Title	Ambiance : expanding personal style to make a connection with public objects
Sub Title	
Author	陈, 玮(Chen, Wei) 稲蔭, 正彦(Inakage, Masahiko)
Publisher	慶應義塾大学大学院メディアデザイン研究科
Publication year	2019
Jtitle	
JaLC DOI	
Abstract	
Notes	修士学位論文. 2019年度メディアデザイン学 第724号
Genre	Thesis or Dissertation
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO40001001-00002019-0724

Master's Thesis
Academic Year 2019

Ambiance:
Expanding Personal Style to Make a Connection with Public Objects

Keio University
Graduate School of Media Design

Wei Chen

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

Wei Chen

Master's Thesis Advisory Committee:

Professor Masa Inakage	(Main Research Supervisor)
Professor Akira Kato	(Sub Research Supervisor)

Master's Thesis Review Committee:

Professor Masa Inakage	(Chair)
Professor Akira Kato	(Co-Reviewer)
Professor Ichiya Nakamura	(Co-Reviewer)

Abstract of Master's Thesis of Academic Year 2019

Ambiance: Expanding Personal Style to Make a Connection with Public Objects

Category: Design

Summary

As people always spending large amounts of time in public places every day, going to working offices or schools, those public objects and physical surroundings can have both physical and psychological influences on them. The reason why people enjoy decorating their houses with objects which different in colors, shapes and materials is that the whole setting can provide them with a sense of belonging and attachment. The objects people choosing show their own identity, affect moods and store experiences. The environment created by the objects creates a feeling they want.

However, in some public places, there is no such personalized setting that meet everyone's requirements and let everyone enjoy.

In this study, we design Ambiance to decorate public objects with one's personal style to achieve a sense of ownership. Ambiance are wearable accessories that project visuals in the theme of accessories on the physical objects. This project expands one's personal style to public objects, building a connection between people and objects so that people can still show their identity and personal styles in a public space.

The project aims to build a close relationship between people and objects, achieve a sense of virtual ownership of the objects, give a feeling of personal control and let people feel more pleased when experiencing a public place.

This study is going to indicate that extending personal style on the physical objects can (1)achieve a virtual ownership of the objects; (2) influence people's feelings about the place; and (3) change other's impressions on users.

Keywords:

Personal Style, Wearable Accessory, Ownership, Public Objects, Interaction

Keio University Graduate School of Media Design

Wei Chen

Contents

List of Figures

List of Tables

Acknowledgements

I would like to give my thanks to professor Masa Inakage, my thesis supervisor, for his guidance through my research, for always inspiring me to think and explore, and for supporting my project. I would also like to thank my sub-supervisor professor Kato Akira, for helping me to organize my thesis and giving me a lot of suggestions. I am also grateful to professor Atsuro Ueki for his supporting and guidance in every stage of this project, and to Assistant Professor Roshan Peiris for assisting me with this project. Besides, I would like to thank my friends Shucheng Huang and Pufang Chen for constantly helping and assisting me to complete this project. I would like to thank fellow researchers Ray Sekine Choi for giving me guidance and being the best collaborators. I would also like to thank all KMD schoolmates for your help and valuable advice. Lastly, I would like to give my great thanks to my father and mother for always supporting and encouraging me in every aspect of my life.

Chapter 1
Introduction

With the development of society, people have an increasing desire to be unique and different. They enjoy matching various clothes and accessories to distinguish themselves from others. They are accustomed to using stylish objects in their lives to show their identities. They even have a requirement for the public places they go to, for instance, whether the interior designs or settings meet their demands or not. There is no doubt that one person could have several kinds of personal style according to different situations. But not every public place can meet the demands of everyone's personal needs. This Ambiance project is intended to personalize the public objects with one's personal style so that people can still express their identity when using the public objects and making the objects belong to themselves. People can create their own space and feel more comfortable in any public space.

1.1. Personal Style

Personal style is not only how a person combining clothes and adornments to dress themselves but also how they present themselves to the world. In this study, we define personal style as the whole matching of garments and adornments on a person at one time. Personal style includes but not limited to different colors, styles, textures and so on. It provides people with an aesthetic pleasure and the charm of novelty. Personal style gives a sense of oneself. The clothes and accessories the person wears represent oneself and tell other people who he or she is and at the same time, the person is still a homogeneous part of a social mass. It offers a way to distinguish oneself from others and satisfies the individual's need for social adaptation and imitation [1]. Moreover, the personal style can also influence one's mood giving you the feeling like confident, gorgeous, chic and so

on. Personal style is also variable according to different situations and people's daily moods.

1.2. Meanings of the Objects

When people pick up and buy an object like chair, cup, eyeglasses and so on, they may consider its material, shape, aesthetic and many other factors. The objects they choose express their goals, identities [2], affect their mood, and give pleasure due to object's aesthetic practical qualities [3]. People use the objects they prefer to decorate their own house to create the atmosphere or ambiance they want to achieve.

Those external objects also viewed as part of self when people are able to exercise power or control over them. The findings of Prelinger suggested that people may impose their identities on possessions and the possessions may impose their identities on people as well [4]. And in further, the objects are regarded not only as a part of self, but also an instrument to maintain self-concept and self-development [5]. Objects play an important role to be an extension of oneself and create a lot of meanings in life.

In this project, we focus on the public objects. Public objects are not owned by the users but they are allowed to use it. The usage is limited to certain places and moment. For instance, customers can use the cups provided by the cafe when they are in that cafe area. When customer leaving the cafe, they cannot use it anymore. Users cannot sell the public object to make profits, destroy it or make any unrecoverable changes to it.

1.3. Research Goal

This research is going to combine the personal style and public objects. As mentioned above, both personal style and the objects owned by people have features reflect one's identity, extend oneself and in further influence one's emotion. There is no doubt that it is easy and free to decorate a house with the objects people like, however, in some public places, there are no such personalized settings to let everyone enjoy. All those interior settings are designed by the owner of this public

place. People may feel uncomfortable in a place where the style is not suitable for themselves.

Therefore, this project is designed to display one's personal style on the public objects to build a relationship between people and objects they use. Although people do not have the ownership of the public objects legally, they could have a virtual ownership of the objects or feel more intimate with the objects.

The ambiance accessory firstly breaks the limitation that personal style can only stay on one's physical body. Secondly, through personalizing public objects, people could have a feeling of personal control over the public objects. A connection between users and the objects will be built. The user will feel more pleased to enjoy the public place. On the other hand, users also can express themselves, show their identities through public objects, which let other people have a direct impression on users as well.

1.4. Differences from Previous Work

Since it is a team project working with Ray Sekine Choi. Her concept and contributions will be summarized in 2.1.1. The project described in this thesis has the following differences from Ray's work:

Concept

Ray's design is to extend personal style from personal body to public space while maintaining three key attributes of personal style: a visual experience, a part of self-consciousness and a variable that may influence mood.

This thesis is going to focus more on the use of expanding one's personal styles out of one's physical body. By projecting personal style on public objects to let the user achieve a sense of virtual ownership of the objects, and feel more comfortable in that place. And at the same time, providing users a digital way to express one's personal image.

Interaction design

In Ray's work, the users were asked to wear the accessory and walked around. A visual effect would be shown on the ground or walls within their proximity. Users can transform the space by extending their personal style.

In this new project, The projectors only project visual effects on more detailed and specific public objects rather than floors or walls. Similarly, the visual effects will appear when users get close. Besides, once users use their fingers to touch the surface of the objects, superimposed animation related to the theme will appear from where users point. And if users do not want to see the visual effects because of any reasons, they can turn off the effects by touching the clip attached to the accessory.

Implementation

In her implementation, she used Mamorio beacons which are low Bluetooth emitting devices to store the responded accessories to make them interactive. Once the Raspberry Pi recognized the Mamorio beacons signal through Bluetooth, the projectors would show the effects. In her second implementation, she used iPhone 7s as a beacon instead of Mamorio to let the Raspberry Pi detect the signal more quickly. She used one high power Qumi projector and three low power projectors, so the visuals were vague and subtle when doing projecting in some bright places.

The new project used an HC-SR04 ultrasonic distance sensor to have a more accurate scale definition. The distance sensor was used to trigger the effects and a new program was created so that the observer was able to switch the themes and turn off the whole visual effects more easily. The system did not need to concern the problem of unstable and low Bluetooth. Besides, two new projectors are used this time so that the visuals are clearer to be seen. The new projects use new prototypes and visual effects as well.

Evaluation

In Ray's thesis, she evaluated whether the visuals were noticeable and matched up with the theme of the accessory, user's mood changes, user's behaviors and their thoughts on the whole experience. Evaluation methods were using Self-Assessment

Manikin (SAM)[1] and interviews.

In this thesis, evaluation methods are the same, but this thesis focuses on evaluating the variable of the user's emotions and feelings about the objects to see if user can have a feeling of ownership towards the object. The user's behaviors will be observed as well. Besides, the observer would not only record the user's feedbacks and emotions but also the impressions from other persons sit around the users or passing by, which aims to see whether this project can change or directly show one's personal image.

1.5. Thesis Organization

This thesis consists of six chapters.

- In chapter 1, as above, discusses the definition of the personal style in this paper, features of personal style and the meaning of the objects, the contribution of this research and give a short comparison of the differences from the previous project.
- Chapter 2 gives a short summary of the previous work. This chapter introduces some related works from three perspectives: expanding one's personal style to the public space, developing an ownership of the objects and strengthening the connection between people and their surroundings.
- And chapter 3 describes the concept of Ambiance project and the interaction design of the project. A description of the target users and vision stories also included in this chapter.
- Chapter 4 mentions the design process of the prototype including the visual effects of different themes and the setting of the system. User tests which concealed in the Wizard of Oz Experiment mentioned in this chapter as well.
- Chapter 5 validates the prototype and analyses the result of the test.
- The last chapter 6 discusses the areas in this project where need to be improved and the future development of this research.

1 See 5.1

Chapter 2
Literature Reviews

2.1. Expand Personal Style out of Body

2.1.1 Previous Project

As it is a team project working with Ray Sekine Choi before, here gives a short summary of Ray's project.

