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Master's Thesis
Academic Year 2014

Shiki: Kindling Emotional Connections Between
Inhabitants and Old Buildings Through Seasonal
Ambience

Graduate School of Media Design,
Keio University

Wei Tzu Li

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

Wei Tzu Li

Thesis Committee:
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Abstract of Master's Thesis of Academic Year 2014

Shiki: Kindling Emotional Connections Between Inhabitants and Old Buildings Through Seasonal Ambience

Category: Design / Ambience / Interaction

Summary

With the objective of imbuing old buildings with contemporary value, whilst maintaining ethnically diverse communities and the buildings' own unique characters, this research utilizes the human scale size of the interior spaces to create an ambience by means of *Shiki*. Through *Shiki*, an ambience filled with sensations of Japan's four seasons prompts inhabitants to be emotionally connected to an old building. The interior of the old building is transformed into an interactive Japanese-style room that allows inhabitants to explore various seasonal sceneries of Japan through different body movements. The sensations of the seasons are comprised of the cherry blossoms of Tokyo, the summer beaches of Izu, the autumn leaves of Kanazawa, and the winter snows of Hokkaido. By experiencing *Shiki*, inhabitants' emotions of excitement, happiness, delight, pleasantness, and comfort are brought out.

Shiki aims to present a new approach to creating ambience for kindling emotional connections between inhabitants and old buildings in Singapore. This paper describes the concept of *Shiki* through the approach of design thinking and ethnography. It reveals the process of design, which includes extensive fieldwork in Singapore and Japan, interior design, an experiment with interaction design, concept design, and a prototype video. The research was carried out in collaboration with CUTE Center, National University of Singapore from April 2013 to July 2014.

Keywords:

Design Thinking, Ethnography, Singapore, Old Building, Ambience, Seasons

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Chapter 1

Introduction

Despite modern skyscrapers standing magnificently in the metropolitan of Singapore, old buildings built before 1970s are also a significant part of the cityscape. Old buildings in Singapore are the locations where the ethnic diversity mingles and flourishes. The relationship between Singaporean history, current identity and a diverse population can be seen in the physical appearance of these old buildings. One of the challenges the country faces is to find the balance between preservation of old buildings and creating economic value from them. When old buildings in some areas are refurbished into entertainment facilities, locals shift their daily activities away from those areas, resulting in communities disappearing. In recent years, the Singapore government has tried to maintain residential capacity instead of commercial capacity in the old buildings. Taking into account that old buildings in Singapore also possess the ideal venue for creating ambience based on the human scale size[1] of the interior, this research utilizes the interior spaces of old buildings to generate contemporary social and economic value through ambience design. *Shiki* is a system that seeks to create a pleasurable ambience within a space through generating sensations of four seasons utilizing multisensory integration.

Singapore is a country with no distinctive seasons; summer persists throughout the year. Winter clothing shops appearing in high-end shopping district shows a demonstrated desire on the part of Singaporeans to experience different climates. Given that Japan's distinctive seasons are unique and popular in Asia, attracting millions of tourists to Japan each year[2], *Shiki* seeks to create an ambience that elicits inhabitants' emotions through utilizing the characteristics of the four sea-

sons of Japan, including spring cherry blossoms of Tokyo, the summer beaches of Izu, the autumn leaves of Kanazawa and the winter snows of Hokkaido.

Based on ethnographic research, old houses in Kanazawa City with similar human scale size of interior possess an inimitable and comforting ambience that inspires people's emotions. Deriving from this research, *Shiki* employed the interior qualities of old houses in Kanazawa City to create an ambience inside an old building in Singapore. Utilizing the idea of borrowed scenery, "Shakkei" in Japanese, *Shiki* emphasizes the scenery of four seasons through projecting on the wall of the room, incorporating scents, and sounds corresponding to the visual contents. An interactive ambience further engages inhabitants deeper in the experience, enabling them to trigger change of seasonal sceneries, sizes and shapes of the window, sounds and scents through various body movements. Through *Shiki*, inhabitants of old buildings perceive a sensation of excitement, pleasure, delight, or comfort within the ambience.

Shiki inspires inhabitants to be emotionally connected to an old building. It allows inhabitants to enjoy living environments, which contributes to raising the value of old buildings through increasing the desire of inhabitants to spend time in and engage with the space. This results in the maintenance of the ethnically diverse communities and ways of life within. *Shiki* is also designed to be installed in old public housings in Singapore. Rich ethnic communities could also be found in old public housings; however, the same situation occurs with people moving to new public housing, resulting in old communities disappearing. By means of *Shiki*, implementation of ambience is possible to be applied on various structures of interior. This research, which took place in Singapore, was in collaboration with CUTE Center in the National University of Singapore from April 2013 to July 2014.

In this chapter, we will explore each factor in turn. The first section inspects the social and demographic role of old buildings in Singapore. The second section discusses the significance of ambience in old buildings in the way people relate to them. The third section explains the importance of the four seasons of Japan. Finally the fourth section proposes a solution that combines these factors within contemporary and technological ways.

1.1. Old Buildings in Singapore

Figure 1.1: Old buildings in Singapore are the locations where the ethnic diversity mingles

Singapore, a small and heavily urbanized country, has a remarkable cosmopolitanism of the population, comprised 74.2% Chinese, 13.3% Malay, 9.2% Indian and 3.3% of various origins[3]. The collage of ethnic groups contributes to the multicultural society of Singapore. The cultural diversity also reflects on different styles of architecture of the old buildings (Figure 1.1). Presently, in Chinatown, Arab Street, Little India, Katong, Tiong Bahru and Bugis, various lifestyles of ethnic origins are maintained in the old buildings. Indian housewives shopping for spices or groceries in the markets can be seen in Little India, whereas Arabian perfume makers selling traditional fragrances can be glimpsed in the old shop houses in Arab Street. The images of magnificent facades and locals carrying about their daily activities, along with unique smell of spices, food or the fragrance, as well as the sound of shop merchants calling out for customers in different languages; these all together create a remarkable phenomenon of old communities housed in old buildings in Singapore.

Old buildings in Singapore house not only people but they provide them a sense of attachment to the homeland, Singapore. It allows locals to continue carrying on daily or cultural activities, serving religious beliefs or knowing where to find their ethnic origins in the communities within old buildings (Figure 1.2). In some areas, including Boat Quay and Clarke Quay, a sort of characterless internationalism has taken over, resulting in buildings restored for entertainment purpose. In order to accommodate new uses to meet contemporary needs, many

Figure 1.2: Locals find their ethnic origins in the communities within old buildings

old buildings are refurbished into luxury hotels, art galleries, museums or restaurants. The distinctive identity of Singapore's communities is in time lost. In recent years, the Singapore government strongly encourages locals to maintain life activities in the historical buildings in order to preserve the ethnical identities in the historical areas[4]. At the time when the rapid pace of change has altered the appearance of cities all over the world, maintaining what is distinctive about the cultural legacy can be a vital part of both reinforcing the identity of a city and in making it attractive to both its local citizens and to those from other countries. The objective of *Shiki* is to balance the demands of modernism and aspiration of Singaporean citizens with a respect to their cultural heritage.

1.2. Ambience in Old Buildings

Ambience is the atmosphere, mood, feel and character of a place or an environment, formed through the space, lighting, openness, and transparency. Kevin Lynch[5] proposes that nothing is experienced by itself, but always in relation to its surroundings, the sequences of events leading up to it, the memory of past experiences. Berman[6] also explains that the ambience is perceived from the subjective viewpoint of the person experiencing the environment. When a person visits a location for the first time; ambience is the first impression. The initial impressions of ambience can be created from the images, words, sounds, sights, smells or pictures. In the earliest stages of a person's consciousness, the ambience may tend to dominate the perception and understanding of a location. Tuan[7] indicates

that ambience may contribute to the transition in which undifferentiated spaces become specific places as the person gets to know it better and endows it with value. As actual visits to a location occur over time, the initial ambience recedes to the background as the location takes on richer meanings based on experience. The initial ambience may gradually fall away to allow specific experiences and knowledge of individual locations to substitute for atmospheric qualities.

Figure 1.3: Old buildings possess ideal size of human scale for creating ambience

Old buildings enrich the perception of ambience for the human scale in architecture[8] (Figure 1.3). Human scale in architecture is described as buildings with sightlines, acoustic properties, ambient lighting, and spatial grammar that fit well with human senses[9]. Architecture was a part of mathematics; in the ancient world, mathematicians were architects whose constructions, including the pyramids, ziggurats, temples, stadia and irrigation projects[10]. Medieval masons had a strong grasp of geometry, which enabled them to construct the great cathedrals according to mathematical principles[11]. Proportional ratios are included with architectural qualities that are perceived intellectually and directly[12]. The presence of the Golden Mean (f = 1.618), the ratios 5:3, 8:5 proportion are found throughout all of historical architecture[13]. The use of proportional ratios often

also subdivides forms so as to define coincident scales, and this has a strongly positive effect[14]. A user has to reconstruct a building's plan in the mind. Modernism removes mathematical information from the built environment[15]. Only traditional architecture tends to be explicitly fractal. "Build structures on a large scale that are natural only on the small scale; they then appear out of place, and therefore novel[16]." Upon ethnographic research in Singapore, this research discovered that old buildings in Singapore possess the space of human scale – which makes the ideal venue for creating ambience.

Historical ambience serves as an initial lure, and still provides a cohesion and enjoyment while strolling the streets[17]. The reverse scenario of an object with historical ambience within a predominantly contemporary appearing setting can also potentially enhance both object and setting[18]. In Singapore, historical old buildings, standing magnificently in historical areas as well as amongst contemporary architecture, create a unique ambience within the urban city. Historical ambience does not exist independently. It only exists in relation to and in its distinctness from an adjacent ambience[19]. A historical ambience does not rely on the uniqueness of its elements. Rather, it relies on people's perceptions of that uniqueness[20]. The old buildings in Singapore are the landmarks and enclaves for different ethnic origins to gather and maintain their cultural activities. They serve the purpose of housing the ethnic diversity, their religious beliefs as well as the purpose of representing their identities. It is the historical facades along with ethnic communities that create the uniqueness of the ambience.

1.3. Creating Ambience Through Four Seasons of Japan

Singapore has a tropical rainforest climate with no distinctive seasons due to its geographical location in Southeast Asia, and maritime exposure[21]. The climate is characterized by searing temperatures, high humidity, and abundant rainfall throughout the year. Giant tropical trees are planted along sidewalks and roads (Figure 1.4), creating shade from the sun while embellishing urban areas with green and natural features. During the day, the average temperature remains around 31 degrees C, whereas at night it is unlikely to dip below 23 degrees C[22].

Figure 1.4: Giant tropical trees planted alongside the road

In general, humidity levels range between 70% and 90%, causing muggy air in the morning and afternoon. Arcade-style buildings provide covered passageways to shade from the sun and rain. Most restaurants and food shops provide seats within the covered passageways, allowing people to enjoy their meals outdoors. Above them are ceiling fans rotating slowly in order to improve the air circulation and sprinkle the customers with mist to cool down the atmosphere (Figure 1.5). In Singapore, summer is the dominant season covering a major part of the year.

Retreating from the scorching and muggy weather, locals prefer staying indoors for daily activities and recreation. Air-conditioned shopping malls provide a comfortable atmosphere, maintaining low humidity and temperature down to 20 degrees C. To allow customers to avoid walking outside under the sun, most of the shopping malls are connected underground and linked directly to the subway stations. While some people attempt to escape from the heat, some attempt to experience different climates. Despite the extremely hot temperatures outside, winter clothing shops appear in the high-end shopping mall, Suntec City[23], in Orchard Road. Winter jackets are found hanging on the walls along with signs of recommended temperatures for wearing the outfits, for example, "10 below to 30

Figure 1.5: Ceiling fans installed in arcade-style buildings

below degrees C." Customers lingering in front of heat-techs, sweaters and winter coats in Ralph Lauren, as well as in Japanese clothing shops, Muji and Uniqlo, can also be seen. Considering that Snow City Singapore[24] is the only place where people can enjoy skiing and snowboarding indoors in Singapore, winter clothing shops in the malls appear to be targeting on those who are keen on traveling to countries with different climates. The popularity of this shows a powerful desire on the part of Singaporeans to experience different climates. This not only implies there is a demonstrated urge among Singaporeans to get away from the mono-climatic setting, but also they are willing to spend money on traveling somewhere different.

Singapore is ranked as one of the three richest countries in the world[25]. With the increase in economic development, Singaporeans have become more affluent and have greater amounts of leisure time. They have a propensity for enjoying a higher standard living and enjoying recreational and leisure activities[26]. As stated by Department of Statistics Singapore[27], there is an increasing proportion of residents who travel to more distant destinations, including Europe, Australia, Japan and South Korea, as their monthly household income from work increases. According to Japan Tourism Marketing Co.[28], Singapore was ranked as the ninth country with the greatest number of tourists travelling to Japan. Singapore-ans traveling to Japan showed interests in experiencing four seasons and natural

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scenery, especially that cannot be found in Singapore[29].

Seasons of Japan are regarded extremely highly within Japanese culture. Elegant representations of nature and the four seasons populate a wide range of Japanese products, cultural activities and media, from poetry and screen painting to tea ceremonies, flower arrangements, and annual observances of cherry blossoms or autumn leaves[30]. Annual change in seasonal fashion, such as clothes, or food and desserts, are also highly related to seasonal change in Japan. In foreign countries, the image of Japan is characterized through tangible media and products, such as Geisha, temples, comic books, or electronics. People can easily purchase Japanese products from the shops or watch Japanese travel programs, dramas or movies on television. However, the sensations of seasons are impossible to be delivered through any media. Each year, millions of travelers from other countries in Asia, including Taiwan, Thailand, Vietnam or Singapore, would fly all the way to experience seasons in Japan. It is the intention of this research to transform this setting into ambience environment within a space. But just by doing so has no value; considering Singapore has its distinctive history, rich ethnic diversity housed in old buildings and old buildings possess human scale sizes that are ideal for ambience representation, we decided to create an ambience for old buildings that imbue the value in Singapore.

1.4. *Shiki*, A System for Creating Ambience

Shiki delivers the experience of seasons through the concept of borrowed scenery in a Japanese-style room (Figure 1.6). Based on the ethnographic research, old houses in Kanazawa City with similar human scale size of interior possess inimitable and comforting ambience that inspires people's emotions (Figure 1.7). Deriving from this research finding, *Shiki* employed the interior elements of old houses in Kanazawa City to create an ambience inside an old building in Singapore.

