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Master's Thesis
Academic Year 2016

City Friends
A Smartphone Application, Applying Social
Things Concept to Tourism

Keio University
Graduate School of Media Design

Hsu Ting Yu

A Master's Thesis
submitted to Keio University Graduate School of Media Design
in partial fulfillment of the requirements for the degree of
MASTER of Media Design

Hsu Ting Yu

Thesis Committee:

Professor Masa Inakage	(Supervisor)
Professor Keiko Okawa	(Co-supervisor)
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Abstract of Master's Thesis of Academic Year 2016

City Friends
A Smartphone Application, Applying Social Things
Concept to Tourism

Category: Design

Summary

Imagine if all the inanimate objects could talk to people or answer someone's request, would the social interactions in the city be changed? Based on the concept of Social Things and the prototype developed for the 2015 KMD Forum, City Friends, which contains smartphone applications and the Autonomous cooperation system and allows people to interact with things in cities, has been created and designed in the study. Through the Autonomous cooperation system, things are connected to each other with the use of Bluetooth and Wi-Fi, forming a closed platform. When the required conditions match, things would start to exchange information and users would be able to understand the information and join the platform interacting with things.

The aim of this study was to change travelers' behaviors by making things actively talk to travelers. The main elements such as IoT, Social Things, interactive storytelling, Smartphone Application Design, and User Experience design will be addressed and discussed in the study.

Keywords:

IoT, Social Things, Smartphone Application Design, User Experience Design, Interactive Storytelling Design

Keio University Graduate School of Media Design

Hsu Ting Yu

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Chapter 1

Introduction

1.1 Motivation

The Internet of Things (IoT) has grabbed the media's attention, adopting several different kinds of sensors to pick up all kinds of data in the physical world and then translate them to the digital world, so-called "the last mile of the internet". It analyzes the collected data to get useful information, leading to the Big Data movement. Following the development of IoT, Social Things have been proposed by numerous researchers and studies on this field have been growing gradually. The concept of Social Things is to apply human social relationship into things' network.

Because of IoT, all things are getting together and start to organize things' social network. The scale of this "new society" will be much larger than the society we have today (Dave 2011). While millions and billions of things start to form their own new society, it seems that only human beings would be excluded.

Besides, AI (artificial intelligence) is improving and progressing significantly; because of its deep learning ability, it defeated a high-ranking professional Go player in 2016¹, which at first was believed impossible to win. If things keep getting smarter and organized, human beings might be forced to deal with this unstoppable trend in the short future. Instead of fighting against the trend, to

1 In March 2016, a computer program called AlphaGo, created by Google DeepMind, beat a high ranking professional Go player in a five-game match. This is the first time a computer program won a 9-dan professional player.

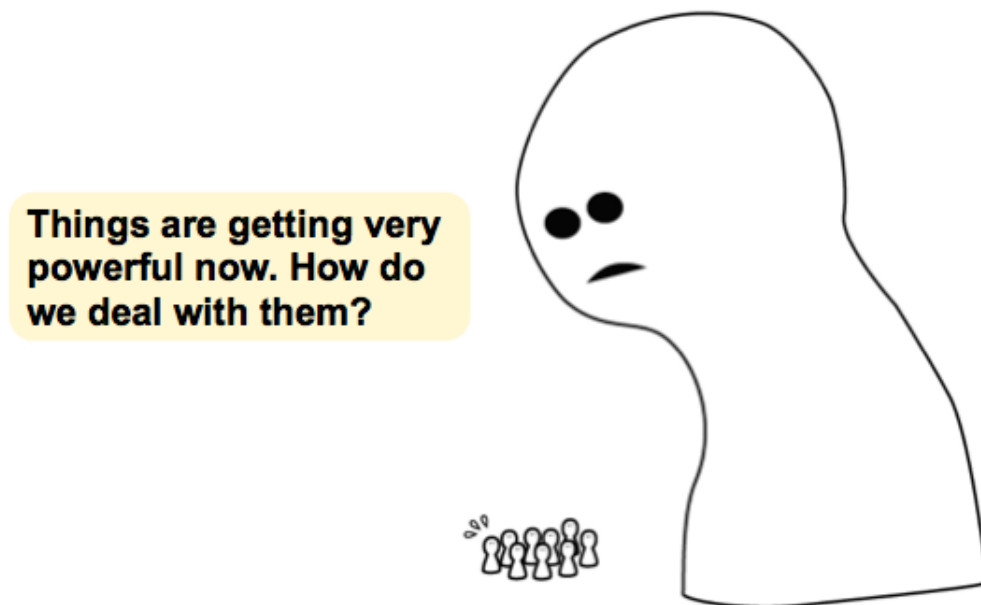


Figure 1.1: things are getting together and forming the largest society

take part in the things' network might be a better choice.

If people become parts of Social Things, there would be several considerable merits. If things start to help people automatically or ask some help from humans, for example, a fan would ask humans to help it move to other places, would the interaction between humans and things be different? Of course, before all these happen, it still needs time and some advanced technical development. It is also difficult to know if all the people would be willing to interact with things. Does it really help if things, which are supposed to be "just things", suddenly could talk? In other words, it still needs some time to investigate if humans could accept the concept that things would talk just like humans and would be willing to join the network formed by things.

1.2 The 2015 KMD Forum

In order to find out the possibility, on November 27-28th 2015, the Social Things project² showed a system of prototype to present the concept of Social Things, including Viska³, three Mascots⁴, the bench⁵ and the prototype of Autonomous corporation system⁶ being implemented. The purpose of this demo was to show visitors how would it feels like if things could interact with each other and talk to humans.



Figure 1.2: 2015 KMD Forum

The scenario is very simple in 2015 KMD Forum; the bench invited visitors to sit on it by sending messages through smartphones. Before the user experiment started, users would be handed a smartphone which Viska was installed and one Mascot represented the user. When users holding Mascot were close to the bench, it would sense the Mascot and send messages to it. Users could see their messages via Viska. Visitors were excited about the idea that things talk to people and we got several feedbacks from the visitors.

2 A research project running by KMD and Ericsson since 2013.

3 Viska is a smartphone application. It is a prototype designed as a platform for Social things and humans to interact

4 Edison modules embed prototypes.

5 A prototype which could interact with Mascots

6 An unique network system. Things could exchange information directly.



Figure 1.3: 2015 KMD Forum

Some visitors pointed out that it was difficult to know which thing is talking. Because there were too many things in the venue, it was difficult to know where the messages came from. If there had been not so many things around, and if things chosen had been easy to be noticed, the problems might have been solved. Besides, the physical connection between users and things was weak (e.g. lights on the Mascots were too small). Users might have confused and missed messages.

Besides, some visitors questioned that how the system could be applied in the real world. But in the real world, there are always many things around. If all the things send messages to users at the same time, users may get annoyed even scared. Too much information may make users be confused and it is difficult to read all the messages at the same time. The possible solution to this problem could be to limit the number of Social Things and apply the filter system.

One tester mentioned that she was worried about the new communication. As she said, for a long time things are created and controlled by humans. If things, all of a sudden, start to communicate with humans actively, she will not feel comfortable. For the actual use in the real life, it might be important to allow users to be able to control this situation. Thus, in order not to make users feel pressure, the first thing to assure the future users is that the concept created is applied and limited to a certain field for a certain use only.

Although most of the testers agreed that the idea that things communicate with human actively is innovative, it could be seen that there are still issues needed to be solved. The feedbacks inspired the researcher to create the concept of "City Friends".

KMD Forum Feedback	Possible Solutions
Difficult to know which thing is talking	Add more physical connection between users and things. Choose attractive things to talk.
How this system could be applied to real world	Limit the number of Social Things. Apply the filter system.
Confused about the new communication	Allow users to control. Clear purpose is necessary.

Figure 1.4: feedback from 2015 KMD Forum

1.3 Purposes of this study

A city is the largest unit where a group of people live and there are lots of things within. Some of them even have existed more than decades. Many things in the city have been watched, used and touched by people who live there, and lots of hidden stories may only be known by the "locals". By creating new connections among things and people, it may be another way to understand cities.



Figure 1.5: Chat with the environment

Based on the concept of Social things, City Friends is proposed and applied

for the travel usage in the study. City Friends is a smartphone application-based travel service. City Friends can give users "things interaction" experiences, providing another possibility for the tourism field. There are three targets in City Friends. First, by making things communicate with users actively, users could know the place they are in better. Second, it would help users be willing to be friends with things in cities. Third, it is designed to allow users to interact with things merrily. Aims of applying City Friends are listed below.

- Allow users to know the place better.
- Make users befriend things in cities.
- Let users have fun interacting with things in cities.

Through City Friends, tourist attractions would start to talk to travelers. The reasons why the tourism field is chosen are stated as follows: first, travelers are usually more curious and interested in knowing new places. Compared with local people, travelers have more time and are much relaxed and ready to see something different. Therefore, it is easier to attract travelers' attention if some famous statues or objects could interact with them.

In order to achieve the three objectives of the study mentioned above and to know the feedback about "Things talk actively" from potential users, three user tests, based on the feedback from the 2015 KMD Forum, are built to mimic the environment.

1.4 Research Method

Because things in cities usually do not "talk" to humans, it is possible that users may feel confused, even terrified. For this reason, some advanced explanations are important. Besides, things in the experiment of City Friends do not directly talk to users; they send messages. Therefore, it is important to make users believe that things are actually talking to them, not the smartphone.

After catching users' attention, objects will start to send messages and guide the users the following steps. To make users immerse into the environment, storytelling plays a vital role in City Friends. How to let users follow the instructions from things without losing their interests is the key to the success of City Friends. By making things imitate human communicating behaviors, such as "accost", "introduce", "recommend", "ask for a favor", "express thanks", things become actors, performing in the real-world.

In this study, three different prototypes will be built, attempting to create the connection among stories (contents), things (real objects) and humans (users). During the tests, users will be asked to be exposed to an environment that things could communicate with each other. It will allow users to experience how City Friends would work. After the experience, testers will be interviewed to see if the targets set are achieved.

1.5 The structure of the study

There are five chapters in the thesis. Chapter one will explain the motivation, purposes and the research methods of the study. Related studies and cases will be addressed in chapter two, including a comparison between current concepts of Social Things. Automatic interactive system used recently such as RFID applied in museums and chatterbot service. Because City Friends is a smartphone application-based travel service, some popular applications in the tourism field are listed and discussed in this chapter too. In chapter three, the design concept, system structure, experience flow of City Friends and two pre-tests will be mentioned.

Before the user test, in order to make sure the system work properly and acquire more knowledge about the key factors, two pre-tests will be executed and explained in chapter four. In chapter five, the detail of storytelling design in the scenario used in the user test will be described . Followed by the design of storytelling,the user test will be executed. Users' experience of the prototype usage and their reaction will also be observed and analyzed. Chapter six will conclude the value and implications of this study for the further researchers.

Chapter 2

Related works

This chapter describes the development of IoT, and Social Things; several cases are raised and discussed. Systems, which can interact with users in real-time, are selected and evaluated from several aspects. Finally, some popular smartphone applications related to the field of tourism are categorized and compared with City Friends, including user interface and functions.

2.1 The Internet of Things

The concept of IoT began to be discussed in 1980s and firstly appeared in the book, "The Road Ahead", written by Bill Gates in 1995. In this book, there is a plot describing that a lost camera returns back to its owner by itself(Gates 1996). In 1998, MIT (Massachusetts Institute of Technology) proposed a concept similar to IoT called EPC (electronic product code). One year later, Auto-ID Lab ¹ announced a system called EPC global based on RFID ² which could automatically recognize different products within a certain distance. Via this system, every product could be easily traced using its code through the EPC network. It is believed that EPCglobal is the first system adopting IoT concept and applying to

1 The Auto-ID Labs network is a research group in the field of networked radio-frequency identification technology.

2 Radio-frequency identification (RFID) is a technology which could identify and track tags attached on objects automatically.

actual business usages. In 2005, ITU (International Telecommunication Union³) coined this kind of concept, the term "Internet of Things", defining it as the network of physical objects(telecommunication union 2005). Since then, IoT has been getting more and more popular (Erin Anzelmo 2011).

The Internet offers a platform where people can share digital information with each other. IoT enlarges this platform. Because of IoT, people can retrieve digital information via not only physical devices but also the Internet. By gathering all the data from the physical world with all kinds of sensors embed in devices, the physical world is digitized and possible to be analyzed effectively.

IoT has being applied to several different fields, including logistics, health care, smart city, etc.; although IoT has not changed human beings' life as much as it was expected, it is still considered as a key with huge potential to the future (of Internal Affairs and Communications 2015).(market analysis 2014)

European Technology Platform on Smart Systems Integration (EPoSS)⁴ RFID Working Group reports had predicted that the development of IoT toward 2020 may go through four steps(Duce 2008). The first step is that things were to be connected during 2010-2015. Then from 2015 to 2020, things are going to gradually become smarter and are able to follow simple instructions. After 2020, things will become AI-oriented which will have their own identities and virtual personalities. With the development of AI and nanotechnology, the embed CPU is going to be getting more powerful. The communication among things, even between things and human, seems possible in the short future. As it is predicted that things could be possible to think like human, some researchers thus introduced a concept called "Social Things", which discusses the potential if things would become socialized.

3 The International Telecommunication Union (ITU) is an organization of the United Nations that is responsible for issues about information and communication technologies.

4 EPoSS is an industry-driven policy initiative to improve the competitive situation of the EU in Smart Systems filed.

2.2 Social Things

Brief review of Social Things

Because of IoT, the potential on the network of things are seen. In order to make the network work effectively, it is necessary for things to have a social structure just like humans do. The basic concept of Social Things is that things are independent from human beings and they can help each other to achieve a certain goal. For the reason, Social Things would be expected to solve more complicated tasks.

In order to understand the concept of Social Things, it is necessary to define the so-called "social structure" and how to apply it to the network of things (Luigi Atzori 2011b) (Luigi Atzori 2011a). However, there are still many issues remaining to be discussed at present. Of course, the relationships in a human society are extremely complicated; social structures are often built with vertical and horizontal relationships. For example, a social hierarchy is a vertical relationship often being seen in the office, family, etc., and the relationships among friends are close to horizontal relationships. These two types of relationships lead to several different discussions in Social Things.

