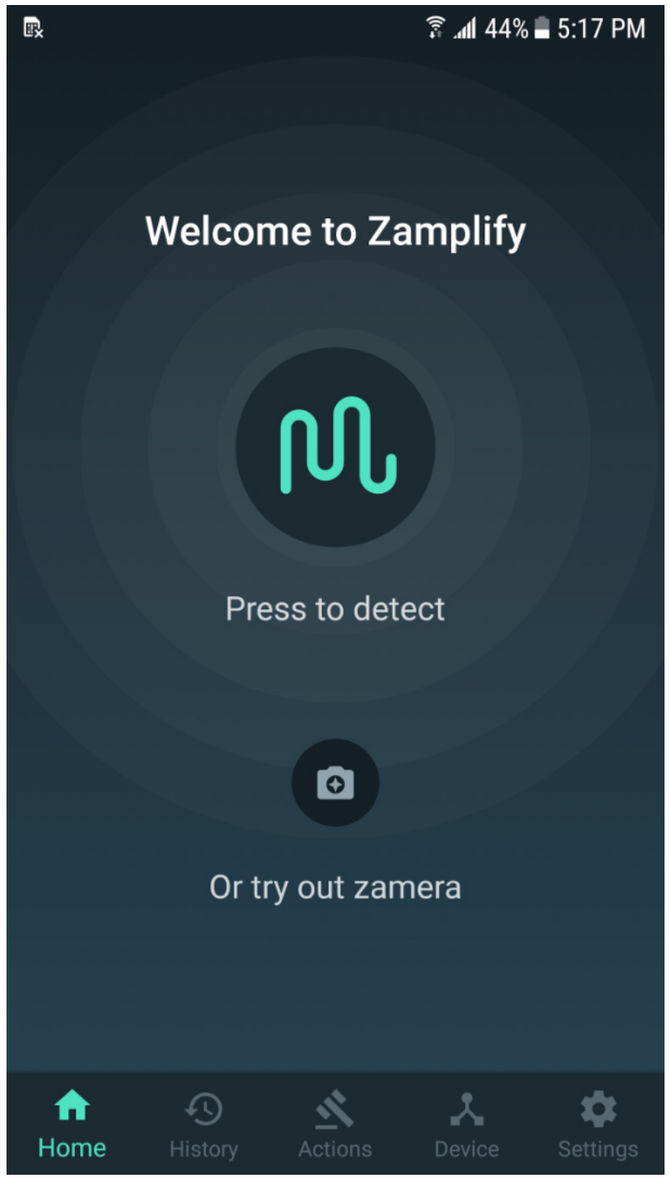
Confusion Matrix of LSTM

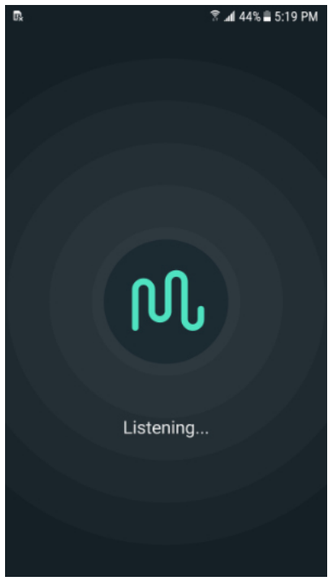


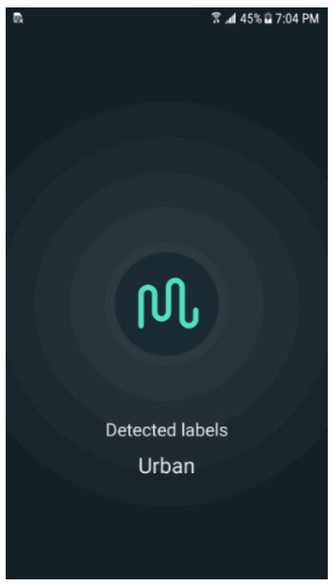
ROC of LSTM

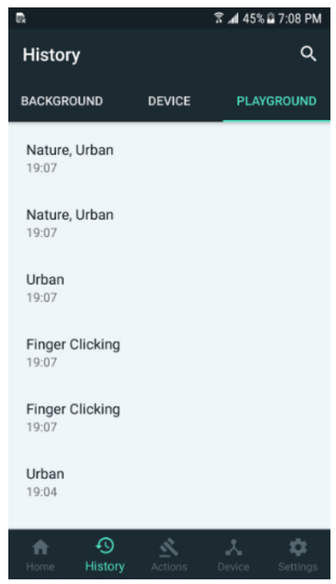
Android App

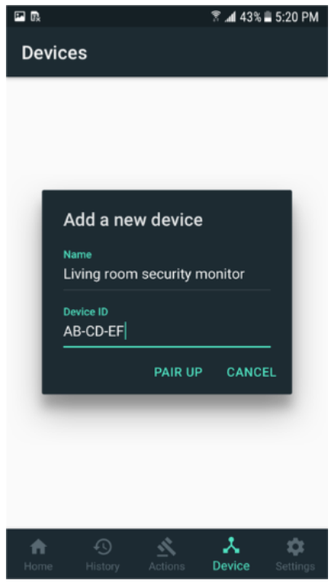
Our Android app allows users to manage their context-action triggers, while at the same time serves as a demonstration of what our API can do. In addition, it allows users to view their recognition history and take photos with sound as a trigger, for example, by snapping fingers.