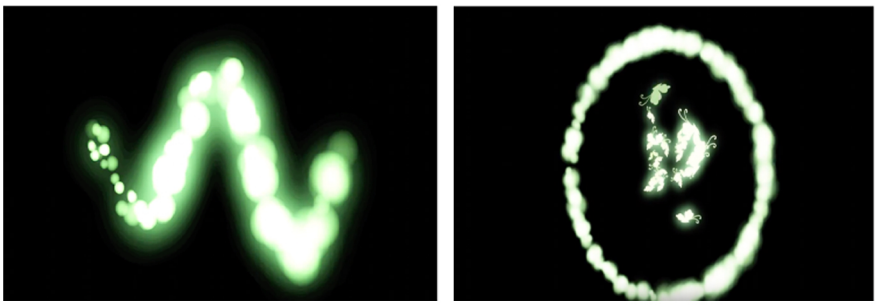
In Ray's thesis, people can use ambiance accessory to expand their personal style to their surroundings while maintaining three key attributes of personal style: a visual experience, a part of self-consciousness and a variable which may influence mood.

The two implementations of Ray's design were Ambiance Found and Ambiance Walkway. Ambiance Found was going to see if users can recognize the visuals they triggered; if the vision corresponded to the theme of accessory and how users felt about the experience.

The three themes were flutter, explosive and speed. She chose a garland for flutter theme, a spiked wrist band for the explosive theme and a sports wrist band for the speed theme. The three accessories were illustrated in Figure 2.1. The flutter theme featured green lights in several floating motions, expressing fleeting moments and transient scenes like a butterfly or fireflies, which is shown in Figure 2.2. The explosive theme featured fire burning in several patterns to give a feeling like a fierce rebel setting their surroundings ablaze, which depicted in Figure 2.3. And the last was speed theme which depicted fast passing geometric neon lines. The theme wanted to let users feel motivated during running in the city, which as illustrated in Figure 2.4.

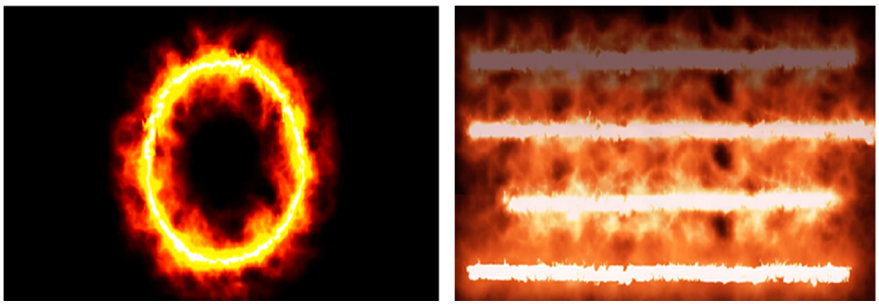
(Source: Ray Sekine Choi's Master Thesis [6])

Figure 2.1 Three pieces of accessory



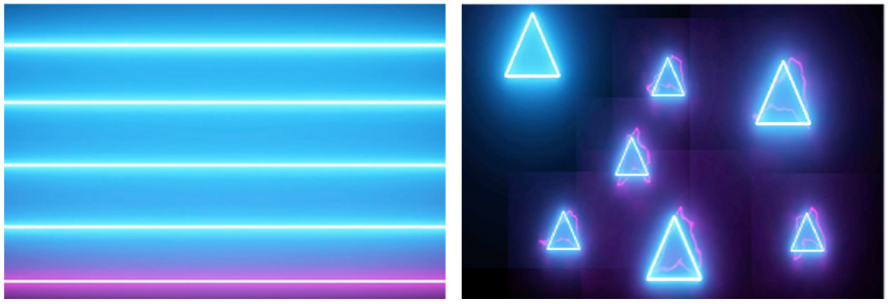
(Source: Ray Sekine Choi's Master Thesis [6])

Figure 2.2 Flutter visual effects



(Source: Ray Sekine Choi's Master Thesis [6])

Figure 2.3 Explosive visual effects



(Source: Ray Sekine Choi's Master Thesis [6])

Figure 2.4 Speed visual effects

In the first implementation, she used Mamorio beacons as shown in Figure 2.5 which are low Bluetooth emitting devices to store the responded accessories to make them interactive. The original Mamorio is 35.5mm x 19.00mm x 3.4mm and only weighs 3 grams. The users were asked to wear the accessory and walked around. When Raspberry Pi detected the Mamorio attached to the accessory by Bluetooth, the projectors would project the visual effects.

(Source: Ray Sekine Choi's Master Thesis [6])

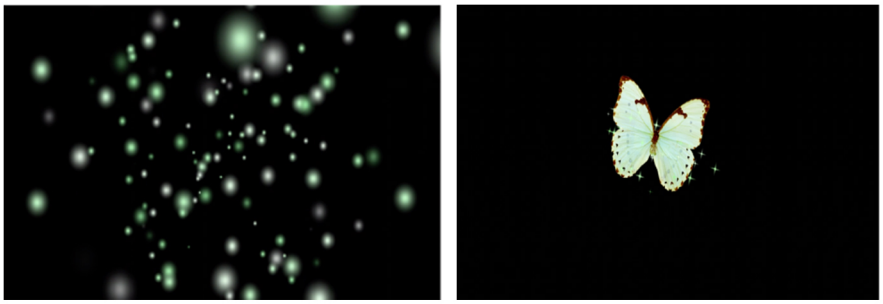
Figure 2.5 The Original Mamorio

The following shows some photos taken during the user test.

(Source: Ray Sekine Choi's Master Thesis [6])

Figure 2.6 User test photos

In the second implementation, Ambiance Walkway, Ray used an application called BLE (Bluetooth Low Energy) Scanner on iPhone 7s so that using a mobile phone as a beacon instead of Mamorio to control the visual effect as the Bluetooth is too poor to discover the signal. This time, she narrowed down the theme into only two, flutter theme and speed theme. She redesigned some visual effects as shown in Figure 2.7 and chose a precise area for users to walk through. SAM was used to record the user's emotions before and after the experience.



(Source: Ray Sekine Choi's Master Thesis [6])

Figure 2.7 New flutter visual effects

Ray's study showed that users enjoyed visual effects in the theme of the accessory; secondly, users felt self-consciousness about the visuals; and the whole experience had an emotional effect on users.

Some points still needed to be improved in her project. First is that more projectors with high lumens were required in the user test so that users can notice and see the visual effects easier. And the visual effects should be improved to match up with the accessory theme. Last but not least, while some users wanted larger scale images, some users felt embarrassed when experiencing.

Based on her idea of expanding one's personal styles, this research is going to use personal style to build a connection between people and public objects, people and space. The project enables people to create their own personal space freely and provide a virtual and digital way for people to express one's personal taste and image.

2.1.2 Butterfly Dress

The butterfly dress is designed by two Istanbul-based Turkish designers Ezra and Tuba Çetin who own the brand Ezra+Tuba, and a software development engineer at Intel. The dress which integrated with the Intel Edison compute module technology is equipped with forty moving butterflies that can fly on and off the physical body. Generally, the butterflies slowly flap their wings. They will flap fervently whenever a person approaches. The butterflies can also release in a dramatic launch when the dress inbuilt proximity sensor is triggered either by the approaching person or via a mobile device communicating with the dress over a wireless network as seen in the Figure 2.8. It is a good example of combining technology and modern fashion to expand one's personal style out of the physical body and at the same time create an interaction with other people. However, the set up of the dress and its system takes time. Since the system does not include letting all the butterflies fly back, once the butterflies fly off the dress, they need to be stuck to the dress manually.

(Source: Hurriyet Daily News [7])

Figure 2.8 The butterfly dress designed by Ezra, Tuba Çetin and the Intel

2.2. Develop the Ownership of the Object

2.2.1 Three Ways to Have a Feeling of Ownership

Several ways have been identified by psychologists to achieve ownership, including having control over the target of ownership, developing knowledge about it, and

investing time, effort, attention and creative energy in it [8].

Control

The ability of taking control of something can develop a feeling of ownership towards it. David McClelland, a well-known psychologist, suggested that the external objects become viewed as part of extensions of ourselves when we are able to exercise more control and power on it [9]. Control indicates a degree of freedom in one's interactions with the objects.

Knowledge

People may have a closer relationship with the objects if they obtain more information and knowledge about the it. The common way is to have a living relationship with an object so that people can develop deep understanding of it, and in further to feel like it belongs to us. According to what theorists wrote, 'the more information and the better knowledge an individual has about an object, the deeper the relationship between the self and the object and, hence, the stronger the feeling of ownership towards it' [10], which implied that people can have a feeling of ownership for objects through intimate association.

Investment

To make objects to be seen as extensions of ourselves, we need to invest time and effort to creating and designing objects, for instance, creating an object which fulfills personal need for efficacy or leaving one's personalized marks on an object to identity with it [11]. Investing time, effort and creative energy on an object is beneficial to lead to a feeling of ownership. Whether the thing created is a physical object or an abstract thought, since it has a mark or other association with the person who created it, that person keeps an identity in it [12].

To develop feelings of ownership towards objects, it should have characteristics that not only satisfy the basic motivations but also facilitate controlling, knowing and self-investment. In spite of the fact that ownership is one of the key goals in marketing and consumerism, a lot of studies can be spurred in this area. In

this thesis, the project is trying to let people feel virtual ownership of the public objects to make them feel more comfortable in that place.

2.3. Improving the Connection with the Environment

2.3.1 HoloLamp Menu

HoloLamp menu is designed by HoloLamp company. The product creates a projected tangible interface on each restaurant tabletop. All the dishes are displayed in a full-size 3D so that customers can select and view directly on the table as illustrated in Figure 2.9. Each selected dish will also feature animated demonstrations performed by an amusing character that tells stories about the dishes being prepared for an outstanding culinary experience. HoloLamp is an augmented reality device which can be easily carried or moved and no need to wear glasses [13]. With the 3D scanning technology, customers can clearly see how their meal looks like, the exact size of the dishes and its preparation on the table instead of a paper menu. This product manages to turn normal tables into an intelligent and smart interface. The interactions with the desk and the story designed behind every dish let customers quickly engage with the surroundings. It creates a pleasant and convivial relationship between customers and the whole restaurant environment.

HoloLamp menu shows a good example that projections and interactions with the restaurant tables is able to build a connection between users and the objects, the user and the whole restaurant environment. In this thesis, Ambiance project will focus on whether it is possible to build a connection with public objects in daily life by taking advantage of personal styles.

