Zhicong Lu

Portfolio 2014

Information & Interaction Design

Contents

About Caleb Zhicong Lu

I'm a Master candidate of Interdisciplinary Studies of Information and Art Design. Before starting my master, I had a bachelor degree of Electronic Engineering and Game Design at Tsinghua University. My research interests are HCI for sustainability and education. With the growth of population, China is facing the challenges from environment and people's well being. I dream of designing products that can solve people's problem and promote sustainability of environment, education, eating and other human activities, especially in developing countries like China. There are many special issues that can influence the solutions. I hope I can get a chance to conduct more research on technical HCI and its use for sustainability in the future. With my strong passion, eye for design, multi-faceted creativity and strong technical skills, I can create technology that is not only effective, but also memorable, enjoyable, desirable and sustainable.

Farm+ Oyster

sense-t
from sensing to intelligence

“Farm+Oyster” Mobile App for Aquaculture

"Farm+ Oyster" is a mobile application for situational awareness of oyster and aquaculture. It helps managers of oyster farms to get the information about the sea where they raise their oysters. The app offers information about water temperature, salinity, water depth, dissolved oxygen and turbidity, so that farm managers can know more about the situation of the water. It can help the managers make wiser decisions and be alerted to abnormal situations, so as to optimise the output of their oyster farms.

My role: Interaction Designer and Developer

Advisor: Henry Duh, University of Tasmania
Co-developer: Yuan Wang

The project was one of the cases of the workshop “HCI in food product innovation” in CHI 2014

Farm+ Oyster

Persona

Name: Julia
Age: 35
Married
Mother of 2
Oyster farm manager

Julia has a large oyster farm of her own. Every day, she goes to the farm every day to check the status of the water. She records water temperature, salinity, depth and other parameters on a PC document, and uses PC to store the data. She uses PC to calculate cost or predict growth of oysters. Sometimes she also need to get infomation from Bureau of Meteorology, Tasmania to know about weather, or alert of algal bloom. She has to take actions if algal bloom is about to come, otherwise she would have huge loss. She often uses mobile in the sun, sometimes the screen reflects sunlight and she can hardly see anything on it.

Sensor made by Sense-t

Services from sense-t

Card Sorting was used to find the appropriate structure

Weather Information

General Info
- Temprature
- Water temprature
- Algal Blooms
- Tide
- Rainfalls
- Harvest closure

History Info
- Temprature
- Water temprature
- rainfalls

Sensor Information

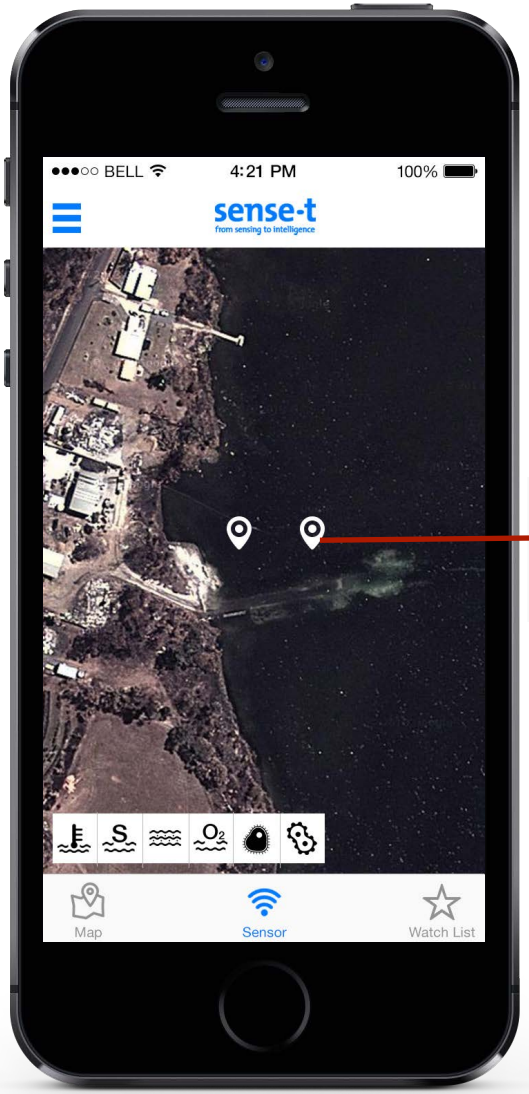
General Info
- Heartbeat
- Size
- Water temperature

History Info

Growth Prediction

Farm+ Oyster

Map View

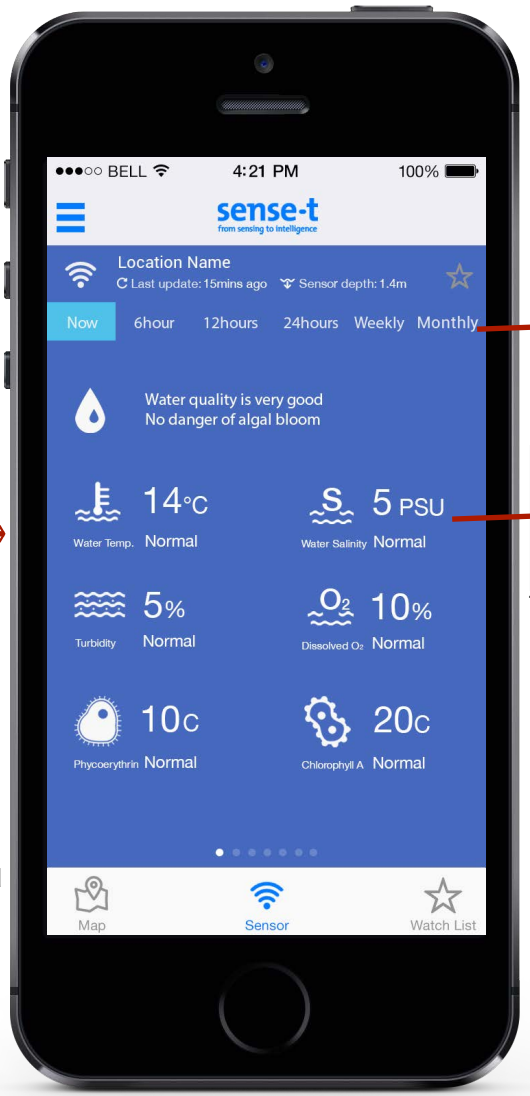


Tap for primary action

Tap to see data

The background color is designed to be visible in the sunlight

Sensor Data View



Tap for primary action

Tap to select timescale

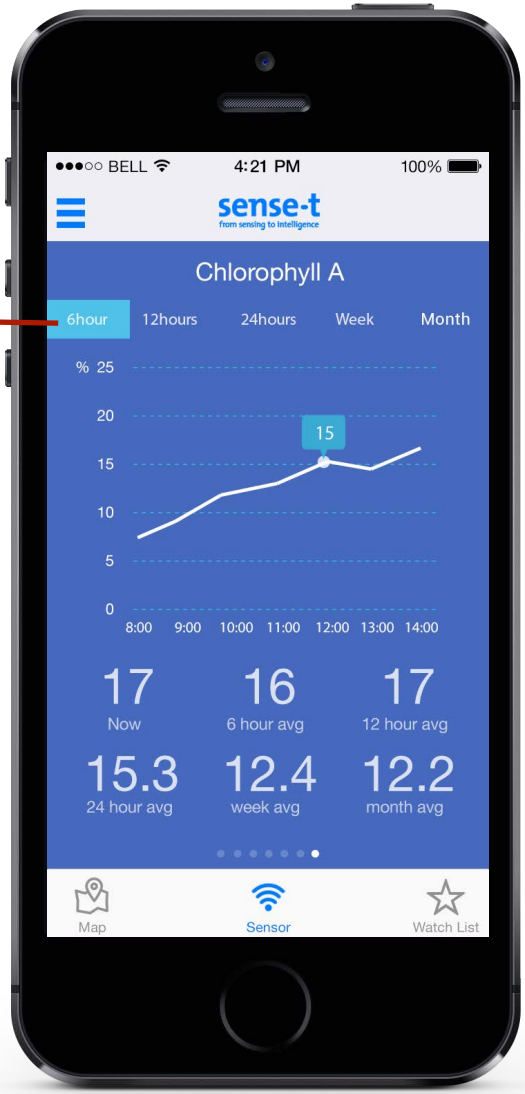
Tap for primary action

Tap to see history

Slide to pan

Slide to see different parameters

Data History



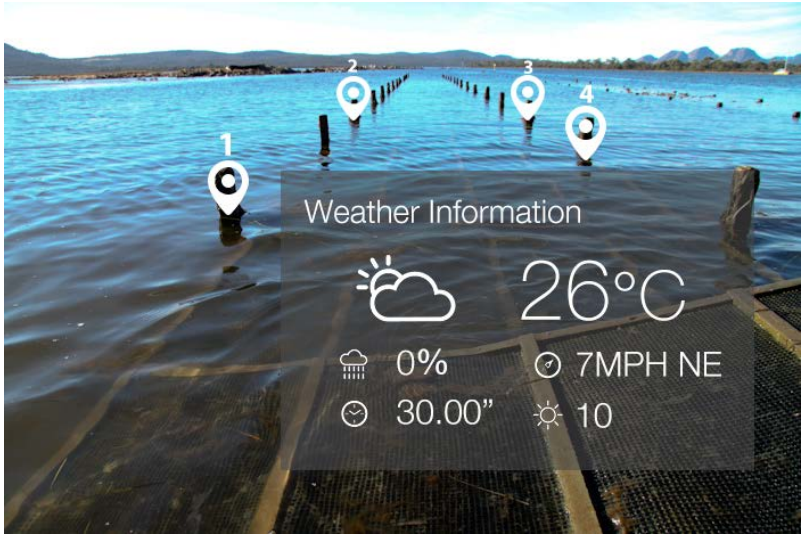
Farm+ Oyster

Concept Design of App on Google Glass for Aquaculture

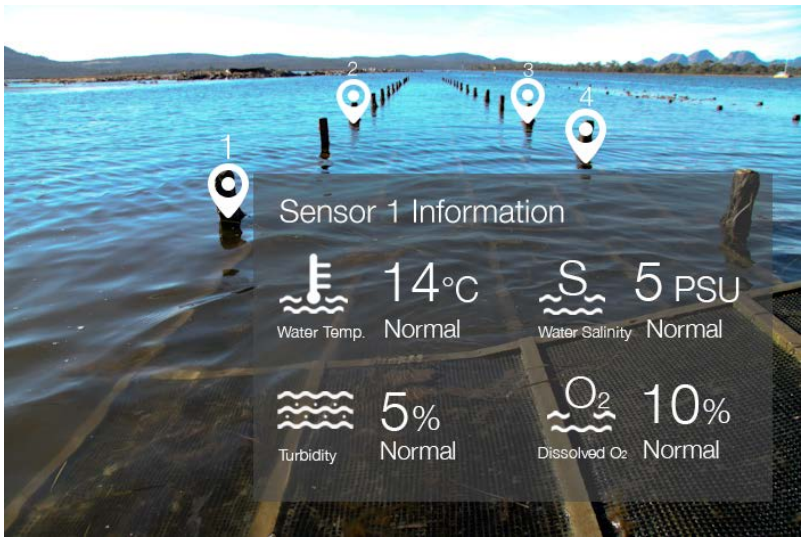
When using the mobile app in the sun, sometimes the screen of the mobile can be invisible in strong sunlight. This situation leads to the concept design of app for aquaculture on Google Glass.

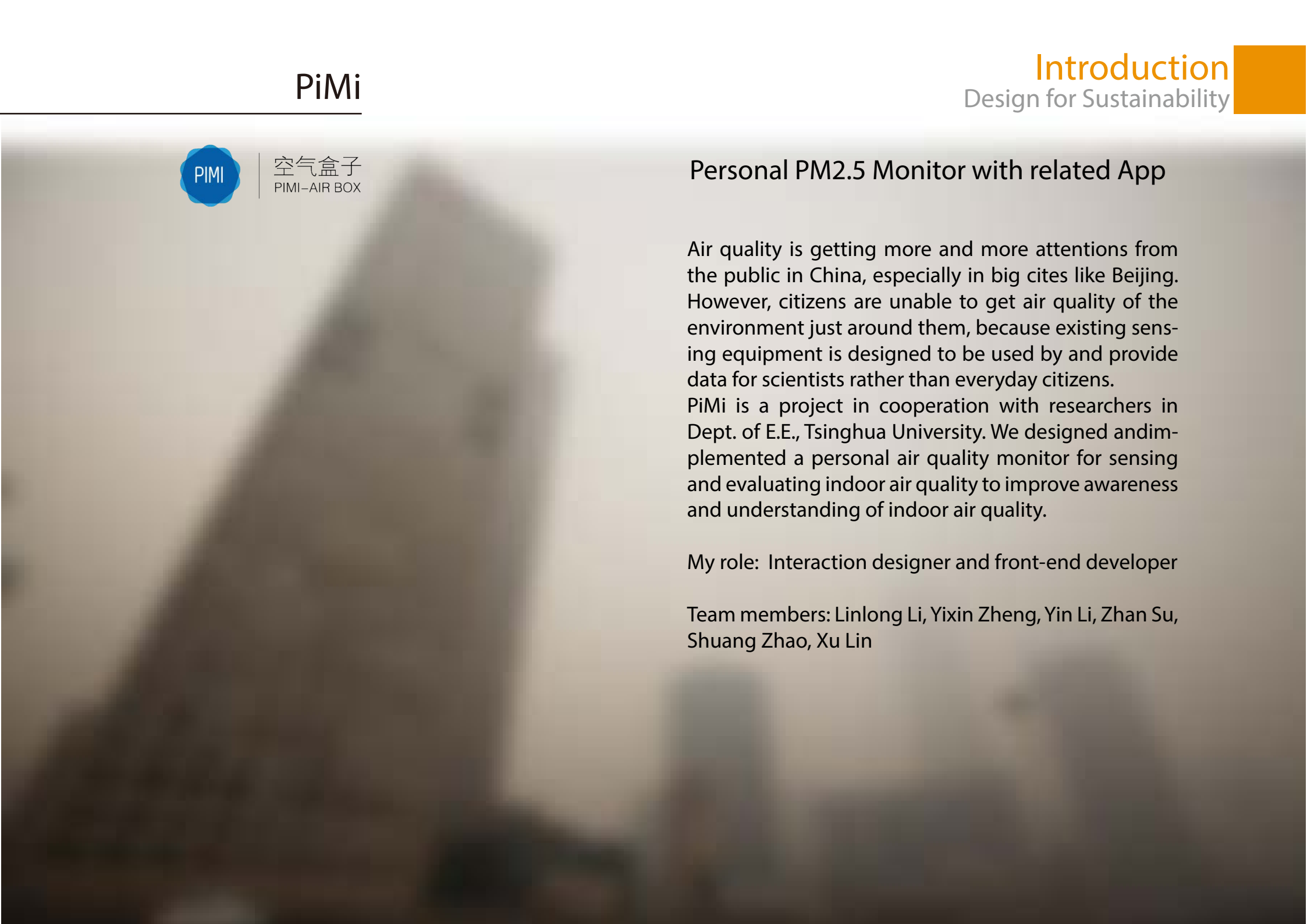
User can use google glass to explore the data he/she wants. He/She can speak to ask about specific information, or just tap on the glass to see different information.
Such experience can give user more natural way of interaction with data from real world.