A traditional Japanese-style room integrates outdoor scenery with indoor surroundings and objects, allowing inhabitants to feel close to nature, and to further perceive the beauty of nature (Figure 1.8). The Japanese-style room is inspired by Japanese traditional Zen philosophy. "Zen seeks artistic expression in forms that are as pure and sublime as the Zen tenets they manifest; it eschews intellectual-
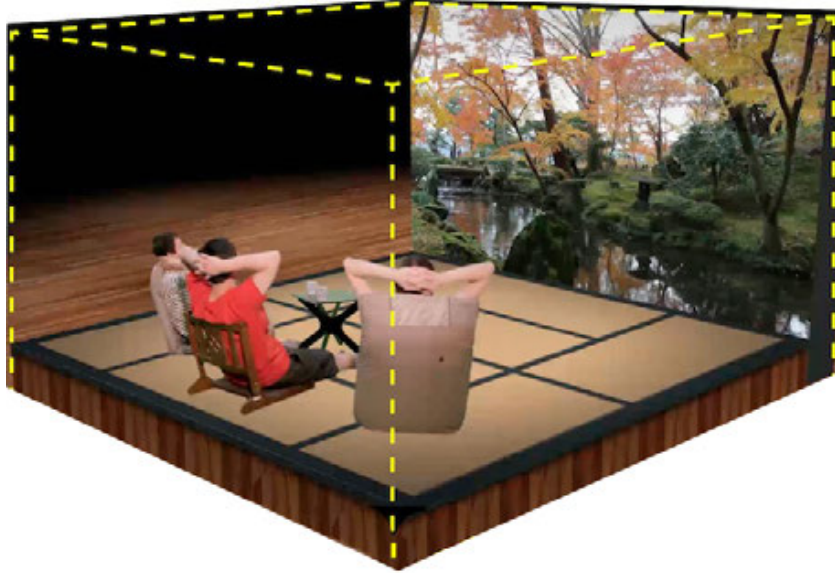
Figure 1.6: Creating ambience in an old building

Figure 1.7: Old houses in Kanazawa have similar human scale size

Figure 1.8: Japanese-style room

ism and pretense and instead aims to unearth and frame the beauty left by the flows of nature[31]." Japanese traditional Zen philosophy translates the essence of life as simplicity and nature[32]; hence, Japanese-style room represents the concept of Zen through the form and the arrangement of objects, the use of materials, the geometry of the layout and the relationship between environments[33].

Figure 1.9: Japanese borrowed scenery

The iconic elements found within in a Japanese-style room are tatami flooring, sliding paper doors (Shoji), a narrow wooden passageway (Engawa), a Japanese window (Shakkei) (Figure 1.9), and a Japanese garden. Tatami flooring, used for seating, is made of rice straw in standard sizes, with the length exactly twice the

width. Sliding paper doors creates an indefinite division between spaces as the light from outside seeps in through the paper into the room and onto the objects. Moreover, Japanese-style room creates a connection with nature by linking the inner space and external with a narrow wooden passageway. It forms a terrace area as a means to appreciate the outside scenery from the inside. Japanese windows (Shakkei), referring to "borrowed scenery" in Japanese, which means to create a dynamic scenery by incorporating background landscapes, for instance, forests, mountains or cascades into the composition of Japanese garden. Based on this, an integration of traditional Japanese-style room into the old building allows inhabitants to feel close to nature and enjoy seasons of Japan in a simple yet comfortable environment with a mind of peace.

The layout of the Japanese-style room is designed to be located in the middle of the building. A giant dark-grey screen replaces the wall in the front of Japanese-style room, integrating into the interior. A high-resolution projector is embedded behind the screen, projecting videos of sceneries from the back. The speakers are installed invisibly on two sides of the screen. The aroma generator is embedded in the furniture. Moreover, three sets of sensing device are embedded on top of the screen in front of the furniture in order to sense body movements of inhabitants.

Interactive ambience further engages inhabitants in the experience of changing seasons, eliciting inhabitants' emotions as they explore various seasonal sceneries with different body movements. Responding to the body movements of inhabitants sitting on the sofa, *Shiki* changes the sensations of four seasons; comprising changes in visual contents, scents, sounds, sizes and shapes of the Japanese window. The design of the interaction system is set for 1 to 3 users. The changing of four seasons is automatic based on time. Within the designated time for each season, user interaction triggers changes in (1) visual contents of seasonal sceneries (2) sounds and scents, (3) sizes and shapes of the Japanese window. Five motions and gestures determine the above changes:

A. Sitting down: seasonal scenery 1, window changes from round to square, seasonal scent generated.
B. Crossing legs: seasonal scenery 2, window extends to normal size, sound of leaves triggered.

C. Putting hands behind the head: seasonal scenery 3, latticework appears on the window, sound of wind triggered.

D. Stretching: seasonal scenery 4, window extends larger, sound of bird triggered.

E. Reaching out for the tea on the table: seasonal scenery 5, window shrinks smaller, seasonal scent generated.

The gestures and motions of the first user determine the change of seasonal sceneries while the second user determines the change of sounds and scents, and the third user determines the change of Japanese window. In the case that two or three of users synchronize to perform the same gesture or motion, the season would change regardless of the time interval. The full experience can be completed with the total of three users in order to encourage interaction between multiple users.

In terms of the implementation of *Shiki*, three components are set to redesign the ambience of an old building in Singapore; (1) eliciting inhabitants' emotions through four seasons, (2) delivering sensations of four seasons through an interior incorporated with images, sounds and scents, and (3) engaging the inhabitants in the ambience through interactive interior. Based on these components, *Shiki* generates four seasons in a building and inspires the feeling of excitement for inhabitants. Five methods are proposed for realizing these components; (1) utilizing the idea of "borrowed scenery" to borrow four seasons from Japan to Singapore, (2) fabricating projector, screen, speakers and sensing devices into the interior, (3) embedding speakers and aroma generators into the furniture, (4) creating seasonal sceneries through videos, audios and scents, and (5) triggering interactions between inhabitants and ambience through sensing devices. *Shiki* is conducted via these three components and five methods. In the future, *Shiki* will be implemented in practice for the purpose of striking a new approach for creating new value of old buildings as well as encouraging inhabitants to live in old buildings. It could also be implemented in the countries with no distinctive changing in seasons.

This thesis consists of five chapters. Chapter 2 reviews previous studies regarding the effects of natural elements on emotions, elements of interior design for creating the ambience, and approaches for interactive ambience design. Chapter 3 explains the design process of *Shiki*, including fieldwork in Singapore and in Japan, ambience design and interior design based on the actual size of an old

building in Singapore, experiment of interaction design utilizing sensing devices as well as the prototype video. In chapter 4, the evaluation of *Shiki* by users is presented. The initial plan for demonstrating the concept of *Shiki* was through an experiential exhibition in an actual building in Singapore; however, due to change of the exhibition date, the concept of *Shiki* was evaluated through creating ambience in old public housings as alternative. *Shiki* was evaluated through qualitative research method, which included an in-depth interview and observation. The user study was conducted in Singapore with five participants fitting the target user group: upper middle class local Singaporeans or permanent residents in Singapore. Chapter 5 concludes the evaluation obtained from the feedback as well as future improvements and implementations of *Shiki*.

Notes

1   Buildings scaled to human physical capabilities have steps, doorways, railings, work surfaces, seating, shelves, fixtures, walking distances, and other features that fit well to the average person.

2   Japan Tourism Marketing Co. http://www.tourism.jp/en/

3   Singapore Tourism Board http://www.yoursingapore.com/content/traveller/en/experience.html

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Chapter 2

Literature Review

This research proposes *Shiki* as a means to create an ambience within an old building in Singapore through four seasons in order to inspire emotional connection between inhabitants and an old building. An interior that is transformed into an interactive Japanese-style room engages inhabitants deeply into experiencing the four distinct seasons of Japan through five senses. Recognizing the importance of the need for encouraging inhabitants to live in the old buildings in Singapore, and the tendency of Singaporeans traveling abroad to experience seasonal sceneries, this research utilizes *Shiki* to create an interactive ambience that elicits the emotions of inhabitants through seasons.

Following a brief outline of this research, selected literature will be reviewed in related to theoretical research and previous work in the same fields. Theoretical research will describe in detail in regard to human feelings and emotions, the fundamentals of interior design and the essentials of interaction design. Related works will discuss the effects of natural factors and interior elements on human emotions, as well as approaches for creating interactive ambience. Based on the theoretical background and previous research, this research presents the novelty of *Shiki*, which elicits inhabitants' emotions by engaging them to the sensations of four sensations through an interactive ambience.

2.1. Effects of Natural Factors on Emotions

Feelings are stimulated by emotional responses[1]. Feelings are described as an emotional state or an experience formed upon an emotion of sensation[2]. Feelings are psychological experiences of body states[3]. According to Differential Emotions Theory[4], a set of principles and hypotheses primarily about the motivational and regulatory functions of discrete emotions, feeling is the grounding for the motivational aspects of emotions. Different emotion feelings have different motivational functions[5] and are likely to lead to different effects[6]. Emotions comprise pleasure and arousal[7], and arousal influences pleasure[8]. Pleasure refers to the degree to which a person feels good, joyful or happy in a situation, whereas arousal refers to the extent to which a person feels stimulated and active[9]. Many studies regarded emotion as a response to both external and internal stimulus[10]. It is believed that emotion is a physical reaction to an external stimulus or environment[11]. It also involves responses from the body and conscious feelings, and thus determines our urges[12]. When triggered by external stimulus, such as experiences related to exteroceptive senses[13], emotions elicit feelings[14].

Many studies have revealed that natural factors stimulate positive effect on human emotions. Immersion in simulated or actual nature fosters vitality[15] and triggers positive affect[16]. It is believed that exposure to a nature-oriented film stimulates positive emotions such as enjoyment and wonder[17]. There is no doubt that human's psychological health is associated with nature[18]. Exposure of green spaces has positive effect on health and longevity[19]. Experience of nature leads to positive psychological states[20]. Scholars[21] further identified that nature is an elicitor of awe.

Howell et al.[22] from Grant MacEwan University, Canada, examined correlations between nature connectedness, emotional and psychological aspects, and the associations between mindfulness and nature connectedness[23]. They believed that experiences in nature, mindfulness and nature connectedness should be positively associated. In their study, nature connectedness is defined as "individual's experiential sense of oneness with the natural world," whereas mindfulness is defined as "being attentive to and aware of what is taking place in the present." Through a questionnaire based on the Mindful Attention Awareness Scale (MAAS)[24], they collected 452 responses from the students in an urban Canadian university in

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2010. The research suggests that higher level of nature connectedness would be associated both with higher levels of wellbeing and with greater mindfulness.

The visual representation of nature is widely used in advertising to evoke positive emotional associations. Evolutionary psychology has proposed that the human mind is a product of evolution by natural selection[25]. Aesthetic responses is associated with pleasurable feeling and neurophysiologic activity elicited by visual encounter with an environment[26]. The attraction toward nature is considered an important aspect of human behavior[27]. Numerous studies[28] have demonstrated human's preference for environments with natural elements over those that are artificially built. Nature has some inherently positive effects on physical and psychological well-being for humans[29]. Greater restorative effects arising from experiences in nature[30]. The exposure to images of nature led to more positive influences on psychological states than urban scenes[31].

Hartmann et al.[32] from University of the Basque Country examined the behavioral effects of landscapes displayed in advertising[33]. They analyzed emotional reactions to advertising using specific sceneries of natural and urban environments. The study was evaluated by interviews, taken place in northern Spain, with total of 750 participants. Thirteen advertisements were shown to the participants and voted by them. The result of interview indicated that advertisement elicited higher positive emotional responses by utilizing images of pleasant natural landscapes with lush green nature scenery. The study evidenced that visual stimulus representing nature scenes generate positive behavioral effects, such as higher purchase intentions and product attribution.

While visual stimulus of natural factors have effects on viewers' emotions and behaviors, another study introduced the influence of environmental factors on cognitive performance. Office workers appeared to be less tired[34] and healthier when they were surrounded by plants and had access to view from window[35]. Abundant studies pointed out that natural environments can have a restorative effect on attention[36]. Raanaasa et al.[37] from Norwegian University of Life Science conducted their study for the purpose of examining possible effect of plants on cognitive performance in a working office[38]. The study took place in an office at the university in Norway, 2010. A total of 34 university students participated in the experiment. The experiment was designed to test students' attention capacity

through Reading Span Task[39]. The result confirmed that natural elements can affect cognitive performance in an office work environment and plants present in an office during the actual work had a positive effect on attention capacity.

2.2. Elements of Interior Design for Creating Ambience

In the book of *Fundamentals of Interior Design*[40], Dodsworth introduces interior design as a means to create a space that satisfies the inhabitants' desire. It is human nature to seek more comfort and better quality for living environments. Our ancestors started from making shelters in caves, marking patterns in dwelling spaces, and then adding on natural elements to embellish the living environments. At present, the living environments are arranged and expressed in a more sophisticated ways. Other than having a comfortable living, style is also taken into consideration. Interior designers, therefore, take on role of imposing meanings and embellishment upon a space. Interior design includes considering appearance as well as individuals use, allowing them to enjoy the space they inhabit and strengthening the experience of the space. Interior design is the means that adds new dimensions and value upon a place through color, lighting, accessories and furniture.

Researchers have examined the factors which determine the human response to an environment[41]. It is noted that light, color, accessories and furniture have a significant effect on one's perception of an environment[42]. Visual appearances and usability have a strong impact on people's perception of artifacts, as well as surroundings[43]. Building with natural and biological forms appear more psychologically comforting[44]. Curved shapes of internal spaces invoke feelings of joy, harmony and well-being[45]. Many studies[46] also indicated that curvilinear forms elicit positive emotions, such as pleasant, elevating and reducing stress.

Dazkir et al.[47] from Oregon State University focused their study on how curvilinear forms of the furniture elicits users' positive emotions towards interior environment[48]. It is their endeavor to understand the influence of visual characteristic, including interior settings and furniture forms, on users' emotional reactions. They used 3D computer graphics to draw out four kinds of interior setting with an

emphasis on the differences furniture forms. Half of the settings were constructed in curvilinear forms while the other half were constructed in rectilinear forms. Using these interior settings as visual stimulus, an online survey was carried to collect emotional responses. The online survey collected responses from 111 people and they used it to measure the circumflexes of emotions triggered in each interior setting. The findings of circumflexes of emotions reflected that interior settings, which constructed in curvilinear forms, elicited higher percentage of pleasant emotions than rectilinear settings. Some respondents stated that curvilinear furniture appeared more comfortable and inviting. One respondent explained he wanted to enjoy lying on the couch for several hours because of the comforting appearances. Another respondent further stated that rounded furniture seems to give off that calming feel. As the result, the study shows that different form styles of furniture and layout influence people's perception, and settings designed with curvilinear lines trigger sensations of happiness, calmness and relaxation.