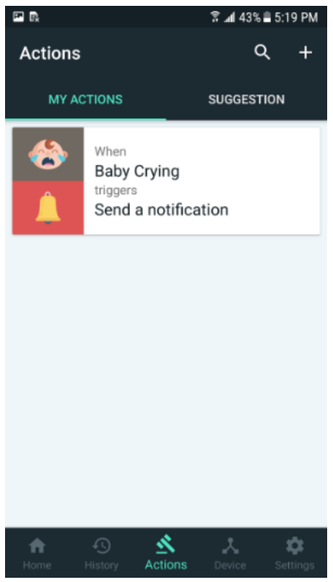


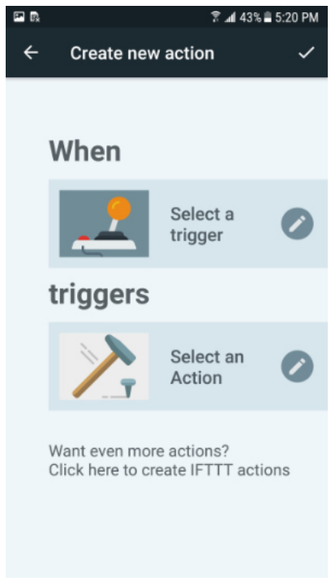


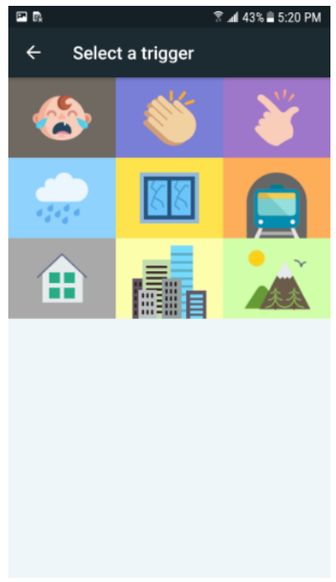


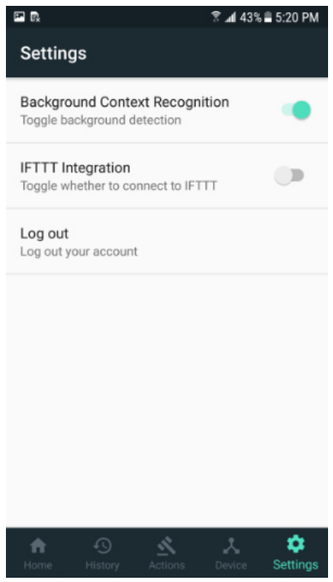






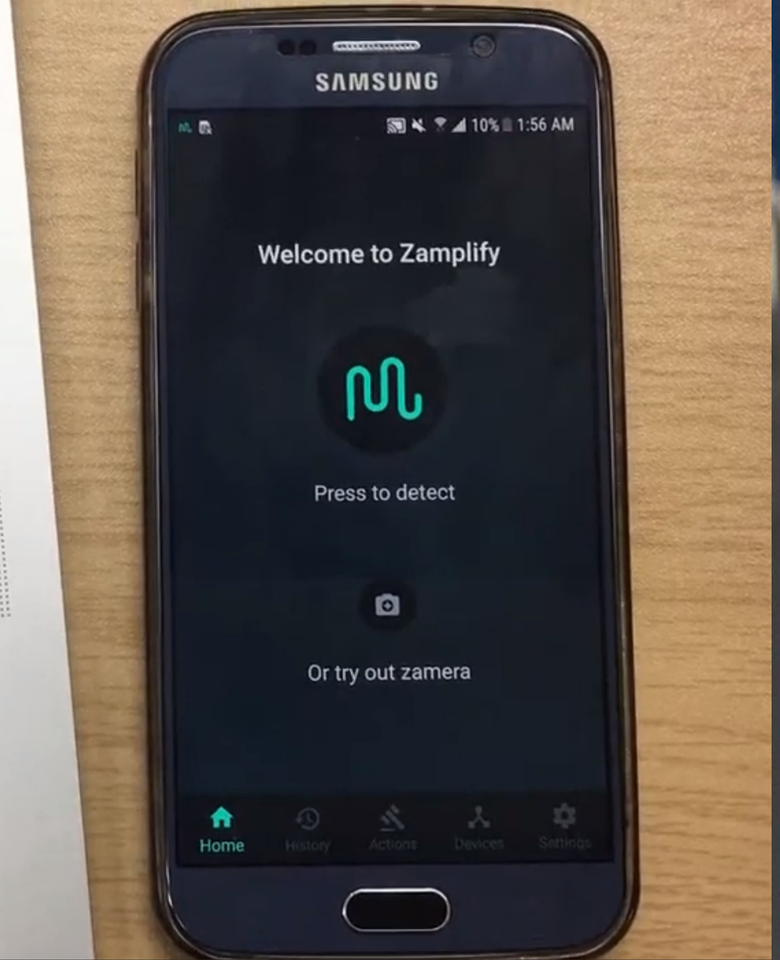






IoT Device

The IoT device that we built is an Internet-connected, always-on sound recognizer that can be used in homes and offices. The device was developed using a Raspberry Pi Zero W microcontroller and a ReSpeaker Mic Hat microphone array. A case was 3D-printed to protect the electronic components and to improve the aesthetics. The