In 2012, Ericsson released a concept video called "The social web of things"⁵. In this video, David, the main character, communicates with the objects in his house through an SNS-like platform. David informs the objects that he is going to go home in forty-five minutes. After receiving the request, the objects start to cooperate for David. Carpet asks Vacuum cleaner to clean it and others try to make dinner for David and his girlfriend, Sophia. It could be seen that once objects receive the instruction from their master, they would start to accomplish each task in order to achieve the final goal making the house clean. In the end of the video, Sophia changes her mind not to eat with David and objects also change their targets accordingly.

This video shows an easy way for viewers to understand its concept and how this could help human's live; however, compared with the concept of Social Things, although things in the video work together and communicate through a platform,

5 <https://youtu.be/i5AuzQXBsG4>

it could be seen that things are not independent from humans and do not work actively. Objects start to work because of receiving David's message, which is different from the basic concept of Social Things. Because it is a concept video, the relationship between objects is also not clearly mentioned.

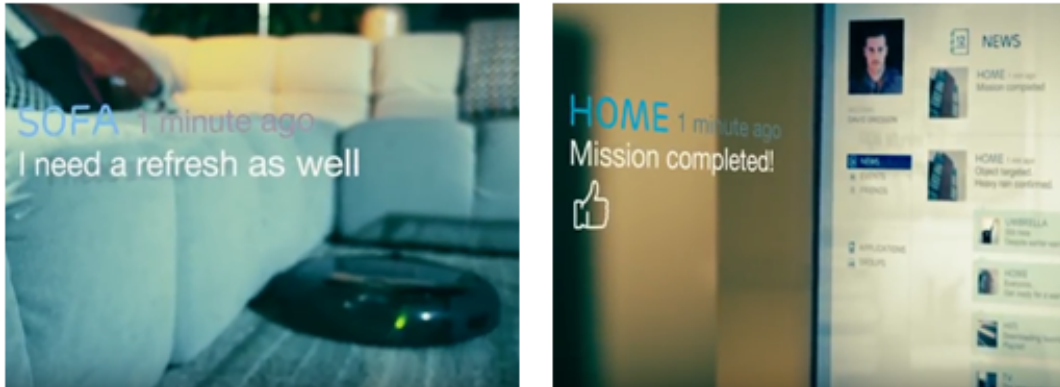


Figure 2.1: The concept video of Ericsson

Another research called Social Internet of things (SIoT) presented by an Italian team (Luigi Atzori and Nitti 2012). The concept of SIoT is similar to Social Things. Based on the study, things have their own network, which is similar to human SNS. However, the communicative methods between things and humans are different. Unlike humans, things could communicate digitally with only little physical limitation; it seems not effective to introduce human's system to things directly.

KMD Social Things project

KMD, together with Ericsson, works on a project named Social Things project. The project has three main principles.

- Things would be equal to human and be capable to judge accordingly

Things would be independent from humans and have abilities to decide what should or should not do. They would have their own goals and help each other

to accomplish their goals through the network of things. Basically things would be equal to humans and sometimes things act unpredictably, depending on the situation.

- Learning and growing

Social Things could learn from others or human beings and improve themselves. By understanding the cause-effect relation, things would decide which way to cooperate.

- Things help with each other

Because each thing has the only limited function, it is important for things to help each other, try to work more effectively, and then achieve complex goals. Therefore, the goals among the things would change dynamically from time to time. In order to achieve the final goal, tasks would be divided into several small missions assigned to Social Things. Tasks and missions might change depending on the situation.

There are several theses related to Social things presented in the KMD forum. Imaki (Imaki 2014) summarized the definition of Social things. Maekawa (Maekawa 2015) created Social Mascots to encourage people who do not know each other to communicate, and when the conditions meet, Mascots will blink as a trigger for users to talk. Meanwhile, Okada (Okada 2015) proposed Autonomous Cooperation system which allows things (mascots and bench) to cooperate.

A new approach to enhance Social Things concept

It could be seen that the research of Social things has been limited by IoT a lot so far. The Social "things" mentioned in the above cases are more likely electronic goods. Because of the term "things", it is not necessary to constrain the possibility to only electronic products. Therefore, the concept of Social Things is expanded in the present study. This study stated that not only electronic goods but also everything could be Social Things, including smartphone users (humans)

and normal objects (travel spots). Based on this structure, human would be a part of Social Things and equal to things. In short, humans and things are assumed to help each other to achieve a better goal, which is also the core value of this paper.

2.3 Systems that interact with people

RFID system

The present study has applied sensing and transferring technologies and one of the most popular technologies so far is RFID (Radio Frequency Identifier) system. RFID is mainly applied in museums and exhibitions. It can sense a specific tag in a certain distance. For example, sticking RFID tags on tickets to provide remote services to users during their visit. Also, by embedding a RFID receiver into a pocket PC, when users are close to RFID tags, the pocket PC senses the tags and shows the specific information or plays the audio guidance automatically. RFID changes the way people visit museum (Spasojevic 2001) (Giuseppe Ghiani 2009).

Compared with the RFID system, the Autonomous cooperation system adopted in City Friends is much complicated. The communication occurs on RFID system is only between receivers and tags, meaning one to many. There is no communication happening among tags. In contrast, if Social Things with preset conditional statements are provided, combinations of varied actions will be triggered by information and transfer inter-thing communication, and the Autonomous cooperation system will achieve autonomous cooperation. With this system, Social things could exchange data with each other, taking action and using data to execute complicated functions.

Chatterbot service

Chatterbot service is one of the Internet bot services. By analyzing the messages, the system automatically chooses messages from database, and then sends to users. Chatterbot services are mainly applied to SNS and smartphone chat applications for business usages. Chatterbot service can imitate human conversa-

tion; by sending messages to interact with users actively, it can encourage users to repeat and share their interests. Since "Eliza" (1966)⁶ developed, Chatterbot has got more and more attention. Chatterbot can perform like a real human, making a person feel s/he is talking to another person temporarily.

Based on the AI level, Chatterbot can be roughly divided into two types, artificial conversational Chatterbot (AC chatterbot) and artificial intelligent Chatterbot (AI chatterbot). Artificial conversational bot is easy to control and much cheaper, often used for simple customer services, such as QA, recommendations, even reservation supports. Many companies, including Facebook⁷, Google⁸, Wechat⁹, etc., have adopted AC Chatterbot for actual business usages.

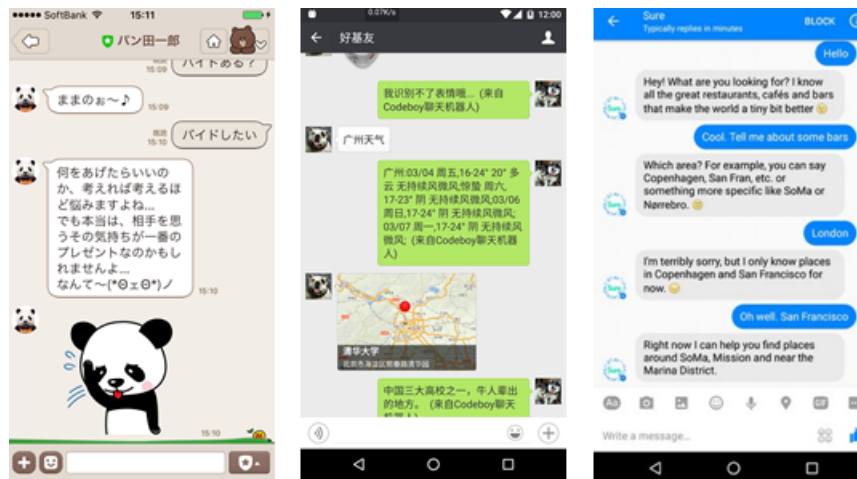


Figure 2.2: Chatterbot services

On the other hand, compared with AC chatterbot, AI chatterbot is computer-based, generating messages on time to interact with users. AI actually thinks and talks like humans to users. Some AI chatterbot even have their own identity and personality. Because AI has great potential and is always controversial, it always

6 an early example of computer program which could generate natural language processing

7 Facebook chatterbot service launched in Jun 2016.

8 Released in May 2016

9 Wechat is the first company adopted chatterbot service in SNS application

attracts more attention. Recently, Microsoft launched a project called Tay¹⁰. Tay is an AI chatterbot which can interact with other users on tweeter. However, it still has lots of problems and technology issues needed to be solved.



Figure 2.3: Tay

Of course, the concept of City Friends is assumed that things would be smart enough to interact with each other. Because of the limited time and skills, in this paper the user test will apply pre-coded messages to interact with users. Besides, compared with City Friends, AC Chatterbot service on-line often acts as virtual characters supporting users one by one to help users accomplish different tasks. On the other hand, rather than virtual characters, in City Friends travel spots are the characters interacting with users. City Friends allows multi characters to send messages in sequence to interact with users. Thus, the storytelling design process should be much complicated than AC chatterbot.

¹⁰ released in Mar 2016.

Storytelling design

One of the targets of City Friends is to let users become friends with things. Of course, it might be possible if things are as smart as humans. However, under current technology level, it is certainly not easy for people to do so. Luckily, we might borrow the power of storytelling. Nothing seems more natural and universal to human beings than telling stories (Miller 1995). Storytelling plays an important role in human society. Stories are more powerful than facts because stories could lead readers into another world (Simmons 2002). Listeners are drawn in, and feel involved and engaged. They forget themselves, and get involved in the efforts and struggles of the characters (Miller 2011). Storytelling has always been an effective way to communicate that truly attracts people.

Besides, in City Friends, users act as one of the "things' friend", interacting with things. They are expected to follow the instruction from "things"; thus, to design the context is more like an interactive storytelling design process. The term interactive storytelling design has been discussed since 1980s, often used in digital entertainment industry, especially RPG¹¹ type video games (Crawford 2004) (Crawford 2199). By following the hints from NPC¹², players are able to fight the final boss which is very similar to City Friends.

Shelly (Shelly 2001) points out that good interactive storytelling could keep players concentrate and feel immersed into games. The feature of interactive storytelling design is that users experience the stories by themselves. Users are the center of the stories. Thus, the contents of stories generate players' action (Jerz 2000). Players normally act as the main character, interacting with the digital environment. Meanwhile, Hagebbling (Hagebbling 2004) describes interactive storytelling design as "stage" design. The stories in interactive storytelling design are more like designing the scripts; users are one of the actors on the stage.

There are two requirements when designing interactive storytelling. One is project requirements and the other one is story requirements (Mateas 2000). Designers need to consider not only stories but also the purpose of the project at the same time. What designers want users to follow is an important part in

11 Role-playing game. A type of game which players act through a process of structured system.

12 Non-player character. A character controlled by computer to interact with players

interactive storytelling. Also, when designers design stories, it is better to concentrate on the interaction between users and stories. Moreover, Braun (Braun 2002) points out that there are two kinds of interactions when users experience interactive storytelling. First is the storytelling layer. In this layer, users interact with the structure of the stories, especially when users are allowed to make decisions real-time in some level. The second layer is the interaction among characters. Users could feel interaction when the personality of character setting is clear.

To sum up, the structure of City Friends is similar to digital entertainment design. It is important to create a strong connection among users, characters and stories. Besides, in City Friends, users will experience and interact in the real world. Thus, the physical interaction between the stage and users might be another issue.

How to convince users that things, which are not supposed to talk, have their own personalities just like each character in the stories would be vital.

2.4 Smartphone applications for travel usages

In this section, smartphone applications for uses in tourism are summarized. There are many traveling applications on the application market. Popular traveling applications, which serve the similar purposes as this study's, "to know the place better", "to be friends with things in cities", "to have fun interacting with things in cities", are picked up and compared with City Friends.

Know the place better

Google Map

Google Map, run by Google Inc., is the most popular free on-line map service. Except for free maps, Google Map allows users to create their own hot spots (changed accordingly). Other users not only can check in those hot spots but also can post comment. Users can decide what to show on Google Map, including the types of spots, icons, etc. Every user can post their opinions freely; thus, the

posted information is various. However, Google Map does not focus on one spot and has no function for users to interact with things.



Figure 2.4: Google Map

However, Google Map does not focus on one spot and has no function for users to interact with each other.

Indie Guides

Indie Guides, run by Diplopixels S.A.R.L., has several versions for different cities. Taking Indie Guides Tokyo version as an example, it assigns artists to choose stores with description. Stores are categorized as five types, such as Culture, Drink, Eat, Shopping and Going out. It helps users to find stores easier and quicker. In order to differentiate from the current market, Indie Guides claims that the introduced stores, including creative stores, Indie bands, special restaurants and art galleries, are unique and normally cannot be found on guidebooks. By introducing subculture, it lets travelers see the other sides of cities.

The left picture is the main screen of the application. There are two buttons on the top, which are sorted "by categories (default setting)" and "by distance". The middle section is the information zone. Stores showed from top to bottom are categorized. If users switch the sorting method to the category "by distance", the list items will become to show from near to far. Users need to slide up and

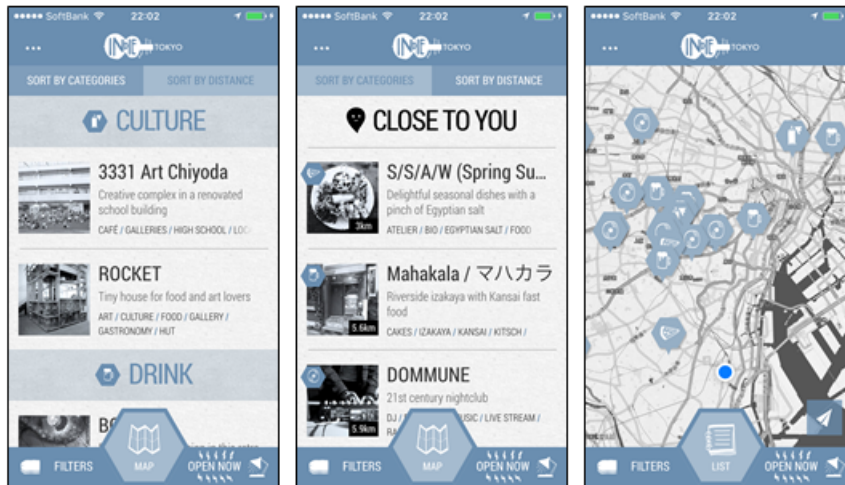


Figure 2.5: Indie Gudie

down to browse information on the display zone. Three buttons which are Filter, Map and Open now are listed from left to right in the bottom of the screen. If users click the Filter button, a window will pop up from the bottom. Users can choose stores by types and hide others. If users click the Map button, then display changes from list to map. Stores are showed on the map with different icons. The Open now button is a switch. If the switch is on, stores, which are closed, will be hidden.