"Color emotion" refers to an emotion evoked when the brain processes the perception of color as a stimulus in the form of light[49]. Each individual color as well as each combination of colors convey distinctive meanings, which evoke a variety of color emotions[50]. In a study of color emotions with regard to stimulated interior spaces, it is noted that "hue," "tone," and "chroma"[51] of a color describe the warmth, coolness and brightness of an environment[52]. Warm colors, such as red or orange, have a stimulating effect and make an interior seem less spacious, whereas cool colors, such as blue or green, have a relaxing effect and evoke increased perceptions of spaciousness[53]. Another research[54] further found out that color and emotion are scientifically related. For instance, red is associated with feeling of excitement and stimulation, implying a state of higher arousal, while blue and purple is associated with feeling of ease, clam and relaxation, implying a state of pleasantness[55]. Color emotion[56] determines people's varying responses to the environment[57]. Various colors stimulate a range of emotions in different people[58].

With a purpose of investigating emotional responses to an interior space across varying color schemes, Yildirim et al.[59] conducted a study to examine color-emotion associations. The study took place in Selcuk and Hacettepe Universities in Turkey in 2009[60]. A questionnaire was designed to analyze participants' perceptions of the environmental conditions. The study compared the emotional

responses with three different color schemes in two different virtual living rooms, including warm colors, cool colors and achromatic colors. A total of 290 students participated in this survey. The results indicate that even though furniture and decoration of the interior are different, similar color schemes had evoked similar emotions in men and women. Warm color elicited higher arousal, evoking feelings of stimulation and excitement, while cool colors elicited feelings of spaciousness, restfulness, clam and peacefulness. The study concludes that color has a prevalent effect on interior design factors, and warm colors should be adopted in interior settings for evoking feelings of arousal, excitement and stimulation.

Another study[61] related to interior colors, lighting and decors was done by Wardono et al.[62] from Chiba University, Japan. They strove to understand the effects of interior elements on sociability, emotion and behavior in regard to social dining. The study was evaluated by creating eight different 3D computer graphics of restaurant interior atmosphere based on one model of a restaurant. The model shows the corner of simple restaurant interior with sets of chairs and tables, which become a fixed element, while unfixed elements include the colors of the wall, ceiling, floor, the tablecloth, the lamps and the decors. The graphics were projected to the screen for study subjects to observe. They collected responses from 162 Japanese students through a questionnaire that contains questions regarding to perception, emotions and behavioral statements. The study showed that participants feel more romantic in the settings with monochromatic colors, dim lighting and plain decors. Out of three elements, lighting is the most important element for creating intimate spaces. The result indicated that colors, lighting and decors were effective to stimulate the subjects in the way they perceive, feel and behave towards the restaurant atmosphere.

2.3. Approaches for Creating Interactive Ambience

Cooper et al.[63] explained interaction design in their book, *About Face3: The Essentials of Interaction Design*[64]. They stated that interaction design is focused on two factors: the design of behavior, and the form and content of design that comes along. The term, interaction design, was first introduced by two industrial

designers, Bill Moggridge and Bill Verplank. They came up this term while they were designing the first laptop computer, the GRiD Compass. It wasn't until the digital era came that the term was brought up for mainstream use. Designers of all stripes hope to influence the experiences people have. While graphic designers manipulate visual items, such as posters, illustrations and photos to create an experience, furniture designers work on a chair with different materials and interior designers using layout, lighting and materials to create an experience. Designers, dealing with digital products, strive to influence people's behavior by designing the mechanisms for interacting with products. With the rise of the digital era, interaction design became an important factor of software design for desktop computers and the basis of creating user interfaces.

While interaction design is taken into consideration in mostly digital products, it can also be seen that designers of other fields tempt to adopt this technique into their work, such as interactive art. A study employed the concept of play to explain how interaction with artwork stimulates positive emotions that lead to pleasant experience. The concept of play was inspired by the idea of interactive art, which encourages audience to adopt an active role in order for the experience to occur[65]. Play is defined as free movement within a fixed structure[66]. The processes of exploration are the precursor to playful behavior. And as the unfamiliar becomes familiar through exploration, the playful behavior occurs[67]. The oscillation between play and exploration drives audiences to have deeper levels of engagement with the artworks[68].

Costello et al.[69] employed stimulation of playful behavior as a design strategy for artwork and created a framework utilizing thirteen pleasure categories of play[70]. Thirteen pleasure categories in the framework were developed as a synthesis of different theories, including aspects of play experience, pleasurable experience, stimulation of playful behavior and types of pleasure in games. This framework was named "pleasure framework." Through a survey, this pleasure framework was evaluated to see whether or not the user experienced the type of pleasure artist had intended to deliver by comparing user evaluation and artist's original intention. The survey took place in an art studio in Sydney from 2003 to 2006. Three art works were designed to evaluate the validity of pleasure framework. The first and second one of artworks were designed without using the

pleasure framework, and only the third one was designed based on the pleasure framework.

According to the survey, the third artwork confirmed the validity of pleasure framework: the artists designed the artwork with a goal of triggering certain types of pleasurable feelings selected from the framework, and customers' perception of pleasurable feelings completely matched the artist's expectation. The result of evaluation showed that playful behavior engages audience in the artwork, and thus creates a pleasurable experience. Costello et al.[71] also noted that this pleasure framework, of which the theoretical based on general studies of play and games, could be applied on other interaction design besides interactive art. Through this pleasure framework, designers could achieve a deep level of audience engagement[72].

In addition to interaction with objects, many studies focus on elevating the possibility of interaction, combining both objects and ambience, especially in the field of medical care. In 2009, Li et al.[73] from Hong Kong Polytechnic University have conducted research on emotional and physical communication-based ambient environment[74]. Considering that networked ambient environment was lacking of emotional engagement for people to interact with others over distances, they enhanced social interaction for people living in different locations through a networked environment by integrating ambient intelligent with emotional design and tangible interactions. They considered using this system to help patients in nursing homes or hospitals to engage in social interactions with their families or friends. This system also aimed to help autistic people and people who have language communication barriers to interpret emotional cues and to process communication.

In their study, they designed a system which delivers messages and emotions between two users in different locations. The perceived emotion is used as communication input from the sender's environment to that of his/her loved one by affecting the receiver's physical environment through change of lighting, colors, music and projected images. Changes to the receiving environment would be reflective of the mood and actions of the sender. An emotional and collaborative connection can be established when the receiver acts on the perceived emotions by conducting responding movement that in turns affects the sender's own environment.

This system introduced four components: universal gestures, non-verbal communication, natural user interface and emotional awareness. First, they identified emotion based on a set of universal body motions through experiments. Next, they applied this framework of emotion and movements to trigger changes in environment to deliver non-verbal communication. Then, they integrated technology into artifacts and environments, allowing users to inhabit and move naturally within the living space. Finally, they employed ambient intelligent[75] for the system, which responds accordingly to users' behaviors, learns individual's life style and changes in emotional expression in different situations, and adjusts its recognition and responses based on established patterns.

Li et al.[76] concluded in their study that emotional design and tangible interaction are the means to deepen the user experience, together with emotions triggered within an individual by physical body motions in space or the operation of objects. Based on these factors, they proposed a system of emotionally intelligent environments that combines the two areas of physical and affective computing and engages users' movements to collaboration over long distances. As the result, they proved that emotive, non-verbal modes of social collaboration can facilitate remote communication over networked intelligent environment.

Anastasiou et al.[77] from University of Bremen, Germany and Indiana University, conducted research on multimodal interaction[78] in an Ambient Assisted Living Lab[79]. The research aimed to help senior or disabled people to master their daily tasks through multimodal applications. Because the design of gesture-based user interfaces has shortfalls in recognizing which gestures are required for which activities, they conducted a user study in order to collect empirical speech and gesture data of natural dialogue in Human-Robot Interaction. The focus of the user study was to observe human users using an intelligent wheelchair to navigate in a smart home environment by means of speech and gesture under a real-life daily scenario. The user study was conducted in Bremen Ambient Assisted Living Lab with 20 German participants (age 25) in Germany, 2011.

In Bremen Ambient Assisted Living Lab, standard living areas were provided, including kitchen, bathroom, bedroom and living room, equipped with intelligent adaptable household appliances and smart furniture. The participants were asked to carry out daily activities through Intelligent Wheelchair. Through the user

study, they collected 317 spoken commands of empirical speech-gesture data and video recordings of the interaction between the participants and technical devices in a smart home. They discovered that participants, who employed in their utterances, did not use gestures. The participants gestured mostly when something happened out of order, for instance, wheelchair drove to a wrong place or stopped too far from the participants. In terms of future work, they planned to conduct two more studies to understand the relationship between gestures and speech. They would require users to perform more challenging daily tasks and to identify universal gestures and locale-dependent gestures.

2.4. *Shiki*, creating ambience that inspires emotional connection between inhabitants and old buildings

Inspired by theoretical research and previous work related to emotions and nature, interior design and interactive ambience design, this research presents three approaches to create emotional connection between inhabitants and old buildings. First, it elicits inhabitant's emotions by four seasons. Secondly, it generates sensations of four seasons through a multi-sensory based interior, incorporating images, sounds and scents. Third, it allows inhabitants to engage in the borrowed sceneries of four seasons through an interactive ambience. Although evidence for proving the effects of four seasons are not apparent, many studies have confirmed that human emotions and behaviors are influenced by natural elements. Similar to natural factors, elements of four seasons can be possibly employed to evoke inhabitant's emotional responses. Furthermore, combining the basic interior factors, such as furniture, lighting and colors, an interior design based on multi-sensory integration, such as interactive images, music and scents, could add on new experience and dimensions into space. Finally, considering the emerging field of interaction design, integration with interactive ambience and objects is feasible for a new life style. In sum, *Shiki* proposed a new way to stimulate inhabitant's emotional responses by creating an interior that generates four seasons through images, sounds and scents, and triggers interactions between ambience and inhab-

itants. By means of *Shiki*, it inspires inhabitants to be emotional connected to the old buildings.

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Chapter 3

Design

The design components of *Shiki* for creating ambience in an old building in Singapore include eliciting inhabitants' emotional feelings through four seasons, delivering sensations of four seasons through an interior incorporated with images, sounds and scents, and creating an interactive ambience that allows inhabitants to engage in the experience of four seasons through different body movements. These design components were derived from the design process, including ethnographic research based on the fieldwork in Singapore and Japan, ambience design based on the size of old buildings in Singapore, experiment of interaction design utilizing sensing devices, and application of the video prototyping method. Through these design components, this research utilizes *Shiki* to bring four seasons into the ambience of an old building in Singapore in order to inspire inhabitants' to be emotionally attached to the old building.

3.1. Design Process

Ethnographic research based on the fieldwork took place in Singapore and Japan for the objectives of understanding the relationship between ethnic diversity and old buildings in Singapore, understanding Singaporeans' lifestyle, and understanding the ambience of old houses in Kanazawa City, Japan. Correspondingly, the design of *Shiki* for creating ambience in an old building in Singapore takes into account the findings of the fieldwork: (1) old buildings in Singapore are built based on human scale sizes (2) old buildings possess unique phenomenon, given to the

architecture, the fragrances, the sound and scenery of regions. (3) Old buildings possess significant value for bonding communities of ethnic diversity living together. (4) Singaporeans have desire of experiencing different climates overseas. (5) Old houses in Kanazawa, constructed in human scale, possess unique interior and exterior ambience. (6) The components of old houses in Kanazawa city are associated with seasonal factors and natural sceneries. It enables inhabitants to experience four seasons from the displayed interior objects, as well as appreciate outdoor nature sceneries through layout of Japanese-style room. For this reason, the elements of Japanese-style room are incorporated into the interior design for *Shiki*. In terms of interactive ambience, an experiment was conducted utilizing sensing devices to identify different body movements. In order to deliver the concept of *Shiki* to the target users, a video prototyping method was applied, based on the scenario derived from the mental model of the target persona.

3.2. Understanding Relationship Between Ethnic Diversity and Old Buildings in Singapore

Singapore is home for a wide variety of ethnic groups with diverse backgrounds, predominately Chinese, Malays, and Indians; but also people from every other country in Asia, as well as Europe and the Americas. Walking in the street, you can hear the harmony of different languages as people communicate amongst themselves in English, Chinese, Malay, or Tamil. The majority of Singaporeans are trilingual, or bilingual at least, since it is the fundamental to their education that everyone has to learn the ethnic language of their ethnic origin in addition to the official language of English. The multicultural diversity reflects not only on the spoken languages but also can be seen in the physical appearance of the architecture. While Singapore is developing rapidly into one of the most modern cities in the world, historical areas are preserved among modern skyscrapers and business buildings. Locals are encouraged with government-offered subsidies to maintain their traditional lifestyles in the old buildings of these areas. The old buildings are the locations, where the mix of citizens with diverse ethnic backgrounds mingles. The embellishments and facades of old buildings represent the identities of ethnic culture. Allowing locals to continue carrying on daily or cul-

tural activities, serving religious beliefs or knowing where to find their ethnic origins in the communities within old buildings. Old buildings in Singapore house not only people but they provide them a sense of attachment to the homeland, Singapore. With the objective of understanding the relationship between ethnic diversity and old buildings in Singapore and capturing environmental image of different ethnic areas utilizing the mapping method proposed by Kevin Lynch[1], the research team conducted fieldwork in Singapore from August 5th to August 20th, 2013.

3.2.1 Chinatown

Figure 3.1: Chinatown

Stepping outside the subway station of Chinatown, the view of old narrow streets and alleys with three-story traditional shophouses alongside the avenues predominates the district (Figure 3.1). Hanging red lanterns and colorful banners overhead weave a glittering sheen over the walkways. Street vendors selling souvenirs, call out for tourists to slow down their steps. People's Park Complex rises above the shophouses. The three-story shophouses in Chinatown reveals the traditional lifestyle Chinese merchants had in the old days, making a living by opening shops on the first floor, while the second and third floors were used for storage and as living quarters for the shop owners and their families. In the present day, the shophouses are still occupied by Chinese medicine halls, traditional crafts stores, clothing shops, and shops selling Chinese herbs, Chinese food and traditional wedding items. The vibrant district of Chinatown retains historical and

cultural significance for Chinese Singaporeans.

Figure 3.2: Sri Mariamman Temple

While Chinatown features distinctive Chinese cultural elements, it is also considered as an enclave for other ethnic origins, such as Arabs and Indians. At the corners of the South Bridge Road, three different types of religious reverences stand out in its predominantly Chinese location; the Islamic Jamae Mosque, a Hindu temple called Sri Mariamman Temple (Figure 3.2), and a Chinese temple named Buddha Tooth Relic Temple. Followers of Islam come to Jamae Mosque to worship their god. Inside of Mosque, we see people walking in barefoot and enjoying meals using their hands. Some followers appear to be living in the back of Mosque, where residence buildings can be found on the site.

Figure 3.3: Boutique hotel and Ann Siang Hill

Just one street away from the center of Chinatown is Ann Siang Hill, a district whose stylish atmosphere distinguishes it from the rest of Chinatown (Figure 3.3). Street vendors can no longer be seen in this area, while shophouses are turned into fashionable cafes and classic restaurants, embellished with green plants and western style roof covers. Dining chairs and tables occupy the arcades and passageways, filled with expatriates enjoying leisurely conversation. The gleaming boutique hotels in restored old buildings stand confidently at the corners of Club Street and Ann Siang Hill (Figure 3.3).