Hi, Google.
Weather information



Hi, Google.
Sensor 1 information





PIMI 空气盒子 PIMI–AIR BOX

Personal PM2.5 Monitor with related App

Air quality is getting more and more attentions from the public in China, especially in big cites like Beijing. However, citizens are unable to get air quality of the environment just around them, because existing sensing equipment is designed to be used by and provide data for scientists rather than everyday citizens.
PiMi is a project in cooperation with researchers in Dept. of E.E., Tsinghua University. We designed andimplemented a personal air quality monitor for sensing and evaluating indoor air quality to improve awareness and understanding of indoor air quality.

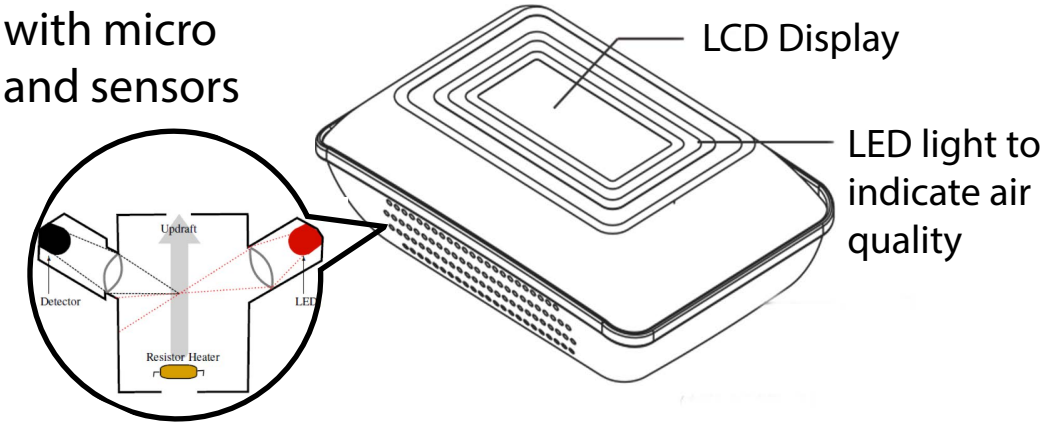
My role: Interaction designer and front-end developer

Team members: Linlong Li, Yixin Zheng, Yin Li, Zhan Su, Shuang Zhao, Xu Lin

PiMi

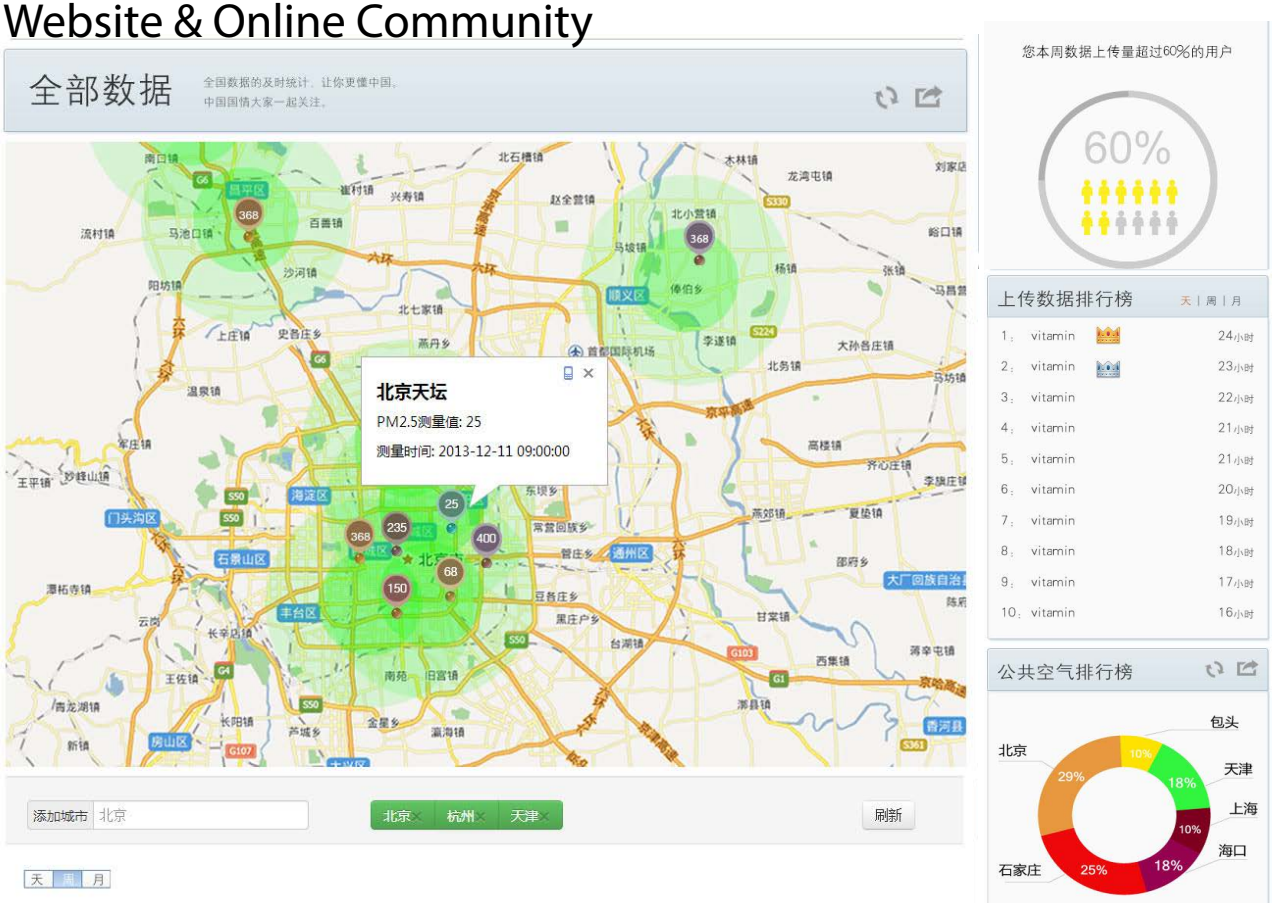
PiMi Air Box consists of 3 parts: hardware, mobile app and online com-muntity.

Hardware with micro controller and sensors



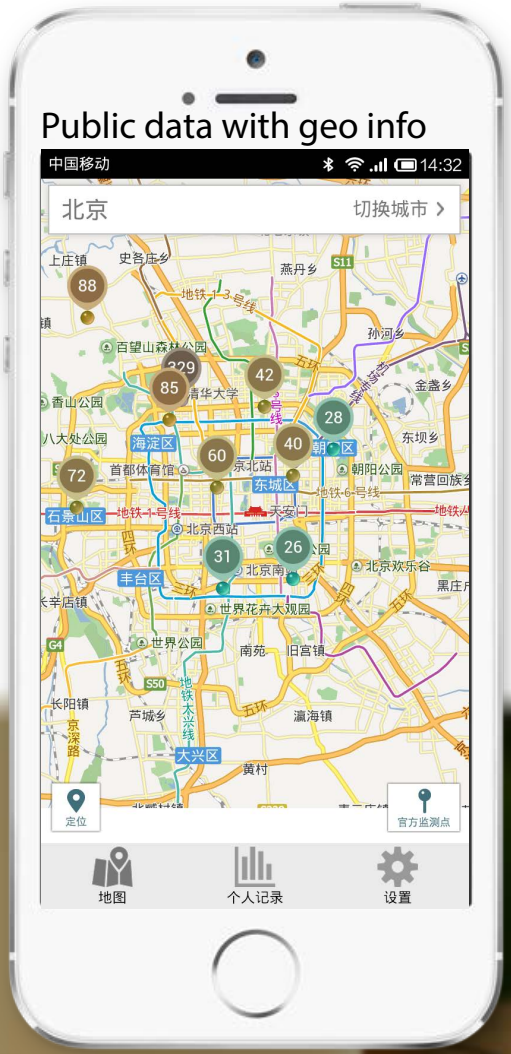
Mobile App

Website & Online Community



Mobile App User Interface Design

Public data with geo info



Sync realtime data with hardware

History data

Website and Online Community Design

Personal Behaviour Log

User can get data from the website. The website also enables user to log their behaviours at the times when data changes significantly. It remind user by asking “What are you doing at that time”? By logging and sharing, users can share their experience and knowledge about indoor air quality.

Rankings

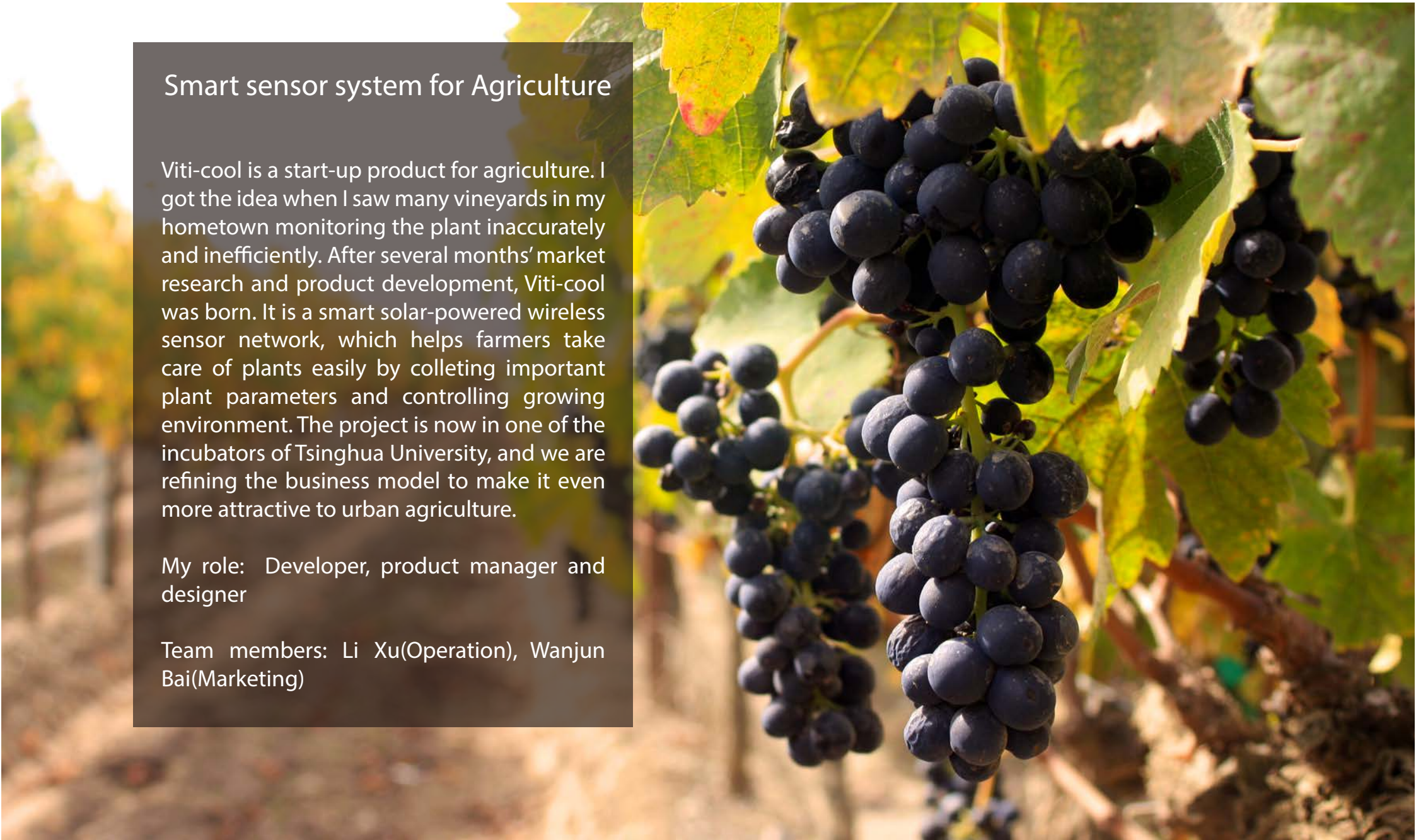
The rankings of the user’s data contribution help to keep user’s enthusiasm of using the device.

PiMi

By sending out about 500 devices to the citizens in Beijing, we got many personal air quality data for several months, expecially the data when Beijing suffered from heavy smog. Analyzing of the data is still in progress. But we do find something interesting about user's behaviour during the experiment. Many people are very curious about the device and they made experiments to test whether the device was working well and posted their findings by social media like Weibo. This helps us raise the public awareness of air quality and some bad behaviours. It also make users have more fun using the device.

For example, one user made an experiment about how the device will change color when smoking. He smoked besides the device, and took photos of the color of light from the device, which indicated the air quality. The photos he tweeted on Weibo showed that the air quality was deteriorating when he was smoking. At last he showed the realtime data on the mobile app, which was terrifying. Many users retweeted it and commented that smoking is really bad, and many other people joined the discussions.
Some people even use the device to warn somebody not to smoke in door. Many potential research deserve further study, such as what is a better way to help people give up unhealthy behaviours like smoking? How to visualize data and how to persuade user?