device constantly records environmental sound and triggers actions specified by its users. Users can use the Zamplify mobile app to configure their trigger-action pair for sounds collected from the IoT devices.



Background

This project was my Final Year Project at the Hong Kong University of Science and Technology.

Date

August 2017 - May 2018

Collaborators

James Cheung

Samwalker Cheng

Martin Shin

Contributions

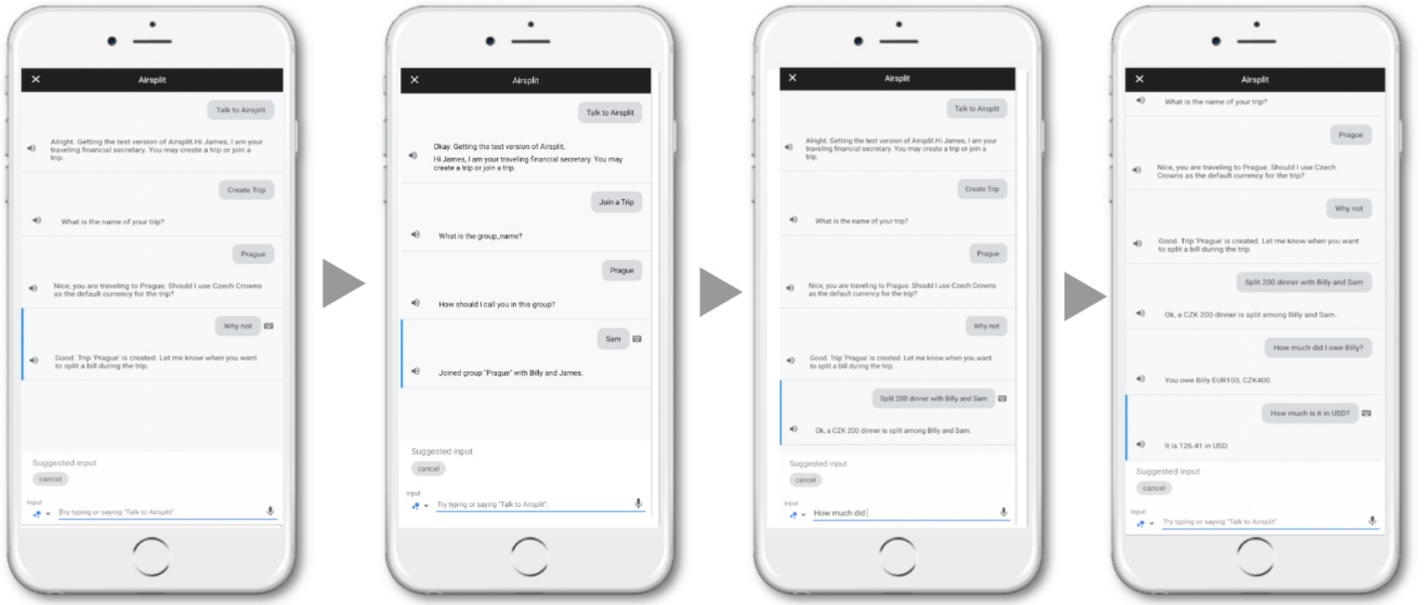
Machine Learning Model Training and Evaluation, Mobile App Design and Development