3.2.2 Little India

Figure 3.4: Little India

Figure 3.5: Sri Veeramakaliamman Temple

Little India is the foremost Indian enclave in Singapore with clusters of gold

jewelry shops, silk sari shops, spice stores, art galleries and backpacker hostels. By the roadsides, there are flower vendors selling garlands and coconuts drink vendors calling out for the customers (Figure 3.4). The fragrances of spices and curry fill up the streets and the sound of car horns and indistinct chattering of the residents create the vibrant image of Little India. Sri Veeramakaliamman Temple, a Hindu temple embellished with colorful ornaments of deities on the roof is located in the heart of Little India. It is one of the oldest and the most important temples for the Indians in Singapore (Figure 3.5).

3.2.3 Katong

Figure 3.6: Peranakan terrace houses and Peranakan tiles

Figure 3.7: Chinese geomantic omens and Chinese temple

The unique architecture in Katong comprises a mixture of Chinese, Peranakan[2] and British colonial styles. Alongside the road is the two-story Peranakan terrace

houses, of which the external walls are embellished with colorful plasters and Peranakan tiles (Figure 3.6). The facades of the entrances show a traditional style of Chinese residences, decorated with Chinese wooden furniture, door and shoe closets, with a touch of Peranakan wall tiles and floor tiles (Figure 3.7). Chinese geomantic omens, associated with Feng Shui, also appear in every entrance of the terrace house as well as shophouses in this area(Figure 3.7). A Chinese temple stands in between the shophouses (Figure 3.7). Presently, Katong is a residential area, housing Chinese and Peranakan community.

3.2.4 Tiong Bahru

Figure 3.8: Tiong Bahru

Figure 3.9: A stylish bookstore and a boutique shop in Tiong Bahru

Tiong Bahru is one of the first public housing estates in Singapore, consisting of apartment blocks with three to five-story flats. In between the blocks is quiet and

public green space for the residents to spend their leisure time with their families and neighbors (Figure 3.8). The architecture features an art deco style, Streamline Moderne, which emphasizes curving forms of balconies, long horizontal windowing, flat rooftops and spiral staircases (Figure 3.8). Red Chinese couplets and lanterns are hung at the doorway, revealing Chinese traditional lifestyle. Presently, the landscape of Tiong Bahru has evolved from an old housing estate to a hippy hood, with new lifestyle shops moving in the community. A stylish bookstore is located on the first floor in an apartment block, while a boutique accessories shop opens right next to it (Figure 3.9).

3.2.5 Bugis

Figure 3.10: Overview of Bugis

Bugis is the most vibrant art and cultural district in Singapore. Art centers, art museums, galleries and boutique furniture shops can be found in the alleys or around the corner. The showroom of furniture company, Space, also takes place in the center of Bugis. Three main shopping malls, Bugis Junction, Bugis Village and Bugis+ (Figure 3.10), provide air-conditioned environments for young people to enjoy shopping the whole day or delicious cuisine at the food courts. On the other side of the shopping malls is Bugis Street, a night market consisted of small shops, selling all ranges of snacks, fruits or cheap goods, such as clothing, souvenirs, bags or electronics.

Figure 3.11: Arab Street

Across the modern area in Bugis is a completely different zone, Arab Street. A Magnificent mosque rises gloriously out of the middle of the street, with Arabian shophouses on both sides (Figure 3.11). Arab Street is famous for boasting a variety of Arab antique shops. The facade of the two-story shophouses is different in contrast to the shophouses decorated mainly in vivid red in Chinatown, for the exterior deco appears to be in solid colors. The rows of shops sell Arabian perfumes and oils, intricate accessories, and vintage goods made in colorful Arabian fabrics, including scarves, dresses, bags, and carpets.

Figure 3.12: Malabar Mosque and Alsagoff Arab School

Few blocks away from the center of Arab Street is the Malabar Mosque (Figure 3.12), in the back of which lays a Muslim Cemetery. Near the cemetery is the Alsagoff Arab School (Figure 3.12), an institution which emphasizes on promoting Islamic school community in Singapore. In addition to its strong Arab culture,

Figure 3.13: Malay Heritage Center

a Malay Heritage Center can also be found in Arab Street (Figure 3.13), which indicates the ethnic diversity in this region.

Haji Lane, located at the edge of Arab Street, boasts a variety of boutique shops. It is a cluster of designers, artists, and boutique lovers, who bring in the culture of changing trends and fashions. The straight and narrow Haji lane possesses a unique modern art atmosphere with splashes of colorful graffiti and neon banners and signs of stores (Figure 3.14). Compared to the shophouses in Chinatown, the ones in Haji Lane are not as spacious. For this reason, the shops in Haji Lane make the use of both the first and second floors, whereas in Chinatown, usage of first floor alone is most commonly found. The mornings in Haji Lane are quiet; however as the day turns into night, the peaceful modern street evolves into a shisha street, luring countless tourists and local teenagers to enjoy a lively Singaporean nightlife.

3.2.6 Findings of Old Buildings in Singapore

Through our extensive observations in Chinatown, Little India, Katong, Tiong Bahru, and Bugis, we were able to discover the diverse ethnic lifestyles fostered in the individual areas and gain insight into the importance of old buildings in promoting the mingling of people and cultures within the same locality. Some neighborhoods, such as Boat Quay and Clarke Quay, displayed a sort of nondescript internationalism with buildings that could be from anywhere and nowhere.

Figure 3.14: Colorful Haji Lane and boutique shops

This shapeless transformation results in a loss of Singapores identity – which is based off an intermixture of different communities who retain their distinct forms rather than a single homologous conglomeration. The unique character of Singapore as a city is defined through the unique character of its diverse communities who are in turn supported through the old buildings. At the same time, these old buildings provide the space of human scale size which is the optimal setting for implementation of ambience.

3.3. Observing Singaporeans' Lifestyle

On October 30th, 2013, the research team went on fieldwork for five days with an objective of observing Singaporeans' lifestyle. Taking into account that the majority of Singaporeans are living in the residential housing developments that are managed by Housing and Development Board (HDB), fieldwork took places in an old housing estate called Pasir Ris, which is publicly governed. Furthermore, in order to understand the mental model of wealthy Singaporeans, fieldwork locations were chosen to take place in the shopping malls in Orchard Road, an enclave for luxury brands, dining and entertainment.

3.3.1 Public Housing Estate

Pasir Ris, lying in the Eastern coast, is one of the old public housing estates in Singapore. Each housing block is considered as a community with common

Figure 3.15: Pasir Ris, public housing

Figure 3.16: Pasir Ris, public housing

area built into the design to increase interactions amongst residents. The housing block consists of 30 to 50-floor apartments, including parking lots, sports and recreational facilities, supermarkets and schools in the neighborhood. A shared common corridor also allows the residents to interact more as they run into each other on their way out for work as well as on their way home (Figure 3.15). The apartment unit comprises two bedrooms, one study room and separated dining and living rooms. Conjoined with the kitchen are a bathroom and a bomb shelter, which is now used as storage. Since there is no balcony, laundry clothes clipped on the bamboo stick hanging out from the kitchen window can be seen commonly in public housing estates (Figure 3.16). As a safety protection from falling or security from robbery, outside the windows of public housing are installed with bars. In general, the residents keep the windows wide-open for improving ventilation because not all the rooms are air-conditioned (Figure 3.16). After having a meal in the dining room, they move to the living room and enjoy making a cup of Chinese tea while feeling the breeze blowing through the windows.

3.3.2 Shopping Malls

Figure 3.17: Orchard Road

Shopping malls and department stores are located in every major subway station in Singapore, indicating that Singaporeans prefer staying indoors for their

leisure time, retreating from the scorching and muggy weather. Orchard Road, the most high-end shopping district, clusters global fashion, fine-dining restaurants, luxury brands, spas, and art galleries (Figure 3.17). In one of the luxurious shopping malls, Suntec City, winter clothing shops appear regardless of the extreme hot temperature outside. Families browse around the shops excitedly, going through stacks of heavy winter jackets while discussing about trips to New Zealand, Australia and Japan. In order to guide their customers to choose the proper materials for the weather, samples of winter jackets are hung above on the walls along with the signs of recommended temperatures for wearing the outfits: below 10 to 30 degrees (Figure 3.18). In other clothing shops, such as Ralph Lauren, Muji and Uniqlo, customers lingering in front of heat-techs, sweaters and winter coats could be seen (Figure 3.18).

Figure 3.18: Winter clothes found in luxurious shopping mall

3.3.3 Findings of Singaporeans' Lifestyle

From the fieldwork, we realized that Singaporeans' lifestyle are influenced tremendously by the tropical rainforest climate. In public housing estates, the majority of the residents tend to keep the windows open for better ventilation since air-conditioning is not installed in every room. The scorching and muggy weather also drive Singaporean to spend most of their leisure time in air-conditioned shopping malls. Winter clothing shops appearing in high-end shopping district further indicates the tendency of Singaporeans travelling abroad to experience different climates.

In old public housing, communities with ethnic diversity could also be seen. It is by regulation of Singapore government that each floor in public housing must consist of families with different ethnic backgrounds. Public recreational facilities are built into design, and with schools, food centers, clinics or super markets located in the neighborhood. Inhabitants are encouraged to share their cultural activities or holidays celebrations with their neighbors. Public housing serves a vital purpose of binding people to live together as communities. And it is the old public housings that keep rich old communities.

3.4. Understanding Old Houses in Kanazawa City

Aiming to design an ambience for the old buildings in Singapore, the objective for the fieldwork in Kanazawa City was to experience and capture the ambience of Japanese old houses. The research team went on a fieldwork trip to Kanazawa City in November 24th, 2013. Kanazawa City is one of the predominant old cities in Japan, preserving traditional Japanese architecture and cultural activities. During this fieldwork, we had a chance to take an in-depth exploration in traditional old teahouses as well as modernized Japanese-style rooms.

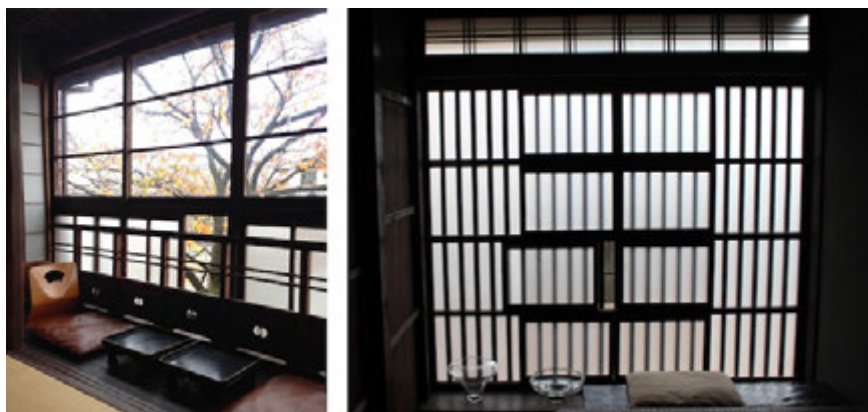### 3.4.1 Kazue Town

Figure 3.19: Kazue Town

Figure 3.20: Kazue Town

The scenery of Kazue town, a preservation belt for Japanese teahouse, consists of long and thin two-story houses on one side, and a running river with autumn trees on the other (Figure 3.19). In the past, traditional teahouses were referred as geisha[3] houses, which provided services of entertainment, fine dining and prostitution. Presently, with the ban of prostitution, teahouses are referred as a meeting point for dining and talking, or sometimes having dinner parties accompanied by geisha's performance, such as shamisen[4], taiko[5] and traditional dance. The upper floors of the teahouses are faced with sliding wooden shutters, which allows people to enjoy the seasonal sceneries (Figure 3.20). The decor of the windows is embellished with latticework, of which the light glimmers through, creating a mysterious interior atmosphere (Figure 3.20).

3.4.2 Higashiyama

Another preservation belt of Japanese teahouses is located in Higashiyama, where the teahouses stand in a row along the street (Figure 3.21). The Japanese teahouses comprise spacious Japanese-style rooms with tatami matting and wooden ceilings (Figure 3.22). Legless chairs or cushions allow people to sit directly on the tatami flooring, which is made of rice straws. A hanging scroll on the wall displays a work of calligraphy, while the golden folding screen stand by the side, bringing in the elements of four seasons through paintings of seasonal events or sceneries. A narrow wooden passageway is also incorporated into the teahouse, forming a terrace area and creating a connection between the inner space and external. Sliding

Figure 3.21: Higashiyama, a preservation belt of Japanese teahouses

Figure 3.22: Japanese-style rooms

paper doors creates an indefinite division between outside and inside as the light from outside seeps in through the paper into the room. Japanese windows, called Shakkei, referring to "borrowed scenery" in Japanese, create dynamic scenery by incorporating background landscapes, for instance, forests, mountains or cascades into the composition of Japanese garden. The cropping of the landscape created by Japanese window allows the inhabitants to enjoy the natural scenery from the inside (Figure 3.23). Colors further enhance the sensation of ambience to the room; vividly colored walls in each room, including red, green and blue, coordinate with the interior objects, creating a calming and solid atmosphere (Figure 3.24).

Figure 3.23: Japanese borrowed scenery

3.4.3 Modernized Japanese-style Room

The highlight of this fieldwork was the visit in the atelier owned by famous Japanese ceramist, Mr. Takuo Nakamura, where we had a chance to experience the space he created using objects incorporated with Rimpa[6] elements (Figure 3.25). Mr. Nakamura is famous for his application of the Rimpa style in pottery works. He believes that Rimpa is a technique to express a relationship with space (Figure 3.25). In his private residence, he built a modernized Japanese-style room (Figure 3.26), in which the tatami flooring is replaced by wooden flooring, the

Figure 3.24: Colors elements in Japanese-style rooms

Figure 3.25: Rimpa elements in pottery works

walls are painted in dark grey, and the Japanese sliding paper doors are made in an unconventional way; the paper covers the entire latticework instead of traditional way where paper is pasted underneath. These sliding paper doors allow sunlight to glimmer through the paper, turning the form of latticework into blurry shadow. The room is decorated with his pottery works, which are integrated as a part of the space. A Japanese window is placed underneath the wall that allows faint light seep into the room. This modernized Japanese-style room is different from the traditional ones; it creates a novel ambience by integrating each object, sliding paper door and window in the room as a whole.