Information is simply presented by those units, such as stores or scenic spots in this type of traveling applications. By posting articles, it lets users know more about cities. Although the purpose is similar to City Friends, the processes and user experiences are different; also all the articles are posted by other users or companies and displayed on the smartphone. But in City Friends, multiple things send pre-code messages to users accordingly. By reading the messages and following the instruction, users know the place better via City Friends.

Furthermore, the way of Indie guides to show units on map and be sorted by distance is similar to City Friends. The only difference is the "unit". In City Friends, units are things; units can interact with each other. In Google Map and Indie guides, units (stores and spots) are not connected to each other and they do not interact with users.

To be friends with cities

So far, on the market, there is no application serving a platform, like City Friends, allowing users to be friends with things in cities. Here, Yelp, as the biggest platform for traveling application is discussed and compared.

Yelp

Yelp was created by Yelp Inc. This application is a SNS platform, similar to Facebook, focusing on travel usages. Users can post and score stores. Other users can read the posts and feedbacks each other by clicking interactive buttons, leaving messages or icons.

After logging in, it goes to Search page directly. There are five common tags, Stores, Search, Post, Feeds and Settings on the bottom. Each page has different functions and it changes by clicking one of them. In the Store page, there are eight types of stores listed in the display zone. By clicking each type, it automatically jumps to the Search page and stores belong to that kind of types will be listed from top to bottom. Both Stores and Search pages have a search bar on the top. Users can key in keywords to search stores. In the Search page, user can set more specific conditions, such as price and distance, etc. The Post page is a shortcut for users to share. Users can post, check in and commend on a certain store easily. In the Feeds page, users can read messages and feedbacks from other people freely. Users can check their personal data in the Setting page.

It could be seen that the platform structure and interactive functions are similar to City Friends; however, interactions happened on Yelp are only for users. Also, unit (store) and unit (store) are not connected to each other. On the other hand, City Friends is a platform for units (things) and users. Users can interact with things through the platform and get information from things.

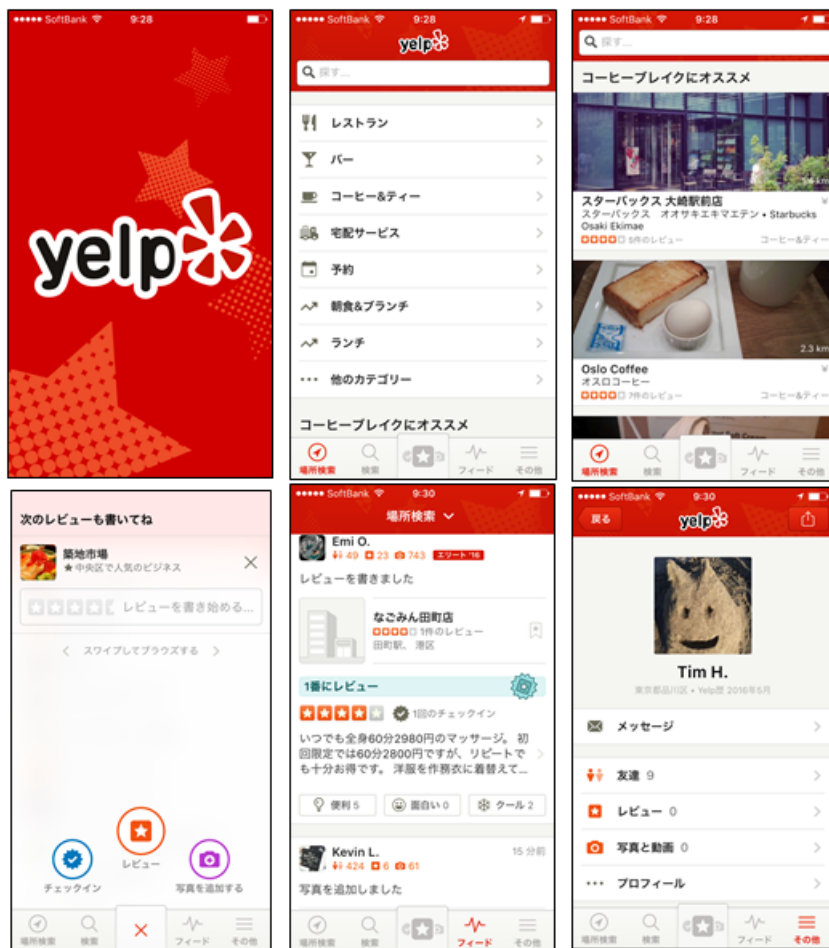


Figure 2.6: Yelp

To Interact with things

Currently, it seems that there is no smartphone application allowing users to interact directly with things in cities. In this section, two applications are discussed and compared with City Friends.

Pokemon GO

Pokemon Go was created by Niantic, Inc. and launched in Jul 2016. It is an AR (augmented reality) based game on smartphone devices. Pokemon Go uses the GPS locating function on smartphones. Virtual creatures called Pokemon appear on the screen only when players are close to the same real-world location. Players can capture and train those virtual creatures. Pokemon Go is the first successful game, using AR technology. After Pokemon Go is released, the number of downloads grows sharply and has achieved the most downloads during the first week in the App Store history ¹³ and becomes a global phenomenon ¹⁴.

As players move in the real world, Pokemon shows randomly on map. Pokemon has several different types of species. Each of the species resides in different areas of the world. When Pokemon shows on map, players can click on it and then change to the AR mode. The AR mode uses the camera on smartphone, displaying the background and a Pokemon. During the AR mode, players could throw a Poke ball to catch Pokemon by flicking from bottom to top on the screen.

Pokemon Go uses the real world as the game-play stage; in order to catch and earn experience, users need to move physically. Pokemon successfully builds the connection between the digital and real world. There are several "PokeStops (the blue circles in figure 2.7)" placed on the virtual map. PokeStops are often placed on the same places as the landmarks in the real world. This also enhances the connection of two worlds. Players could get virtual items and experience when they are close enough to the stops.

Compared with City Friends, although Pokemon Go uses real world as the background stage, it focuses only on the game purpose. The PokeStops work only as the stage properties. It shows only pictures but no information about the places appears. Players are motivated to visit because of the virtual items. Besides,

13 Apple says Pokemon Go is the most downloaded app in a first week ever. Source from <https://techcrunch.com/2016/07/22/apple-says-pokemon-go-is-the-most-downloaded-app-in-its-first-week-ever/> accessed on 25th July 2016.

14 Pokemon Go' Gives Boost to National Parks. Source from <http://www.wsj.com/articles/pokemon-go-gives-boost-to-national-parks-1468447301>, accessed on 25th July 2016.

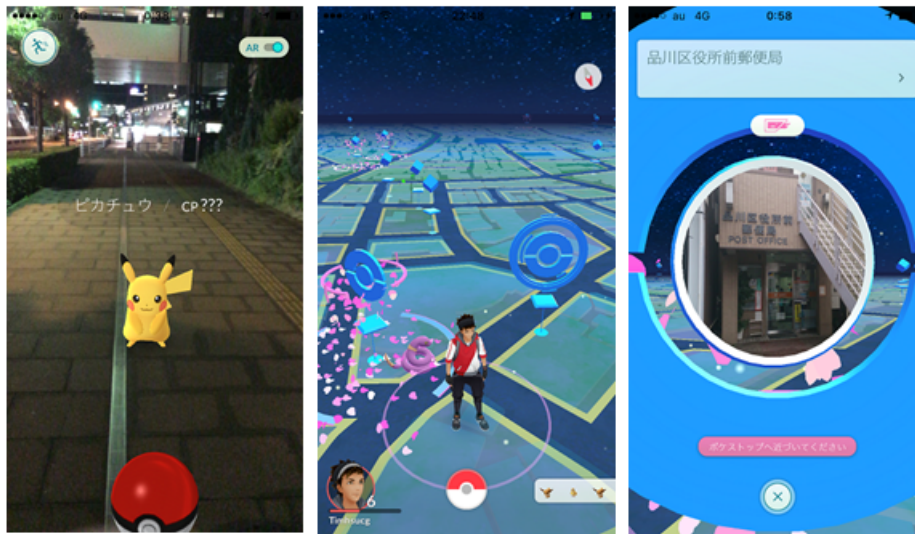


Figure 2.7: Pokemon GO

there is no storytelling in Pokemon Go and neither Pokemon nor PokeStops talk to players.

Recho

Currently, it seems that there is no smartphone application allowing users to interact with things. Recho provides a platform which allows users to leave voice messages. Users can leave his/her voice messages on a certain place. When another user comes to the place nearby, users can choose to play the messages. The main screen of Recho shows below. There is a circle in the middle of the screen, representing users' position. Around the circle there are several small bubbles. All bubbles are the voice messages left by other users before. When users move, bubbles also will change accordingly at the same time. Once bubbles come into the circle, users can click them to hear the messages. There is a small circle in dot in the top of the screen. When it is clicked, it jumps to explore pages where it can be chosen to hide or show any types of messages.

The user interface of Recho is similar to the search page of City Friends. Although in this application users interact with things (messages), things (messages) are still left by other users. Things do not approach users directly and actively.

Also, there is no interactive factor between things (messages) and things (messages).

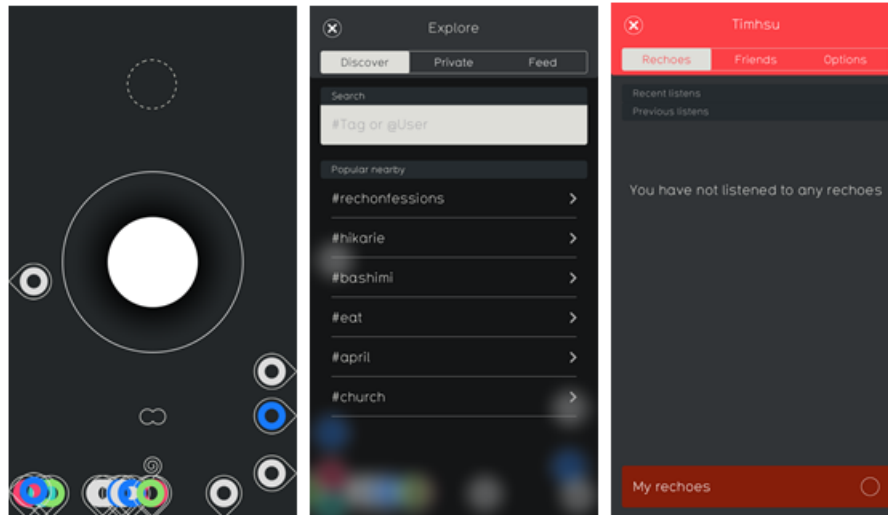


Figure 2.8: Recho

Other Applications

Crowd Trails

Crowd Trails was developed by Keio-NUS CUTE (Connective Ubiquitous Technology for embodiments) center and launched in May 2016. Crowd Trails is a location-based application for creating and sharing geographic trails. CUTE claims that travelers seem more satisfied and are more possible to acquire more knowledge systematically with path-based schedules. Users could simply click explore to follow certain paths other users created or design their own paths, sharing on-line. When entering edit mode, users are asked to decide type of themes (such as "Classic heritages Tokyo" or "best restaurants in Tokyo") for their paths first. Afterward, by selecting and adding description to several different places, stores or areas in a row, it generates paths automatically.

For the structure point of view, City Friends is also a path-driven travel application. However, compared with Crowd Trails, all the spots are connected

by stories in City Friends. There are clues and leads in conversations between characters and users. Users are expected to follow the instruction and complete each step while they interact with characters. On the other hand, the connection among spots in Crowd Trails is only because all the spots belong to a certain theme.

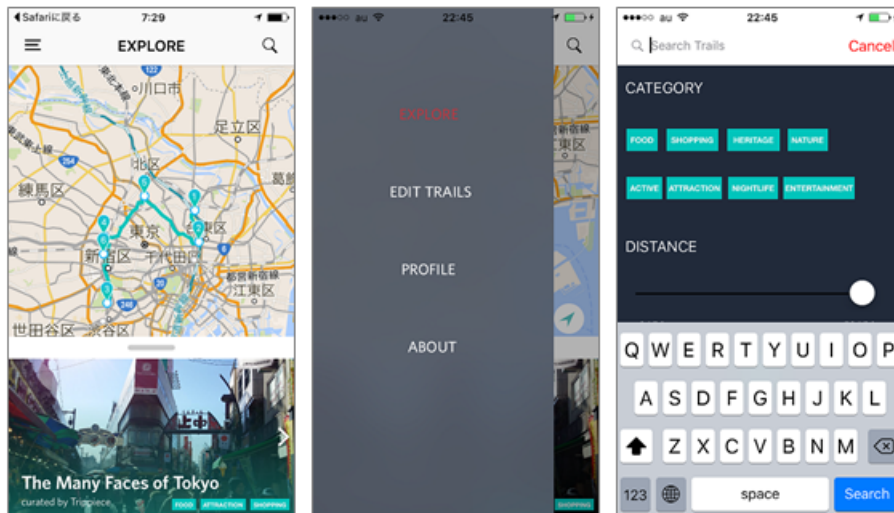


Figure 2.9: Crowd Trails

2.5 Short conclusion

In this chapter, the basic knowledge of IoT and Social Things has been mentioned and discussed. The cases and the concept of applied Social Things have been reviewed and compared with each other. Interactive systems used in the similar usage and Chatterbot service also have been discussed. The popular travel smartphone applications have been categorized and compared with City Friends. In the next chapter, the concept of City Friends and the design of prototype will be addressed.

Chapter 3

City Friends

3.1 Concept of City Friends

The purpose of City Friends is to make tourists know the city better and create some fun travel experiences. Through smartphones, things, including both famous scenic spots and ordinary things, could interact with tourists. By making friends with things in cities, it would help tourists immerse in the environment more.

In this section, the design thinking process is applied to explain the concept. First, the problem, which City Friends is going to solve, is discussed. Afterwards, the possible solutions, users' experience, the prototype and its system structure design are addressed.