Additional Project Highlights

5 Airsplit

Group travel expense management over voice interface

Airsplit is a bill splitting voice service enabling lightning-fast bill logging and automatic currency conversion. It requires no app installation, minimizing the friction for new users. Its functionalities are also directly integrated into Google Assistant, making it convenient to interact on the go. After logging the bill with a single voice command, users can put down their phones and enjoy the precious travel time with their friends and family. Built with Dialogflow, Firebase and Google Actions, this voice service was developed in Google Developer Group Global Voice+Travel Hackathon 2019 and won the Global Top 10.



1. You start by creating a Trip by saying:

"Create Trip Prague as James" or answer the questions raised by *Airsplit*

2. Your travel buddies join the group you created by saying:

"Join trip Prague as Sam" or answer the questions raised by *Airsplit*

3. Split a bill among your friends by saying:

"Split a 200 dinner with Billy and Sam" or answer the questions raised by *Airsplit*

4. Check your 'debts' by asking:

"How much did I owe Billy" or "How much did Sam owe me".

You may convert it to your prefer currency too!

Background

This is a project in the Google Developer Group Global Voice Hackathon 2019.

Date

September 2019

Collaborators

James Cheung

Samwalker Cheng

Martin Shin

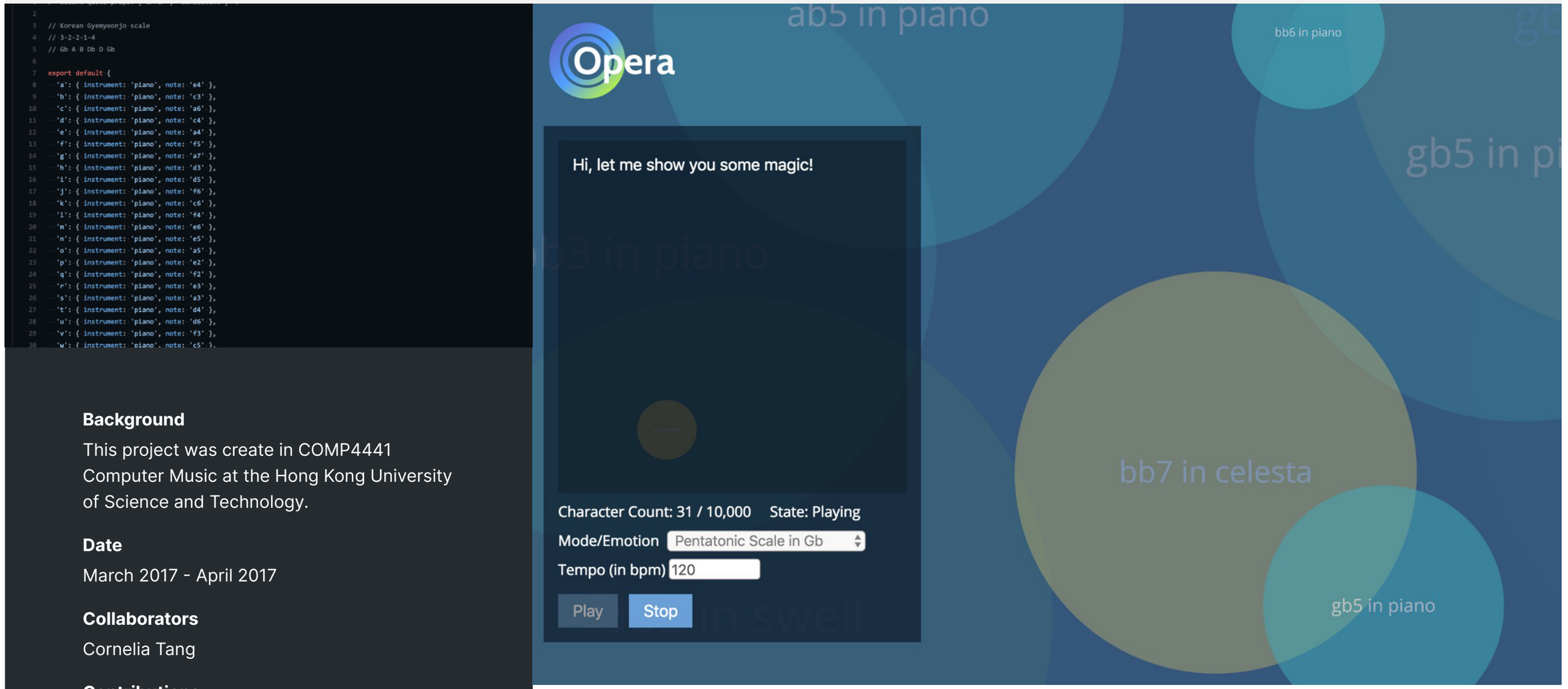
Contributions

Language Model Training, Back-end Development, Conversation Design

6 Opera

Turn any text into soothing music

This project explores the possibility of mapping textual data into melodies to provide an alternative way to appreciate a piece of text. This is done by transforming each character into a music note performed in a specific instrument. Users can select different mapping schemes to create different moods of music. For example, pentatonic scale tends to produce a calm and peaceful low-fi song. Musicians can also use this tool to find inspiration for new melodies.



Background

This project was create in COMP4441 Computer Music at the Hong Kong University of Science and Technology.