Viti-cool



Smart sensor system for Agriculture

Viti-cool is a start-up product for agriculture. I got the idea when I saw many vineyards in my hometown monitoring the plant inaccurately and inefficiently. After several months' market research and product development, Viti-cool was born. It is a smart solar-powered wireless sensor network, which helps farmers take care of plants easily by colleting important plant parameters and controlling growing environment. The project is now in one of the incubators of Tsinghua University, and we are refining the business model to make it even more attractive to urban agriculture.

My role: Developer, product manager and designer

Team members: Li Xu(Operation), Wanjun Bai(Marketing)

Viti-cool

Initial User Research

We interviewed 10 vineyard managers in China about their methods of monitoring parameters of their plants and the cost. They're monitoring by inviting experts from abroad, which is very expensive and inconvenient.We also performed a competitive analysis on existing product like Eydn.

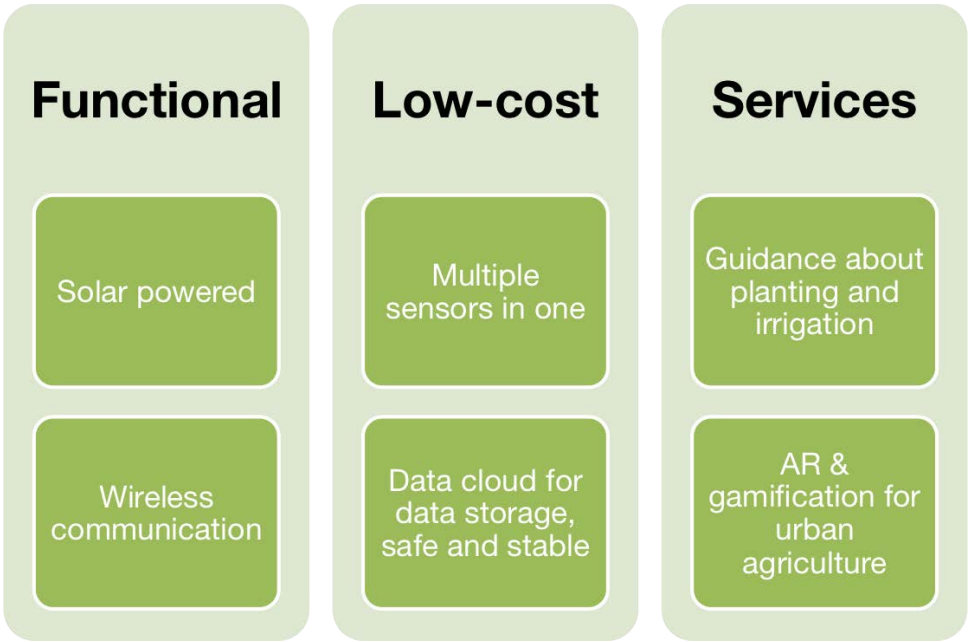
New Market

As people in China are worrying more and more about pollution and food safety, many people begin to grow their own fruits and vegetables by urban agriculture. Some companies rent fields for urban citizens to grow their plants. However, many people don't have enough time to take care of the plants and enough knowledge about growing plants, and can't get what they expect from the field they rent. This is a waste of field and money. After we made an online survay about people's opinion about intelligent system of agriculture, we found many people think they need such product.

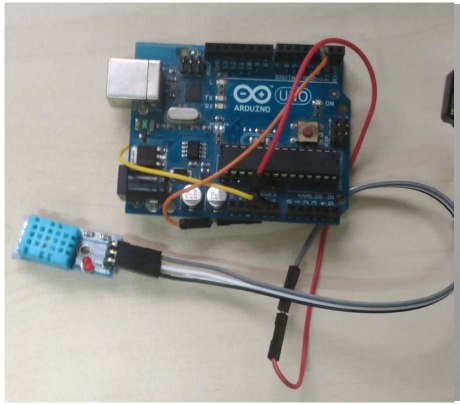
User Needs and Oppertunities

Wineries in China	Our Intelligent System
• Inaccurate monitoring • Inconvenient • High Labor cost	• Accurate monitoring • Efficient & Remote • Less Labor & cost

Competitive Edges of Our System

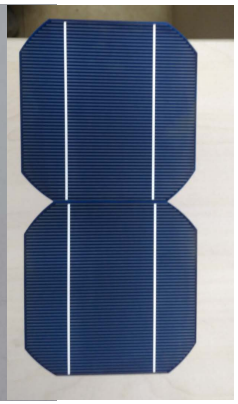


Prototype



Arduino & Sensor

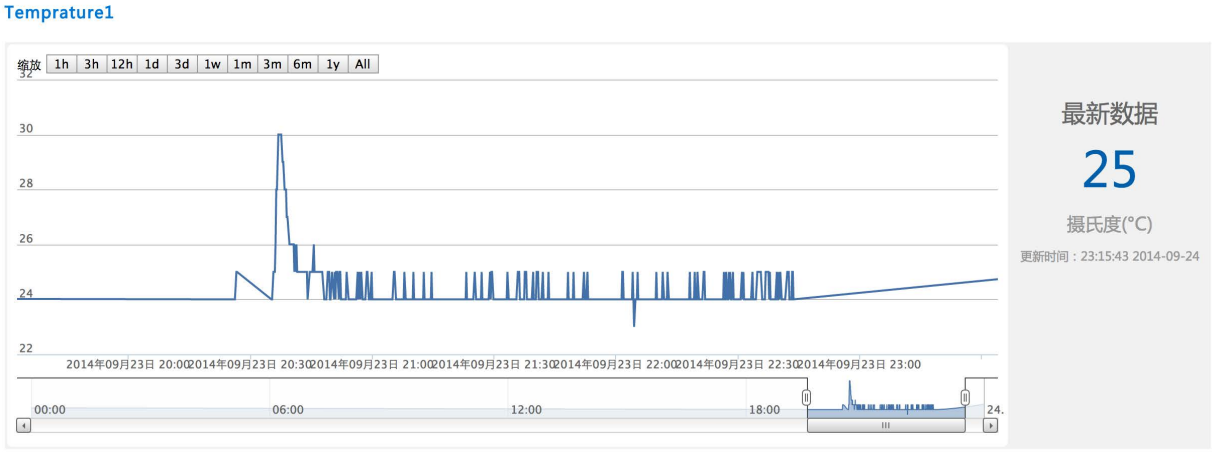
Raspberry Pi



Solar Panel

We made a prototype by Arduino and Raspberry Pi. Arduino samples the sensor data and send data to Raspberry Pi through serial communication. And Pi sends the data to the server.

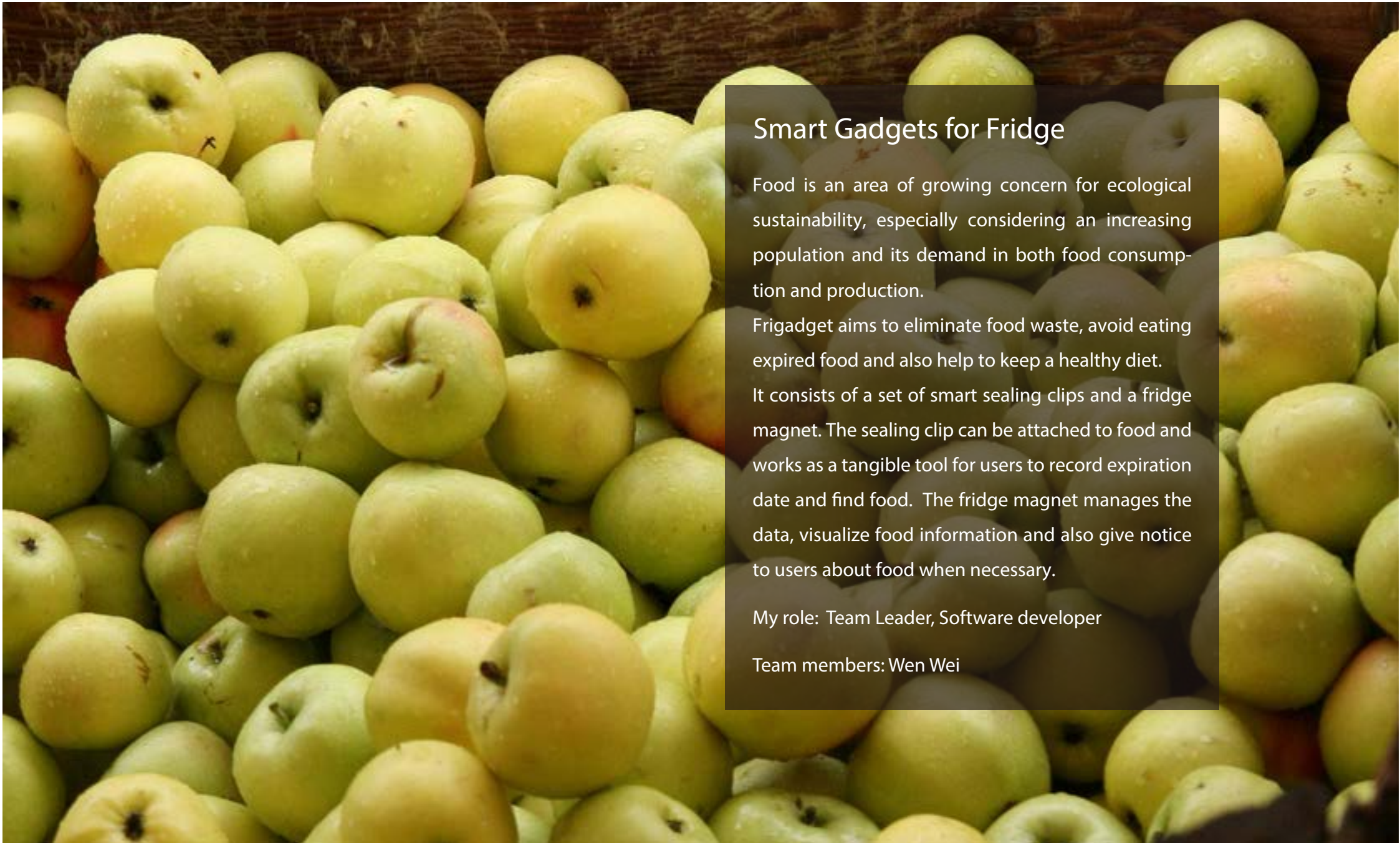
Software on the server visualize the data.



Prototyping Web Application

Prototyping Mobile App for vineyard

Frigadget



Smart Gadgets for Fridge

Food is an area of growing concern for ecological sustainability, especially considering an increasing population and its demand in both food consumption and production.

Frigadget aims to eliminate food waste, avoid eating expired food and also help to keep a healthy diet.

It consists of a set of smart sealing clips and a fridge magnet. The sealing clip can be attached to food and works as a tangible tool for users to record expiration date and find food. The fridge magnet manages the data, visualize food information and also give notice to users about food when necessary.

My role: Team Leader, Software developer

Team members: Wen Wei

Initial User Research

We made a short survey among students in China, about the problems they meet at home. Most students reported that they have problems of managing food. Most reported problems with food:

- Over-buying of the food
- Finding food in the crowded fridge
- Food expiration because of ignoring
- Food purchase suggestions
- Food nutrition guide
- Additctions with snacks

Needfinding

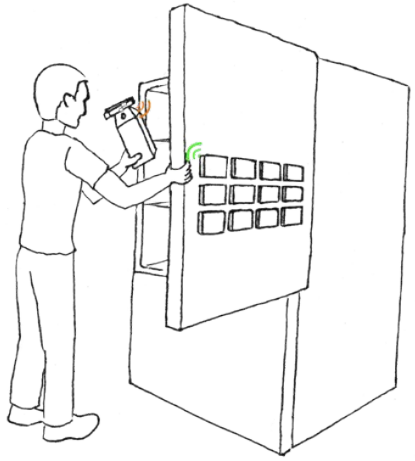
People need help to:

- Reduce food waste
- Reduce over-buying of the food
- Be reminded about food expiration
- Plan shopping list about food
- Plan nutritious food
- Change unhealthy eating habbit

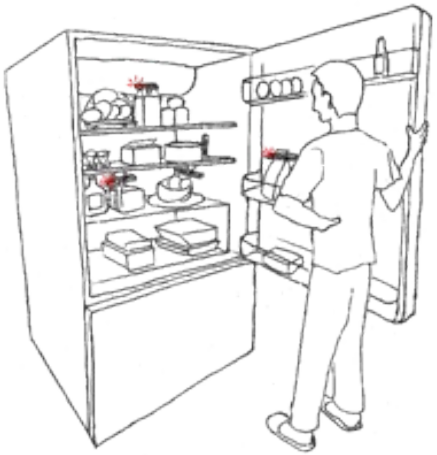
Frigadget

The mobile app can inform users about the food stored at home and the amount.

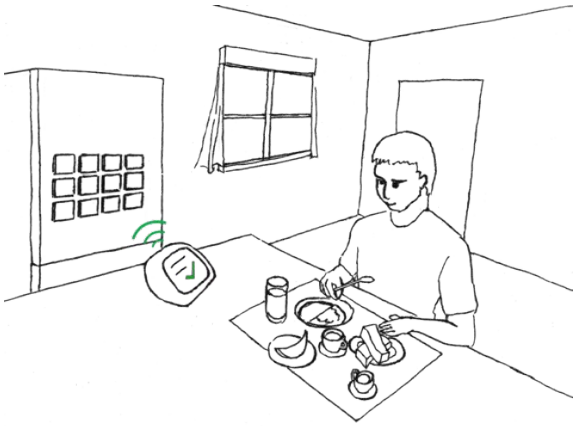
It can also give suggestions on what and how much to buy for healthy diet.



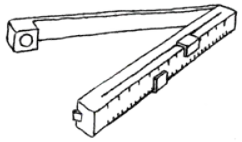
User attaches sensor to the food, set the expiration date, put it in the fridge and tell the system what it is. The system will record information about the food automatically. Users can see the status of the food on fridge magnets.



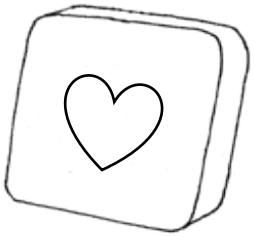
Users once touch the magnet, the LED on its paired clip will light up to help find the food easily. When the user gets too much food from fridge, he will be warned by the little robot.