Philosophy - people should interact with cities more

Cities always have lots of stories behind. Ancient monuments, statues, etc. which left hundreds of years all have their own stories. For quite a long time, people try hard to follow travel guides, read articles from other media or do bloggers' recommendations when they travel. Sometimes, they even pay more attention to reading books rather than really visiting cities.

Most stories written for scenic signs are set nearby. Those signs do not connect each other and most of them are difficult to understand. Most of the stories are not designed as a whole; they describe themselves separately. It turns out that tourists only could catch piece by piece and then figure it out by themselves. Most

importantly, except for monuments and statues, there are more stories inside the cities which are not shown on guide books or signs.

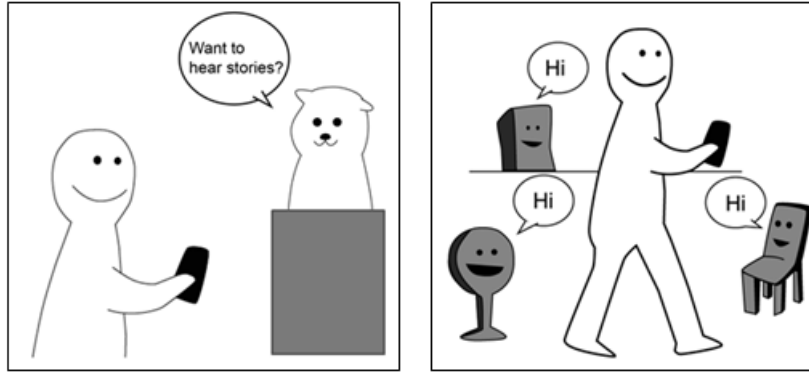


Figure 3.1: image of City Friends

If the stories could be presented by cities themselves, cities could interact with tourists and make a tour a party and tourists could become friends with cities, the experiences of travel might be totally different.

Vision - a new type of tourism

Because there is too much information in guidebooks and on the Internet, it is extremely time-consuming to read all the information and it does not make sense especially in this information-explosion era. When people finally make up their mind going outside, instead of being relaxed, they still have to spend more time finding famous scenic spots, or popular restaurants on maps. After all the struggles, it is common that they know nothing about the place. Moreover, it is not easy for people from outside of the city to travel alone. City Friends will make travel simple. Through City Friends, tourists will be able to interact with things in cities. Things could talk to users directly, introducing their stories. Traveling is no longer holding travel guides, and finding places. Users of City Friends could immerse themselves in the environment and be friends with cities.

City Friends is based on the concept of Social Things. By making things imitate human's communicating skills such as "accosting", "introducing", "recommending", "asking favors", "expressing acknowledgement", things would invite

Types	Description
The Organized Mass Tourist	For whom the emphasis is on physical recreation. This type of tourists only follow the guide and barely make decisions.
The Individual Mass Tourist	Tourists who seek ways of forgetting their everyday life at home. Although they tend to arrange schedules by themselves, they still rely on traveler agents.
The Explorer	Tourists looking for authentic experiences. This type of tourists try immersing themselves to the place.
The Drifter	Tourists who want to totally immerse themselves in the culture and lifestyles of their vacation destination. They barely use travel agents and usually do not have any specific schedules.

(Source: Cohen, 1972)

Figure 3.2: Four types of tourists

users to join their network. Things of City Friends would introduce cities from "their point of view"; such experience will be totally different from reading guide-books. The scenic spots would interact with users, saying hello to users and even asking favors. In the meantime, users could see things talk to each other. City Friends would make cities fun and friendlier.

Target group

The reason why the tourism field is chosen is because, first, tourists are more interested in the environment. Compared with local people, tourists are more willing to know the place. It might be a good reason for things to talk. Second, instead of ordinary things, famous scenic spots might be easier to be noticed, especially when people are not ready to talk to all things. Tourists usually pay more attention to famous things and are interested in the stories behind them. By making famous things talk, it is assumed that travelers would be easier to be invited to join things' network. Third, when people travel, they are more relaxed and may accept more surprises and unexpected. They may be more comfortable to try new things. Even when the situation goes wrong, tourists may be much more tolerable. Besides, because tourists may have motivation to interact with the place, it is expected that they would use the service served by things.

The definition of tourism varies person by person. In this paper, the term tourism refers to UNWTO's (World Tourism Organization) definition which is "Tourism comprises the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes." Besides, Cohen (Cohan 1972) categorized travelers into four types by the way they travel and how they travel .

The recreational tourist from Cohen's definition is removed from the target group of City Friends, because City Friends needs tourists to stay at a certain place and last a period of time. Furthermore, City Friends is a smartphone application; it might be difficult for tourists who are not familiar with smartphones. Also, the UI design of City Friends is like an SNS chat platform. Messages are displayed one by one from top to bottom. It is better if users are familiar with chat applications.

To sum up, the target group of City Friends is people, aged from fifteen to thirty-five years old, who are familiar with the SNS chat smartphone application and like to travel, especially alone. They are on their trip and do not belong to "the organized mass tourists".

3.2 Scenario of City Friends

One day, Tim has free time and is excited to try a new application called City Friends that he downloaded several days ago. He opens the application and searches all the routes and finally the "story of Hachi¹" is chosen. So, Tim takes train to Shibuya station².

After arriving the station, Tim goes to the City Friends counter and borrows one of the mini narrators he likes. He turns on the narrators, and synchronizes his phone and the narrator. After few seconds, the narrator, named Mini Masa starts

1 Hachiko (November 10, 1923 - March 8, 1935) was an Akita dog and is remembered for his remarkable loyalty to his owner which continued for more than nine years after his owner's death.

2 Shibuya is the second largest city in Tokyo, having lots of restaurants and stores. It is also the main gate from Tokyo to Kanagawa; lots of trains stop here, making Shibuya a convenient city.

to introduce itself to Tim. After a short conversation, the trip starts. First, Mini Masa leads Tim to Hachi's statue which is nearby the station. When they are close to the statue, Hachi say hello to them. Mini Masa introduces Tim to Hachi and Hachi is very happy to have a new friend who is from another country. Hachi starts to talk about himself, including how long he has been in front of Shibuya station and why he became a statue. Afterwards, Hachi suggests they go to place A, because Hachi really likes the place when he was a dog.

After a short walk, they arrive place A. When they get close to a stele named Mr. A, which Hachi mentioned, Mr. A says hello to them. It seems Hachi has already asked Mr. A to arrange a party for Mini Masa and Tim. Mr. A introduces his family to Tim. Suddenly the place becomes so fun. Everyone wants to talk to Tim. According to the A family, Hachi liked to stay around with them when he was a dog. And they perform a song which Hachi's owner, Mr. Ueno liked most.

After the show, Mr. A tells Mini Masa and Tim to visit Mr. Ueno (Statue). While Mini Masa and Tim are going, The chair suddenly talked to them. The chair says it needs to go back to its place but it cannot. Mini Masa asks Tim to help and Tim said OK. So Tim carried back to the chair to its original position. The chair is very happy because Tim helps it to go back. It invites Mini Masa and Tim to sit and enjoy the dessert on the table. It also introduces them that Hachi likes this dessert a lot. He always ate this when he waited his owner back from work. Mini Masa and the chair talk about news around the place. The chair is so surprised because it does not know that the Mayor of Tokyo quit his job all of a sudden. Everything on the road leads Mini Masa and Tim and finally they met Mr. Ueno (Statue). Mr. Ueno says he is happy to talk with Tim and share his story. Tim has a great time and says goodbye to Mini Masa.

3.3 The prototype

The prototype and system structure

The prototype of City Friends is based on Viska and the prototype of Autonomous corporation system used in the 2015 KMD forum. Autonomous corporation system is used as the platform for three Edison modules and Viska to exchange

information.

Only when all of the devices connect to the Internet through the same WiFi connection, the system starts to work. Bluetooth on all devices recognizes distance among each other and transfers the information to Viska via the Internet.

Viska

Viska has three main functions, which are "searching", "sending messages" and "display messages". Viska summarizes the information, showing on the screen. Users could know how many and how far Social Things are around by using Searching function. Users could receive messages from things and interact with things with Receiving and Display messages functions.

For the user interface design, there are two pages, "Searching page" and "Conversation page" in this prototype. When Social Things are nearby, their icons will be displayed on the Searching page, categorized into three types, immediate, near and far, which depend on the distance between objects and smartphones.

Distance which is less than 30cm is classified into immediate; 30cm to 2M is near and farther than 2M is far. Social Things are shown as icons accordingly. While the testers move around the room, the position of icons changes simultaneously. Users who hold smartphones are shown on the top of the sector. Users can see messages sent by Social Things on Messages page (right of figure 3.8). Latest messages will be shown on the top of the page and all messages are listed from top to bottom. There are Social Things icons on the left of each sentence. Users can know which thing sends what sentence easily.

By utilizing the information as a trigger, it is possible to generate preset messages when the condition meets. All the pre-coded conversations are triggered by conditions. Before the user experience, the three Edison modules are placed on three different objects. During the test, testers are asked to hold the smartphone and walk around the experiment place.

In this example, when the tester walk to Object A, after the distance between the tester and Object A becomes less than two meters (condition Near),

because the condition of Event-01 is satisfied, Object A starts to send messages (Conversation-01) to the tester and display on the Message page. After Event-01, the tester follows the instruction and goes close to Object A and Object B which makes Event-02 satisfied. Viska then generates Conversation-02. Once the conversation ends, Viska will change back to the standby mode and wait until the next event happens.

Because the prototype is distance-based, all the pre-coded conversations will be triggered by position changes. It is important to guide the testers to certain positions. By guiding the testers change their positions they can continuously receive messages and experience the story.

3.4 The workflow of the system and possible user's reactions

Figure 3.10 shows the System workflow and users' possible reactions. When the experiment starts, Viska and Social Things sense each other continuously and send information to each other. Once the condition meets, Viska vibrates smartphones to remind users of reading messages. The lights of Social Things blink at the same time to make users notice that the messages are from them.

For the possible user reactions, it is assumed that there would be three users' reactions, notice, read and follow during the experiment. First is noticing. When messages are generated, smartphones vibrate and light on things blinks. Users are expected to notice the connection and react. After noticing, users stop walking and start to read messages, acquiring information and instructions. After the conversation is finished, users are expected to follow the instructions to the next event and complete the story.

3.5 Expected result and the interview

City Friends has proposed a new style for tourism and is expected to change tourists' behaviors. Tourists might be more willing to know the place, having fun

interacting with things in cities when they use the service of City Friends. In order to know if the experiment could achieve these goals, the testers are interviewed after the user test. Finally, their feedback will be analyzed to see if City Friends could reach the goals. Goals of the user test is listed below:

- Allow users to know the place better.
- Make users befriend things in cities.
- Let users have fun interacting with things in cities.

The list of Interview Questions

1. Testers' basic information (age, gender, education level, etc.)?
2. Do you think City Friends help you to understand the environment?
3. After the experiment, do you see traveling different?
4. Do you feel stressful during the interaction with things?
5. Will you use this service in the future?
6. Which do you like most during the experiment?
7. What do you think about City Friends?
8. Do you have any other comments for City Friends?

In this chapter, the concept of City Friends has been proposed. Based on the feedback from the 2015 KMD Forum, the prototype was modified and applied to City Friends. By applying this prototype, pre-tests were executed. In chapter four, the detail of the pre-tests and the testers' interviews will be covered and discussed.