Figure 3.26: Modernized Japanese-style room

3.4.4 Findings of Old Houses in Kanazawa City

Being inspired by the ambience in traditional Japanese old houses, we gained a better understanding towards the approaches for creating ambience in old buildings in Singapore. During fieldwork in Kanazawa City, we noticed that old houses in Kanazawa City with similar human scale size of interior possess inimitable and comforting ambience that inspires people's emotions. In particular the structure of Japanese houses, which integrate the veranda and large open windows, breaks

the distinction of interior and exterior of the house. This allows nature to become a part of the room, and allows the people in the room to feel they are not separated from the outside. Rather, they are in a special space within the nature. The essential objects of Japanese-style room include tatami flooring, sliding paper doors (Shoji), a narrow wooden passageway (Engawa), a Japanese window (Shakkei) and a Japanese garden. For this reason, *Shiki* incorporates these components into the ambience design in order to enhance inhabitants' experience of Japanese four seasons.

3.5. Ambience Design
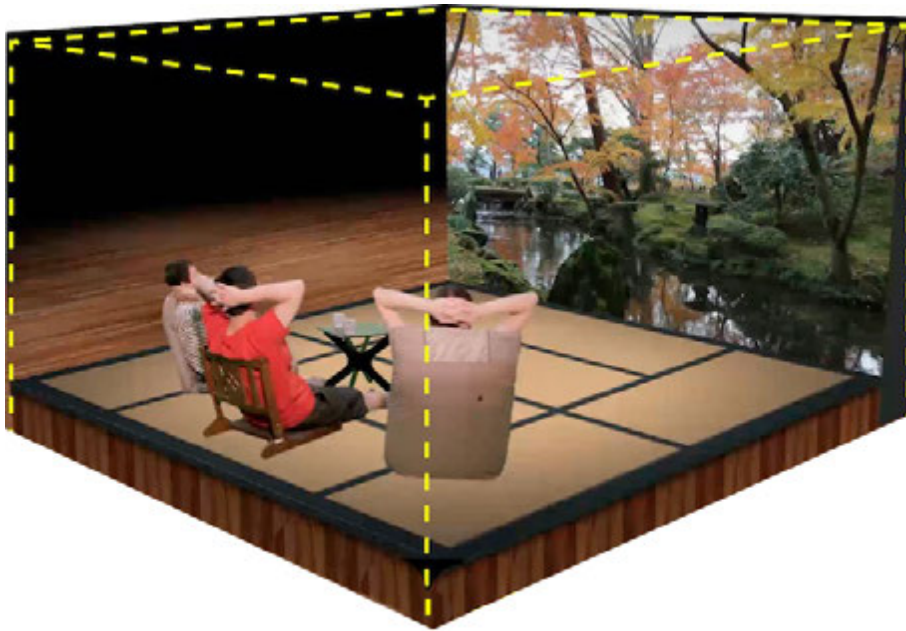
Figure 3.27: Creating ambience in an old building

Derived from the findings of ethnographic research based on the fieldwork, the objective of *Shiki* is to bring ambience we experienced in old houses in Kanazawa city into an old building in Singapore (Figure 3.27). The initial plan for demonstrating the concept of *Shiki* was through an experiential exhibition in an actual old building in Singapore. Within the old building, we designed a private space,

a Japanese-style living room, to allow people to experience the ambience of four seasons. However, due to change of the exhibition date, the concept of *Shiki* was delivered through video prototype as an alternative. *Shiki* is also designed to be installed in old public housings in Singapore, considering it imbues the value of old public housings through maintaining the communities of rich ethnic diversity.

The old building in which we planned to implement *Shiki* is located on the crossroad of Waterloo Street and Middle Road in the Bugis area of Singapore. The old building caught our attention because it was the one of a few old buildings that remained in the new developing district. Originally built in 1870, this old building had suffered through the Second World War and is comprised of various cultural backgrounds. It was once a Christian institute, the housing of Methodist Girls School, a Malay Church, a Chinese restaurant, and a motorcycle workshop including a parking lot. Despite its unique appearance and rich ethnic history, the interior of the building remains vacant and plain for gallery use.

Figure 3.28: Gothic Revival style building

Presently, the condition of the old building has been well maintained both exteriorly and interiorly. The Gothic Revival style building, consisting of circular vents and arc windows, is colored by yellow pastel with an iron sheet rooftop (Figure 3.28). Entering the building, there is no view to the outside, for the windows are sealed completely from the inside (Figure 3.29). The inner space is 2,099 square feet with a 9m high pillar-free ceiling. The surrounding walls are painted in white. While the ground is constructed by light grey concretes, the interior roof is composed of black wooden beams (Figure 3.29).

Figure 3.29: Interior of the old building

3.5.1 Design of The Interior Layout

In terms of the interior layout, the stage, a Japanese-style living room, for people to experience four seasons was designed to be located in the center of the building (Figure 3.30). Entering from entrance of the old building, inhabitants will walk through an aisle, which leads them to the stage. Next, they will see an elevated Japanese-style room on their right hand side. Before stepping on to Japanese room, they will remove their shoes, and then enter the tatami flooring. In front of them are three sets of legless chairs and a table, facing towards a screen, on which projected Japanese paper sliding doors. As they sit down on the legless chairs, the paper sliding doors open, revealing a Japanese window that displays Japanese scenery. As the inhabitants stretch out their arms, the sceneries change with corresponding sounds and scents. They can explore different sceneries, background sounds and scents through five different body movements: sitting down, crossing legs, putting hands behind the heads, stretching arms and reaching out for the tea on the table.

The Japanese-style room was designed to be incorporated with operation system and technical devices to create experience as well as trigger interactions (Figure 3.31). A giant dark-grey screen replaces the wall in the front of Japanese-style room, integrated as a part of interior. The technique of generating four seasons is through aroma generators and speakers that are woven into the legless chairs. A high-resolution projector is embedded behind the screen, projecting high quality videos of sceneries from the back. Two speakers are installed invisibly on two sides of the screen. Three sets of sensing devices are fabricated into the wall for
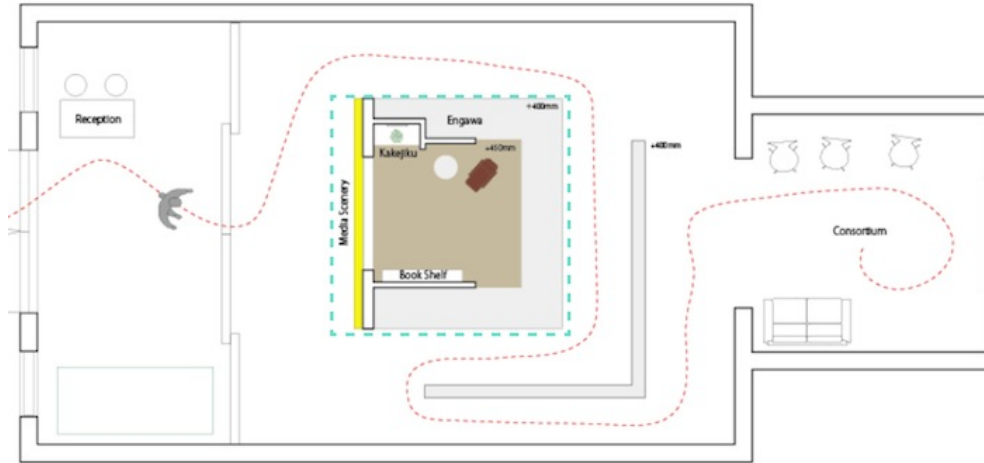
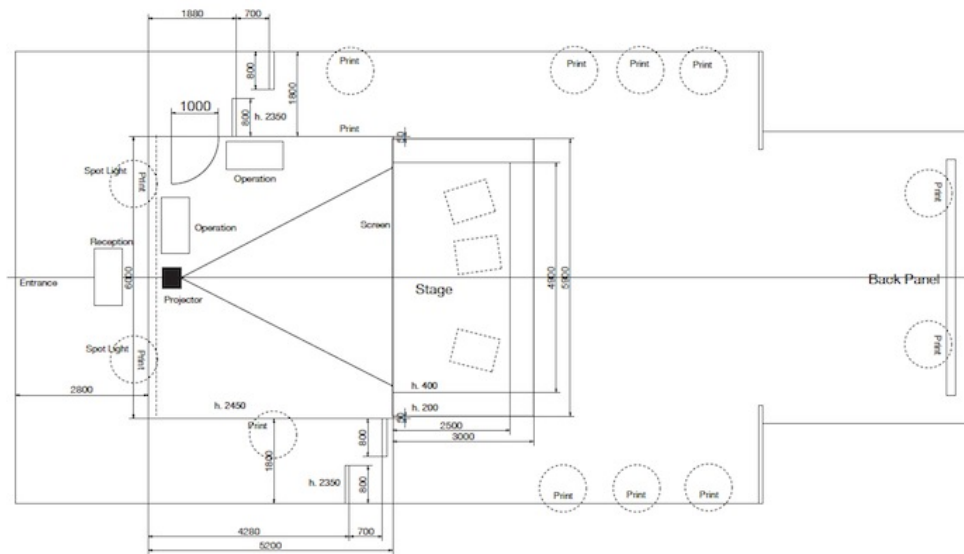Figure 3.30: Creating ambience in a Japanese-style living room (outlined in green)

Figure 3.31: Implementing operation system and technical devices into interior

sensing an inhabitant's body movements, which then triggers interactions between inhabitants and the seasonal sceneries.

3.5.2 Experiment of Interaction System

Derived from theoretic research and previous study, an interactive ambience allows people to engage deeply into surroundings. This research proposed to include interaction design in *Shiki*, allowing inhabitants sitting on the chair to unconsciously trigger changes of seasonal sceneries and further engage in the experience.

With the objective of observing common body movements as someone sitting on a legless chair, a fieldwork was conducted on December 12th, 2013. We spent two hours observing our fieldwork master, sitting on a legless chair while working on her assignment in the room. Due to the height of the chair, our master kept her legs in the same position of crossing her legs most of the time. Occasionally, she stretched her arms above her head to relax her shoulder and neck from using the computer. When she listened to the music, she put her hands behind her head and leant back to the chair. When she intended to grab a book from the shelf or her CDs from the bed next to the table, she could reach out for the items without standing up. Sometimes, she laid down on the floor to read books or use her cell-phone. From this fieldwork, we determined the key five body movements that trigger interaction, which includes sitting down, crossing legs, putting hands behind the head, stretching of the arms, and reaching out for the tea on the table.

Figure 3.32: Experiment of interaction utilizing sensing devices

On February 12th, 2014, the research team conducted sensing device experiment, based on these five body movements. The experiment took place in Toyo

University in Saitama prefecture, Japan. We utilized two sets of Microsoft Kinect as prototype sensing devices, which recognized body motions and gestures through calculating the positions of elbow joints and knee joints (Figure 3.32). One of the difficulties we found was that as the people are sitting down on the chairs, it was difficult to detect the positions of knee joints. Therefore, the sensing devices were placed 1.5 meters high above the chairs and 1 meter in front of the chair (Figure 3.32).

3.6. Applying Video Prototyping Method

This research employed video prototyping method based on the theory of ethnographic video. According to *Doing Visual Ethnography*[7], the author defined ethnography as a methodology; a process of creating and representing knowledge (about society, culture and individuals) that is based on ethnographers' own experience. It does not claim to produce an objective or truthful account of reality, but should aim to offer versions of ethnographers' experience of reality that are as loyal as possible to the context, negotiations and inter-subjectivities through which the knowledge was produced. The ethnographicness of any image or representation is contingent on how it is situated, interpreted and used to invoke meanings and knowledge that are of ethnographic interest. Ethnographic video refers to any video footage that is of ethnographic interest or is used to represent ethnographic knowledge regardless film styles or conventions.

Three components were set for the making of prototype video, including (1) allowing users to understand the experience of four seasons, including visualizing the effects of sounds and scents, (2) allowing users to experience the scenery changes authentically, and (3) allowing users to explore the interactions utilizing five body movements. In order to achieve these components, the prototype video was designed through (1) 3D modeling of the ambience in a Japanese-style room; (2) visual effects of sounds and scents demonstrate where the sounds and scents are coming from; (3) designing a scenario that describes different body movements to trigger changes of sceneries and each user determines different changes in factors: first user determines changes in visual contents, second user determines changes in sounds and scents, and third user determines changes in the size of window.

3.6.1 Target Persona

Figure 3.33: Target persona

Derived from the findings of fieldwork in Singapore, we gained an understanding towards the mental model of Singaporeans. Singaporeans living in old buildings or old public housings are closely connected to the communities. Inhabitants in old buildings are allowed to carry on their traditional daily activities in certain areas. People go to those certain areas to find their cultural and ethnic origins. Inhabitants in old public housings share cultural activities or holidays celebrations with their neighbors. In the meanwhile, Singaporeans spend the majority of their leisure time indoors, retreating from the scorching weather. Due to the limited land size and unchanged climate, entertainment plays an important part in their life; this can be seen from numerous shopping malls, museums, amusement parks, zoos, clubs and casinos. As the country became more affluent, Singaporeans acquired the tendency of enjoying a higher standard living and were able to afford more recreation outside the country. The appearance of winter clothing shops in the high-end shopping district, Orchard Road, indicates that Singaporeans have the desire to experience different climates. In the past decade, there has been an increasing proportion of Singaporeans who travel to distant destinations. Those who travel to Japan showed interest in experiencing natural sceneries they do not have in Singapore, such as distinct four seasons.

A target persona was created based on the mental model of Singaporeans. The target persona is Mr. Lin, a 33 year-old local Singaporean (Figure 3.33), who is currently a chief of Design R & D in Singapore. He graduated from National

University of Singapore and attained his master's degree in Japan. During his two-year stay in Tokyo, he was able to experience a distinctive change in seasons. After attaining the master's degree, Mr. Lin moved back to Singapore with his girlfriend whom he met in graduate school. He and his girlfriend like to travel around within Singapore or to nearby countries. Due to his heavy load of work, Mr. Lin is always seeking for places to relax during the weekend and enjoy some quality time with his girlfriend. They like to browse around the restaurants or cafes in the historical areas. One of their favorite spots is the cafe located in restored old buildings in Tiong Bahru. The cozy environment and quiet atmosphere allow them to refresh their mood from work and to enjoy a nice afternoon, doing the tasks they bring from work while chatting casually and being served with their favorite drinks and desserts. As a co-founder of creative start-up company, Mr. Lin is interested in discovering innovative designs in daily life. He also enjoys planting tomatoes in the corridor outside his apartment. Mr. Lin is currently living in an old public housing with his girlfriend and his parents. He is considering renovating the house once he marries his girlfriend. A comforting and refreshing environment is indeed important for him and his family to alleviate the current living environment.

3.6.2 Concept Design

The concept of *Shiki* was derived from the findings of ethnographic research in Singapore and Kanazawa City, ideation of interior layout based on the size of old building in Singapore, experiment of interaction system utilizing sensing device, and target persona based on the mental model of Singaporeans. The concept of *Shiki* is to create an ambience that inspires inhabitants to be emotionally connected to an old building. Three components were set up for realizing the concept: (1) delivering sensations of four seasons through an interior incorporated with images, sounds and scents, (2) eliciting inhabitants' emotions through four seasons, and (3) engaging the inhabitants in the ambience through interactive interior. Five methods are proposed for realizing these components; (1) utilizing the idea of "borrowed scenery" to borrow four seasons from Japan to Singapore, (2) fabricating projector, screen, speakers and sensing devices into the interior, (3) embedding speakers and aroma generators into the furniture, (4) creating seasonal sceneries through videos, audios and scents, and (5) triggering interactions

between inhabitants and ambience through sensing devices.