(Source: HOLOLAMP [13])

Figure 2.9 HoloLamp Menu projecting on the restaurant table

2.3.2 MoonFlower Sagaya Ginza

MoonFlower Sagaya Ginza is a dining space consisted of Sagaya Ginza, a restaurant that serves delicate dished and high-ranking Wagyu beef, and the art collective teamLab [14]. The theme of MoonFlower is worlds unleashed and then connected. When guests are having dinner, the restaurant's space will be decorated with an interactive digital art featuring trees and flowers, which is shown in Figure 2.10. Those visuals spread widely onto the exquisite dinnerware, table and other available space. Besides, a bird released from one dish can fly to the branch of a tree that appeared from another, which a larger world will be created. The Sagaya Ginza creates an immersive space combines elegant cuisine and ceramic art with real-time projections that canvas the restaurant's walls and tables. The interaction design and story it tells not only connect the guests and the environment but also improve the relationship between guests as well. However, the design still has a commercial purpose, the price is expensive, only eight people can be served and only in the night. The art space it created provides an immersive environment for guests enjoying their dishes, but does not consider every guest's personal taste and style. The ambiance project is designed to show everyone's unique style and different personalities. It could let people show their personal style on public objects like dinnerware and desks to create their own space and enjoy themselves.

(Source: Teamlab [14])

Figure 2.10 Seasonal trees and flowers are depicted on the table and surroundings

Chapter 3
Concept

3.1. Design Concept

Ambiance project is going to imagine a world where people can personalize public objects with their personal style. They can create their own space freely and feel comfortable in a public place. For instance, people who prefer an elegant life can wear an exquisite accessory and decorate the coffee mugs with delicate patterns to enjoy their own space. The ambiance accessory can expand one's personal style to public objects. The whole experience is aimed to build a connection between people and objects, achieve a sense of virtual ownership of the objects, give a feeling of personal control and let people feel more pleased when experiencing a public place. And on the other side, decorating public objects with personal style also displays one's personalities and identity, which let other people have a direct impression on the users as well.

3.2. Target User

The target user for Ambiance accessory is young women and men aged from 15 to 30 years old. They have a colorful lifestyle and enjoy dressing themselves according to different situations and their daily moods. They prefer to have their own personal space in public. However, sometimes they feel uncomfortable or being constrained in some places because they do not like the setting or decoration style of the places or any other reasons. In addition, those target users also pay attention to their personal images in everyday life, expressing themselves by matching clothes and accessories. They believe that one's personal style can be the basic to start a conversation.

3.3. Preliminary Research

In the beginning of the research, some interviews were conducted to discover how people choose the goods or places and how people use objects to make their own personal space. The interview revealed that most interviewees were agreed that objects play an important role when creating their own space. Besides, the physical characteristics of settings like fashion styles and lightnings may be considered as one of the key factors when people deciding they like or dislike the place.

3.4. Scenario

Following text describes the vision stories of the Ambiance project.

> Katherine, a 20 years old university student studying in an art college. She is a romantic girl who enjoys a delicate lifestyle. She loves those exquisite designs and enjoys buying classical daily products to decorate her living space. All the setting let her feel like she is an elegant princess living delicately in 18th-century England.
>
> But there is one thing that recently troubles her. Katherine was asked to have an afternoon tea by her best friends but the café they planned to go was not the one fit her taste. Instead of a café, it was more like a fast food restaurant. The café serves meals in pure white plates and coffee in white mugs or glass cups. The only decoration is the logo printed on the that. The café shop is suitable for salary men and those who like a simple lifestyle, but not for Katherine. But this time Katherine wear a retro and classical style ambiance bracelet to go there. She orders a cup of Macchiato. The cup is as the same as the ordinary one from the beginning, but once she picks up the cup by the handle, at that moment, some exquisite patterns like twining brown vines appear increasingly from the bottom of the cup to the top. The patterns make the cup looks chic and classical. Katherine likes this kind of change. The cup looks different from other people and the style is match up with her own fashion style as well. Katherine

feels that she creates a zone where she is accustomed to and kind of enjoy this place from now on. On the other hand, her friends are also surprised to see the change of it. Through that, they get a further understanding of how much Katherine loves the retro style.

Zoe is a 29 years old computer programmer working in a famous information technology company. She loves nature and wants a free life but cannot realize because of her work and busy daily schedule. She lives in a city full of skyscrapers.

Every day she works in the office, she feels like being constrained in a cage that made of steel and concrete. But now Zoe finds out ambiance accessory which could project one's personal style on the objects to give her a feeling she wants. She wears an ambiance hair band and when she gets close to her office desk, it turns to a green grass land. She uses her fingers to point on the desk, all of a sudden, where she points at, a little bright yellow lily grows up. She can see some spots twinkling which soften the visuals on her office desk. All the changes provide her with a connection between the office and what she truly needs. When she feels tired and suffers from being constrained, just have a look of her desk may bring her to another fresh and relaxing environment. She likes the desk since it looks like that special desk only belongs to her and begins to feel a sense of belonging to the office. It is also convenient for her to turn off the effect by pushing a button set on her bracelet. Besides, after expressing her personal style on the desk, her colleagues start to know that she is a person like greenery. They sometimes invite Zoe to go hiking or have a picnic with them. The ambiance accessory not only allow Zoe to create her own zone, but also let more people know more about her.

3.5. Sketch

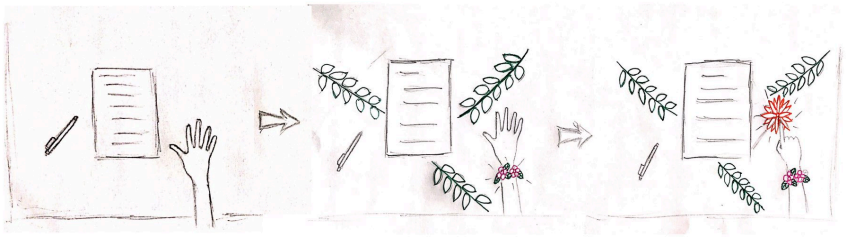


Figure 3.1 Concept Sketch

The sketch as illustrated in Figure 3.1 above describes the concept of the project that people could personalize the public objects with their personal style. The visions appeared on the surface of the objects should match up with the accessory themes. And another effects will appear when people touch the objects. Like what depicted in the sketch, when a person wears an Ambiance flower bracelet, some lovely flowers and green leaves will appear and grow on the desk. There is nothing happen if the person does not wear the Ambiance accessory.

3.6. Interaction Design

The whole experience is designed to build a connection between user and the objects and let the user create their own space.

At first, showing users three accessories and telling the vision story of each one. The reason of this step is to give a preliminary background introduction of the accessory to the user. They could choose what kind of accessory match their personal styles and feelings they want to experience at that moment. Users will also be told that they can turn off the whole experience by pressing the button

set on the accessory ("Knowledge"[1]). After the user picks one, let user wear the accessory and get close to the desk.

In order to let user feel that they are in control of their own space, a distance sensor is used to detect the distance between desk and themselves. And considering to make a personal space and also not to bother other, the distance to trigger the effect is 50cm which is an intimate distance defined by Edward Hall [15]. The distance trigger can not only let users control the space but also give them a surprise to see the visual effect which relative to their personal style.

Once the user wears the accessory, they are asked to go to the desk set up nearby. As they approaching to the object within the distance set in advance, the visual effect which in the theme of accessory will be appeared on the desk and mug which laid on the desk.

Each accessory only corresponds to one visual pattern. The visions keep the same until the user uses a finger to point the surface the object. Wherever the user points, some patterns corresponded to the theme of accessory will show. It is aimed to motivate the user's effect and creativity to design the desk and mug freely ("Control" and "investment"[2]).

In addition, each accessory has a switch clip. If the user do not want the visual effects anymore because of any emergency cases or other reasons, they can touch the clip and turn off the effect. On the other hand, if they carelessly turn it off but still stay in the distance, they can turn it on by touching the clip again. The small switch clip here are aim to give users a power to control the whole experience ("Control"[3]).

Through the whole experience, users are easily to control and create their own objects by showing their personal style. They can build a short-time relationship with the public objects. The change of the style may help them to be pleased to stay in a public place. And on the other hand, it is also a novel way to express their personal style to other people.

1 See 2.2.1

2 See 2.2.1

3 See 2.2.1

Chapter 4
Prototyping and Setting

4.1. Prototyping

4.1.1 Location

In preliminary interviews, the writer asked people some questions like what type of objects do users use to personalize their living environment? How do that objects influence their feelings about the place? Which place they always stay except for their own house?

According to the answers, the observer found that for girls, mostly they preferred decorating their house with green stuff, like put some small plants on the desk or on the balcony. They also like using aroma or fragrance lamps in houses to make the space cozy and delicate. And most boys prefer to have animation figures lay on the desks and decorate the wall with posters. They think these objects make them feel more energetic and enjoyable when staying at home.

Since the place they mentioned that they frequently stayed was the school's project room, the observer kept asking questions like how do they feel about the project room on the third floor of Collaboration Complex[1] and is there anything they do not like about that place? What factors may influence their choices when going to a public indoor place?

When speaking of the project room in the school, some people are not willing to stay in that room for a long time as they feel depressed and being constrained in it, because the room is lack of sunshine and greenery plants. All the disordered stuff let them feel a little bit annoyed. They hope they could have their own space

1 Keio University Graduate School of Media Design
`http://www.kmd.keio.ac.jp/`

in that room.

For those factors which may influence the personal choice of places, except services or food served in that place, the design of the whole place and the style of the setting also be mentioned a lot during the interview.

According to the interview, the observer designed to use ambiance accessory to build a connection between students and the public products in the project room. Projecting personal style on the public desks and white mugs, or to say personalizing the desks and mugs is going to build a relation between people and objects, achieving a sense of virtual ownership of the objects, give a feeling of personal control and let users feel more pleased when experiencing in project room. And on the other side, those objects which decorated by the user's personal style can change other's impression on the user as well. It provides a direct vision or image of oneself to other people, especially to those strangers.

Therefore, the user test was planned to conduct in project room, a place with a dark grey blanket floor and a white spotted ceiling. Several shelves full of goods occupied one side of the room and glass windows were set on the other side, but nothing greenery or beautiful scenes could be seen through the windows. When seeing through the windows, other classrooms could be seen in a short distance. The visual effects were designed to appear on the project room's wood grain desks which are sometimes occupied with a lot of stuff. And the white mug was set as a public mug provided by the school to students.

4.1.2 Theme Design

Based on the preliminary interview, the observer designed three themes for the ambiance project.

Freshness

The first theme is freshness, a coral flower bracelet depicted in Figure 4.1 is chosen as the accessory corresponds to the theme. The vision shows people a greenery scene with great grassy plains. With the sight moving, some yellow twinkling spots flutter from the grassland, which softens the visuals of whole effect and lets users feel calm down. And when the user use one finger to touch the desk, pink

daisies and dandelions will blossom increasingly on the green land.