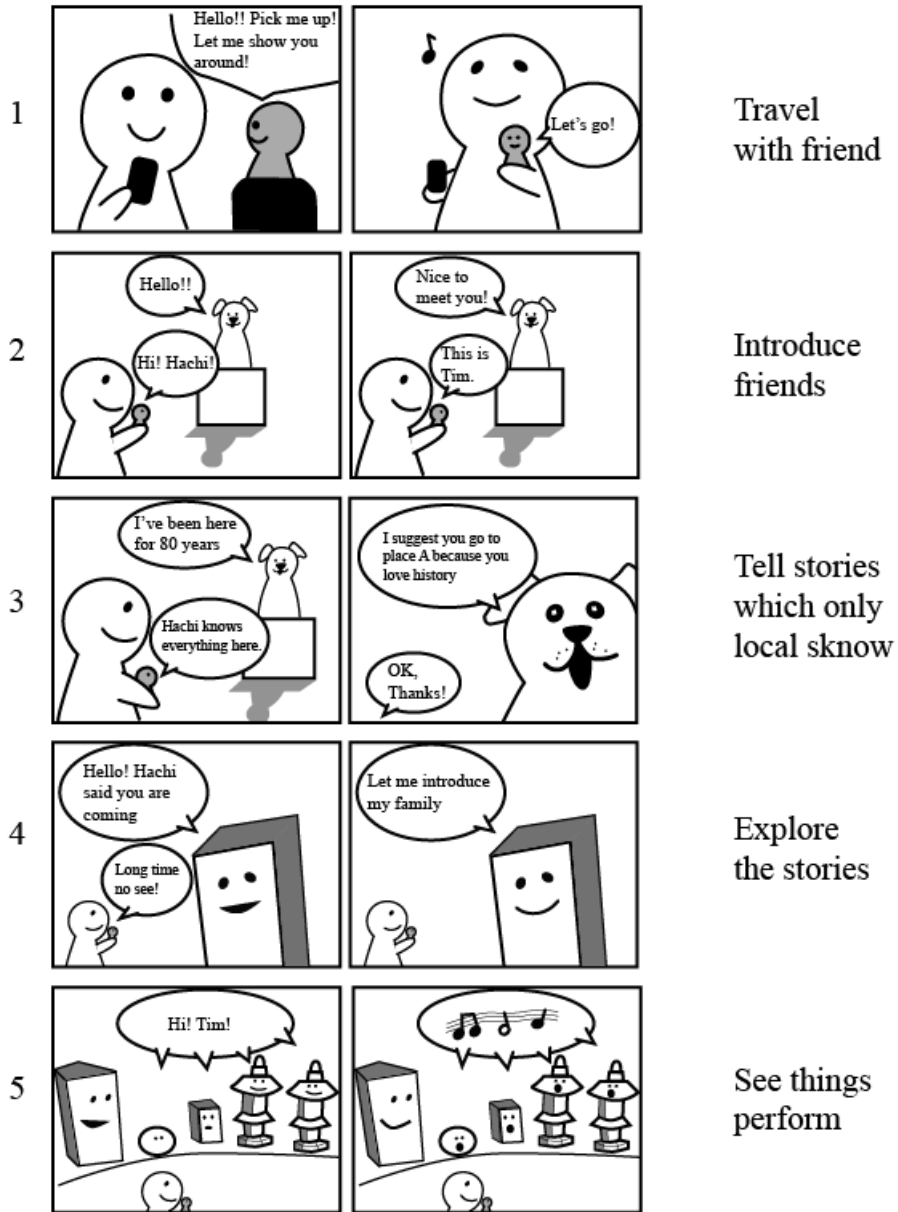


Figure 3.3: Scenario of City Friends



Figure 3.4: Scenario of City Friends

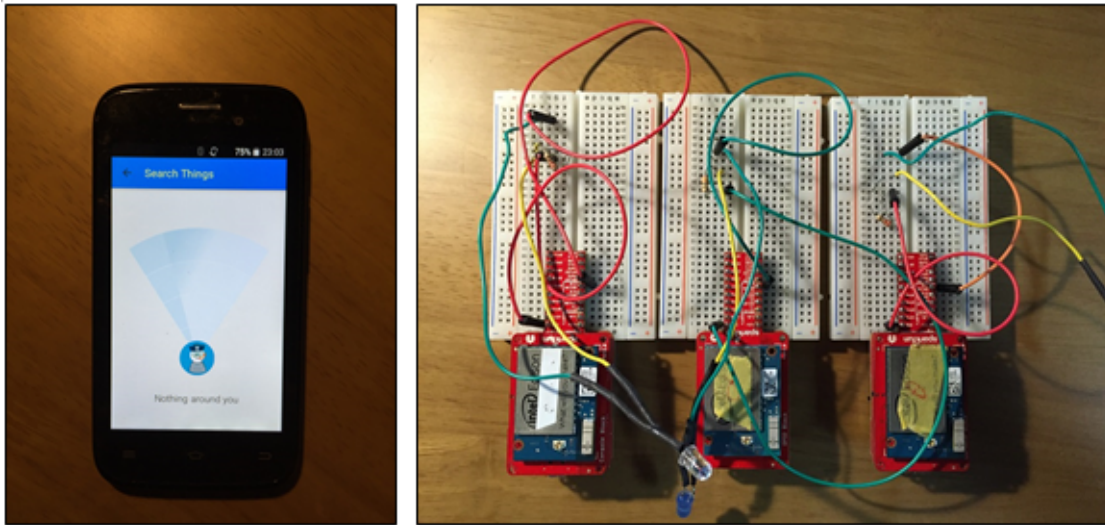


Figure 3.5: Smartphone with Viska and Edison modules

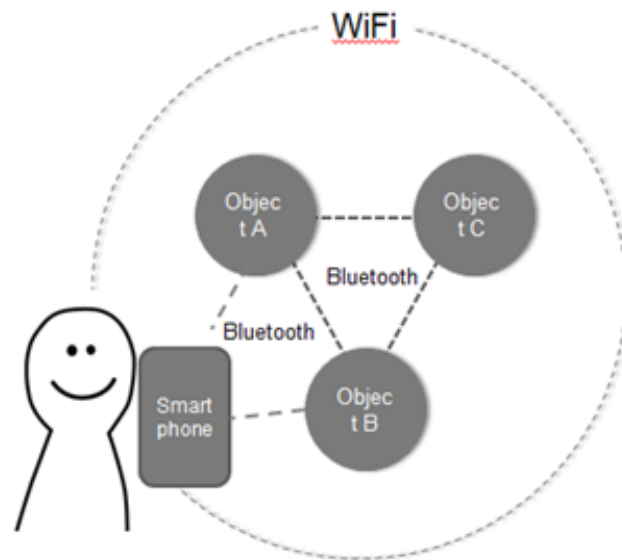


Figure 3.6: the structure of prototype of City Friends

Function	Description
Searching	Find things' locations
Receiving messages	Hachi says hi.
Display messages	See things talk to each other. Find more stories behind.

Figure 3.7: Social Mascots

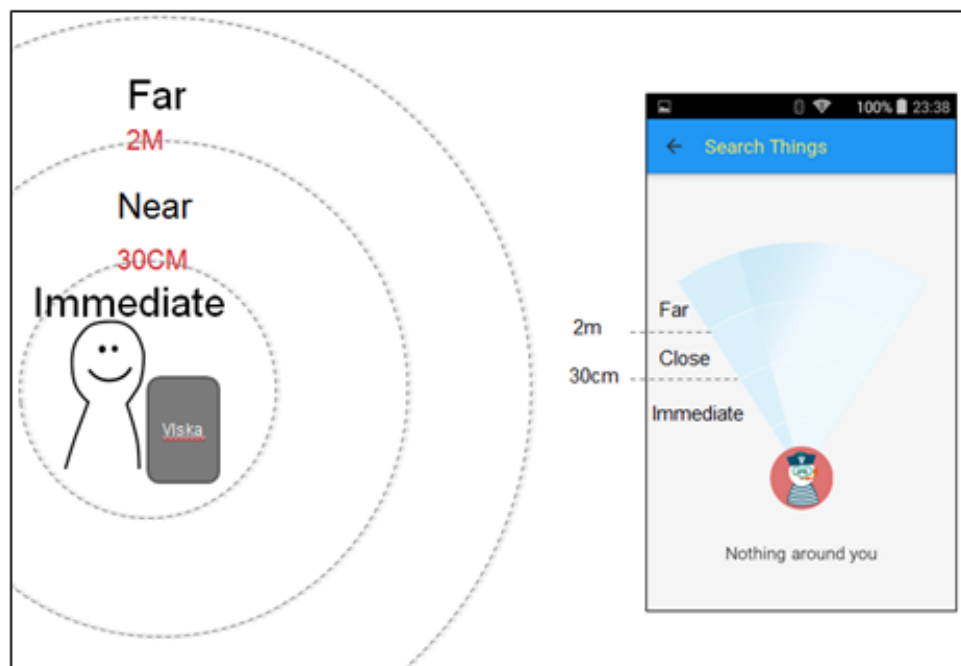


Figure 3.8: main functions of the prototype

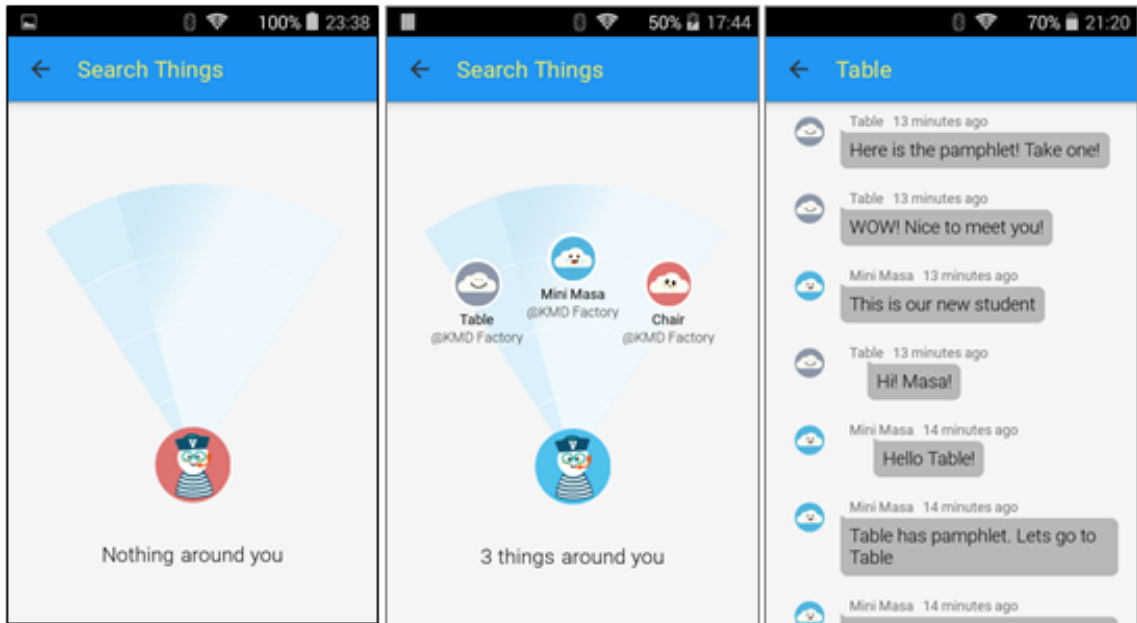


Figure 3.9: the user interface design of City Friends

Items	Condition			Generate messages
	Object A	Object B	Object C	
Event_01	Near	-	-	Conversation_01
Event_02	Immediate	Near	-	Conversation_02

Figure 3.10: an example of condition settings

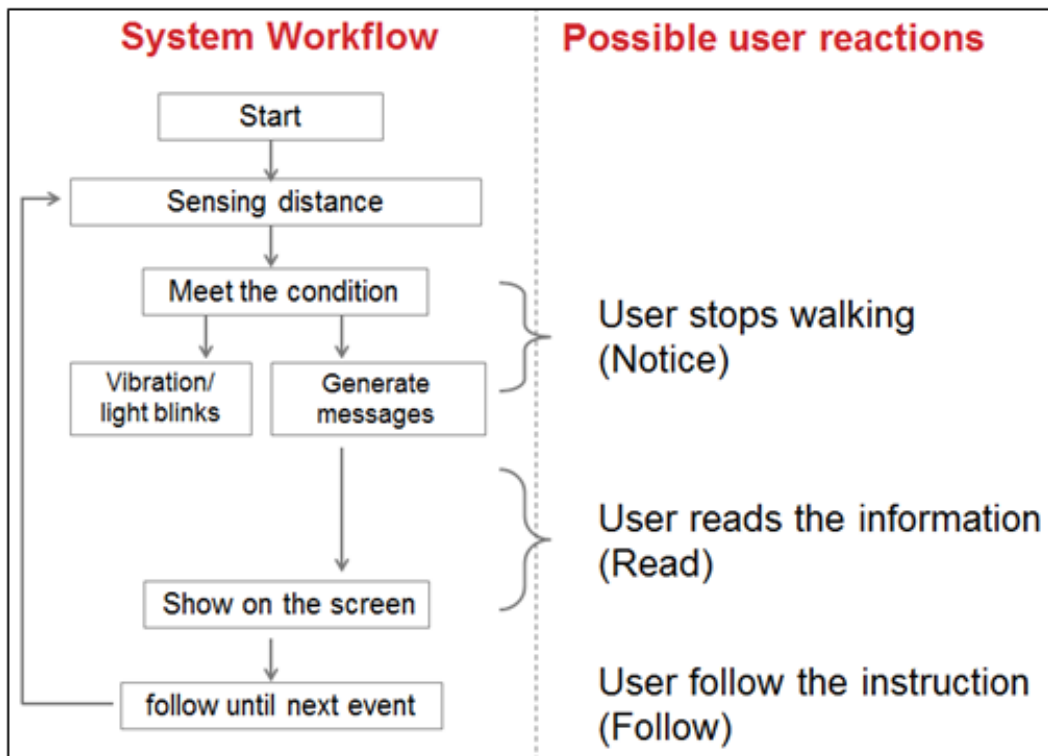


Figure 3.11: The system workflow and possible user's reactions

Chapter 4

Pre-tests

Because several issues arose while prototyping, before the final user test two pre-tests were executed respectively. These two pre-tests are on different dates with different types of prototypes. There are two reasons why pre-tests were executed. First is to find out the key design factors. Second is to check whether Viska and Autonomous cooperation system work or not. In this section, the two pre-tests are addressed in detail and a short conclusion comes afterwards.

4.1 Pre-test version I

When the first test was taken place, the prototype of City Friends had not been ready. Thus, instead of the real prototype, a smartphone SNS application called "Messenger¹" was used. In order to make the conversation happen, four objects, Viska, Object A, B and C. Four new Facebook accounts were applied.

Once four accounts were created, users' profile pictures were changed to the objects which they represented. After those accounts were tested to be ready, "create group function" of Messenger was applied to form a chat room.

In order to send messages without delay, two laptops were used. In order to make messages simple and clear, when one test was finished, another new chat room would be created for the next tester.

1 a smartphone application run by Facebook





Accounts	Representing object	Icons
STViska@gmail.com	Viska Kmd	
STobjectA@gmail.com	Mini Masa	
STobjectB@gmail.com	Chair Kmd	
STobjectC@gmail.com	Table Kmd	

Figure 4.1: The prototype of pre-test version I

Settings

The purpose of pre-test I is to acquire more knowledge of designing City Friends, especially the interaction part. Thus, the story was simple and designed based on asking a favor. Mainly after briefly introduction, Object A asked for Object B's help. The arranged events and conversations between objects are listed below.

When the test starts, the tester is asked to walk to Object A. When the tester

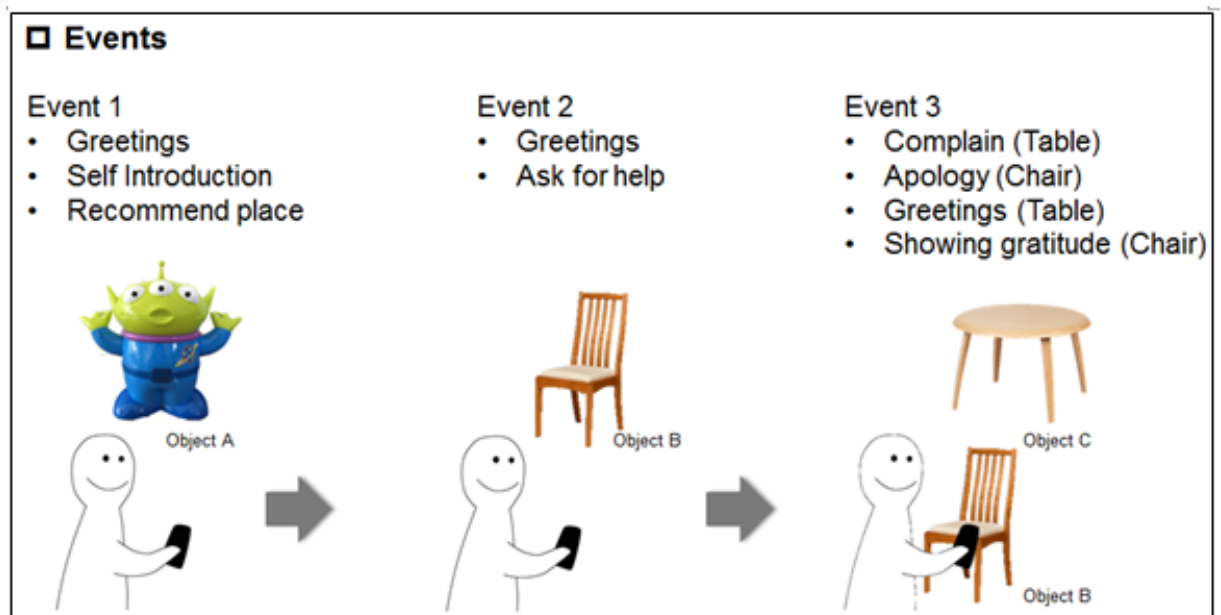


Figure 4.2: Tools used in pre-test version I

Steps	time	Interact target
Before the test	00:00-05:00	Research team
Event_01	05:00-7:00	Object A
Event_02	07:00-07:30	Object A, Object B
Event_03	07:30-08:00	Object A, Object B and Object C
End the test	08:00-15:00	Research team

Figure 4.3: Events in pre-test version I

is approaching to Object A, research team starts to send messages. The tester gets instruction to go to Object C then starts to move. While user is going to Object C, the tester receives message from Object B. The tester gets instruction to carry Object B to Object C. When the tester, carrying Object B approaches Object C, the tester receives conversation-03. Conversations are shown below in detail.