Shiki delivers the experience of seasons through the idea of borrowed scenery in a Japanese-style room. Based on the ethnographic research, old houses in Kanazawa City with similar human scale size of interior possess inimitable and comforting ambience that inspires people's emotions. Deriving from this research finding, *Shiki* employs the interior elements of old houses in Kanazawa City to create an ambience inside an old building in Singapore. The interior layout was based on the old building that was initially planned to be the exhibition venue of *Shiki*.
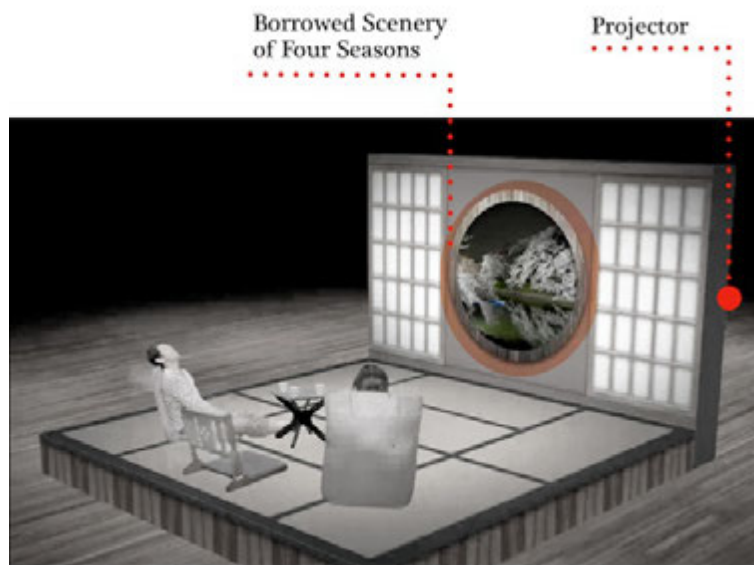
Figure 3.34: A projector fabricated behind the screen, projecting the visual contents of four seasons

Walking into the old building, inhabitants will see an elevated Japanese-style living room located in the center. It is comprised of a narrow wooden passageway and tatami flooring. A giant dark-grey screen replaces the wall in the front of Japanese-style room, integrating into the interior. A high-resolution projector is embedded behind the screen, projecting videos of sceneries from the back. The aroma generators and speakers are embedded in the furniture (Figure 3.34). Furthermore, three sets of sensing devices are installed invisibly on top of the screen in front of the furniture in order to sense body movements of inhabitants (Figure

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Figure 3.35: Sensing devices installed invisibly on top of the screen while aroma generators and speakers are embedded in the furniture

3.35).

Through videos, audios and scents, inhabitants will enjoy four seasons of Japan, including the spring cherry blossoms of Tokyo, the summer beaches of Izu, the autumn leaves of Kanazawa and the winter snows of Hokkaido (Figure 3.36). The contents were collected in Tokyo, Izu, Kanazawa and Hokkaido in 2013 and 2014. They were selected for being some of the most iconic seasonal sceneries in Japan. The visual contents of the cherry blossoms in daylight were taken at the Nakameguro river in Tokyo, whereas the cherry blossoms at night were taken in Chidorigafuchi park (Figure 3.37). The visual contents of summer beaches were collected in Izu, located south of Tokyo (Figure 3.37). The visual contents of autumn leaves were taken in Kenrokuen, one of the three great gardens of Japan (Figure 3.37). The visual contents of winter snow were recorded in Hokkaido, the most northern point of Japan, famous for its snow sceneries and activities (Figure 3.37). Corresponding to the visual contents, the fragrance of cherry blossoms is generated in spring, the fragrance of sea (salt) is generated in summer, the fragrance of fragrant olive is generated in autumn, and the fragrance of green tea is generated in winter.
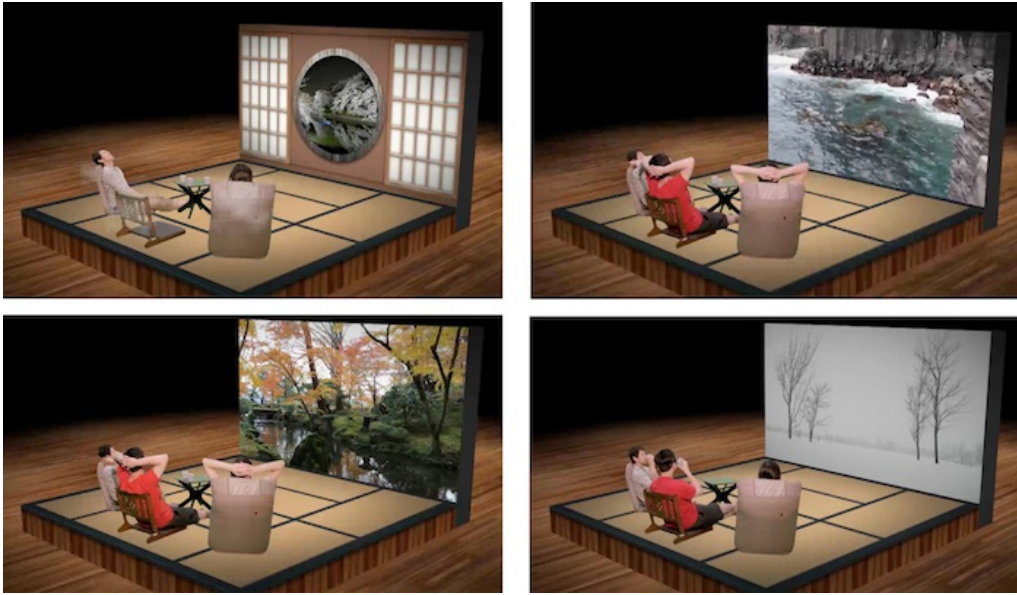
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Figure 3.36: From left to right, top to down is the order of four seasons, including the cherry blossoms of Tokyo, the summer beaches of Izu, the autumn leaves of Kanazawa and the winter snows of Hokkaido

Interactive ambience further engages inhabitants in the experience of changing seasons, eliciting inhabitants' emotions as they explore various seasonal sceneries with different body movements. Responding to the body movements of inhabitants sitting on the sofa, *Shiki* changes the sensations of four seasons, comprised of changes in visual contents, scents, sounds, sizes and shapes of the Japanese window. The design of the interaction system is set for 1 to 3 users. The changing of four seasons is automatic based on time. Within the designated time for each season, user interaction triggers changes in (1) visual contents of seasonal sceneries (2) sounds and scents, (3) sizes and shapes of the Japanese window (Figure 3.38). Five motions and gestures determine the above changes:

A. Sitting down: seasonal scenery 1, window changes from round to square, seasonal scent generated.

B. Crossing legs: seasonal scenery 2, window extends to normal size, sound of leaves triggered.

C. Putting hands behind the head: seasonal scenery 3, latticework appears on the window, sound of wind triggered.
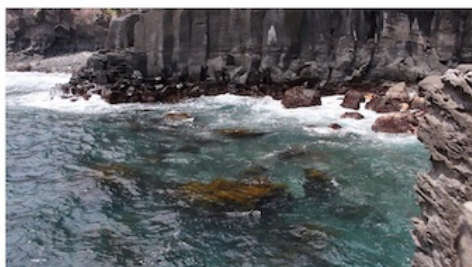
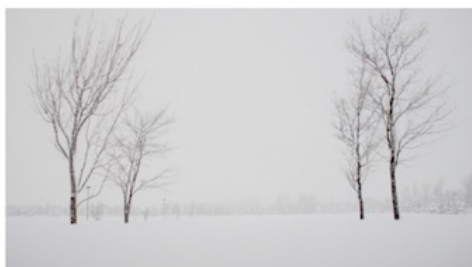Spring

Spring

Summer

Summer

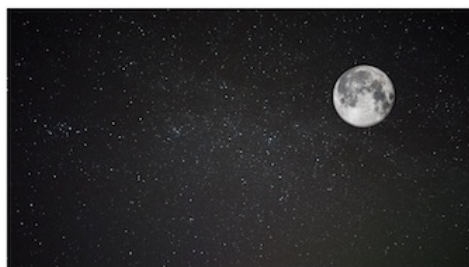Autumn

Autumn

Winter

Winter
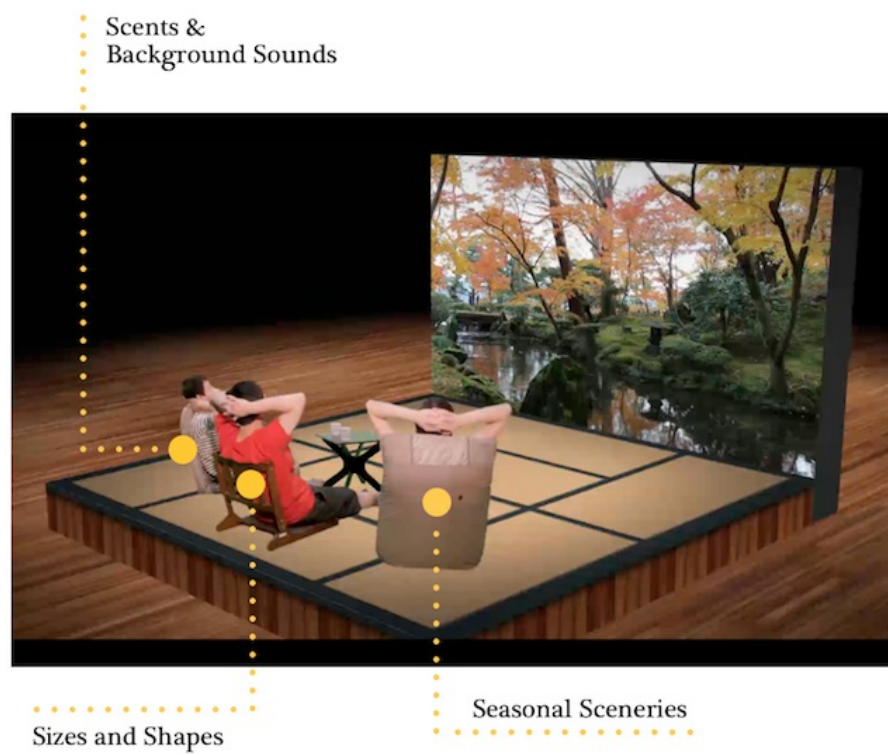
Figure 3.37: Contents of four seasons

Figure 3.38: Body movements of inhabitants trigger changes in visual contents, scents, sounds, sizes and shapes of the Japanese window

D. Stretching: seasonal scenery 4, window extends larger, sound of bird triggered.

E. Reaching out for the tea on the table: seasonal scenery 5, window shrinks smaller, seasonal scent generated.

The gestures and motions of the first user determine the change of seasonal sceneries while the second user determines the change of sounds and scents, and the third user determines the change of Japanese window. In the case that two or three of users synchronize to perform the same gesture or motion, the season will change regardless of the time interval. The full experience can be completed with the total of three users in order to encourage interaction between multiple users.

Figure 3.39: Installing *Shiki* into the space of an old building

The three components to realize *Shiki*: (1) eliciting inhabitants' emotions through four seasons, (2) delivering authentic four seasons through an interior incorporated with images, sounds and scents, and (3) engaging the inhabitants with the ambience through interactive interior. These are the key principles to create an ambience in an old building. An interactive interior enables them to be engaged deeper in the surrounding environment and objects. An interior fabricated with images, sounds and scents delivers authentic sensations of four seasons in the ambience. And through the experience of four seasons, positive emotions of inhabitants are elicited. *Shiki* creates an ambience that inspires inhabitants to

be emotionally connected to an ambience of the old building (Figure 3.39).

3.6.3 Scenario

Figure 3.40: Scenario

This scenario arises in an old building in Bugis, Singapore. Miss Lee, Mr. Lin's girlfriend, is enjoying her afternoon in a Japanese style room. Later on, Mr. Lin, getting off from work, returns home with a friend, Mr. Kim, to enjoy a cup of tea.

(See Figure 3.40) Walking into the building, Miss Li sees an aisle leading her further inside to the center of the room. Gradually, she starts to see yellow light glowing at the end of aisle, and smell of tatami mat floats in the air. Appearing in front of her is an elevated Japanese-style room, embellished by a narrow wooden passageway, beige colored tatami flooring, three legless chairs and a black wooden table. Miss Li nears the room, taking off her shoes. Then she sets her foot on the tatami flooring, entering into the Japanese-style room. Underneath her feet, the feeling of tatami mat texture is rough, hard and cold. She moves towards the legless chair, in front of which is Japanese sliding doors made of paper and wooden frames.
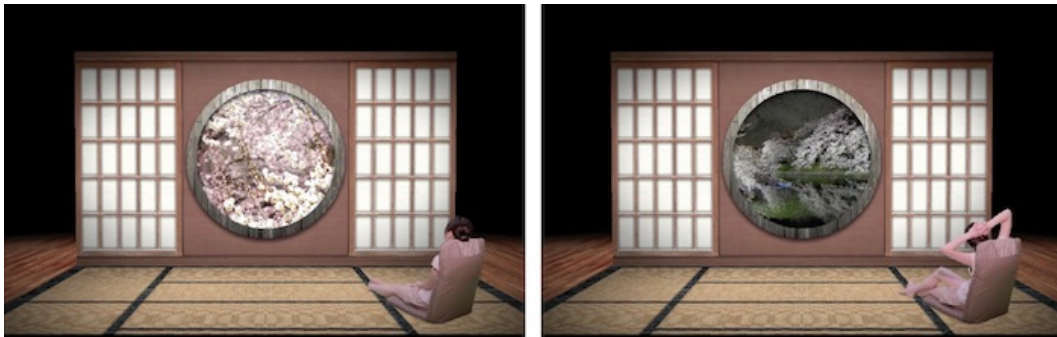

Figure 3.41: Responding the body movement of first user, the scenery changes from cherry blossoms in daylight to cherry blossoms at night

(See Figure 3.41) As she sits down on the chair on the right, the doors slide open simultaneously. A round window is revealed from behind the doors, displaying vivid scenery of Japanese Sakura trees blossoming, integrating with the sound of wind blowing on the Sakura flowers. As Miss Li crosses her legs, a river appears with Sakura trees blossoming on the riverbanks.