For the mug version, the vision shows that a pink dandelion grows slowly from the bottom of the mug. When the dandelion disappears, a bunch of China aster in different colors will grow, creating the image that flowers keep growing and blooming.

The theme aims to let people feel like they are close to nature, breathing the fresh air, and feel relax and comfortable when staying in the room.

Figure 4.1 Coral flower bracelet for freshness theme

The visual effects of freshness theme created for the desk are as follows:

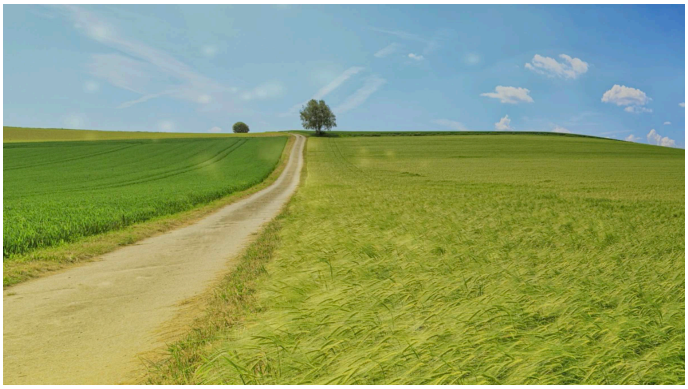


Figure 4.2 Visual effect of freshness 1

Figure 4.3 Visual effect of freshness 2

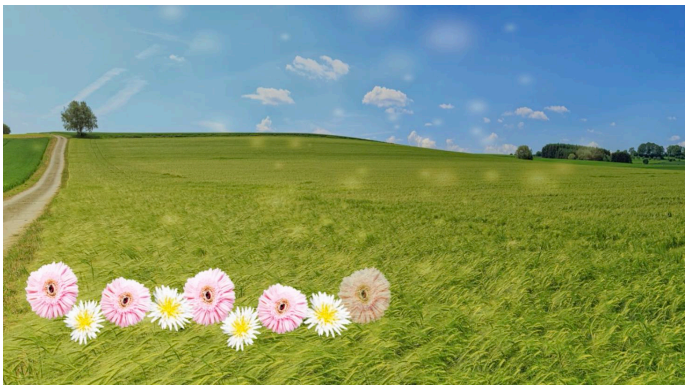


Figure 4.4 Visual effect of freshness 3 (when the user point the table)

The visual effects of freshness theme created for the white mug are as follows:

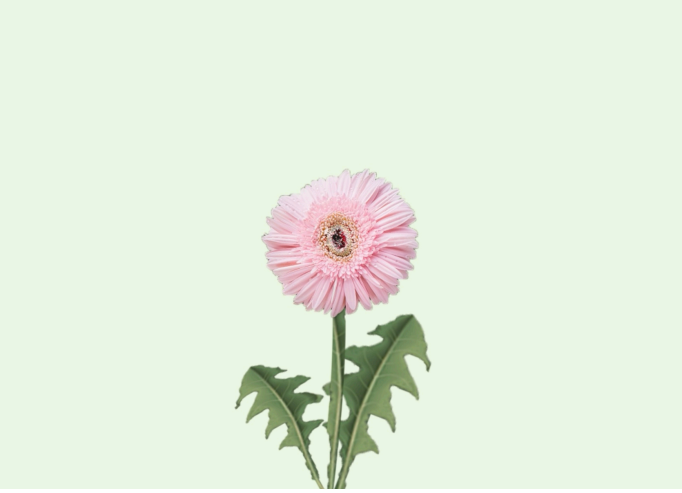


Figure 4.5 Visual effect of freshness on mug 1

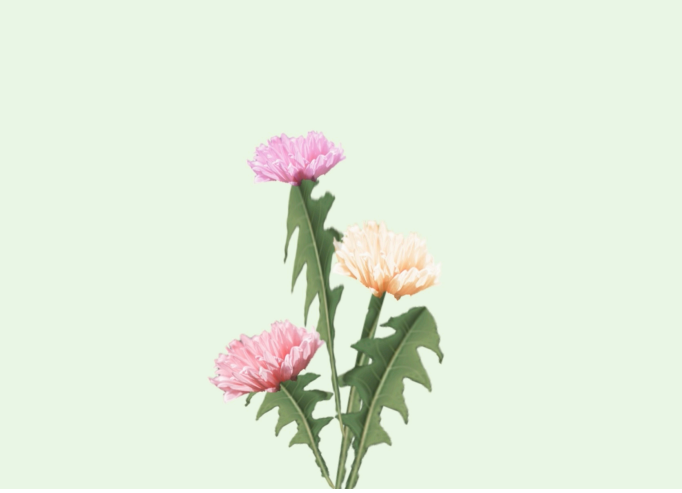


Figure 4.6 Visual effect of freshness on mug 2

Sports

The second one is a sports style. I choose several fashion waistbands which showed in Figure 4.7 as the accessory and combine them. The visual effect of this style depicts a broad and mysterious starlit sky. Dazzling meteors sometimes rapidly

pass by like neon lights. When the user point the desk, several energy balls of different colors will spark among the stars. The whole visual provides a feeling that you are energetic and powerful enough to quickly pass through thousands of stars, chasing after the treasure and goal you want to achieve. The vision shows on the mug is similar to the desk version. Sports theme expresses a kind of passion and enthusiasm, which encourage people to be actively and full of energy.

Figure 4.7 Fashion waistbands for sports theme

The visual effects of sports theme created for the desk are as follows:

Figure 4.8 Visual effect of sports 1

Figure 4.9 Visual effect of sports 2 (when the user point the table)

The visual effects of freshness theme created for the white mug are as follows:

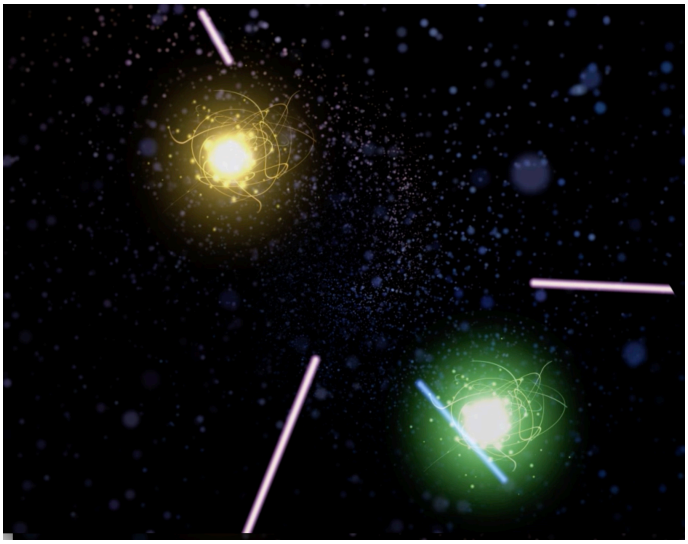


Figure 4.10 Visual effect of sports on mug 1

Elegance

The last one is elegance. A retro navy bracelet is chosen as the accessory as illustrated in Figure 4.11. The visual effect is constructed by lots of classical and retro-styled lines and patterns. The silhouette of leaves and dark brown curve

lines sketch the outline of a classical frame, which makes the table more vintage and elegance. And once touch the table, several pieces of leaves will grow in the middle of the interface and combine like a garland. For the white mug, it is going to depicts a scene that some vines are twining with each other and climbing to a classical window sill. The word 'elegance' will appear in the middle of a retro frame later. The visual effect gives people the feeling that they are enjoying an exquisite and delicate living environment.

Figure 4.11 Navy blue retro bracelet for elegance theme

The visual effects of elegance theme created for the desk are as follows:

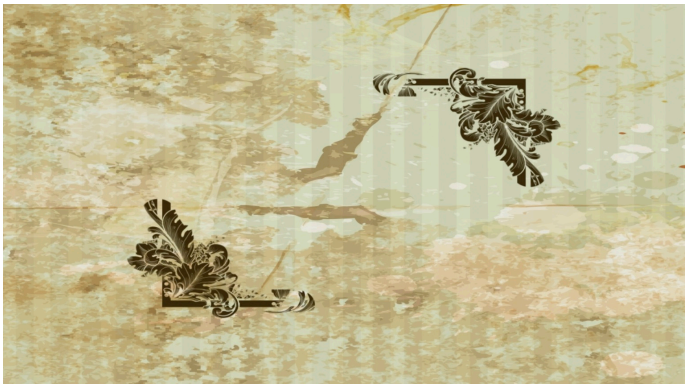


Figure 4.12 Visual effect of Elegance 1

Figure 4.13 Visual effect of Elegance 2

Figure 4.14 Visual effect of Elegance 3 (when the user point the table)

Figure 4.15 Visual effect of Elegance 4(when the user point the table)

The visual effects of freshness theme created for the white mug are as follows:

Figure 4.16 Visual effect of Elegance on mug 1

Figure 4.17 Visual effect of Elegance on mug 2

All the visual effects were created by Adobe After Effect. Each video effect for the desk last 20 seconds, while 15 seconds for the white mug. During testing, video effects looped continuously until the user touch the switch clip to turn off it.