Test starts

Conversation-01

(Imitating human behavior: accosting, introducing and recommending)

1. Object A (Mini Masa): Hello! I am Masa, how are you?
2. Object A: It is our first time to meet each other. Come here. Let's be friends!
3. Object A: OK, let me introduce myself. I am a professor in KMD. I love to innovate. Students love to talk to me. I assume you are interested in KMD and that is why you are here, right?
4. Object A: So, you are now on the third floor at KMD building. Could you feel the innovative power? On this floor there are several meeting rooms. So many innovations have been created and come out here.
5. Object A: I suggest you go to Table. You can get a very nice pamphlet from there.

Instruction: Go to Object C

Conversation-02

(Imitating human behavior: asking a favor)

1. Object B (Chair KMD): Hello, I am Chair KMD. You can call me Chair. I just see you passing by.
2. Object B: I heard that you are going to Table, right?
3. Object B: If you are ok, could you take me to Table?

Instruction: Take Object B to Object C

Conversation-03

(Imitating human behavior: expressing acknowledgement)

1. Object C (Table): Hey, Chair. Why did you take so long to come here? You are the one Masa mentioned. Please take the pamphlet and enjoy!

2. Object B: Thank you! See you next time!

Story ends.

Before the experiment, testers were explained that the prototype was only for seizing the concept. There were five steps during the pre-test version I, including an explanation, test and short interview. Event-01 takes two minutes, Event-02 and 03 are thirty seconds.

Steps	time	Interact target
Before the test	00:00-05:00	Research team
Event_01	05:00-7:00	Object A
Event_02	07:00-07:30	Object A, Object B
Event_03	07:30-08:00	Object A, Object B and Object C
End the test	08:00-15:00	Research team

Figure 4.4: the steps of pre-test version I

User feedback

User K

- Background: A student from KMD
- Date: 21st May, 2016
- Time: 14:00
- Place: Kyoseikan

User K is a student from Keio Media Design who is familiar with immersed experience design. Because user K was the first tester, there were several problems happened during the test. First, the speed of showing messages was too slow. And, because Messenger did not vibrate when it received messages, user K got confused several times. Except for Mini Masa, Chair and Table seemed not easy to be noticed.



Figure 4.5: user K

User K mentioned that the concept of "cities chat" is very exciting; however, the user test was not interesting as he expected. He thought there would be more interactions among things and the user when he first heard the concept. He suggested that the way of interactions should be improved in some ways, such as, to utilize lights or sounds, and to create more actions.

As he said, it was difficult to feel immersed into the environment if the final product would be like this prototype. If the only thing that users need to do is to read the messages, there is nothing different from the devices used in the museum at present. It would be better to reduce the contents and add more actions. He also mentioned that he never considered and imaged those ordinary things such as Chair and Table could talk. This is the reason why he did not know how to react to those messages at first. However, as he said, the multiple chats from things will have great potential.

User E

- Background: A housewife who likes to visit museum
- Date: 30th May, 2016
- Time: 20:00
- Place: Taipei



Figure 4.6: User E

In the second test, the speed problem happened before was improved; thus, user E confused less and seemed happier with the test. User E is a housewife who likes to visit museums. Compared with user K, user E is not familiar with engineering or technology. Besides, before the test, user E had only limited ideas about IoT.

User E mentioned that because she liked that "little green men" (Object A; Mini Masa), she was interested in what it said. It is assumed that this is also a

reason why she followed the instruction better than user K. She said that there have been similar devices which guide people offered in museums. Because those devices she mentioned are only for providing information about the exhibition to users, it seems different from the concept of City Friends. When being asked if she felt immersed into the environment, she answered that she immersed more in the content than in the environment. Although she knew that Chair and Table were set to talk, she still felt strange but did not know how to describe this feeling. The concept seemed to her like "the fantasy world of Disney", and she will be happy to see City Friends on the market in the future.

Short conclusion for prototype - version I

Both users agreed the concept of City Friends is good. However, it could be seen that users' background led to different results significantly. User K paid more attention to the physical interactive experience; on the other hand, user E seemed satisfied with the messages sent. Besides, user E's attitude toward Disney character "little green men (Mini Masa)" helped her immersed into the story during the test. It could be seen that a successful character setting could be important to City Friends.

Because the messages are hand-typed and sent by research team, pre-test version I did not go well at the beginning. Once the messages delayed, user lost attention and possibly user might give up. Meanwhile, messages delay or repeat sometimes shows the personality of characters. Also, the lines should not too long in one conversation. If it is too long, user could lose attention. Besides, the physical interaction is also important, especially the timing when system sending messages. It could enhance the connection between things and users.

In addition, it could be seen that ordinary things seem more difficult to "be accepted" if they could talk in the real life, as both users did not notice and expect that things could talk at first.

4.2 Pre-test version II

Instead of Messenger, Viska and Autonomous Corporation system was applied for version II. Compared with pre-test version I, the content was shortened based on the user feedback. Also, three remote control lights were installed for creating more connection. The lights were controlled by a research team member, blinking according to the content to enhance interactions. Because WiFi was needed, a pocket WiFi was rented.



Figure 4.7: pocket WiFi and remote control light

Settings

The purpose of pre-test II is to check if Viska system could work or not. The story was the same as pre-test version I. The number of words is reduced from 171 to 130 words; mainly reduced from Event-01. In addition, the remote lights blinked while Social Things are talking. Conversations are shown below in detail.

Test starts

Conversation-01

(Imitating human behavior: accosting, introducing and recommending)

1. Object A(Mini Masa): Hello! I am Masa, how are you? (Light A blinks)
2. Object A: Yes, I am talking to you (Light A blinks)! It seems this is our first time to meet each other. Come here. Let's be friends! (Light A blinks)
3. Object A: I am a professor in KMD. I love to innovate. I assume you are interested in KMD, right? (Light A blinks)
4. Object A: So, you are now on the third floor at KMD . So many innovations have been created and come out here. (Light A blinks)
5. Object A: I suggest you go to Table. You can get a very nice pamphlet from Table. (Light C blinks)

Conversation-02

(Imitating human behavior: asking a favor)

1. Object B(Chair KMD): Hello, I am Chair KMD. Just see you passing by. (Light B blinks)
2. Object B: I heard that you are going to Table, right? (Light B blinks)
3. Object B: If you are ok, could you take me to Table? (Light B blinks)

Conversation-03

(Imitating human behavior: expressing acknowledgement)

1. Object C (Table): You are the one Masa mentioned. Please take the pamphlet and enjoy! (Light C blinks)
2. Object B: Thank you! See you next time! (Light B blinks)

Test ends.

The time table is the same as pre-test version I. Different from pre-test version I, all the messages are generated by system.

Steps	time	Interact target
Before the test	00:00-05:00	Research team
Event_01	05:00-7:00	Object A
Event_02	07:00-07:30	Object A, Object B
Event_03	07:30-08:00	Object A, Object B and Object C
End the test	08:00-15:00	Research team

Figure 4.8: steps in pre-test version II

The condition settings in pre-test version II is described below. When the test starts, the tester is asked to walk to Object A. After the distance between the tester and Object A becomes less than two meters (condition Near). Because the condition of Event-01 is satisfied, Object A starts to send messages (Conversation-01) to the tester and display on the Message page. After Event-01, the tester follows the instruction and goes to Object C which makes Event-02 satisfied. Viska then generates Conversation-02. After Event-02, the user carries Object B and walks toward Object C. When both tester and Object B get close to Object C, making Event-03 satisfied and Conversation-03 is generated.

Items	Condition			Generate messages
	Object A	Object B	Object C	
Event_01	Near	-	-	Conversation_01
Event_02	Immediate	-	-	Conversation_02
Event_03	Immediate	Near	-	Conversation_03

Figure 4.9: condition settings in pre-test version II

Next, results of the pre-test version II will be addressed in detail.

User feedback

User L

- Background: A sales person in Taiwan

- Date: 11th June, 2016
- Time: 20:00
- Place: Oimachi



Figure 4.10: User L

User L is a sales man in Taiwan. He likes to travel to Japan and most of the time he travels alone. He enjoys different culture, food and always searches information on the internet. However, because he does not know Japanese, he sometimes feels inconvenient.

During the test, because the messages were written in English and displayed with fixed timing, user L seemed to have difficulty catching up with the speed. And, once the program started, it continuously showed messages and cannot be stopped. Thus, user L missed the instruction at the first time and needed to try it again.

User L mentioned that this service could change the way that the industry of tourism works now. As he said, if City Friends were on the market, perhaps most tour guides might lose their jobs. He was especially excited about the Edison module. He emphasized that with this kind of "module", everything could be a smart thing in the future. As he also mentioned, nobody will refuse "Gundam" in Odaiba if it recommends a specific restaurant to him or her. He believed that City Friends will have great potential to create a new chapter for the tourism industry, and it is possible to build a niche market for people who want to travel alone but are worried about their language ability.

In addition, by creating more interesting and complicated contents, it is highly possible that City Friends could make travel become a RPG in the real life. Cities would lead tourists to visit cities, collecting items and completing missions. And, if cities memorize the interests of every tourist, the current business model will be changed hugely. Of course, if things are really smart enough and understand users' messages, it would be much more interesting. He concluded that he wishes this kind of service could launch to the market sooner.

User C

- Background: A PhD student in Tokyo University
- Date: 12th June, 2016
- Time: 20:00
- Place: Tokyo University

User C is a Ph.D. student at Tokyo University, majoring in international relations. He likes to travel but unlike user L, user C dislikes staying at a place for too long. Because user C is also not familiar with English, time taking to receive messages was extended; however, he still missed instructions when Chair asked him a favor.

User C mentioned that he thought the concept of the idea is interesting, especially the multiple communications from different things. It would be fun to see things communicate with each other through City Friends; however, the diameter



Figure 4.11: User C

of the sensing distance was better to be shortened. Or people cannot deal with all the information sent from things everywhere.

User C also said he could not understand why people would need to help things when traveling, especially from those things which might not important. He said he understood the purpose of the user test, allowing testers to experience interaction between things; however, the scenario seemed to him difficult to catch the image. It might be better to change the scenario.

He also suggested that the system of City Friends could be applied to children education. Unlike adults, children immerse themselves in environment easily. As he suggested that there should be more reasons to apply City Friends in children's education for more contributions. It is better not to hide the modules because people might feel more comfortable when they know which things can talk.

When being asked if he felt immersed in the environment, he answered no. He also said that he likes the way he travels now because he does not want to be bothered and interrupted so much except the famous ones. "I do not think

that to talk to "a stone" or something trivial will boost my travel experience", emphasized by user C several times.

User EE

- Background: A student in KMD
- Date: 13th June, 2016
- Time: 20:00
- Place: Kyoseikan



Figure 4.12: User EE

User EE said he would be happy to use City Friends if City Friends were on the market; because with City Friends, he would not need to buy guidebooks

anymore. User EE often goes to new places and likes the idea of communicating with things in new places. When traveling, people always rely on the information written by someone. The idea of information related to places coming to the tourists automatically makes travel fun and more like explorations. However, as he suggested that it is better not to overload information and how to control the quality and amount of the information should be important, too.

Through City Friends, he felt more close to things but not in the "relationship way". Take helping the chair in the test as an example, rather than helping the chair, he felt more like someone behind somewhere wants him to do so. Things are not humans so how to define the relations between things and humans will be a challenging issue in the future.

Besides, user EE said that it is possible that users might miss the messages when the place is crowded. He suggested that perhaps this idea could be applied to not only smartphones but also other kinds of platforms such as wearable devices. As he also said, it seems that smartphones are probably the most effective platforms to the present.

However, the concept of City Friends may be able to be applied to other services. In his opinion, AI might influence the experience a lot. Stories talked by things themselves would make a lot of differences. If people can ask the scenic spots questions directly, it will be a very exciting experience. On the other hand, if things keep sending the same messages, it would make people feel bored soon or later. "If things could think and the conversation could be more human-like, City Friends will be much cooler", he concluded.

Short conclusion for pre-test version II

It could be seen that Viska prototype worked better than pre-test version II. All of the three testers complete the tests without difficulty. In addition, after making lights blink to create more connections between users and things, result shows testers were confused less. All three testers talked more about their ideas about new travelling style, even applying the system to other field. However, because City Friends is a message-based application, it could be seen that a language barrier occurred in both experiments. This problem shows that language will be

an issue to City Friends, especially for foreign tourists.

In addition, user C pointed out that instead of hiding the modules, it is better to show it on the Social Things. By doing this, users could know which thing could talk at the first stage and feel less stressful.

Although all the three testers agreed City Friends has potential and the user test seemed to work well, when they were asked if they have fun interacting with things, the answers from user C and EE were negative. It seemed user C and EE does not immerse to story too much. Both of them considered the scenario was not attractive and got confused when they were asked to move a chair by "a chair". It could be seen that the story and also the personalities of the characters were still weak. In order to improve the user experience, it is necessary to add more storytelling design in the content. In next chapter the scenario used in pre-tests will be analyzed first. Based on the result, another story based on original idea will be proposed. Afterwards, user test will be executed.