The system gets the ingredients' information of a meal by analyzing which clips are taken off, visualizes the information on mobile phone or tablets, and gives suggestions on healthy eating.

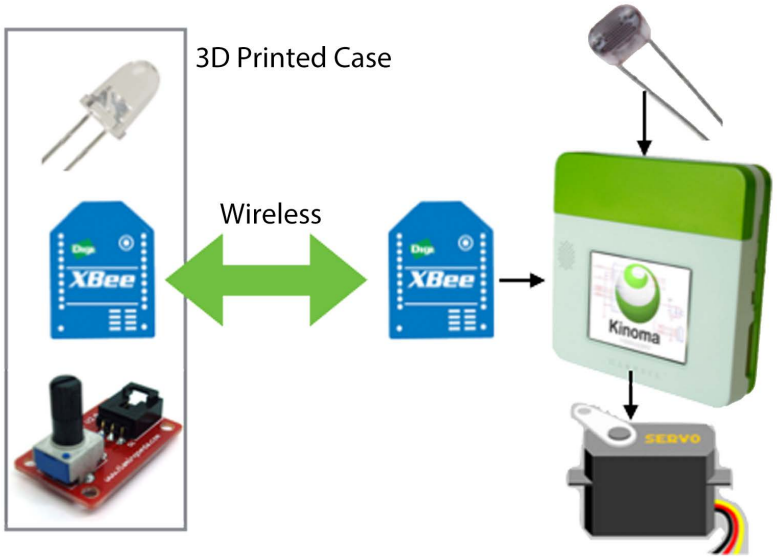


Sealing clips with sensor and LED

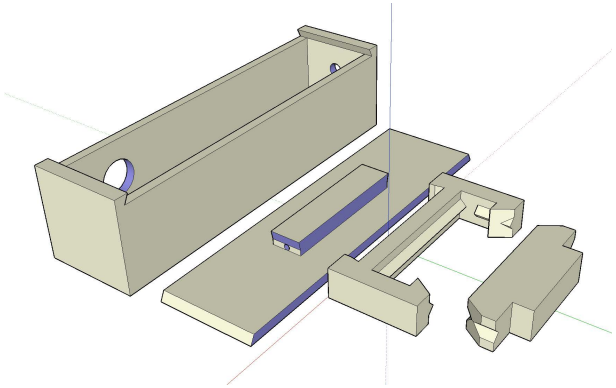


Fridge magbets to show information

Frigadget

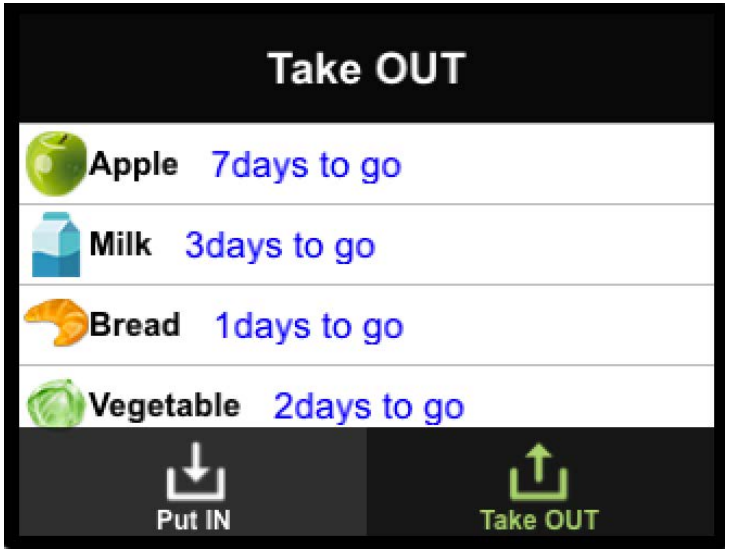


Implementation



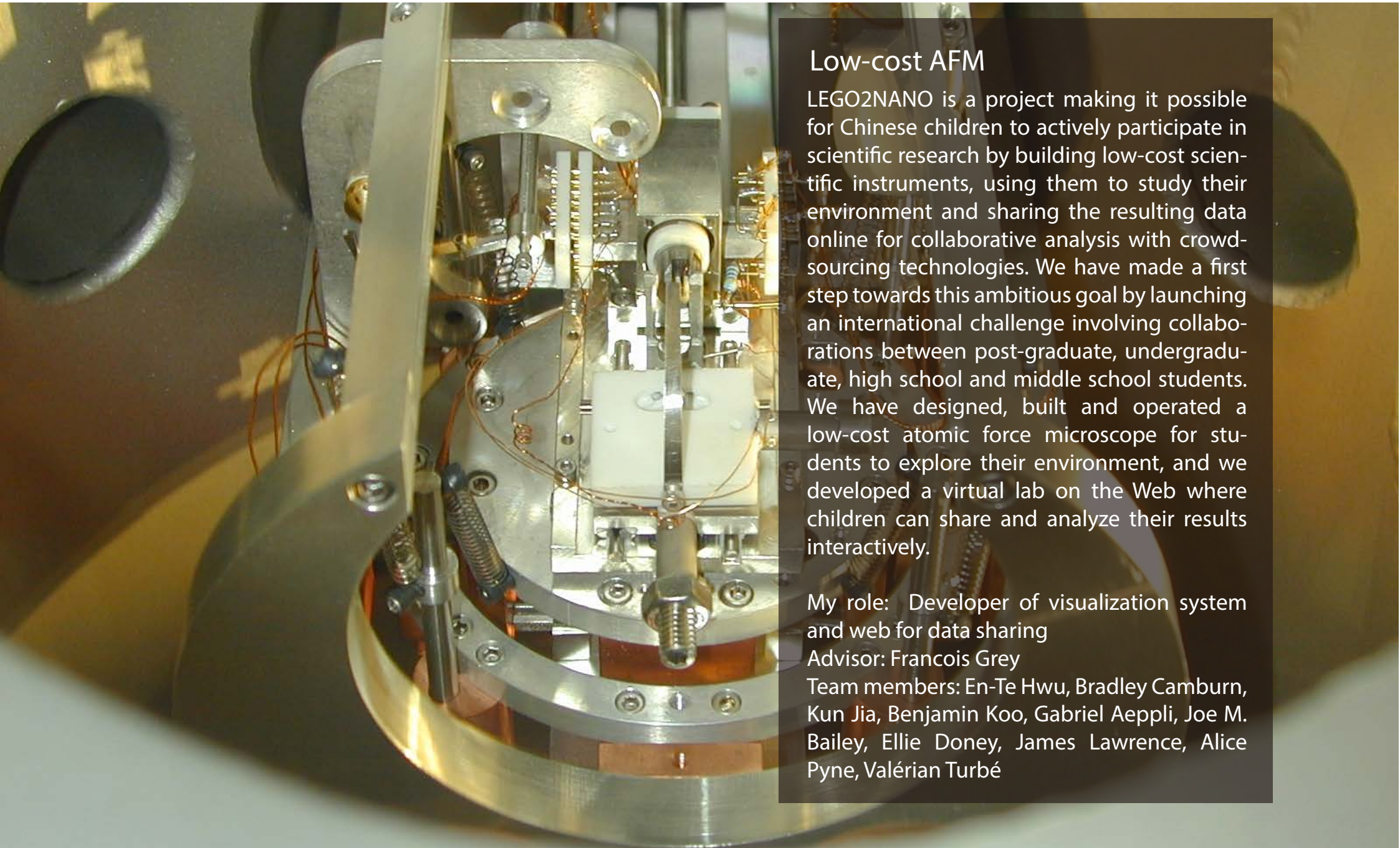
Clip 3D model

3D Printed Clip



Kinoma Create UI Design

LEGO2NANO



Low-cost AFM

LEGO2NANO is a project making it possible for Chinese children to actively participate in scientific research by building low-cost scientific instruments, using them to study their environment and sharing the resulting data online for collaborative analysis with crowdsourcing technologies. We have made a first step towards this ambitious goal by launching an international challenge involving collaborations between post-graduate, undergraduate, high school and middle school students. We have designed, built and operated a low-cost atomic force microscope for students to explore their environment, and we developed a virtual lab on the Web where children can share and analyze their results interactively.

My role: Developer of visualization system and web for data sharing
Advisor: Francois Grey
Team members: En-Te Hwu, Bradley Camburn, Kun Jia, Benjamin Koo, Gabriel Aeppli, Joe M. Bailey, Ellie Doney, James Lawrence, Alice Pyne, Valérian Turbé

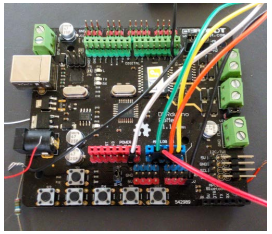
Problem

Atomic Force Microscope (AFM) relys on sensing the direct action between a probe and a sample surface. It is a great scientific instrument for exploring materials and samples. However, children in China and other developing countries are hard to get access to such instruments because they are very expensive. We want to design and develop an AFM that costs less than $100.

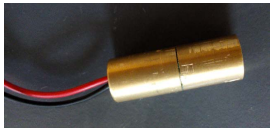
The Making of Low-cost AFM

The low-cost LEGO AFM is designed to work in the contact mode, and the tip will be in contact with the sample during the scanning process. The LEGO AFM contains a sample stage that moves in x and y direction, a cantilever holder that moves in z direction, a laser and a photo detector to readout the deformation of the cantilever and a control system based on Arduino

The structure of the LEGO AFM. In this hybrid stricter of LEGO AFM, the main structure is made of metal to guarantee a good stability, while the holders are assembled by LEGO part as well as 3D printed part to offer some versatility

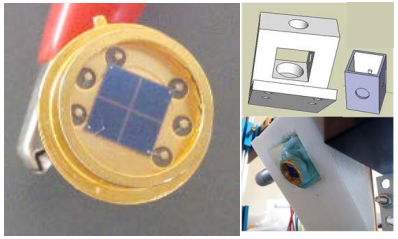


The Arduino based control system is to give the controlling signal for scanning voltage and take in the signal from the photo detector for analysis.

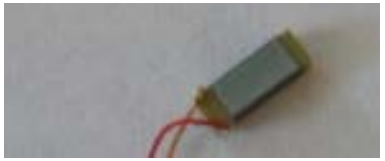


Laser spot is reflected by the cantilever to readout the deformation

The probes used for the LEGO AFM. The probes are cantilever made of silicon nitride and with a sharp tip at the flexible end give a high resolution. The cantilevers are coated with gold to reflection the laser spot for readout.



Four-quadrant photo detector is to detect the position of the reflected laser spot. Its holder is 3D-printed.



The piezoelectric actuators will extend or shrink with applied voltage to give a displacement in nanometer scale. The scanning voltage is tuned by Arduino

Participatory Design with Children

To make the LEGO2NANO AFM more suitable for children to use, we did some usability studies with students in China.Students try to make their own AFM with the help of our instructions, and explore different materials with the AFM and software.

We found several design spaces for scientific instrument for children:

Learning by making

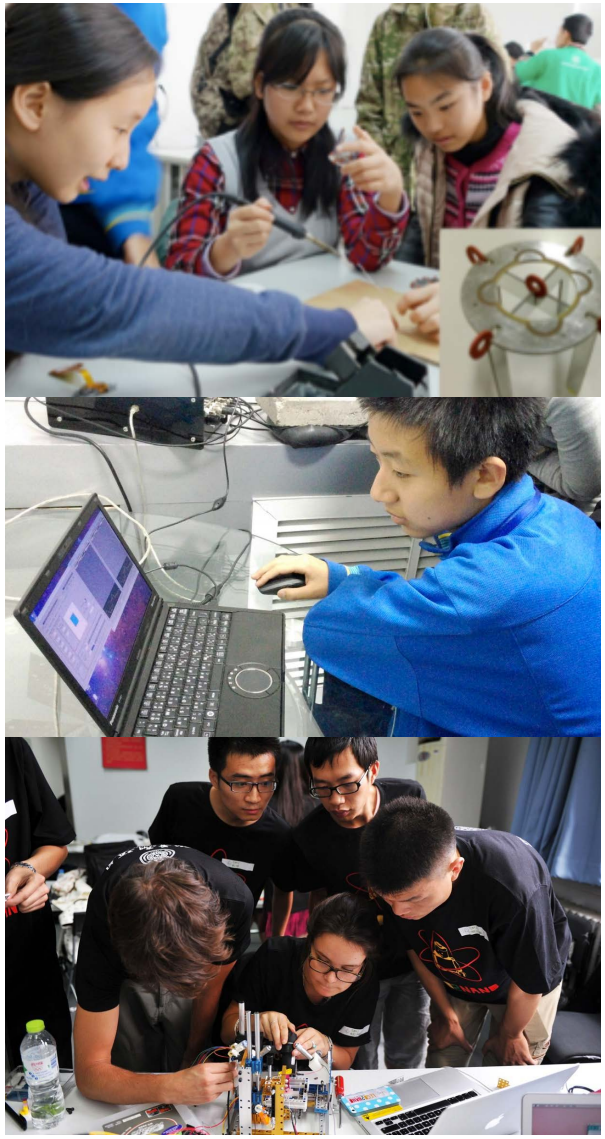
- Students not only like to use the instrument itself, but also like to know how to make the instrument.
- How to design an interactive instruction for them to build their own instrument?