4.2. Experiment

4.2.1 Equipment

For the user test, the equipment we used is listed as follows:

- One Raspberry Pi 3 Model B+ (Figure 4.18)

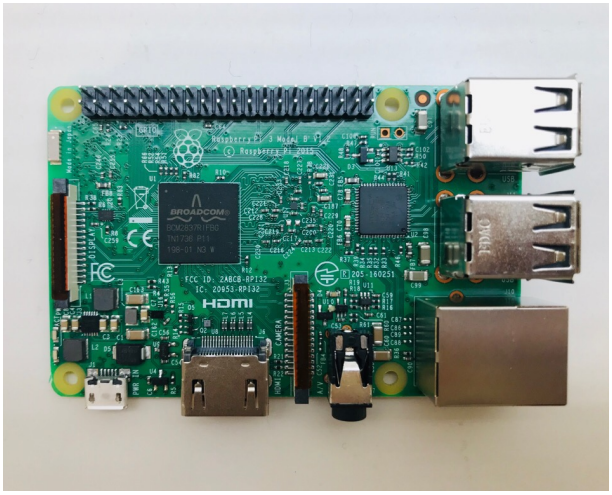


Figure 4.18 Raspberry Pi 3 Model B+

- One HC-SR04 Ultrasonic Distance Sensor (Figure 4.19)

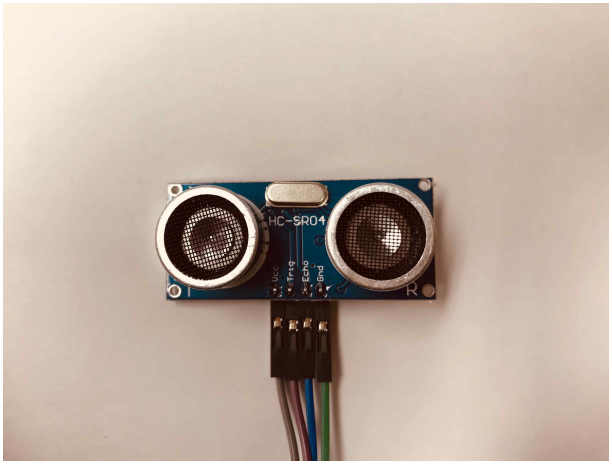


Figure 4.19 HC-SR04 Ultrasonic Distance Sensor

- Two 175cm-330cm Black Manfrotto Mini-autopole
- One ASUS P3B Mobile Battery Projector

ASUS P3B Projector showed in Figure 4.20 is a lightweight and compact Battery-Powered projector. It weighs 750g, and the size of it is similar to a CD case (153.5 x 43 x 131.2mm). The projector features an 800 lumens light output and 100% NTSC color gamut, and provides crisp Wide XGA 1280 x 800 resolution images.

Figure 4.20 ASUS P3B Mobile Battery Projector

- One VANKYO Hobby Projector LEISURE 3

VANKYO Hobby Projector LEISURE 3 showed in Figure 4.21 is powered by MStar Advanced Color Engine. It weighs 1.08kg and the size is 198 x 68 x 148.6mm. The projector supports 1920 x 1080 resolution images with a maximum brightness of 2400 lumens.

Figure 4.21 VANKYO Hobby Projector LEISURE 3

- One ELEPHAS DLP Mini-3D-Projector

ELEPHAS DLP Mini-3D-Projector showed in Figure 4.22 weighs 0.28kg with a tiny size (100 x 108 x 40mm) and compact design. It features a maximum 1920 x 1080 resolution images and 100 ANSI lumens. It can connect to the Wi-Fi and Android or IOS devices via Airplay or Miracast.

Figure 4.22 ELEPHAS DLP Mini-3D-Projector

4.2.2 System Design

According to the interaction design, when the user wearing the accessory and get closer to the desk, the appearance of the desk will be changed. A program with the push buttons, as shown in Figure 4.23 was designed on the Raspberry Pi so that the observer could switch from one theme to another easily. Through this program, the whole system did not need to worry about the problem of unstable Bluetooth signal, and on the other side, it only required one Raspberry Pi so that it was also convenient to connect with. So, after the user picked up one accessory, the observer only needed to push the button of the corresponded theme, then the projectors would project the visual effect autonomously.

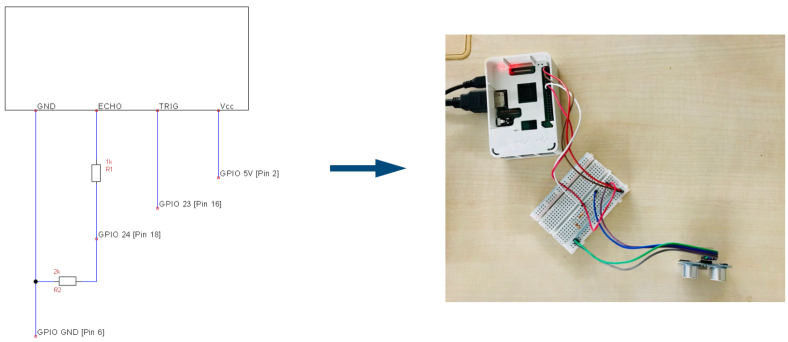
Figure 4.23 Push Button on iPhone's interface

The observer used two applications as shown in Figure 4.24 to connect iPhone 7 with Raspberry Pi to remote control and hide system operation from the users. One is iTerminal, a simple Secure Shell (SSH) and Telnet client to let mobile phone connect to remote servers. The other one is VNC (Virtual Network Computing) Viewer. This application allows the mobile phone to have an instant remote access to Mac, Windows and Linux Computer like Raspberry Pi.

Figure 4.24 Applications: iTerminal and VNC Viewer

In order to use SSH service and VNC Viewer, the observer first should get the Internet Protocol (IP) address of Raspberry Pi. The iTerminal required IP address to make a connection between iPhone 7 and Raspberry Pi. Finally, log in to the VNC Viewer and graphical user interface would show on the mobile phone successfully and be easily controlled by finger moving.

The circuit diagram of how to connect the HC-SR04 ultrasonic distance sensor and the Raspberry Pi shows is as follows in Figure 4.25. While the left circuit diagram used a 1kΩ for R1 and a 2kΩ resistor for R2, in fact, the observer used a 1kΩ for R1 and two 1kΩ resistors for R2 in the right one because of the lack of a 2kΩ resistor.



(Source of the left picture: The Pi Hut [16])

Figure 4.25 Circuit diagram

The following diagram shows the whole process of the system.

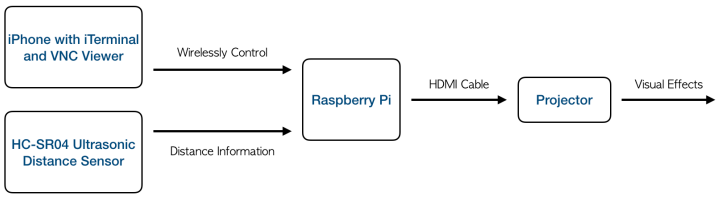


Figure 4.26 The flow diagram of the system

An iPhone installed with iTerminal and VNC Viewer application is used to wirelessly control the Raspberry Pi. The observer can switch the themes and turn off the effects with the iPhone. And the ultrasonic distance sensor is used to collect distance information. Once the distance meets the demand that set in the program, the projector which connected with Raspberry Pi through HDMI cable will project the visuals recorded in the Raspberry Pi.

4.2.3 Testing

The user test is conducted in the project room. The three view drawing of the test setting is showed in Figure 4.27. And Figure 4.28 illustrated how the setting

actually looked like during the user test. Three projectors covered in black paper were used so that user would not find the projector. Two were hanging on the pole, and one which not shown in the Figure 4.28 lied on the desk in front of the mug. In order not to let the dazzling light of the projector influence people those who were sitting on the opposite chairs, the observer used a piece of black paper to set around the mug.

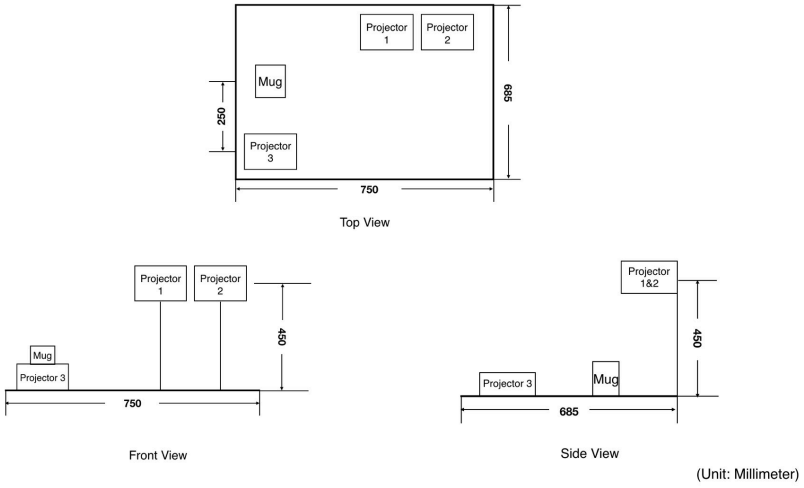


Figure 4.27 Three view drawing of the test setting

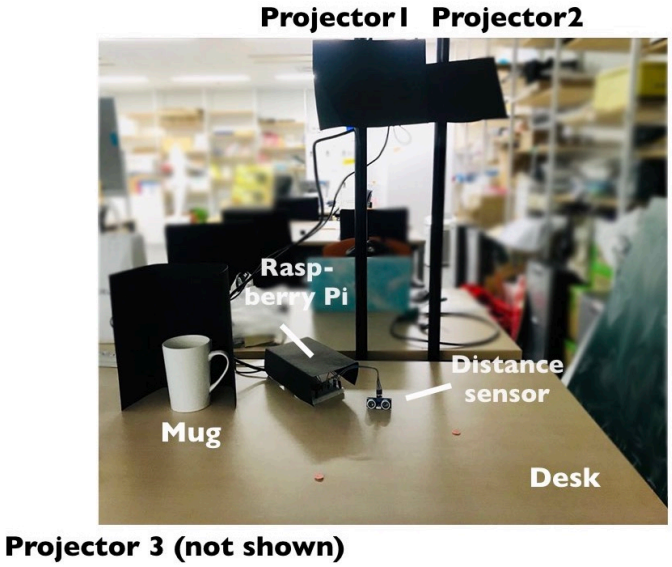


Figure 4.28 The setting during the test

Each user test was last around twenty to thirty minutes. The user test was concealed in the Wizard of Oz Experiment (WOz). Users can interact with a designed system which seems like autonomous, but instead controlled manually. WOz is useful for envisioning and proactively evaluating those hi-tech and complicated interfaces [17].During the WOz, a human operator is regarded as the Wizard and imitate the response of the application to the subjects. Subjects' interactions are observed to serve the evaluation purpose as if they are interacting with a real system. By using this experiment, it would be easier to display the whole project system to the users and observe user's behaviors and feedbacks directly.

During the experiment, the observer firstly invited one user to come to the project room. The observer would ask the user to stay for three to five minutes on purpose by using an excuse that the equipment needed to be checked. After three to five minutes, the observer would record user's emotions and feelings through the desk, the mug and the whole project room.

Then, the observer showed the user three different kinds of accessory. The user was told the background story of the accessory and asked to pick up one to try,

which might take around two to three minutes. The observer would introduce the user that there was a switch clip attached to the accessory. They could turn it off once they did not want the effects. After they wore the accessory, the observer would lead them to sit closer to the desk and visual effects would appear once the distance is shorter than 50 centimeters.