Date

March 2017 - April 2017

Collaborators

Cornelia Tang

Contributions

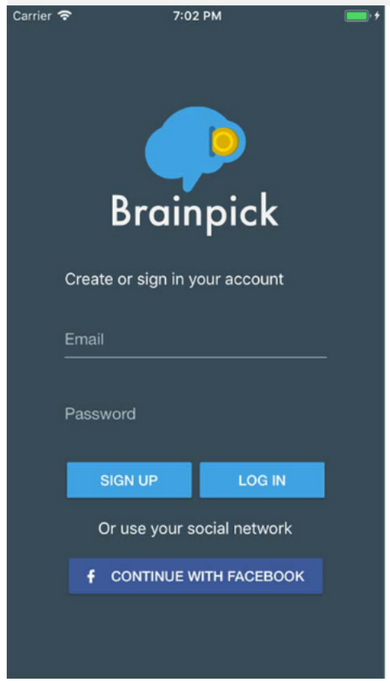
UI Design, Front-end Development, Music

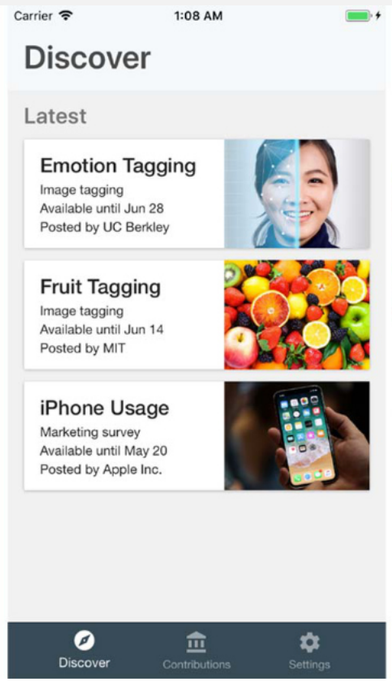
https://project-opera.netlify.app

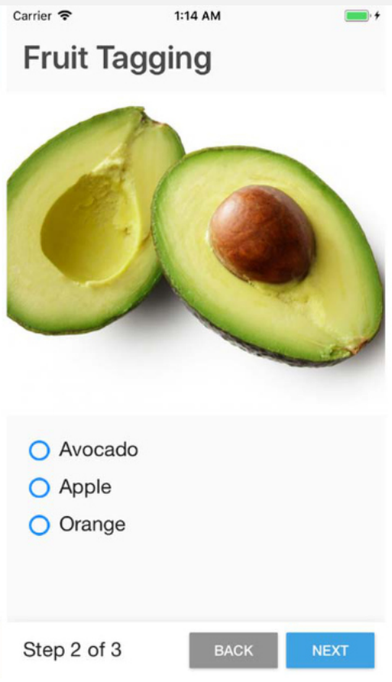
7 Brainpick

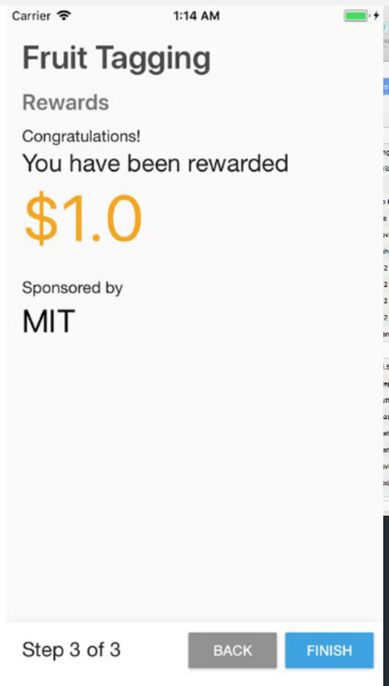
Crowdsource data for machine learning research

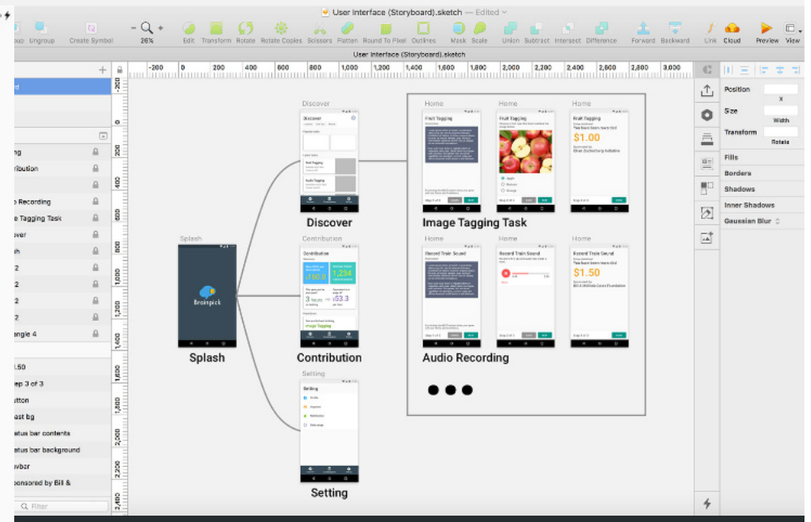
Brainpick is an intelligence crowdsourcing app that minimizes researchers' time and effort in data collection and processing, while providing a way for