Better Interface Design

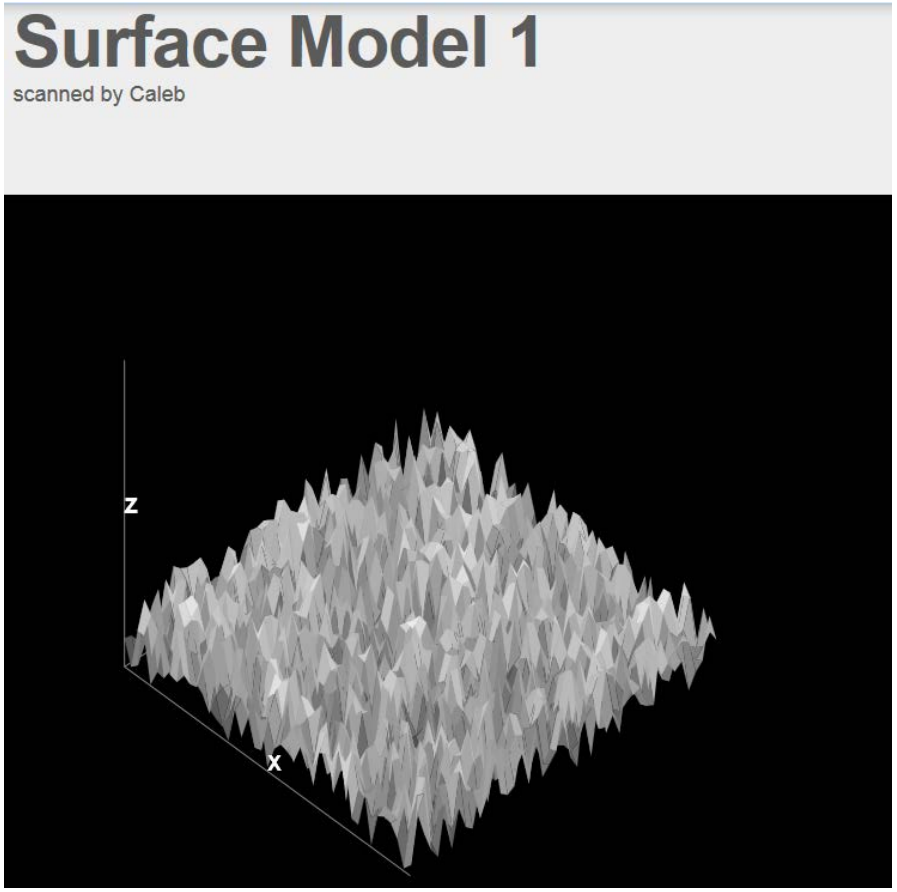
- The students are creative in choosing topics, how should the interface increase their creativity in choosing research topics?

Online Platform

- Students can help each other learn science online, and discuss hard problems together
- How to promote cooperation and increase learning efficiency?

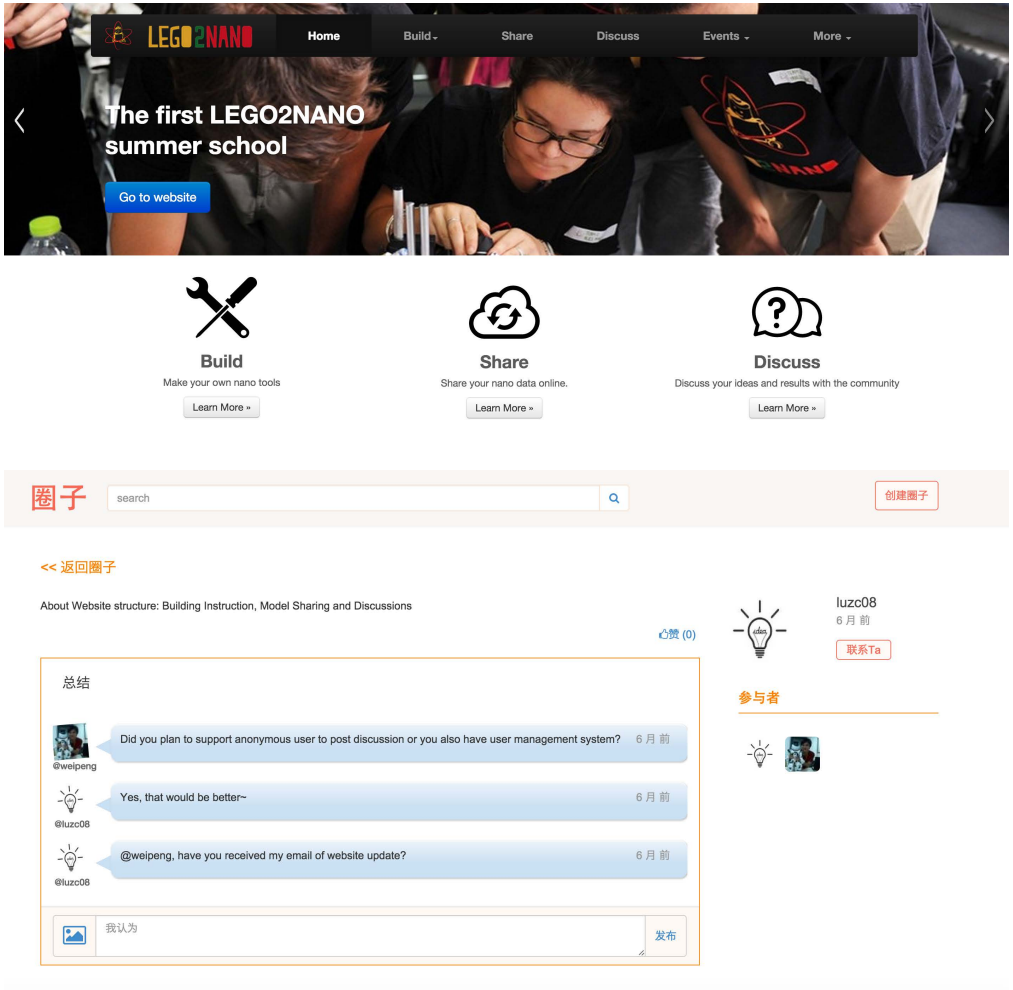


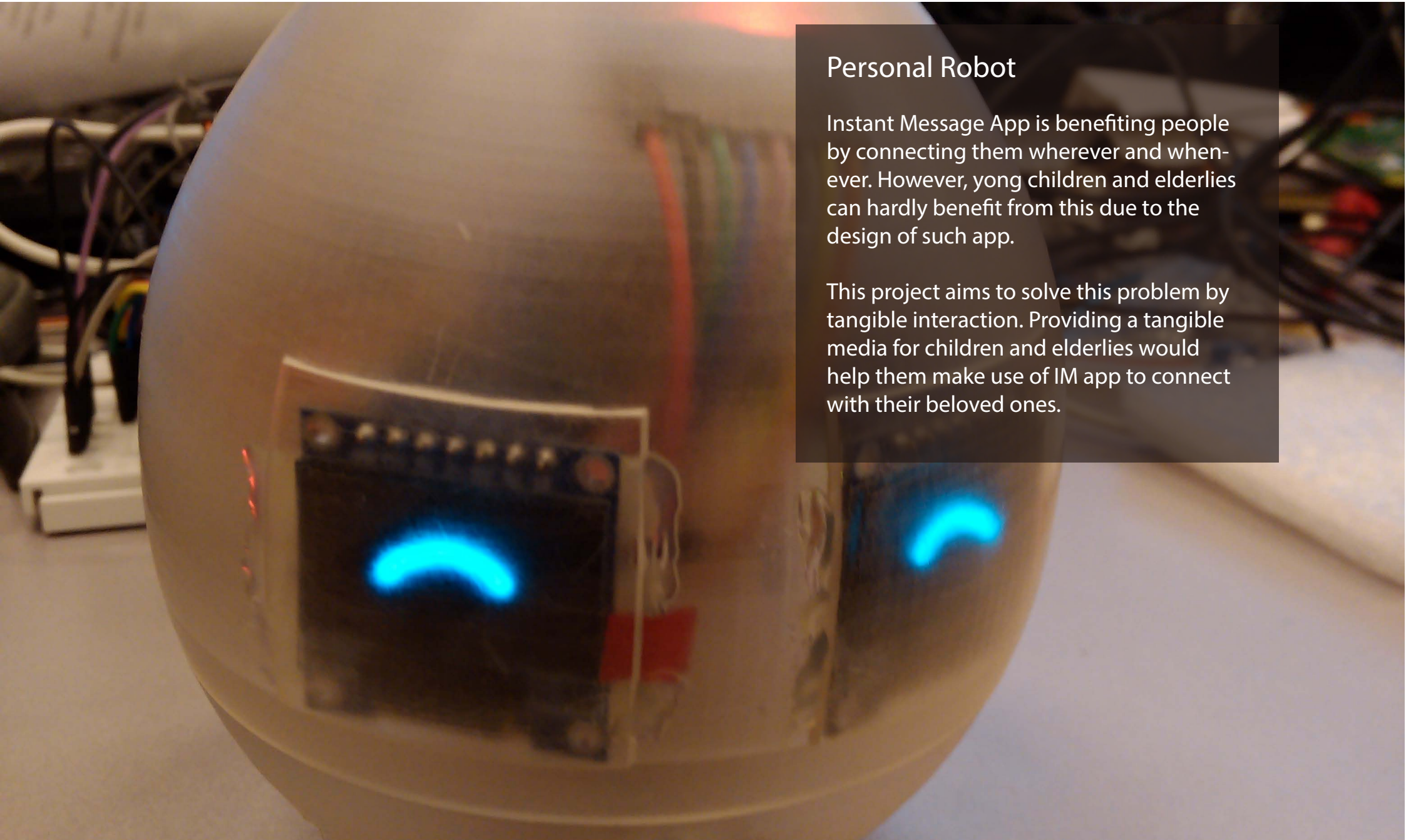
AFM Visualization Interface



Student can use mouse to rotate the scanned 3D model

Online Platform





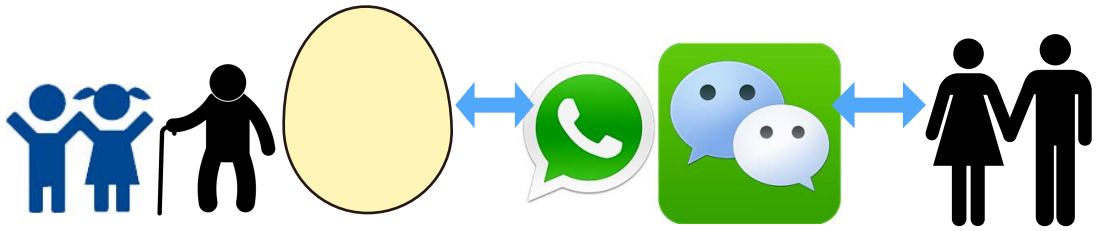
Personal Robot

Instant Message App is benefiting people by connecting them wherever and whenever. However, yong children and elderlies can hardly benefit from this due to the design of such app.

This project aims to solve this problem by tangible interaction. Providing a tangible media for children and elderlies would help them make use of IM app to connect with their beloved ones.

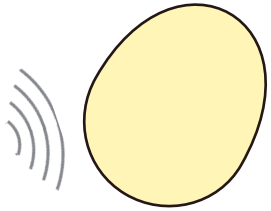
Pirobot

Concept

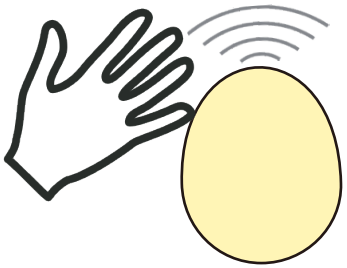


Low-cost and portable tangible media for remote message

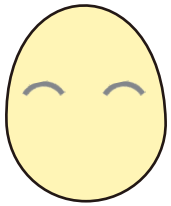
Interactions



Tilt and speak to record and send message



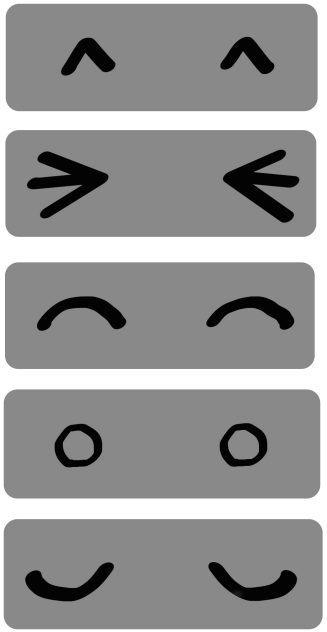
Pat to hear the received message



Expressions and sound to indicate status

Expression Design

The robot shows different expressions according to the context



Pirobot

Implementation

Raspberry Pi
+Sound Card, Microphone
& Speaker

Sensor MPU 6050

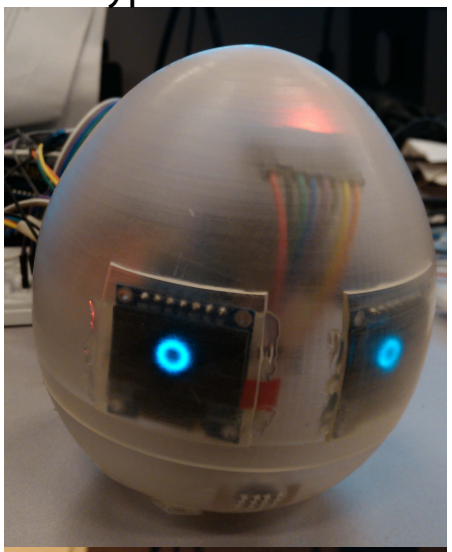
OLED Display

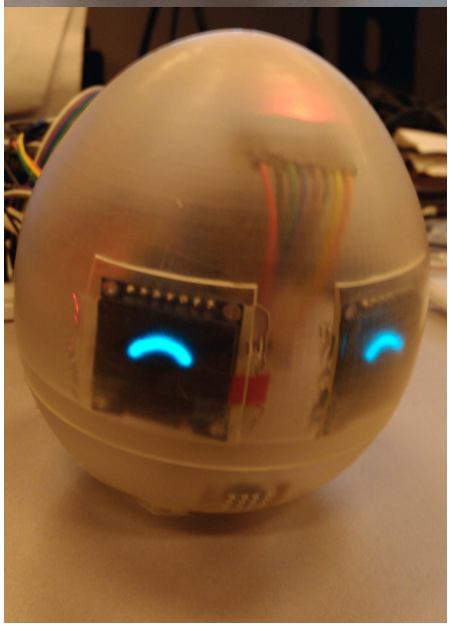
Server for message transfer

Wechat API

Wechat message

Prototype





Falling in Love with Library

Tsinghua Library Project

Library provides many resources for students. However, many students don't know them at all. We made 5 video dramas and a web-based book shelf matching game for students to get more knowledge about library.