In order to achieve the effect that where the user point the table, some different visual effects will be added to the current visions showed. Two circle dots were stick on the table to attract user's attention to touch. So, once the user touched the pink dots, the observer would manually control the projector to play a superimposed animation.

Besides, the white mug is put on the left side of the user, the distance from the user was more than 50 centimeters. Only when users stretch out their hands to reach for the mug would come out the visual effects.

During the whole user's experience, the observer paid attention to the user's facial expressions, actions, behaviors, and any words or verbal feedback. Besides, the observation of other people passing by or someone who sit around the user was also needed. When the user touched the switch clip, the observer would immediately turn off all the visual effects.

After finishing the experience, the user was asked to mark their emotions or feeling through the desk, the mug and the room space again. The observer conducted an interview with some questions with the user later.

Some photos taken during the user test are as follows:

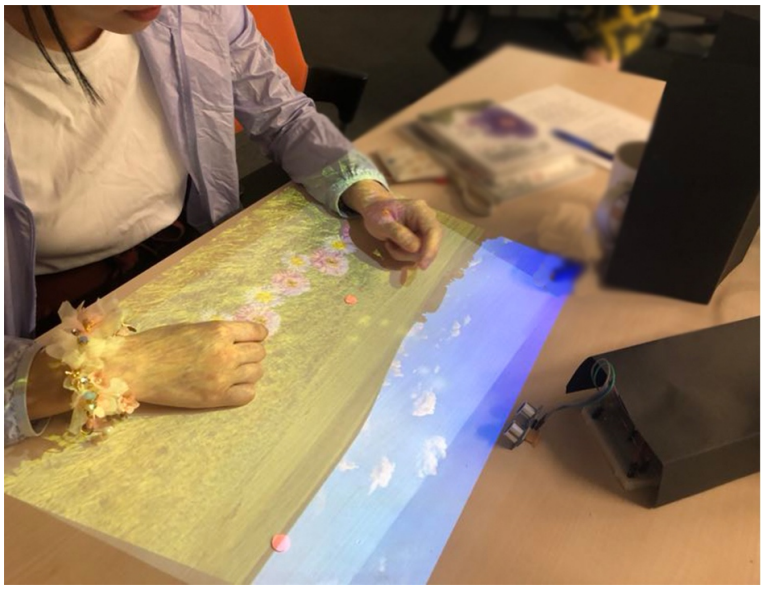


Figure 4.29 User test in the theme of freshness

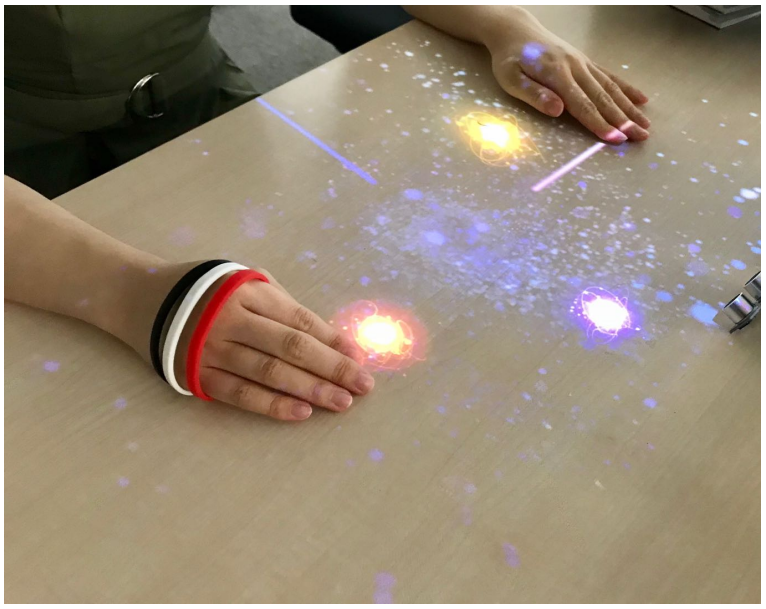


Figure 4.30 User test in the theme of sports

Figure 4.31 User test in the theme of elegance

Figure 4.32 User test for the mug in the theme of freshness

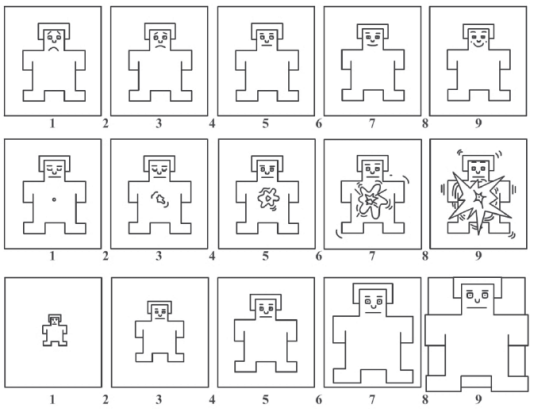
Figure 4.33 User test for the mug in the theme of sports

Figure 4.34 User test for the mug in the theme of elegance

Chapter 5
Proof of Concept

5.1. Method

The Self-Assessment Manikin (SAM) as shown in the Figure 5.1 is a non-verbal pictorial assessment technique that directly measures the pleasure, arousal and dominance associated in response to an object or event [18]. When describing the pleasure dimension, some bipolar adjective pairs like unhappy-happy, annoyed- pleased and bored-relaxed. The arousal dimension can be described with calm-excited, unaroused-aroused and so on. And for the dominance dimension, bipolar adjective pairs like controlled-controlling, submissive-dominant and guided-autonomous [19]. SAM has been proved to be used effectively to measure emotional responses in a variety of situations.



(Source: James Russell's Self Assessment Mannequin [18])

Figure 5.1 Self-Assessment Manikin

Since in the test, the observer needs to test whether user can have a feeling

that they build a connection or become more intimate with the public objects, and besides, whether the whole experience could let them feel more comfortable when staying in this room or not, it is helpful to use SAM to record and measure the user's emotions and feelings. The test used a 9-scale SAM. The users were asked to place the "X" on a figure or between figures that represented how they feel at that time [20], as shown in the Figure 5.2.

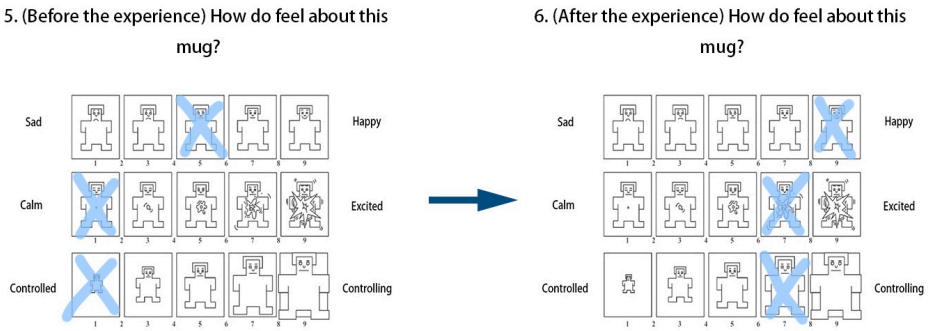


Figure 5.2 A part of the questions to let user mark before and after the test

The user needed to mark their emotions before and after the experience. And after that, the observer would have a face to face interview with the user to get more details and feedbacks.

The main research questions were asked as follows:

- Why do you choose this accessory?
- Could you feel a connection with the object? Could you feel a sense of ownership?
- Does the whole experience enable you to feel more comfortable/willing to stay in this place?
- Are you willing to use it in other public places?

5.2. Result of Self-Assessment Manikin

Fifteen users had been tested for the Ambiance project and five users for each theme by coincidence. Fifteen users were all aged around twenty-three to twenty-six years old, and only two were males, the others were females. The observer used SAM to record their emotion changes. The change of the user's emotions had been recorded to see if the theme can give the correct feelings users want to have and also, if users could achieve a sense of virtual ownership over the objects.

Table 5.1 Average changes in different dimensions for different themes

Average change	Freshness Theme		Sports Theme		Elegance Theme	
Different theme	Desk	Mug	Desk	Mug	Desk	Mug
SAM-valence	+2.2	+2.2	+4.0	+4.4	+3.8	+3.4
SAM-arousal	- 0.8	+1.2	+1.4	+3.8	+2.6	+4.3
SAM-dominance	+2.2	+1.0	+2.2	+1.4	+1.6	+2.0

According to the Table 5.1 above, it can be seen that freshness theme have a effect to make people feel calm down , sports theme has the strongest effect to make people happier and the elegance theme make people feel excited. It seems that some visual effects need to be improved in the future.

Table 5.2 Average changes in different dimensions at all

Average change at all	Desk	Mug	Room
SAM-valence	+3.3	+3.3	+2.1
SAM-valence	+1.1	+3.1	+0.7
SAM-valence	+2.0	+1.5	+2.5

And if only compare the effect on desk, mug and room without considering different theme as shown in the Table 5.2, both can make users feel joyful and passionate. The control feeling over the desk is higher than the mug. And for the whole room, the emotion influence of the whole experience were not as strong as the desk and the mug one but still can make people more pleased and have a control over the room.

The observer did not do the comparison of the influence between male and female since there were only two males in this test. More statistics are needed to be collected in the future.

Besides, eleven out of fifteen users mentioned that they felt more connection to the desk rather than the mug because what they had done could design the desk interface, which improved their feelings of control. And the other four users said that the projection on the mug was rarely seen and more novelty.

5.3. Considerations

5.3.1 Connectivity with the Objects

When asking users if they could build a connection with the objects or feel a sense of virtual ownership for the objects through the whole experience. All the users felt that they could develop more or less connection with the desk and mug. Four users mentioned that they felt more connection to the mug while the others felt more connections to the desk.

Users who built a strong connection with the objects said that they enjoyed the appearance changes of the desk and mug.The Figure 5.3 showed how her emotion changed before and after the test. The interactions of the desk were interesting and had a power that let them once forget the surroundings and immerse into the designed environment. The visual effects also confirmed to the feelings they want. They felt the desk and mug were becoming special from anyone else's. The changes let them feel happier when staying in this room.

There was one user who felt a really strong connection with the objects stated that she viewed the white mug as her friends instead of an object. The patterns which matched up with her style make the mug become an intimate friend to accompany her. She would be more willing to stay in that room if everything had such effects.