Chapter 5

Evaluation

Storytelling design was realized lack after looking into the results of pre-tests. Thus, in this chapter, it will be focused more on storytelling design. By comparing the scenario used pre-tests, a new prototype will be proposed.

Also, in order to make the prototype easier to connect to the same WiFi, in prototype version II, a pocket WiFi was used; however, due to IP consistently changing, serious problems occurred to the Edison modules unexpectedly. Because a stable WiFi connection was needed during the user tests, the test environment was limited. For this reason, the final user test was executed on the third floor of KMD Kyosei-kan (Hacking studio). Thus, the scenario of user test was scaled down to "Travel around Keio University" accordingly. The target group of the user test was also changed to people who were interested in visiting KMD, aged from twenty to thirty years old. The scenario will be proposed based on this situation.

5.1 Storytelling design

A story is a narrative of events arranged in their time sequence (Forseter 1927). By telling each event in sequence, it makes an understandable story (Glassner 2004). Freytag (Freytag 1863) analyzed Shakespeare's plays and summarized that there are five act structures, exposition, rising action, climax and denouement. In the user test, the interaction between things is considered the climax of the story because things interaction is assumed more impact.

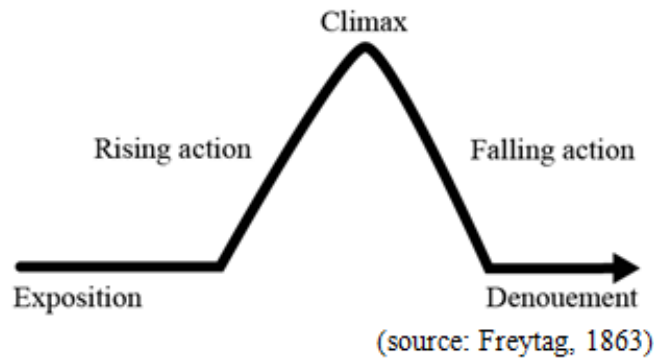


Figure 5.1: act structure of story

The act structure of story in pre-tests is analyzed below. More than half of the time spent on exposition (Mini Masa introduces), and only a minute on the other four portions. After the long exposition (Mini Masa introduces), following a short rising action then climax (help chair) happened suddenly and story ends (Mini Masa, chair and table chat). It could be seen there were several problems in the story structure used in pre-tests.

Steps	Time	Act structure	Interact target
Before the test	00:00-05:00	-	Research team
Event_01	05:00-7:00	Exposition?	Mini Masa
Event_02	07:00-07:30	Rising action, Climax	Mini Masa, Chair
Event_03	07:30-08:00	Falling action and Denouement	Mini Masa, Chari and Table
End the test	08:00-15:00	-	Research team

Figure 5.2: act structure of story design in pre-tests

Moreover, according to Mateas, Stern and Braun's study addressed in chapter two, we understand a strong connection among users, characters and stories is necessary to interactive storytelling. And clear personality of each character is the key to the connection. In the story of pre-tests, Mini Masa talked more than fifty percent which makes the personality of Chair and Table weak. In addition, Mini Masa is original a Disney character which makes Chair and Table less attractive. Furthermore, the speed of messages was the same during the test; the testers did could only receive the emotion from messages. This is also a possible reason why

testers did not feel immersive during their tests.

Items	Characters		Physical interaction	
	Names	Personality	Speed of message	Speed of blink
Objet A	Mini Masa	Friendly	Same	Same
Object B	Chair	Not clear	Same	Same
Object C	Table	Not clear	Same	Same

Figure 5.3: the characters setting in pre-tests

Based on the storytelling structure and character settings discussed above, another scenario for the user test is proposed in next section.

Scenario

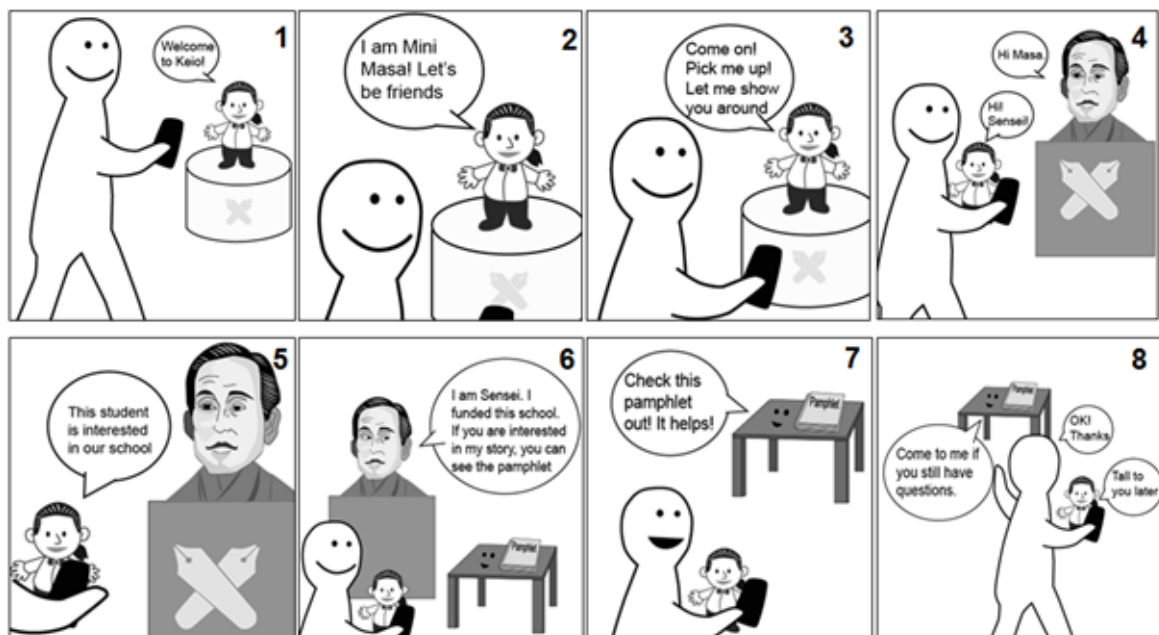


Figure 5.4: the scenario of the prototype of City Friends

(Scenario starts) Tim comes to Keio holding his smartphone with City Friends. When Tim is close to the entrance, a small thing, called Mini masa, says hi to

him. Mini masa is super friendly. He likes to be friends with students. Mini Masa introduces himself and asks Tim to pick him up in order to show him around. When they approach to Table, Masa introduces Tim to Table. Then, Mini Masa and Table talk a little bit then Table suggests Tim take a pamphlet on the table because there are more information. After that, Mini Masa and Tim say goodbye to the Table (end the scenario).

Based on the scenario, the personality of each character is created and listed below. In order to enhance the physical interaction, speed of messages and light blink are different by modifying the parameters. Mini Masa, as a chatty helper, has most lines in the plot. Sensei, on the contrary, talks less and slowly.

Items	Characters		Physical interaction	
	Names	Personality	Speed of message	Speed of blink
Objet A	Mini Masa	Chatty	Fast	Fast
Object B	Table	Calm	Slow	Slow

Figure 5.5: The character setting in user test

This scenario contains five events. There are instructions in each conversation for every event. In order to make testers follow the instruction while they experience the story, instructions are designed and hidden into tones of each sentence of the conversations based on the purposes of the project and personality of the characters.

Act structure

Conversations are shown below in detail.

Conversation-01: Exposition

(Imitating human behavior "accosting")

1. Object A (Mini Masa): Hello! Welcome to KMD!
2. Object A: I am Masa, how are you?

3. Object A: Yes, I am talking to you! It seems this is our first time to meet each other. Come here. Let's be friends!

Instruction: User goes closer to Object A.

Conversation-02: Rising action

(Imitating human behavior "asking favors")

1. Object A: I am a professor in KMD. I love to innovate. Let me show you around! Come on! Pick me up!

2. Object A: Well, Do you see table there. Let's go to Table

3. Object A: Table has pamphlet. Let's go to Table.

Instruction: User picks Object A up and starts to walk toward Object B.

Conversation-03: Climax

(Imitating human behavior "introducing")

1. Object A: Hi, Table!

2. Object B (Sensei): Hi Masa.

3. Object A: This is our new student!

4. Object B: Wow! Nice to meet you!

Instruction: User walks toward Object B.

Conversation-04: Falling action

(Imitating human behavior "recommend")

1. Object B: Here is the pamphlet! Take one!

2. Object B: Take one!

Instruction: User picks up the pamphlet

Conversation-05: Denouement

(Imitating human behavior "expressing acknowledgement")

1. Object B: Have fun!
2. Object B: Come to me if you still have questions
3. Object A: Bye!

The story ends.

5.2 Positions and condition settings

In order to make users feel more controlled, instead of hiding them, the Edison modules are put in front of things in user test. Users could easily recognize them from their appearance. In this section, the condition settings will be addressed in detail.

When the test starts, the tester is asked to walk to Object A. After the distance between the tester and Object A becomes less than two meters (condition Near), because the condition of Event-01 is satisfied, Object A starts to send messages (Conversation-01) to the tester and display on the Message page. After Event-01, the tester follows the instruction and goes close to Object A which makes Event-02 satisfied. Viska then generates Conversation-02. After Event-02, the user picks up Object A and walks toward Object B. When the tester gets close to Object B, Object B becomes near, making Event-03 satisfied and Conversation-03 is generated. After Event-03, the tester approaches to Object C and then Conversation-04 is generated. Following the instruction in Conversation-04, the tester leaves the table and the condition of Object C becomes Near, generating the last Conversation.

5.3 The act structure of the user test

There are seven steps during the test and the whole test takes around fifteen minutes, including an explanation, test and short interview. Except for the climax (one minute), each event is planned to take around thirty seconds. After a basic explanation, users have to experience the test by themselves. The research team will help only when it is needed. Before the test starts, the research team explains the process of the experiment and confirms if testers would agree to be taken pictures. Afterwards, the research team hands over a smartphone and explains how the device works to testers. Testers will see three things displayed on the screen before the experiment starts. And, the Message page will still be empty.

5.4 User test

User W

- Background: A student from KMD
- Date: 14th Jun, 2016
- Time: 20:00
- Place: Kyoseikan

User W said she dislikes reading guidebooks when travel. If there are more these kinds of modules, City Friends will be an exciting service. If putting the modules on things in cities, things would be more connected to each other, forming a powerful knowledge map. With this knowledge map, tour experience could be different. There will be lots of interactions among things and human everywhere. Although it is interesting to see where things will lead users to, it would be better if users could decide in a certain level, she said. Lights may not be suitable for tourism, because blinks from lights may impact and damage the entire scenic spot. Also, lights could not be noticed if the environment is bright. Besides, lights may be difficult if there are many users needing the service at the same time. And if

there are multiple users, how to distinguish which light will blink and to whom is also a very vital issue to be discussed.

Moreover, she was satisfied with the messages based UI; however, reading messages could be dangerous if the area visited in cities is not safe. Vocal messages via earphones might be a solution but it also may depend on the environment.

She likes the idea to bring the guide (Mini Masa) with her during the test. It will make her feel relieved if she is in an unfamiliar city, she said. She suggested wristband may be a good product for City Friends as well. For example, there are several types of wristbands such as history, architecture, etc. Users could choose each type to wear to get related information when travel around. Also, bicycles could be another product for City Friends. Users could enjoy visiting when they ride around the city.

As she said, City Friends has great potential. It could be a life style. By simply interacting with things, people enjoy the contents they choose. They could visit special shops or restaurants without books. It might be a further recommendation area and breakthrough for the future improvement of City Friends, she emphasized.

User J

- Background: A student from KMD
- Date: 14th Jun, 2016
- Time: 20:30
- Place: Kyoseikan

User J said she does not like to follow the tour guide when travel; although she thought Mini Masa was a little bit noisy at first, she would use City Friends especially when travel alone. It will be even better if the content is interesting, she pointed out. Famous attractions are the main foci for tourists. They have lots of stories, which make them easily to create contents. It is possible to direct tourists only if the contents are interesting. It is a challenge to lead tourists and do things, which they did not usually do in the past.

Besides, Mini masa was too big to her. It was difficult to do things when she carried Mini Masa. Also, the connections between lights and things were weak. She did not notice lights blinking. Additionally, if users could ask things questions, City Friends would be more interactive.

Because of the story, she followed the instruction unconsciously, just like in a RPG, she said. Therefore, as she suggest, in order to stimulate users to interact with things, it might be good to put RPG factors into the content, such as collection or missions. If things in cities give the users tasks, allowing users to enjoy visiting with fun, or deciding which mission they want to follow, It would even be better. Besides, not only the famous spots, perhaps even if tourists setting next to some artificial things could create interactions.

She also mentioned that instead of smartphones, earphones might be better. It would be fun if users could hear jokes told by things. Also, when travel to a new place, she likes to see the environment. If she has to keep reading messages from smartphones, it would be a little bit strange to her. Perhaps as he proposed, it is better to change to vocal devices in the next experiment but new problems might also happen.

User S

- Background: A student from KMD
- Date: 14th Jun, 2016
- Time: 21:30
- Place: Kyoseikan

User S said that because he was also a research member of Social things before, it was very exciting to experience the test. He said that this user test has been the most Social things-like experience he even did. He especially liked the idea that via City Friends, not only things but also humans are all parts of Social things' network. People and things could help each other. Based on this point of view, there are friends everywhere. Tourists could ask questions at any time, in any

places, when they need the information provided by "local things" and they could find lots of different stories behind.

Rather than big cities, small towns are much more suitable for City Friends when it would be promoted. City Friends only would cost a little budget for purchasing modules and software. And small towns are more like one closed environment with their unique cultures and history. City Friends would be good for tourists to discover the stories. With different contents provided, City Friends would create several virtual paths, allowing tourists to follow.

User S felt Mini Masa was more like his friend, not just a tour guide. Although at first he thought Mini Masa talked too much, he accepted it as his personality afterwards. Because of Mini Masa, he felt it could be possible to be friends with other things. He also felt that everything showed its personality in conversation during the test. It might be interesting to embed lights whose color could be changeable to represent things' emotion.