The project was awarded 1st place of 10th IFLA International Marketing Award in 2012

Team members: Sheng Qiu, Huiyang Lian, Wenhui He

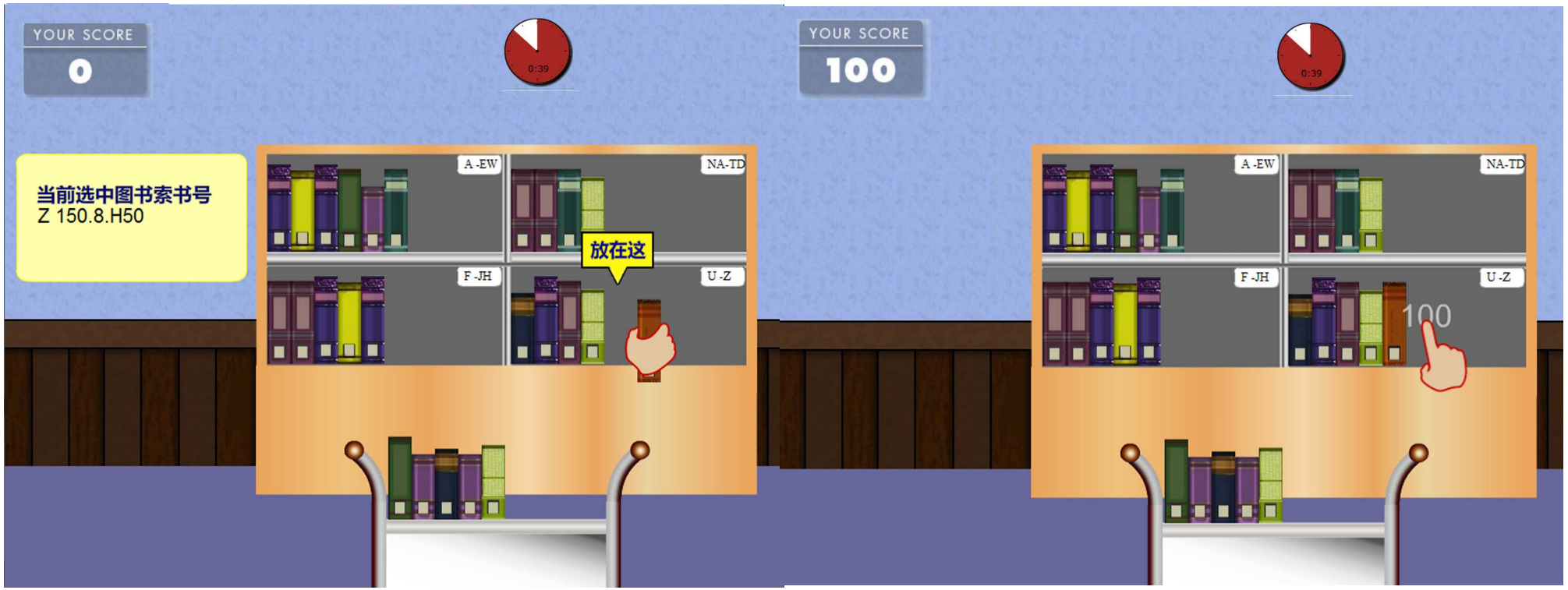
Advisor: Lifeng Han and Yuan Wang

Falling in Love with Library

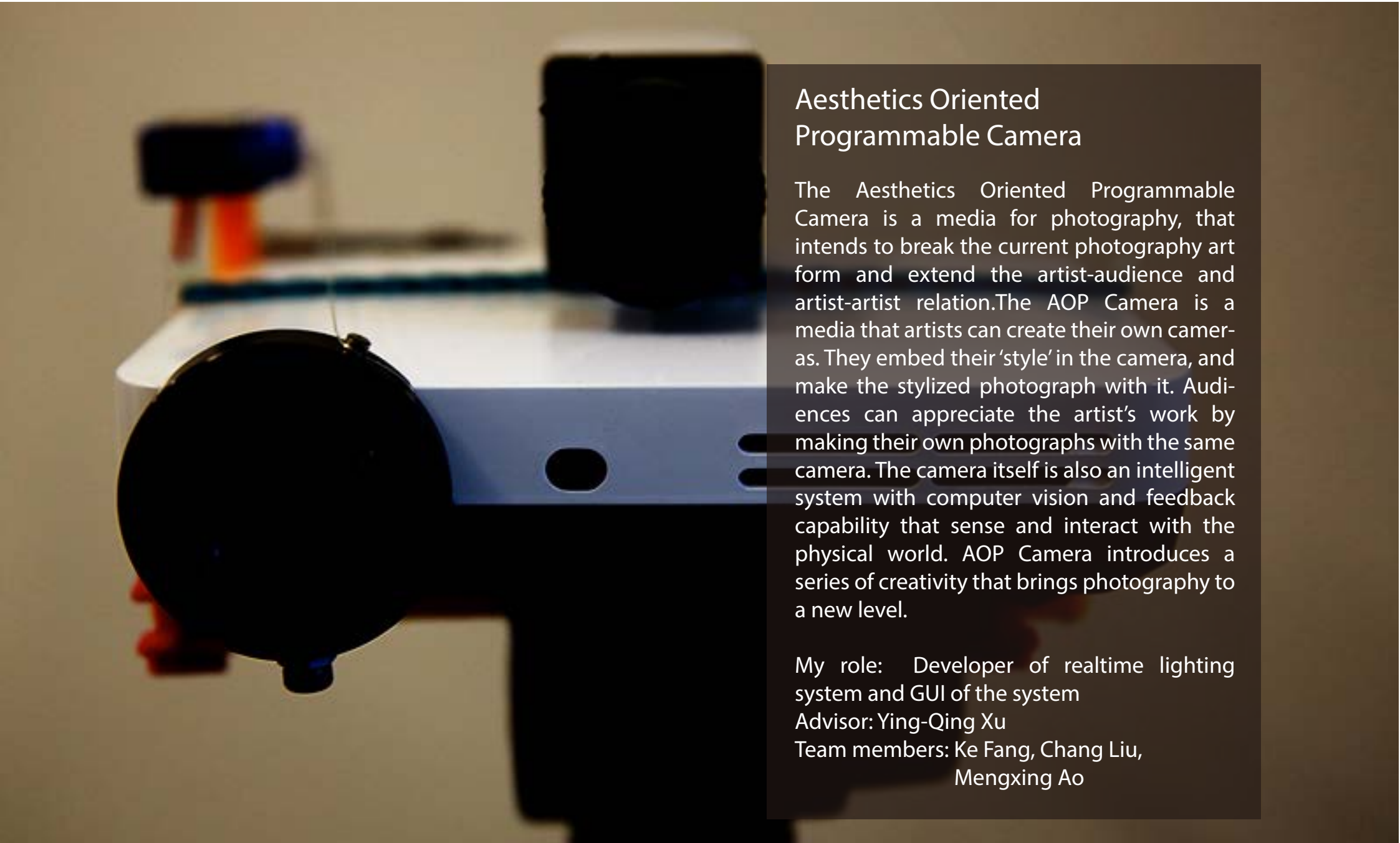
We made 5 vedio dramas of a love story to promote library awareness of students in Tsinghua. The story aims to show what library can provide to students with interesting stories and beautiful images.

The drama was very successful and was discussed on many social networks. It was watched for over 100,000 times.
It was also reported by many local newspaper and media.

Falling in Love with Library



First Library Game in China
Freshmen can learn the rules of bookshelf in the library by playing the game developed by Flash.
They can get a score and a batch after win the game, and can share the results on social media to compete with their friends.
The game was played by over 10,000 students of Tsinghua.

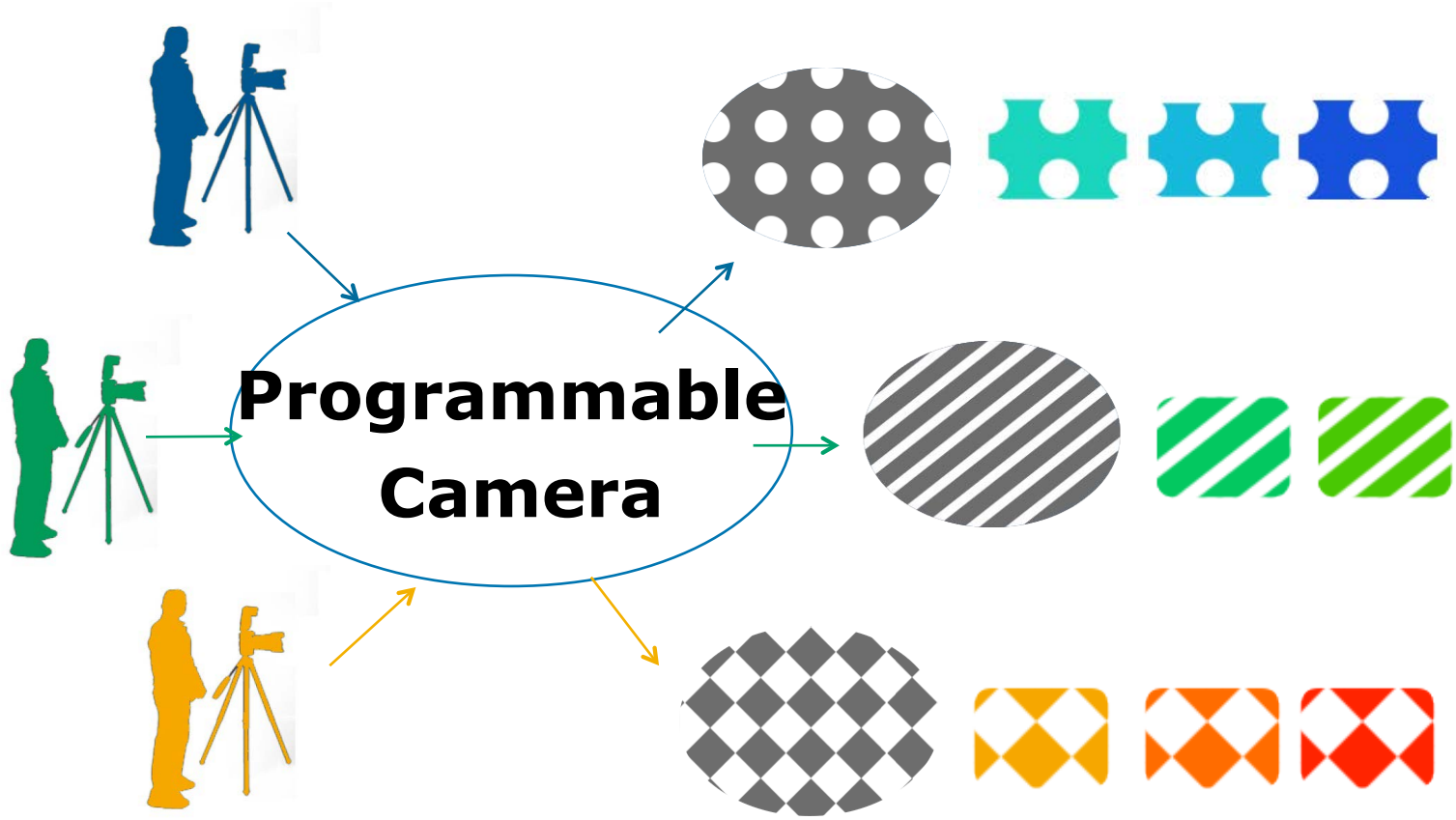


Aesthetics Oriented Programmable Camera

The Aesthetics Oriented Programmable Camera is a media for photography, that intends to break the current photography art form and extend the artist-audience and artist-artist relation.The AOP Camera is a media that artists can create their own cameras. They embed their 'style' in the camera, and make the stylized photograph with it. Audiences can appreciate the artist's work by making their own photographs with the same camera. The camera itself is also an intelligent system with computer vision and feedback capability that sense and interact with the physical world. AOP Camera introduces a series of creativity that brings photography to a new level.

My role: Developer of realtime lighting system and GUI of the system
Advisor: Ying-Qing Xu
Team members: Ke Fang, Chang Liu, Mengxing Ao

Programmable Camera



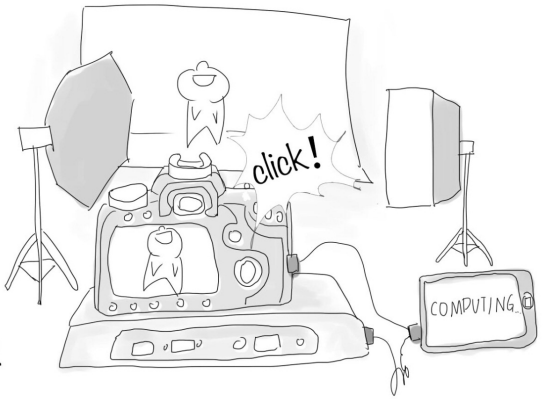
Photographer ⟶ Stylized Camera Photograph

Artists can program the camera to make different styles, users can make stylized photograph with the style

Programmable Camera

1

Pre-define the texture and style.

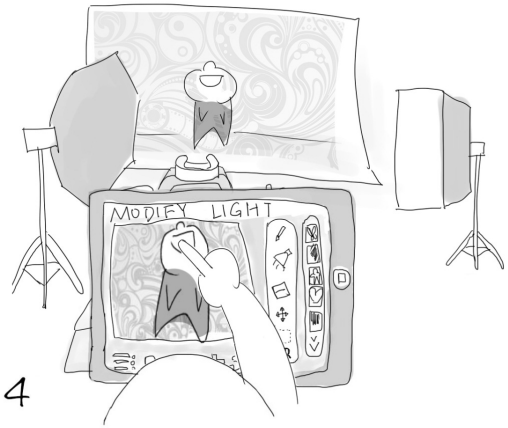


2

Pre-shoot to capture the model position.

3

Programmed light field is calculated and added to the scene.

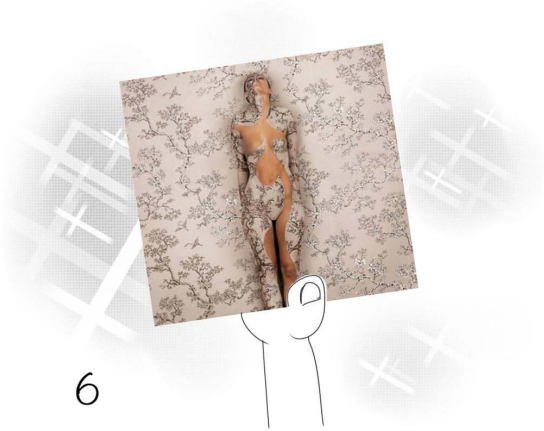


4

If needed, artist can modify the light at interface, and the light field is updated in real time.