One of the user who had a strong connection with the objects, her emotion marked as follows:

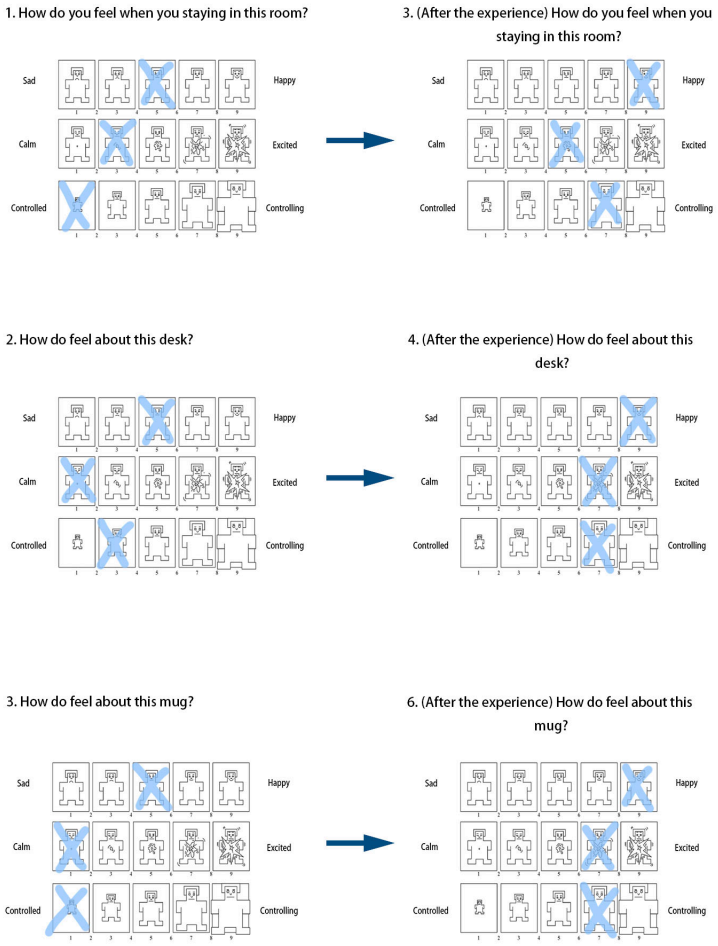


Figure 5.3 Emotion changes of a user who felt a strong connection

Some users who had a little connection mentioned that because what they had done could change the interface, which improved their feelings of control. They believed that it was interesting to see one's personal style on public objects, but they preferred more changes to be designed and could constantly change according to the seasons or time.

One of the user who had a weak connection with the objects, her emotion marked as follows:

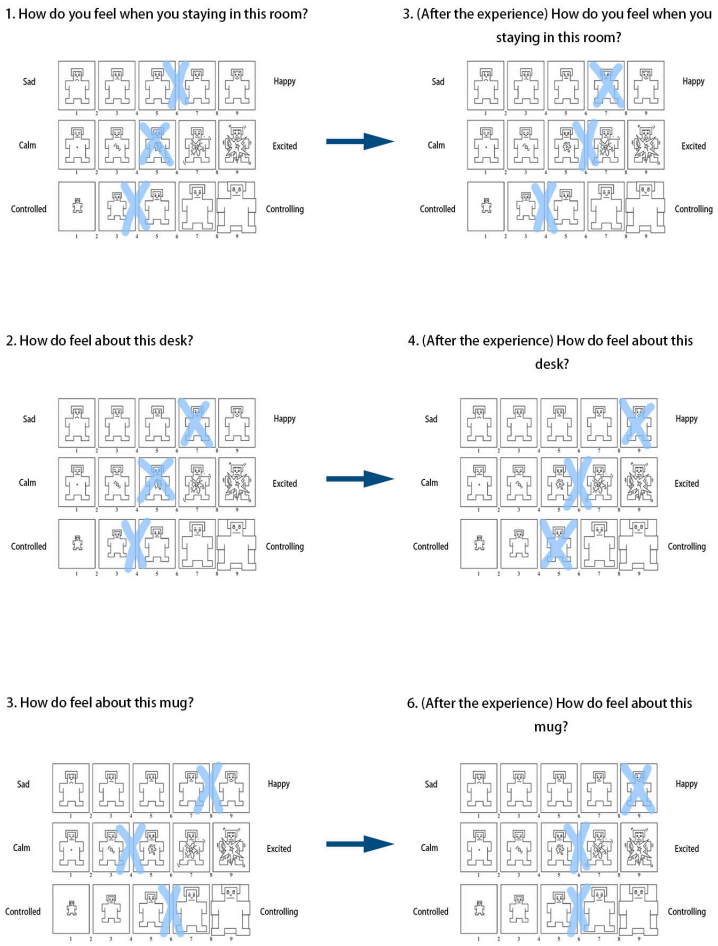


Figure 5.4 Emotion changes of a user who felt a weak connection

Based on McClelland's hypotheses about power and control, the ability of taking

control of something can develop a feeling of ownership towards it[1]. It could be seen that users who had a great control feeling change would build a strong connection with the objects, regarding the objects as their own. For those who had a weak connection with the objects, the change in the dominance dimension was not too much.

The interactions designed could provide the user a feeling that they could control and design the appearance of the objects, which in further is useful to build the connection between users and public objects.

5.3.2 Feelings about the Room

Thirteen out of fifteen users felt happier and more willing to stay in the room than before, while two users did not have emotion changes. Most users stated that the experience made project room become more colorful and interesting. When they studying in the project room before, they sometimes felt boring and depressive. Since they were not familiar with every person in the project room, they sometimes felt lonely as well. They thought this project change and decorate the environment around themselves in the project room. It could let them feel more powerful and interesting in the project room.

One user said that she did not feel well on that day, but after she wore the Ambiance accessory and experienced freshness theme, she kind of felt better. The green plains and cute colorful flowers she viewed let her feel comfortable. Besides, the slow pace of the theme also gave her a feeling that she could have a deep breath and keep away from the heavy study and feelings of under the weather.

5.3.3 User Behaviors

During the test, the user wore the accessory and was asked to move closer the desk. When the visual effect came all of a sudden when they get close, most users were surprised about the sudden changes. They would stare at the desk to see the changes of the visual effects. Although the observer stuck some small dots as triggers on the desk, only half of the users noticed at first. Those who

1 See 2.2.1

noticed from the beginning would try to touch the dots and felt interesting when seeing the changes. For those who did not find out at first, they touched the dots unconsciously and would be surprised when the effects came out. Almost every user enjoyed a lot to touch the dots and see the changes. Some users would stretch their hands to let the visual effects show on their hands, which looked like some pink flowers were growing in their hands.

Since they already knew the interaction with the desk, so when they wore the accessory and stretched their hands to the mug handle, they looked less surprised than experiencing the desk, but still looked enjoyable. Some users even wanted to take photos when they held the mug handle and visuals appeared on the mug.

5.3.4 Other Locations for Implementation

The users also gave the observer a lot of recommendations for the places where the project could be applied. One user suggested that she would like to use it in a train seat. She considered it as a way to create her personal space on the train, and on the other hand, it also reminded other people to keep a distance from her.

Another user recommended using it in a library when she is reading a book or magazines. She said the projectors could be set up under the table so the projection would not influence her reading. The visual effects appearing on the desk could let her feel more comfortable when reading books in the library.

In addition, many users mentioned to use it in the café. They thought that nowadays most cafés turned to be like a fast food restaurant which serves café. People buy a cup a coffee and take it away. And the café also no longer paid a lot of attention to their tableware and interior settings. The relation between café and customer has gradually changed. She thought by using Ambiance project, it was possible to make people rebuild their connection with the café, let them enjoying drinking, sitting and chatting in the café. For the café, they could also attract more customers to come to their shops.

5.3.5 Other's Impressions on Users

When the user was having the experiment, most people passing by looked interested in the visions of the user's desk. There was one girl passed by and said that

was impressive and amazing.

The project also enabled to change other's impressions on the user. There was one impressive case that a male user, who looked fit. All his classmates including the observer knew that he loves playing games. The observer at first thought he would choose to experience sports style, however, he chose the pretty coral flower bracelet. After the experience and interview, the observer knew that he actually loves those green and flowers stuff, which out of the expectation. Besides, some people sit opposite to him also surprised. They never thought he could have such sensitive and soft affections. It is a vivid case that the Ambiance project managed to let people show their personal style and personal images more directly.

Chapter 6
Discussion and Conclusion

6.1. Discussion

Owing to the limited time and resources, some limitations still existed in this experiment.

6.1.1 Technical Limitations

In the concept design, the desk should become a digital and intelligent interface so that it can detect where the user's finger is and show the visual effects in accordance to the places where the user's finger points at. Most parts were controlled manually during the user test, so automatic detection and control are required in the future. In that way, the whole experience would be more natural and vivid for the users.

Moreover, doing projection on the white mug also very difficult. Due to the lack of technology, this experiment only projected visual effects on the half side of the white mug instead of the whole body of it. And during the experiment, the mug cannot be moved or picked up or it will lose the visions. In the concept, the mug is movable and the visual should keep on the mug during movement.

6.1.2 Testing Issue

The testing implementation needed to be improved in the future. Due to the equipment limitation and for the sake of security, the projectors were not hanging vertically during the user test so that the shape of the visions showed on the table were in trapezoid and not perfect enough.

The location chosen in this experiment was also limited. The project aims to build a connection between people and public objects, people and public space. it

would be better if the project could be tested in a lot of public spaces like cafés or public libraries instead of only in the school.

Except for the location, the test also needs more test users. Although the project room to some degree is a public place in the school, the subjects do not have so many differences. They have similar ages and almost all of them are students. Besides, this user test had more female testers than male. The observer needs to obtain more experiment data from different types of users in various public places in the future.

6.2. Future Work

For future work, the first and easiest to achieve is designing more visual effects patterns for each theme and for different public objects and make sure that the visuals will not let user feel dizzy. Most users mentioned that they preferred the effects that could be changed according to the different seasons or weather or other factors. The visual effects can also be more personalized to satisfy every user's demands to show their unique personal style to others. The prototypes in the same type could have more different colors and the visual effects should match up with those colors as well. Other objects like seats or plates needed to be tested as well in the future.

Secondly, the project requires a better system, figuring out how to improve the experience of interactions. It is needed to be designed that how to let the visions appear on the object surface that the user touches. The object surfaces should turn into an intelligent interface.

Last but not least, thinking about the future development of the Ambiance project, the project aims to let people personalize the public objects in their surroundings to build a connection with the objects. But it cannot be denied that some places are not suitable to set up this system because of some safety reasons or other reasons. Therefore, it is necessary to decide where and who could support and implement the whole system and the devices. People can enjoy and express themselves in city public places with the Ambiance project.