ordinary people to utilize their free time to earn money. Both commercial and academic researchers can submit tasks on the platform. The system will automatically distribute micro-tasks to all users, for example, photo tagging, price estimation, questionnaire, text sentiment, and so on. In exchange, users receive monetary rewards provided by either the submitters or sponsors.

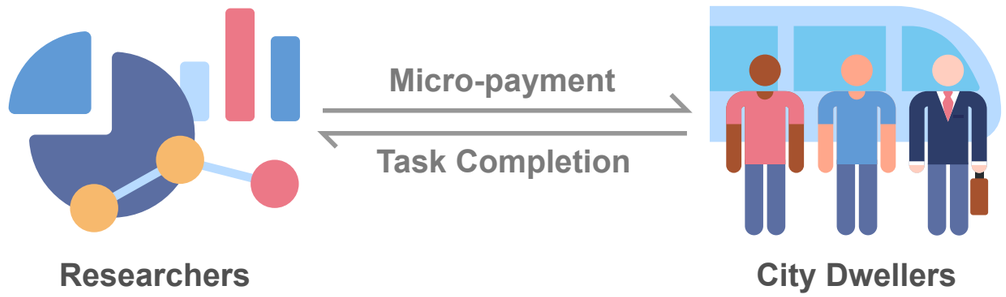












Background

This project was create in COMP4521 Mobile Application Development at the Hong Kong University of Science and Technology.