(See Figure 3.42) Mr. Lin, coming back from work, steps on the Japanese-style room, and joins his girlfriend's interaction with the sceneries. As he sits down, they both are surprised by the scent of Sakura filling up the room, generated from the back of chairs. It reminds them of the memories and wonderful time they had in Japan. The first time they met was underneath Sakura trees as they were having gathering to admire the cherry blossoms in Yoyogi Park. Feeling relaxed by the scent and beautiful scenery of Sakura, he stretched his arms above his head. Then, the sound of bird singing from the ceiling surrounds the room.
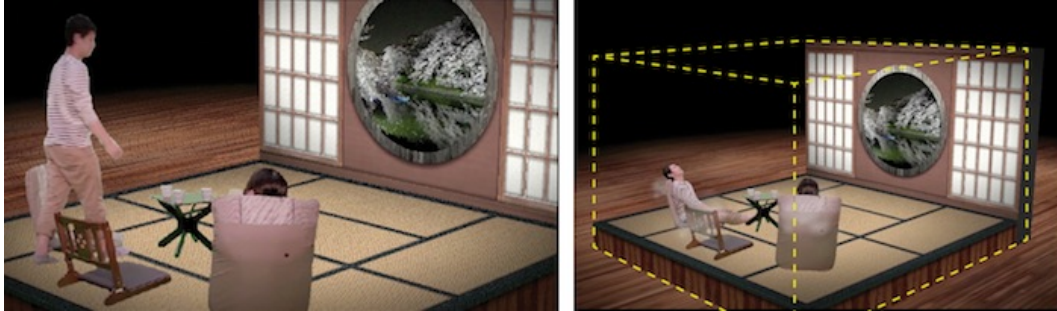
66

Figure 3.42: As the second user comes in, the fragrances are generated from aroma generators embedded in sofas
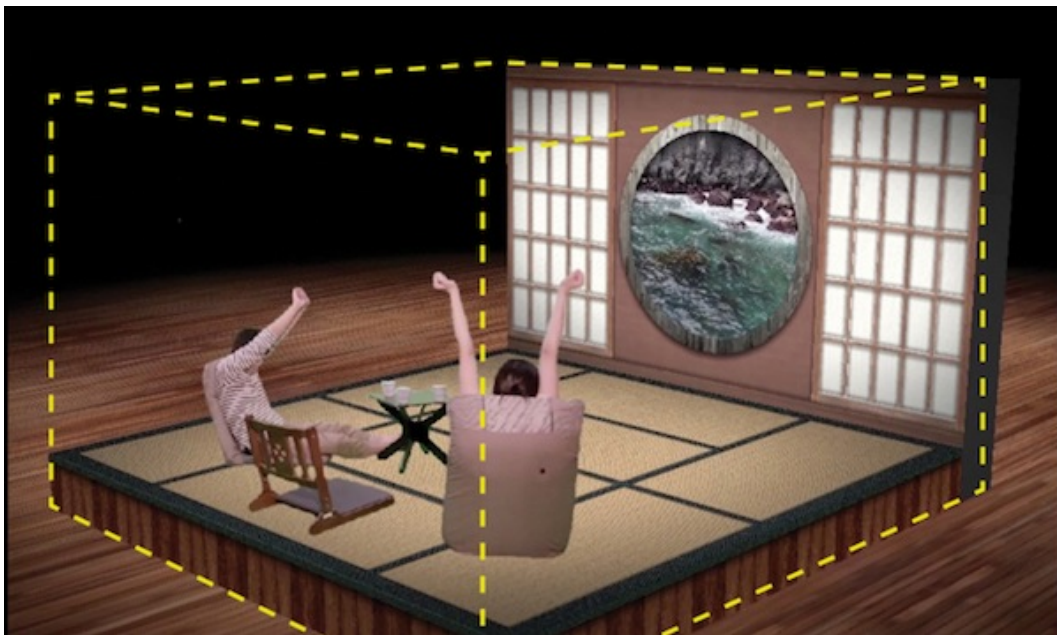

Figure 3.43: Synchronized body movements change the season from spring to summer

(See Figure 3.43) As Miss Li stretches her arms together with him, the seasons change from spring to summer. Now, appearing in front of them is the summer ocean of Izu, where they went on a date for the first time. The color of the ocean is different from the beach in Singapore; it is transparent, mixed with blue and green. The sound of wave washing upon the shores adds another layer to the sensory experience.
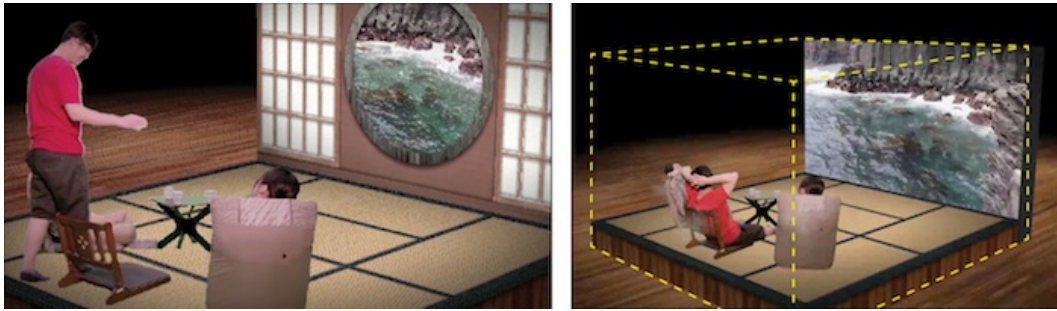

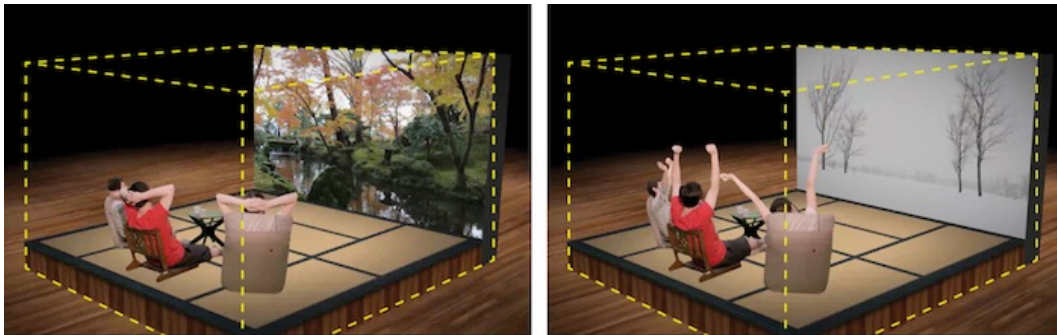Figure 3.44: As the third user comes in, the size of window extends

Figure 3.45: With the synchronized body movements, the seasons change from summer to autumn, from autumn to winter

(See Figure 3.44) Then, Mr. Kim walks into the Japanese-style room. As he sits down on the chair, the window extends to the same size as the wall. The seasons change from summer to autumn as three of them put their hands behind the heads together. A Japanese traditional pond appears in front of them, surrounded by red autumn trees (See Figure 3.45). It is the moment that they realize that only when they do identical body movements will the seasons change. Eager to explore the next seasonal scenery, they stretch their arms together and trigger the

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season changes from autumn to winter. It is winter scenery of Hokkaido, an island located in the northern part of Japan. Snow falling heavily in the scenery, making the sight of trees less distinct. Feeling the chill of snow, three of them reach out to the hot tea sitting on the table. They hold up the teacups and greet each other, "cheers!" It is when they drink up the teas, the snow scenery in front of them turns into a glowing ball. Following the glowing ball floating to the ceiling, three of them look up and find above their heads is a starry night and a shining moon (See Figure 3.46).
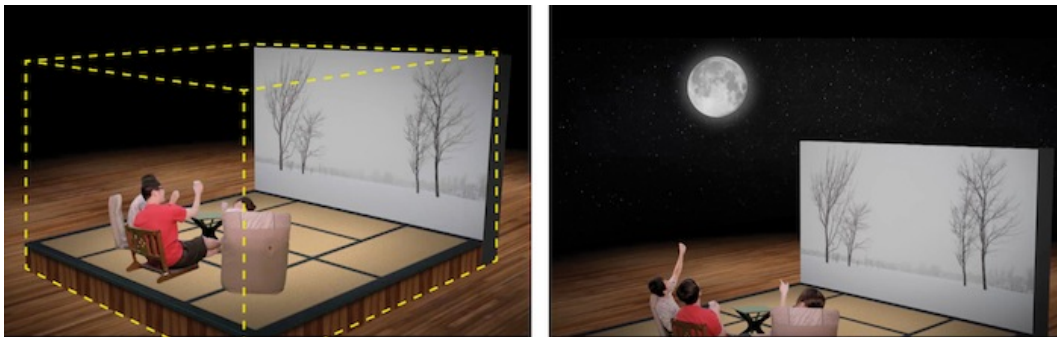

Figure 3.46: As they reach out the tea cups and cheer, the winter sky of Hokkaido appear above their heads

Notes

1   Lynch 1960 *The image of the city.* Vol. 11. MIT press, 1960.

2   A term used for the Chinese descendants of the 15th through 17th-century Chinese immigrants to the Indonesian archipelago and British Malaya.

3   A Japanese hostess trained to entertain men with conversation, dance, and song.

4   A Japanese musical instrument with three strings.

5   A Japanese drum.

6   One of the major historical schools of Japanese painting.

7   Pink 2013 *Doing visual ethnography.* Sage, 2013, pp. 17-19

Chapter 4

Evaluation

In June of 2014, two user studies were conducted for evaluating the ambience *Shiki* creates based on qualitative research method. In the public housing state, Pasir Ris and Clementiwoods Condo, the living rooms were set up for creating ambience through images, sounds and scents. The prototype video was projected on the wall, with speakers and incenses placed on two sides of the sofa, where participants would be sitting.

This research proposed *Shiki* as an approach for creating an ambience in an old building and inspiring inhabitants to be emotionally connected to the old building through generating four seasons. *Shiki* utilizes three components for building up an ambience: (1) eliciting inhabitants' emotions through four seasons, (2) delivering sensations of four seasons through an interior incorporated with images, sounds and scents, and (3) engaging the inhabitants in the ambience through interactive interior. The idea of triggering positive emotions through four seasons derived from previous research regarding the effects of natural factors and sceneries on human emotions and behaviors. Previous studies on interior design indicated that lighting, colors and furniture forms are important factors for creating an ambience. Taking into consideration of those factors, this research also incorporates images, sounds and scents into the interior design. Related work of interactive ambience has proved that inhabitants are engaged deeply in the surroundings and objects within an interactive environment.

To realize these three components into building the ambience in an old building, five methods are proposed: (1) utilizing the idea of "borrowed scenery" to

borrow four seasons from Japan to Singapore, (2) fabricating projector, screen, speakers and sensing devices into the interior, (3) embedding speakers and aroma generators into the furniture, (4) creating seasonal sceneries through videos, audios and scents, and (5) triggering interactions between inhabitants and ambience through sensing devices. An exhibition was initially planned for implementing and demonstrating the ambience of *Shiki* in Singapore in March 2014. Due to change of the exhibition date, this research evaluated the concept of *Shiki* through prototype video as alternative.

The concept of *Shiki* was delivered through prototype video based on ethnographic video method. It demonstrated the experience of *Shiki* from the perspective of the inhabitant, walking into the interior, exploring the seasonal sceneries through interactions based on five body movements and triggering changing of sceneries with other inhabitants. The scenario of the prototype video is based on the concept of actual exhibition. The prototype video was evaluated by qualitative research method, including an in-depth interview and observation utilizing video cued-recall method with a goal of understanding participants' feelings, beliefs, actions and behaviors.

The prototype video was shown to five participants fitting the target user group. Given that the objective of this project was to imbue old buildings with new value, the target users were selected for two reasons: (1) maintaining old communities in old buildings or old public housings by alleviating the living environment of current inhabitants, and (2) encouraging current inhabitants to install *Shiki* at home. Target users were selected to be upper middle class local Singaporeans or permanent residents in Singapore, who are currently living in old buildings or old public housings.

4.1. Evaluation Method

The prototype video was evaluated by qualitative research methods. According to *Qualitative Research Methods*[1], the objective of qualitative research is to gain a detailed understanding of underlying reasons, beliefs or motivations, with a purpose of understanding the following questions: "Why? " "How? " "What is the process? " "What are the influences or contexts? " The data for qualitative

research are textual data, or words. It is conducted within a small number of participants or interviewees, selected purposively. The data collection methods include in-depth interviews, observation and group discussions. The outcome of qualitative research is to develop an initial understanding, to identify and explain behavior, beliefs or actions. Based on qualitative research method, *Shiki* is evaluated through in-depth interviews and observation.

In terms of in-depth interview, three components were taken into consideration: (1) Flexibility of conversation includes key topics and issues to be covered during the interview. (2) Interaction between the interviewer and interviewee. The interviewer will ask an initial question in a way as to encourage the interviewee to talk freely when answering the question. (3) Follow-up questions to obtain deeper and fuller understanding of the interviewee's meaning. The in-depth format also permits the interviewer to explore fully all the factors that underpin the answers: reasons, feelings, opinions and beliefs. Furthermore, an observation based on video-cued recall method helps the participants recall the detail of their experience and avoid selective interpretation[2]