6.3. Conclusion

People buy different kinds of objects in their life. The objects they choose express their taste and emotions, show their personalities and identities, affect their mood, and give pleasure to their daily life. However, people are exposed to the public space with public objects in most of their daily life. Some of them enjoy working and living in a public place, while some of them are not satisfied with the environment or have negative emotions there.

The Ambiance project is designed to develop a connection between people and objects, achieve a sense of virtual ownership of the objects, give a feeling of personal control and let people feel more pleased when experiencing a public place. And on the other side, decorating public objects with personal style also displays one's personalities and identity, which let other people have a direct impression on the users as well.

This thesis shows that every user could build a strong or weak connection to the objects by using Ambiance accessory. Those who had a strong connection can feel a virtual ownership of the objects, regarding the objects as their friends that accompany them. The change of the public objects which users used also let them feel more comfortable to stay in that environment. While according to the feedback, there are a lot of things needed to be improved in the future, the project gives a preliminary trial to connect people and public objects, people and the public space by using personal styles.

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Appendices

A. Code for HC-SR04 Ultrasonic Distance Sensor

```
## begin of code
import os
import sys
import subprocess
from PIL import Image
from gpiozero import DistanceSensor
from time import sleep
from guizero import App, PushButton, Picture, Text, Box, Window
from subprocess import Popen

sensor =DistanceSensor(14,15)
fresh_video='/home/pi/Desktop/videoplay_chen_wei/freshness.mp4'
sport_video='/home/pi/Desktop/videoplay_chen_wei/sport.mp4'
elegance_video='/home/pi/Desktop/videoplay_chen_wei/elegance.mp4'
black_video='/home/pi/Desktop/videoplay_chen_wei/black.mp4'
myprocess=None

def fresh_v():
    while True:
        print('Distance to nearest obeject is ', sensor.distance, 'm')
        sleep(1)
        if sensor.distance < 0.5:
            break
    myprocess=subprocess.Popen(['omxplayer','--win', '100 0 1920 1280',
        '--loop','--no-osd',fresh_video])
```

```
def sport_v():
    while True:
        print('Distance to nearest obeject is ', sensor.distance, 'm')
        sleep(1)
        if sensor.distance < 0.5:
            break
    myprocess=subprocess.Popen(['omxplayer','--win', '100 0 1920 1280',
        '--loop','--no-osd',sport_video])
def elegance_v():
    while True:
        print('Distance to nearest obeject is ', sensor.distance, 'm')
        sleep(1)
        if sensor.distance < 0.5:
            break
    myprocess=subprocess.Popen(['omxplayer','--win','100 0 1920 1280',
        '--loop','--no-osd',elegance_video])
def offff():
   print("System shut down")
   myprocess=subprocess.Popen(['omxplayer','--win','100 0 1920 1280',
       '--loop','--no-osd',black_video])
def qqq():
    os.system("killall omxplayer.bin")

app =App(height=200,width=50)
buttons_box= Box(app,layout="grid",width="fill",align="top")

#  text pushbutton
fresh = PushButton(buttons_box, text="Fre", grid=[0,0],command=fresh_v)
speed = PushButton(buttons_box, text="Spt", grid=[0,1],command=sport_v)
elegance = PushButton(buttons_box, text="Elg", grid=[0,2],command=elegance_v)
qqqq= PushButton(buttons_box,grid=[0,3],text="quit",command=qqq)
offf= PushButton(buttons_box,grid=[0,4],text="Off",command=offff)

#  image pushbutton (uncomment if want to use)
# fresh = PushButton(buttons_box, image='fre.png', grid=[0,0],
#             command=fresh_v)
```

```
# speed = PushButton(buttons_box, image='spt.png', grid=[1,0],
# .            command=speed_v)
# elegance = PushButton(buttons_box, image='eleg.png',grid=[2,0],
# .            command=elegance_v)

#  caption for image pushbutton (under the image)
#  fre_label=Text(buttons_box,text="Freshness",grid=[0,1])
#  spt_label=Text(buttons_box,text="Sport",grid=[1,1])
#  eleg_label=Text(buttons_box,ext="Elegance",grid=[2,1])

app.display()

#while True:
#print('Distance to nearest obeject is ', sensor.distance, 'm')
#   sleep(1)
```

B. Self-Assessment Manikin Used during Experiment

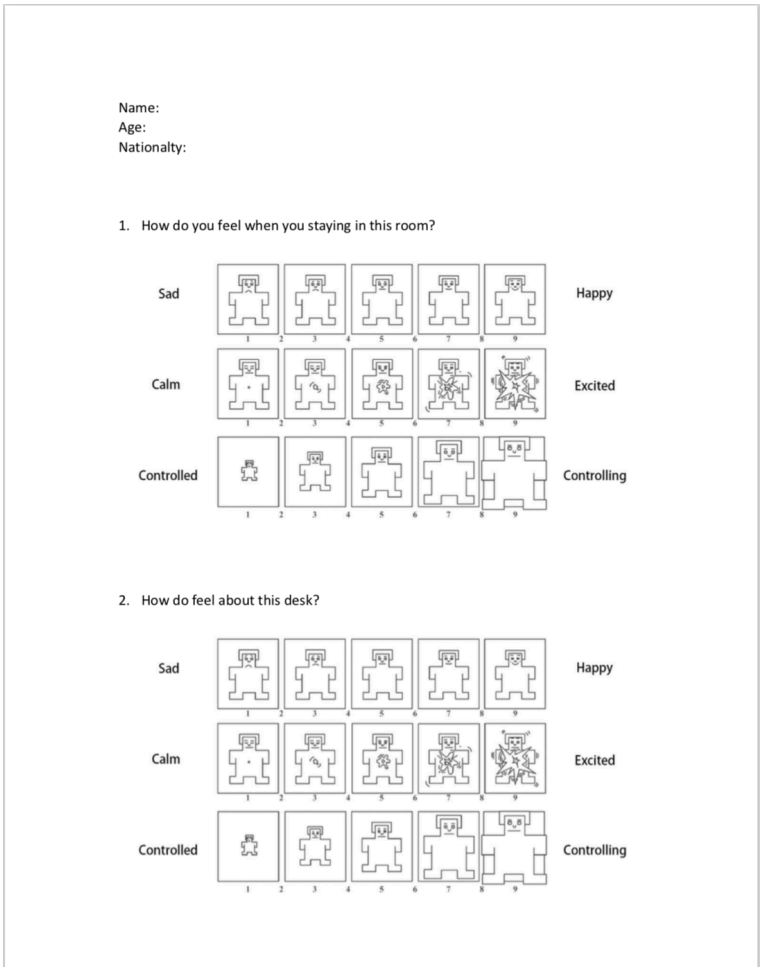

Figure B.1 Self-Assessment Manikin Used during Experiment 1

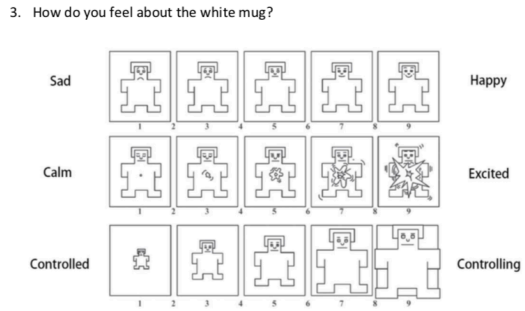

Figure B.2 Self-Assessment Manikin Used during Experiment 2

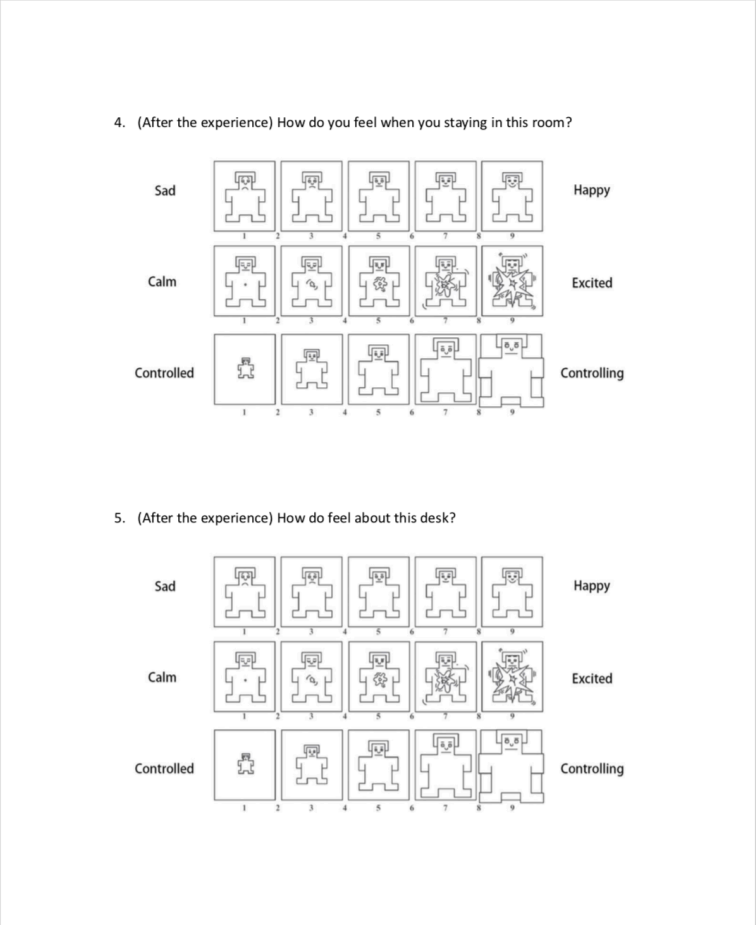

Figure B.3 Self-Assessment Manikin Used during Experiment 3

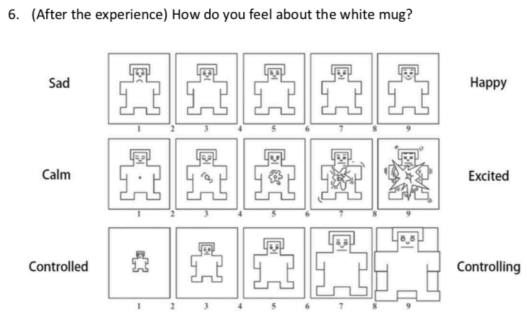

Figure B.4 Self-Assessment Manikin Used during Experiment 4