Date

February 2018 - May 2018

Collaborators

Martin Shin

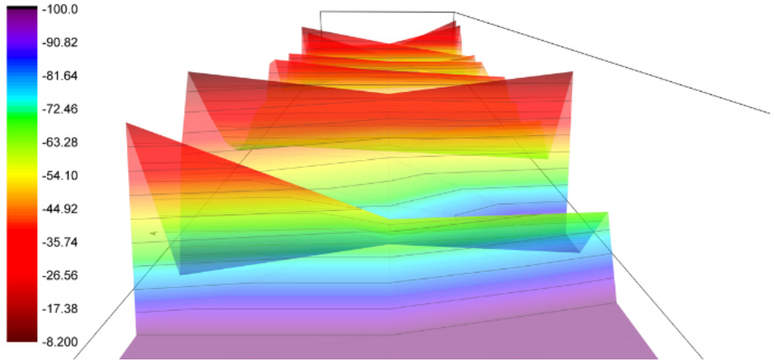
Contributions

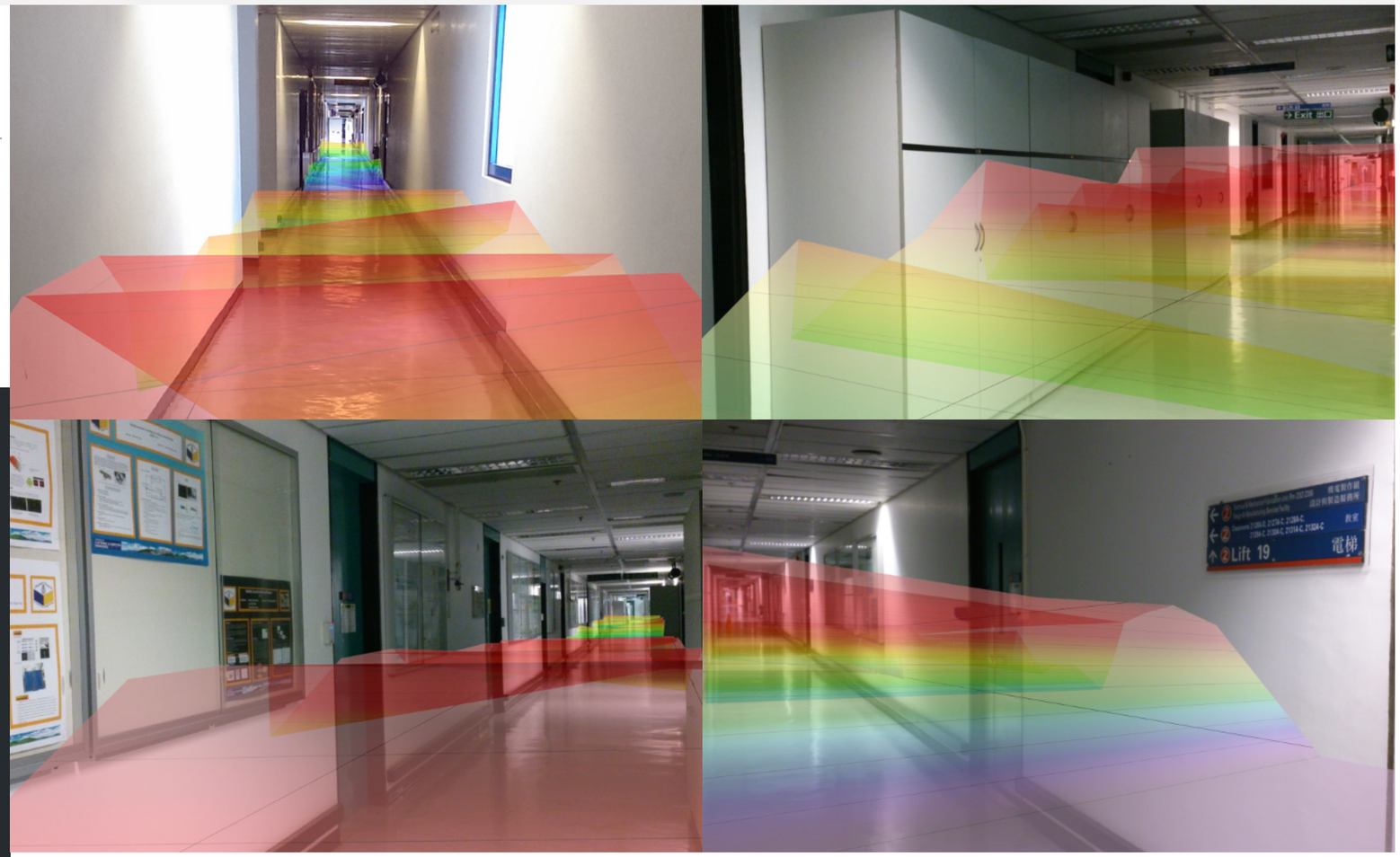
UI/UX Design, Android Development

8 Wireless Visualization

Visualizing indoor Wi-Fi signals

Wi-Fi is one of the most common technologies in our daily life. The research project aims at visualizing Wi-Fi signals to understand how a Wi-Fi network covers humans' working and living areas. By analyzing Wi-Fi signal strength (represented by RSSI) in several places on HKUST campus, we rendered a set of Wi-Fi signal visualizations. The result enabled researchers to further study the patterns and fingerprints of indoor Wi-Fi signals, which could be correlated to other data to reveal new applications, such as indoor localization, human activity monitoring, and so on.





Background

This project was created in the Undergraduate Research Opportunity Program (UROP) at the Hong Kong University of Science and Technology.

Date

June 2014 - August 2014

Collaborators