5

A final shot is taken with modified light field.



6

Final effect.

Programmable Camera

Apart

Apart

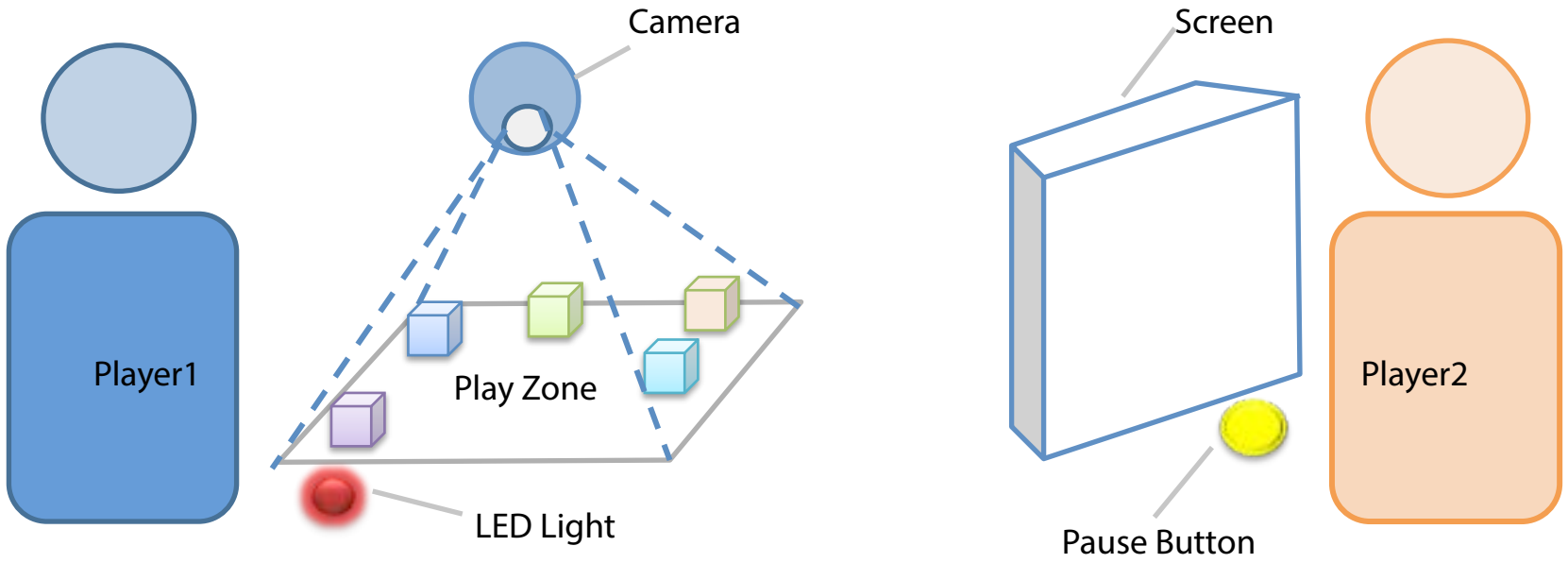
Apart is a tangible augmented reality game to promote collaborations between players. Players must play together, because neither of them has the full control of the game. One can see the image but cannot control the virtual players, while the other can't see the image but can control the postion of vitual players. In this case, conversations are forced to happen, and they must convey efficiently ebough to win the game together.

My role: Developer and game designer

Advisor: Yan Guan, Tsinghua University
Team member: Tianyi Hu

Apart

This game is designed to be played by two. Players must cooperate together to survive the game. Player 1 can only manipulate tangible blocks while player 2 can only see the screen. Player1 must do as what Player2 tells to achieve goals or avoid obstacles.



It aims to find a way of controlling in game without mouse or touch screen, but manipulation of tangible things. And it aims to promote conversation between players by seperating vision and controlling, which provides a unique experience.

Apart

The Story

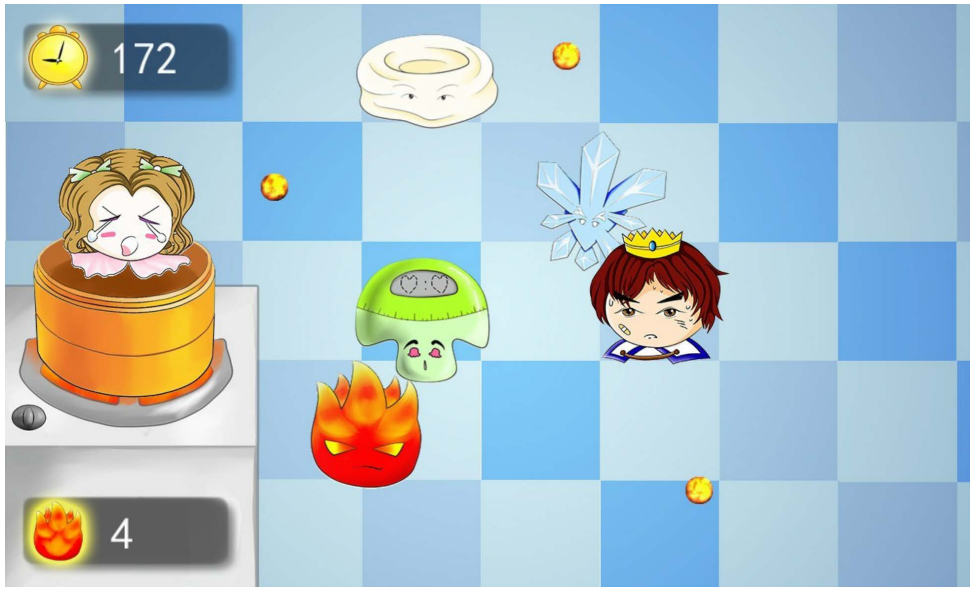
The game is about brave prince saving princess. However, princes can't see any enemies since they become invisible. Only the princess can see them. So princess must tell the situations to prince, and prince do as she says. Two players role play respectively so that they must collaborate