He said that he was surprised and would use City Friends if it were on the market now. City Friends would be especially suitable to some theme parks, such as Tokyo Disney land. Children would like it. However, he preferred to use City Friends in the train station because to him train stations are the loneliest place of the world. Because there are always many people in the train station, no one talks to each other. If City Friends is applied, it would be fun to talking to benches and see things chat with each other while waiting for the train coming and It would be even greater if things help users get to know each other, working as physical Tinder.

User T

- Background: A student from KMD
- Date: 20th Jun, 2016
- Time: 20:30
- Place: Kyoseikan

User T likes this service because users actually walk around the place. While People travel around, they can read the stories. City Friends is good for people who like to know the stories behind the cities. When people travel, they tend to go to the places recommended by someone famous. It would be interesting to see things to introduce the cities. User T likes the idea to bring the guide (Mini Masa) with her during the test as well. It feels accompanied, she said. She felt Mini Masa is very friendly because the way it talks. Mini Masa is friendly and makes user want to see the messages.

User T laughed a lot when table said hi to her. Although it is scary if this is real, it is very interesting to see table talk like this because I never thought table would talk, she said. Perhaps it would be fun to make things talk during people shop, she said. This application should be able to be applied to theme park. If add some game factors, children will love City Friends.

User M

- Background: A student from KMD
- Date: 20th Jun, 2016
- Time: 21:00
- Place: Kyoseikan

User M said through this user test, he knows more about the concept of Social Things. This experience is new to him. It will be fun to see different things talk, especially some things people never thought it could talk. Things talk actively makes the world fun. To join things' network makes him feel special an exciting, he said.

This service will be helpful for people who want to visit another country but worries about the communication problem. People do not need to bother the others and can enjoy the local history, even food.

People do not need to ask others and could enjoy the small trip with things. It will be interesting to see what things will ask people to do. This experience makes he consider more about the interaction between humans and things, he said.

Different things in different places might talk different. For example things in office might talk very fast. Mini Masa talks really fast and makes it unique. It might be a new way to add value to normal things. Also, it could be a good education material to teach children to see things differently.

5.5 Conclusion for the user test

It could be seen that all five testers followed the whole instruction and took the pamphlets. Also, after the scenario was adjusted, feedbacks from users were tended to be more positive than pre-tests. All five testers answered that they had fun with things. User W, S and M felt that they were close to things and would like to be friends with things. Instead of hiding the devices, Edison modules were placed in front of the objects this time. It could be seen that users felt more comfortable when they could recognize which things could talk in the first place.

Most of the testers agreed that they knew the place better through City Friends; some of them believed that City Friends could take over guidebooks and even change the way of the tourism industry now. Also, most of the users were positive toward the target of the second test, which is to have fun interacting with things. All of them agreed that to interact with things would have great potential. Furthermore, in their cases, the scenario made the result different. Obviously, moving Chair seems not fun to most of them. Some of them expected that City Friends would become a real life RPG with interesting contents and game factors.

When being asked if they would become friends with the scenic spots, three of the users agreed. It could be seen that everyone dealt with things differently and it divers a lot. The testers' attitudes toward things made whether to accept the idea or not. User W believed people would be friends with things if they are smart enough. User S said it was fun to be friends with things, because there would be lots of stories behind. User M said it is very interesting and willing to help things. On the other hand, User K and C in pre-tests were not interested in communicating with things at all. For them, ordinary things seem not easy to be accepted as friends of humans. Therefore, it is better to say because every tester had his or her own beliefs whose beliefs simply would lead to the different results

of the experiments.

To sum up, it could be seen that physical interaction attracts the users at the first place. Storytelling design plays a vital role to drag the users to the conversation which is possible to change people's behavior.

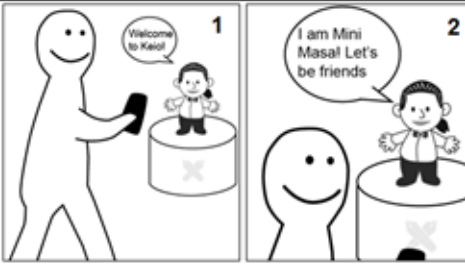




Event_01 Exposition		Users are attracted by Mini Masa because of the light and the vibration from the smartphone. In order to let testers feel less stressful, Mini Masa explains himself with warm words like friends.
Event_02 Rising action		After Event_01, testers are expected to understand the rules and should be able to follow more complicated instructions. Also, by holding Object A, it also enhances the physical connection between the tester and things.
Event_03 Climax		When Object A introduces user to Object B, testers are expected to feel immersed because users are dragged into the conversation and the information are interesting to users.
Event_04 Falling action		Users follow the instructions and complete the task successfully. Testers feel released when Object C said great.
Event_05 Denouemen t		Here testers acquire enough information, follow instruction well and are ready for another plot.

Figure 5.6: the interactive storytelling design of the prototype of City Friends

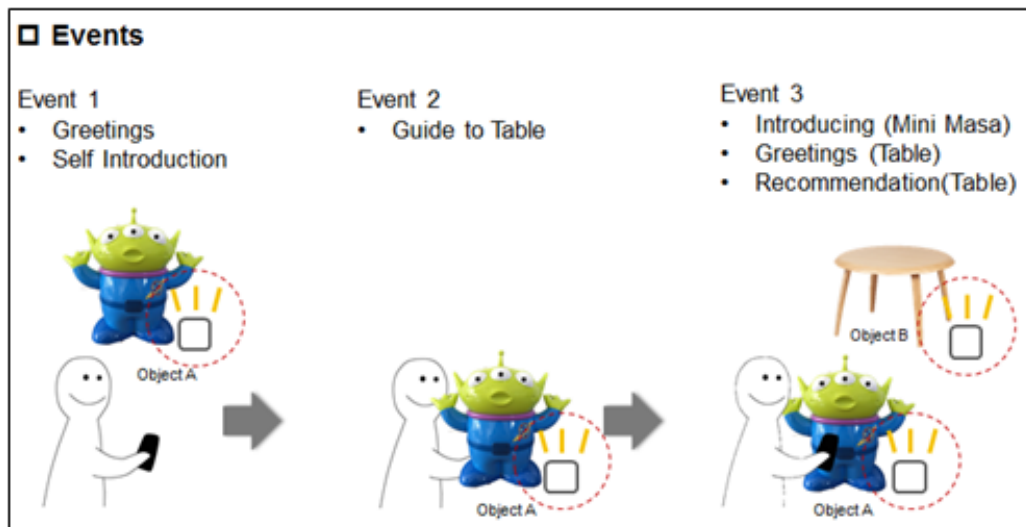


Figure 5.7: Events in user test

Items	Condition			Generate messages
	Object A	Object B	Object C	
Event_01	Near	-	-	Conversation_01
Event_02	Immediate	-	-	Conversation_02
Event_03	Immediate	Near	-	Conversation_03
Event_04	Immediate	Near	Immediate	Conversation_04
Event_05	Immediate	-	Near	Conversation_05

Figure 5.8: condition settings of each conversation

Steps	Act structure	Time	Interact target
Before the test	Explanation	00:00-05:00	Staff
Event_01	Exposition	05:00-05:30	Object A
Event_02	Rising action	05:30-06:00	Object A
Event_03	Climax	06:00-07:00	Object A, Object B
Event_04	Falling action	07:00-07:30	Object A, Object C
Event_05	Denouement	07:30-08:00	Object A, Object C
End the test	Interview	08:00-15:00	Staff

Figure 5.9: Act structures in user test



Figure 5.10: User W

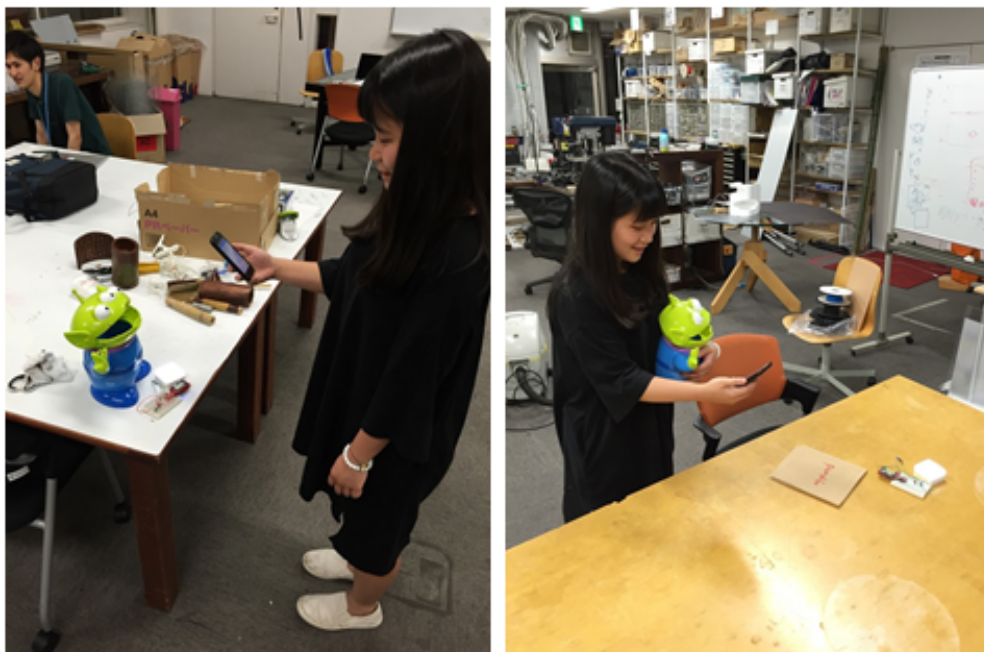


Figure 5.11: User J



Figure 5.12: User S

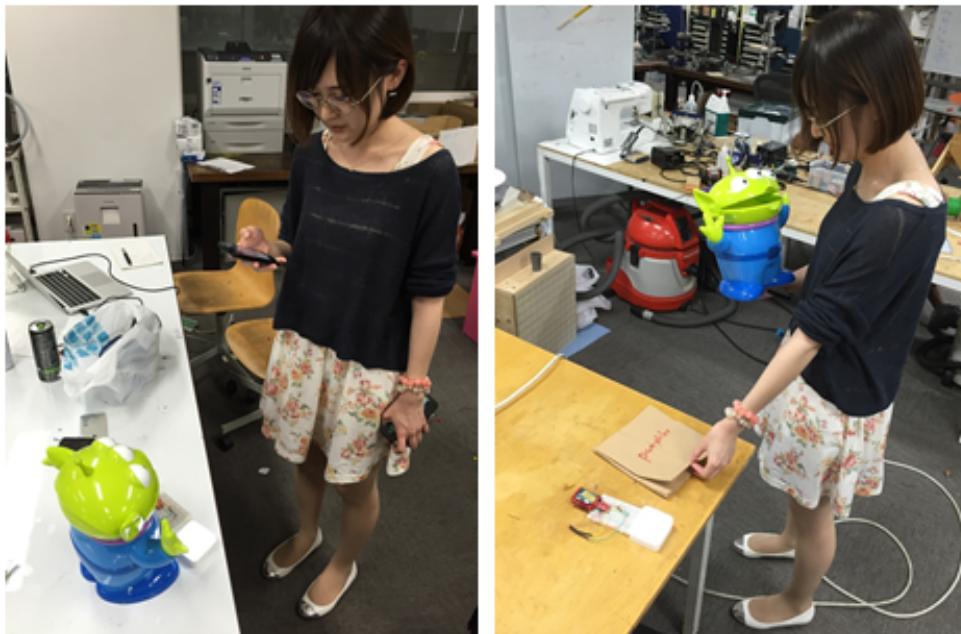


Figure 5.13: User T



Figure 5.14: User M

User number	Users	Know the place better than before	Have fun interact with things	Be friends with the spots
User01	W	O	O	O
User02	J	O	O	Δ
User03	S	O	O	O
User04	T	O	O	Δ
User05	M	O	O	O

Figure 5.15: conclusion of user test

Chapter 6

Conclusion

6.1 Conclusion

This study has tried to apply the concept of Social Things to the tourism industry. Generally speaking, when people discuss IoT or Social things, things always are referred to electronic devices. In this study, not only electronic devices but also ordinary things, such as famous scenic spots, figures and tables, or even humans, could be part of Social things. Most of the users thought that City Friends will have potential to replace tour guides or even change the way of the tourism industry operates if it is successfully developed. The study has shown that when being asked to join the network of things the testers were possible to be immersed more in the environment. Moreover, when things are smart enough to interact with people, it might be possible for humans to befriend with even everything.

Still, there are several different kinds of tourists. Not all the tourists would need the same services. It should be better if the contents could change automatically according to different users. It could be seen that "contents" designed will be a key to the success of City Friends in the future. Thus, how to define what is famous and worth being talked to and how to decide what to talk are other important issues because the selection of Social Things would be difficult, especially to decide which ordinary things could be set to talk. How to be interesting and fun for users should be the vital issue for future developments.

6.2 Future work

In order to create a better user experience, prototypes used in this study were modified several times based on the users' feedbacks. By improving the prototypes, several important factors and possible future works for City Friends have been found.

Prototype	System	Lights	Objects	Edison	Interaction
Pre-test I	Facebook	No	Three	Hided	Help Chair
Pre-test II	Viska	Yes	Three	Hided	Help Chair
User test	Viska	Yes	Two	Shown	Take Mini Masa

Figure 6.1: The summary of user tests

Problems	Solutions	Results
Physical interaction is weak	Install Remote lights into prototypes	Improved but still not enough
Story is not easy to follow	Re-design the act structure of the story	Improved
Confused about helping chair	Change the scenario	Improved but still need to be discussed
Confused about things talk	Show the Edison modules	Improved
Enhance the personality of characters	<ol style="list-style-type: none"> 1. Modify the messages speed 2. Modify the speed of light blinks 3. Add tones in lines 	Improved

Figure 6.2: Problems and solutions

First, interaction is important, both physical and storytelling. Because of varied limitations, interaction in current version of City Friends relies only on the messages. By changing the speed or volume of the messages and modifying the content, the personality of things could actually be created; more interactions occurred and the results changed. However, because of the user test is short, it is necessary to test under longer period. Besides, how to mix local and historical information into the conversation might be another issue to be covered.

Additionally, the possibility of adding game factors might be another challenge. Third, physical interaction design could be the next step for City Friends, including how to encourage people to interact with things in different ways and what kind of new devices are suitable to City friends to apply.

Finally, this study has proposed a framework for applying Social things to the real life. It would be great to recommend other potential applications, such as to different fields where social things could be created and developed in the future.

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