Kin Yip Au

Xin Yuan Yu

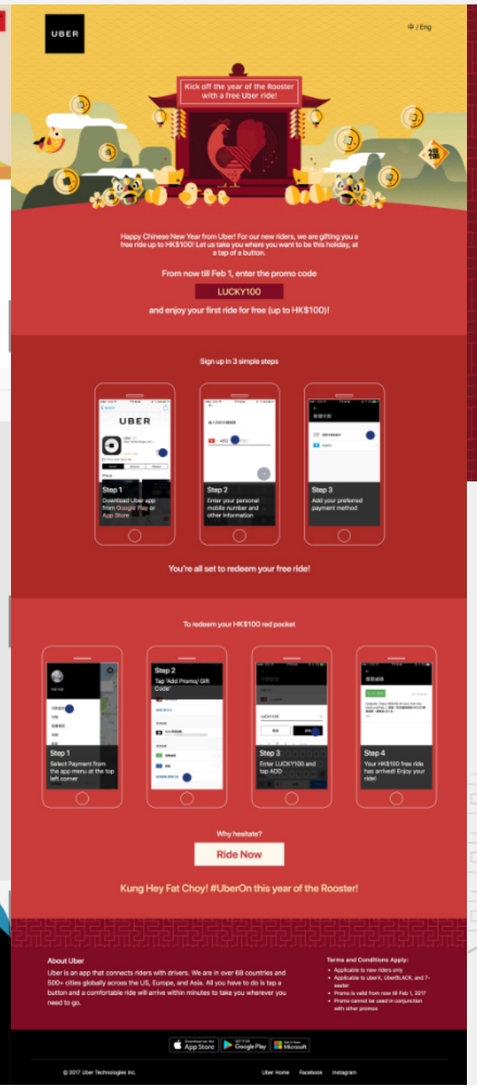
Contributions

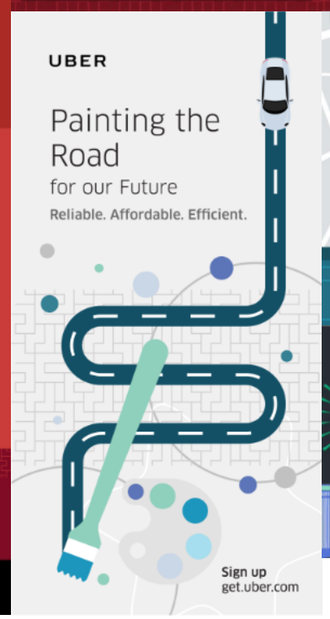
Data collection, 3D Modeling, Visualization

9 Uber Design Collection

A collection of design works for rider acquisition and driver retention campaigns

This is a collection of graphics, animations, and landing pages I designed in my internship at Uber Hong Kong. They are mainly created for acquiring new riders in social media campaigns. There is also a microsite helping drivers keep track of the latest benefits and promotions. To make the content engaging, I intentionally included cultural references that specifically resonate with the local audience in Hong Kong. A lot of them ended up reaching a very high engagement and conversion rate.





Background

These graphics, animations, and landing pages were designed in my internship at Uber Hong Kong.

Date

December 2016 - February 2017

Collaborators

N/A

Contributions

N/A

More projects available at

https://billykwok.me/work