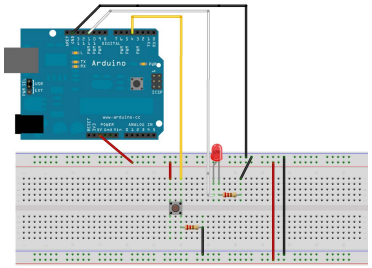
Role Design

Tangible blocks Design

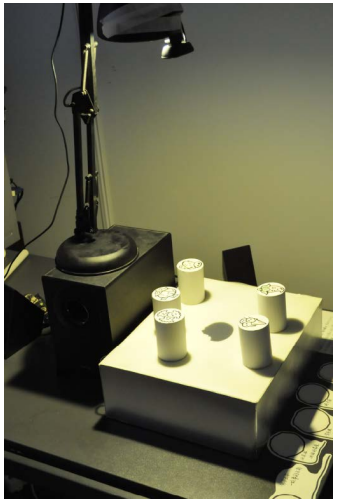
Apart

Game Screen for Player 2

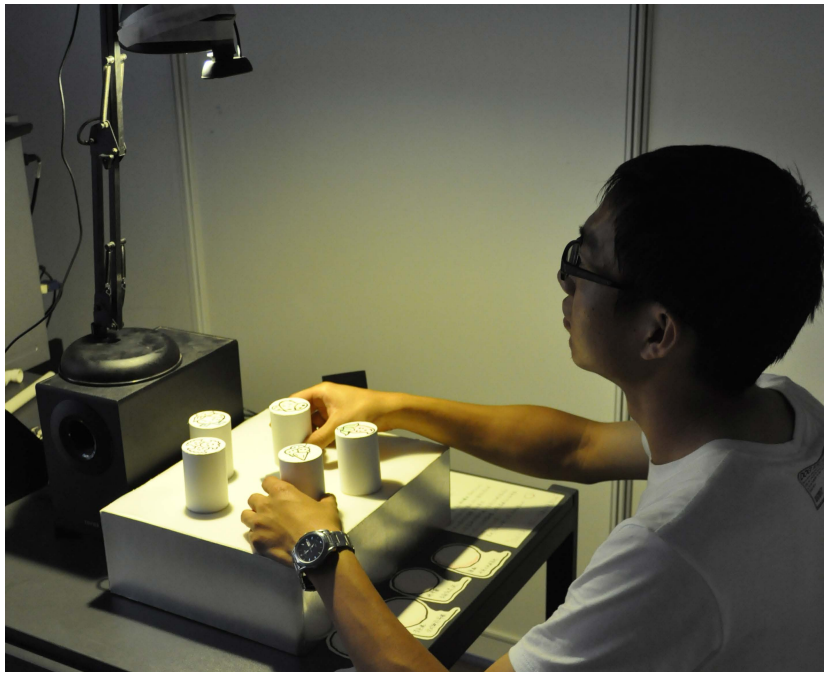


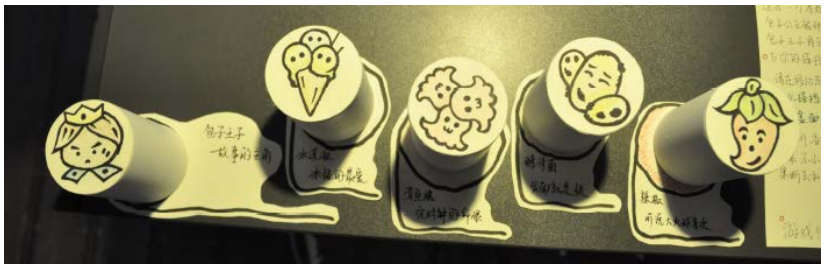


Tools



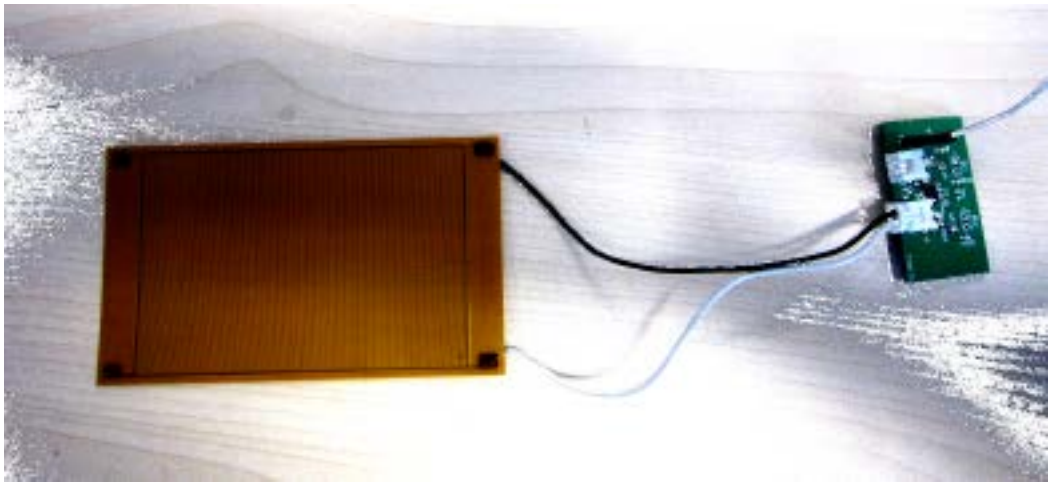
Tangble play platform for Player 1

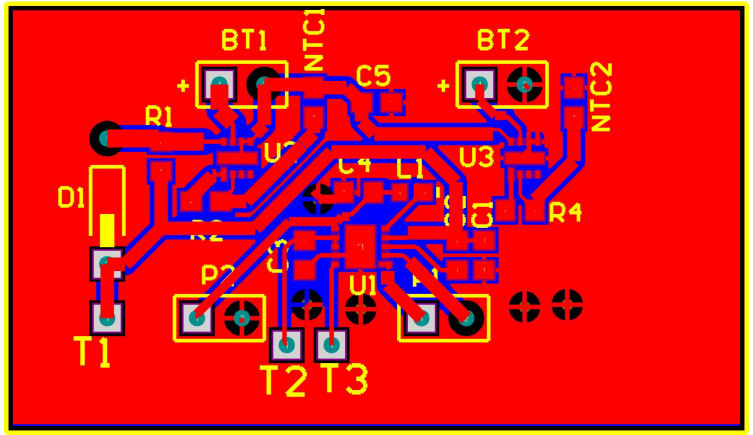


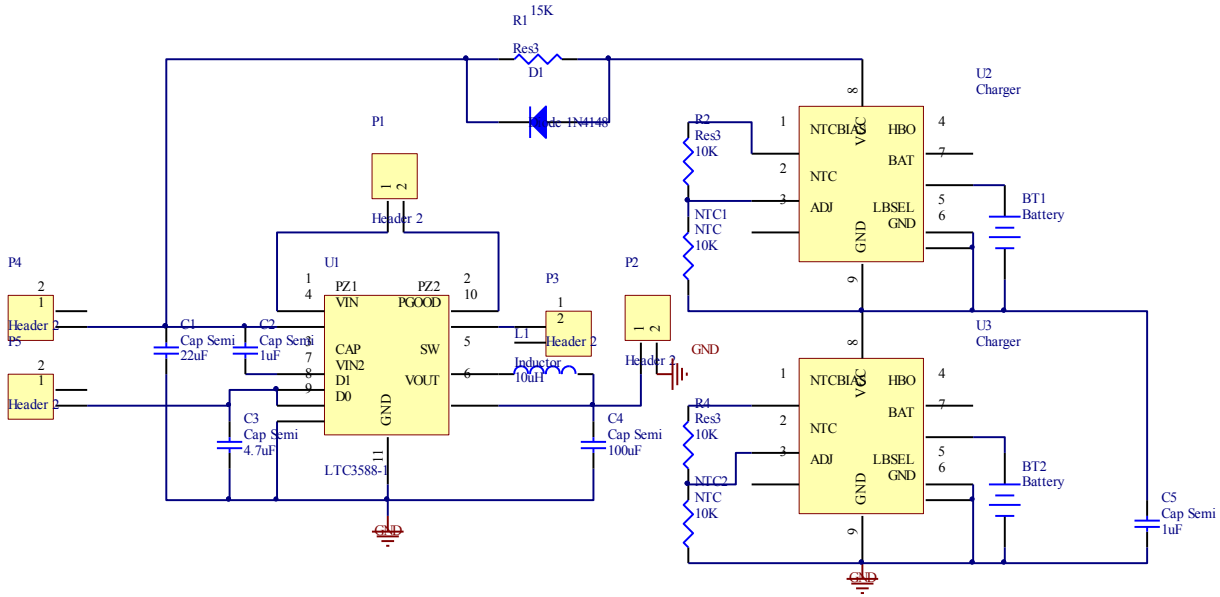


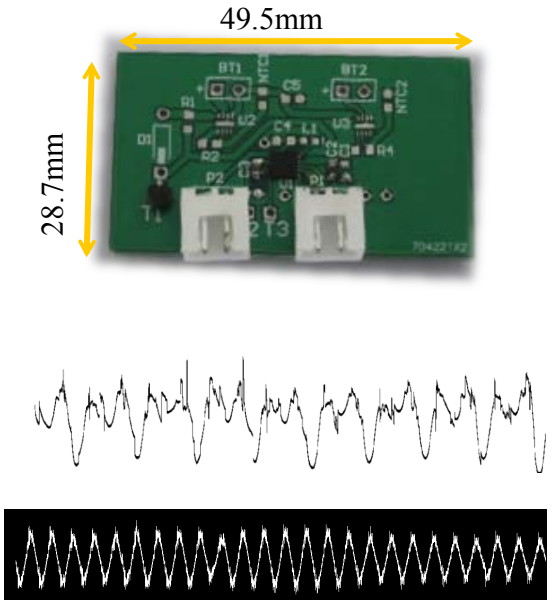
Energy Harvesting

Micro Fiber Composite for vibration energy harvesting. PCB Layouts and circuits

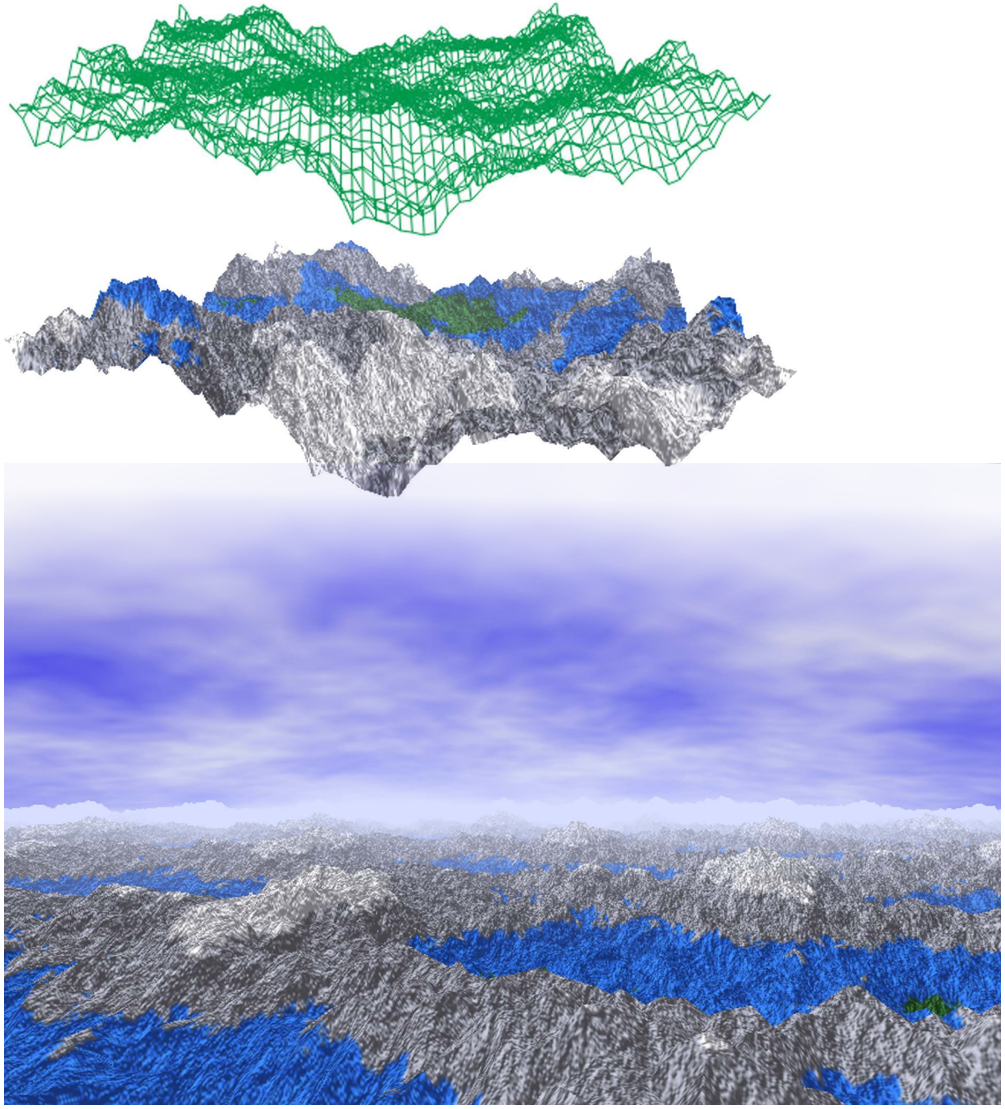


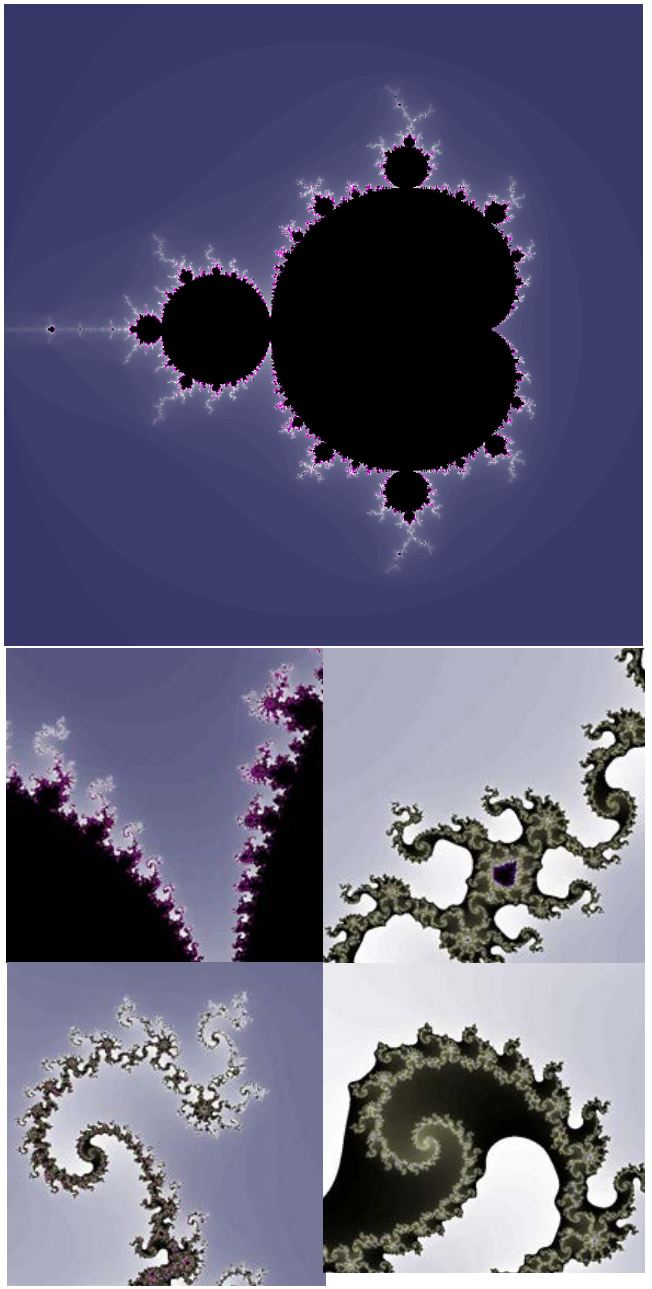






Fractal





Maya Modelling

Motion Capture

RMB Notes Recognition

Recognizing notes is difficult for the blind. I developed a mobile app to help the blind recognize notes. The mobile app uses Histogram and SIFT to recognize different pattern and give the user sound feedback.

Mobile App Screen Capture

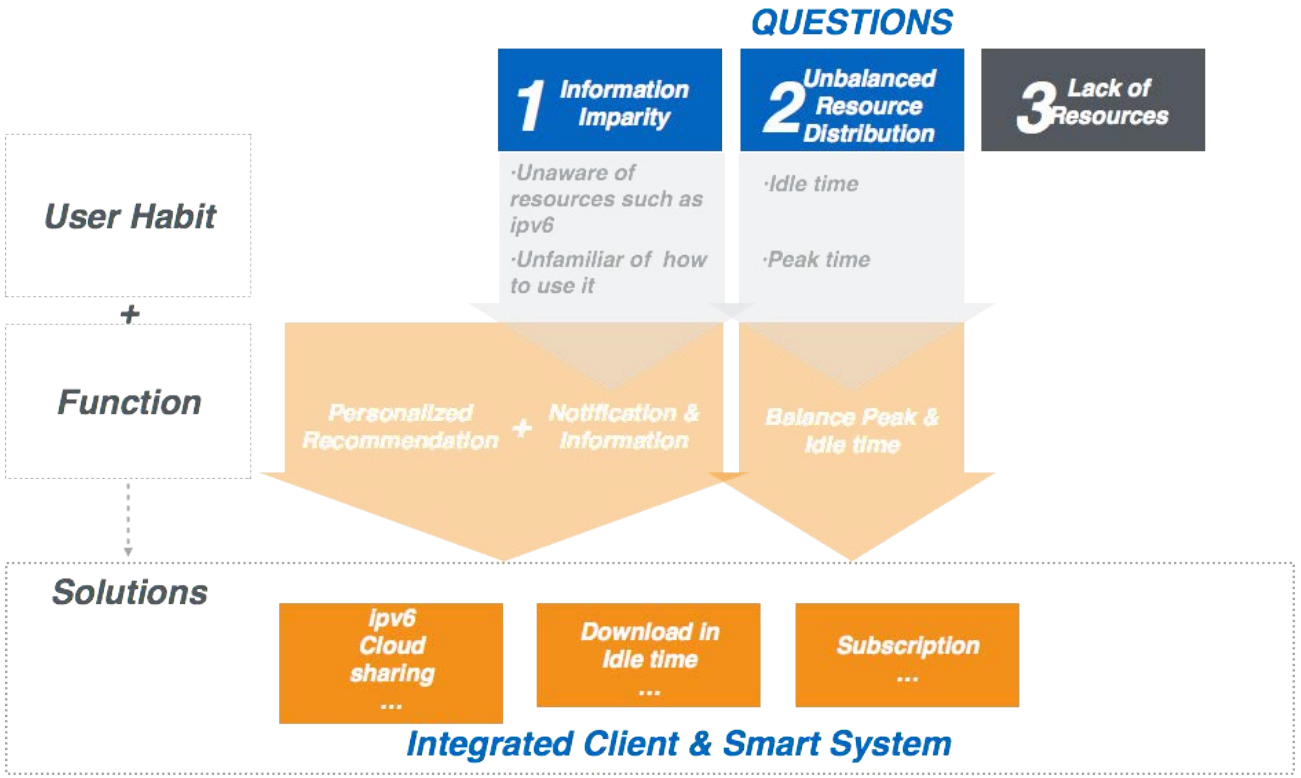
Histogram Pattern of RMB Notes

RMB Notes	Histogram Peak Value
100	0~5 178~180
10	132
50	95
20	34
5	46
1	86

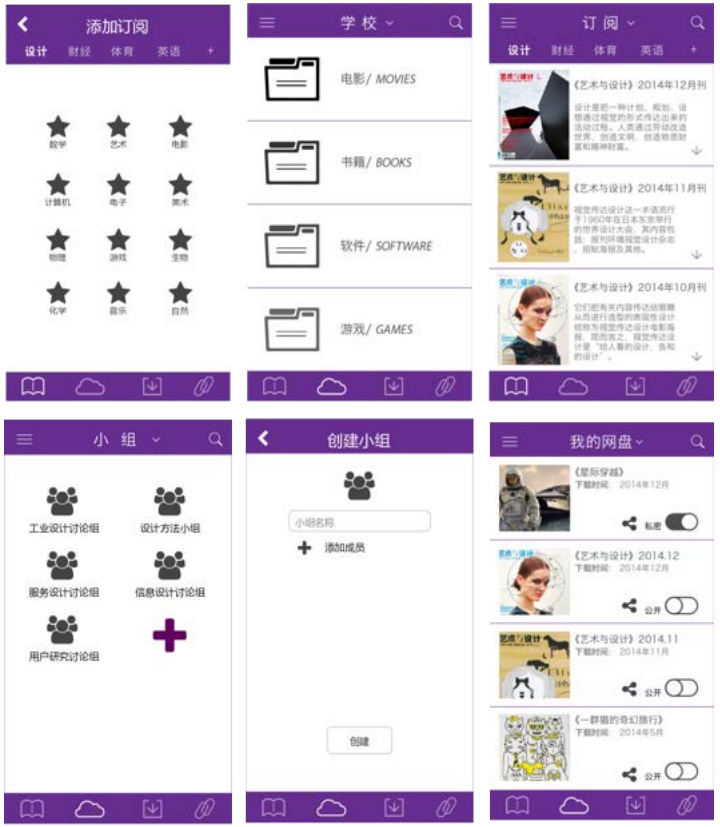
Network Service Optimization for Tsinghua Students

Students in Tsinghua are suffering from slow network connections in rush hours.
This is a service design to solve the problem, using cloud service of the school and IPv6 capacity.
It encourages students to make full use of resources on campus and share resouces with fellows in the cloud, as well as recommend relevent resources to those who may need them.

Problem Analysis



High Fidelity Prototype of the mobile app



Human-Computer Interaction seems like a new path for me.
I like Electronics, Computer Science and Design.
However, each of them has its restrictions.
HCI can combine them and overcome their shortcomings to make more possibilities.
That's the path I want to pursue for my whole life.

Zhicong Lu (Caleb)
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Email: calebluzc08@gmail.com