The components for evaluation focused on (1) how participants perceived the ambience through the sensations of four seasons, (2) what kind of emotions participants have experienced through four seasons as well as interactions with ambience and other participants, (3) how participants felt emotionally connection towards the ambience of old buildings. These three components were evaluated based on an in-depth interview right after the participants watched the video and an observation through the video recording of participants' reactions as they watched the video. The interview was 45 minutes long for the first group and 30 minutes long for the second group. The in-depth interview started from basic conversation, and then gradually developed into in-depth discussion regarding their feelings and perceptions about the experience. The majority of the time, the families would answer the questions together, and the interviewer would ask further questions one by one. The interview questions include (1) what did they experience from the ambience? (2) What kind of feelings did they perceive from the ambience? Using three adjectives to describe the feelings. Why did they feel that? (3) Would they like to experience four seasons in the ambience of an old building? Why? (4) Would they like to install *Shiki* in their living room? Why?
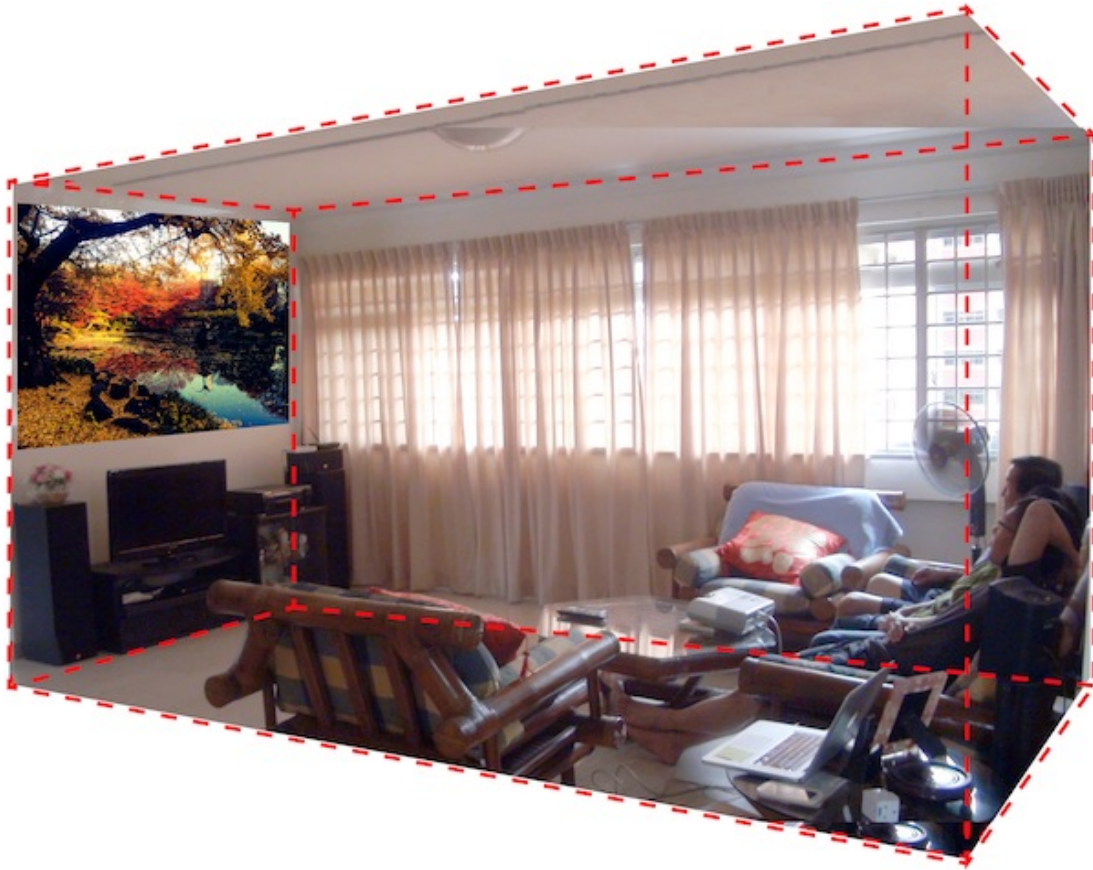
4.2. Setting

Figure 4.1: Setting for the user study

The evaluation was taken place in Pasir Ris, an old public housing in Singapore. The living room, size of 18.87 m2, was set up for evaluation (Figure 4.1). In order to deliver the ambience through images, sounds and scents authentically, the prototype video was projected on one side of the wall, 1.5mx2.5m, in the living room, 3 meters away from the sofa, where the participants sat. The speakers were set up on two sides of sofa; whereas one set of incenses was placed in front of participants. During the test, incenses were manually operated by one of research team members in order to create a vivid experience of fragrances. The participants were informed beforehand regarding the background of the project, initial plan of the exhibition and five body movements that would trigger changes of sceneries.

While they were watching the video, they were video tapped in order to observe their reactions and changes in facial expressions.

The first group was a family of three, including a mother, a father and a son. The father was a 69-year old teacher in junior high school, who had experienced the seasons of autumn and winter in Japan. The mother was a 64-year old housewife, who had also experienced the same seasons of autumn and winter in Japan. The son was a 33-year old co-founder of a design company, who had experienced four seasons in Japan, including spring, summer, autumn and winter. They are all local Singaporeans and have been living in old public housing for their entire life.

Figure 4.2: First group of participants

It was in the evening of Saturday, June 14th. The first group of participants came into the living room and sat down on the sofa. They were chatting causally with each other as the sceneries of four seasons being projected on the wall in front of them. They immediately recognized they were experiencing four seasons of Japan from the iconic cherry blossom; "Oh is it cherry blossoms?" said the mother cheerfully (Figure 4.2). The son nodded as response to his mother. The son smiled as he smelled the scents of cherry blossoms coming from the incenses placed on the desk in front of them. He leaned behind against the sofa, "I felt relaxed as I saw natural sceneries, living in such big city, people are seeking for nature to relax." (Figure 4.2) When the season changed from spring to summer, the mother and father said excitedly, "Two people changed the seasons!!" They soon realized that two people synchronizing the actions triggered changes in seasons. When the window shape changed from round to square, the mother all the sudden got excited and elbowed the father, "Hey! The window changed. It's square now!" The father raised his eyebrows and stared at the video for a while, trying to figure

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out which body movements triggered the interaction. As the scenery turned into winter, the son, still in the lying position, said, "I wish I could feel the temperature of snow, or the wind." Finally, it was the scenery of winter sky full of stars and a shining moon. The father raised his arms up, "Wow!" (Figure 4.2). "Look at the stars," said the mother pointing her finger up towards the ceiling and smiling to the father.
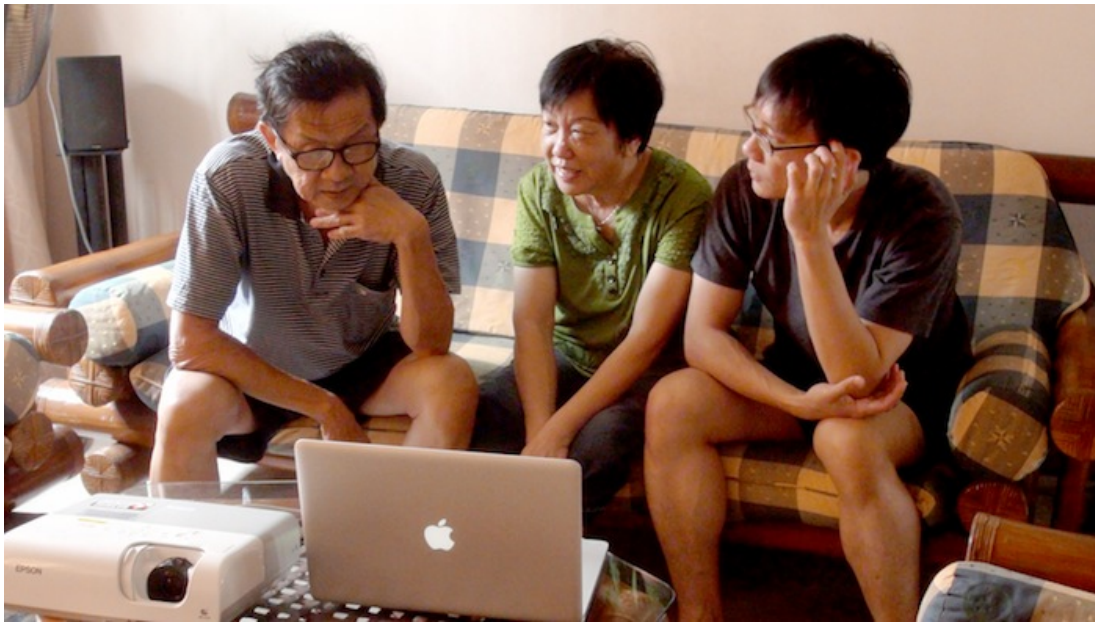

Figure 4.3: In-depth interview

The interview was conducted right after they watched the prototype video with the purpose of understanding their feelings, beliefs, actions, and behaviors (Figure 4.3). Even though the mother had never seen cherry blossoms in real life, she recognized the scenery immediately. "I have seen cherry blossoms in Japanese movies. It is very iconic natural scenery of Japan," she commented. The fragrance of cherry blossoms together with the images was the most authentic factor she perceived from the ambience. Out of all the seasons, she favored winter scenery the most, for it was something she could never experience in Singapore. She described her feelings towards the ambience filled with sensations of four seasons were exciting, comfortable and delightful. Excitement was the strongest emotions she had perceived, "I was really excited when I found out the actions triggered

changes in the seasons. And I noticed the numbers of people triggered different changes too!" In terms of installation of *Shiki*, she noted that she would definitely want to install it. "It is nice to see something natural. I like to be surrounded by greens." She believed that with the installation of *Shiki*, the living style in old building would be more enjoyable.

In the interview with the father, he stated that he did not recognize it was four seasons of Japan until the mother pointed out. For him, the most authentic section of the experience was autumn leaves of Kanazawa given to that he saw people walking in the scenery. "It was a bit too simple in other seasons. I want to see some people doing activities, matching with the seasonal sceneries. For example, people playing with snow or people sitting in the park enjoying cherry blossoms," he noted. He would like to listen to background music instead of background sounds, "It was too quiet. Classic music matches with different seasonal sceneries would be better." Overall, the experience of ambience was very refreshing for him, especially the fragrance in spring and summer. He explained that for him, the highlight of this experience was the last part, which was shown in the video as he put both his arms up in the air and cheered, "Wow!" It was the scene that the winter sky was projected above the ceiling. "It is my favorite because we don't get to see stars in the city." He would consider installing it if the system could improve the selections of videos and background music as he had mentioned previously.

The son was the only participant in this group who had experienced four seasons of Japan during his study in Tokyo. He had the strongest emotional attachment towards every season due to the memories, "It reminded me a lot of happy memories in Japan," he noted. He said it was very comfortable and relaxing to see seasonal sceneries, "I felt relaxed when I saw summer beach and winter snow. Living in a crowded city, you are always seeking for relaxation from the nature." He felt excited as he figured out the interactions with the ambience. "I noticed that the body movements are daily basis. Actually I was also putting my hands behind the head, just like the people doing in the video, and I didn't even realize it." He would like to experience different seasonal sceneries every time and also temperature changing. "It would be nice if I could feel the temperature of snow." He was very enthusiastic about installing *Shiki*; he explained *Shiki* would

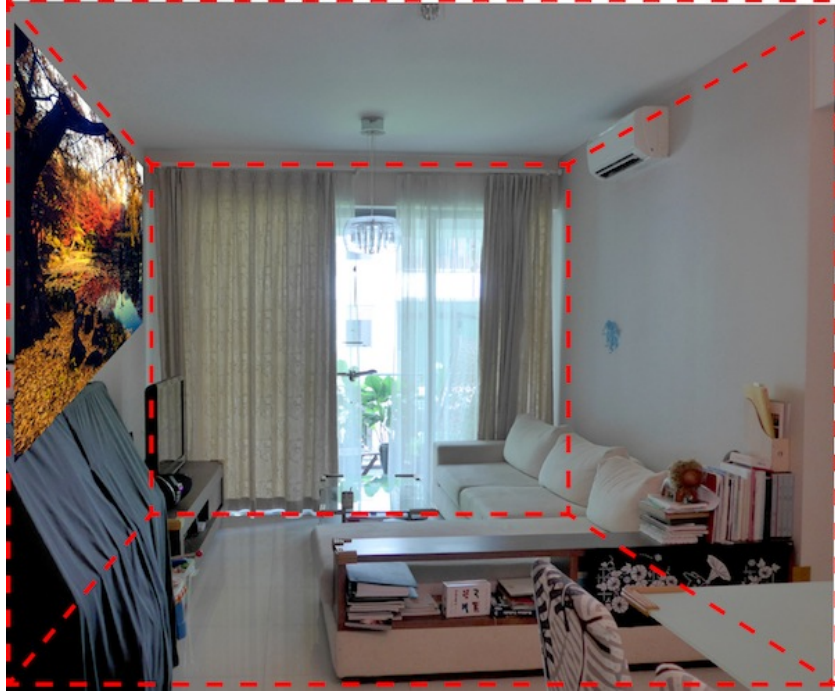make the living in old buildings more enjoyable and fun.

Figure 4.4: Setting for the user study

The second evaluation was taken place in Clementiwoods Condo, a condominium in Singapore. The living room, size of 3.4m x 6.5m, was set up for evaluation (Figure 4.4). In order to deliver the ambience through images, sounds and scents authentically, the prototype video was projected on one side of the wall, 1.5mx2.5m, in the living room, 3 meters away from the sofa, where the participants sat. The speakers were set up on two sides of sofa; whereas one set of incenses was placed in front of participants. During the test, incenses were manually operated by one of research team members in order to create a vivid experience of fragrances. The participants were informed beforehand regarding the background of the project, initial plan of the exhibition and five body movements that would trigger changes of sceneries. While they were watching the video, they were video tapped in order to observe their reactions and changes in facial expressions.

The second group was a family of two, who also fitted the target user group for *Shiki*. One of the participants was a 30-year old housewife, and another one

was a 31-year old CEO who was currently working for an online gaming company in Singapore. Originated from China, currently they were permanent residents in Singapore, having moved to Singapore five years ago. Both of them have visited Japan before; however, neither of them had full experience of four seasons of Japan.

Figure 4.5: Second group of participants

It was in the evening of Saturday, June 21st. The second group of participants came into the living room. They appeared to be calm as they sat down, adjusting the positions for viewing the video. Soon as the sensations of seasons filled up the ambience, the wife raised her hand pointing to the borrowed scenery, "It's Japanese cherry blossoms," she said (Figure 4.5). When the seasons changed from spring to summer, the wife smiled, "Very interesting; the window size is changed by the motions," she laughed. Then, the husband mimicked the motion and put his hands behind his head (Figure 4.5). "The seasons changed when they

did the same motions," said the husband with a smile. As it turned into autumn leaves, the wife said, "Wow! So pretty. I want to go there." The husband, still mimicking the motion according to the video, stretched his arms up (Figure 4.5). When it came to the last part as the scenery change to winter scenery, and then winter night appearing with a bright moon and staring stars, the wife nodded slightly.

The interview was conducted right after they watched the prototype video. The wife was speaking in an energetic tone throughout the interview. She enjoyed the scenery of winter and spring the most due to the fragrance of cherry blossoms and shining moon on the ceiling. She liked how the scene changed so naturally and the sound of waves in summer, "In general, I like how the sound and fragrance filled up the room. It felt really authentic," she stated. She described her emotions towards the experience was pleasant, comfortable and exciting especially as the fragrance came out and the interaction triggered changes. "I was smiling because the window became so huge when that person did something. It was very interesting to explore what it would happen with different actions." She commented that it is nice to be able to see Japanese sceneries, especially natural sceneries. She showed a strong motivation to install *Shiki* for creating the ambience, "I would enjoy it very much if you could install *Shiki*."

The husband perceived the ambience through the sounds and images of four seasons. He enjoyed the summer most, "I like recreations near the beach," he explained. He thought it was fun, exciting and relaxing throughout the experience of changing seasons. "I especially like being able to interact with the seasons part. Also being able to see some nature because we live in the urban. I think it has the effect of comforting." He believed that an environment filled up with sensation of nature would be more comfortable for living, "This would be nice for creating an interesting and comfortable living environment if you could make it more authentic" He stated that if *Shiki* could provide more varieties in the contents, he would definitely install it.

4.3. Proof of Concept

The three components to realize the concept of *Shiki*: (1) eliciting inhabitants' emotions through four seasons, (2) delivering authentic four seasons through an interior incorporated with images, sounds and scents, and (3) engaging the inhabitants in the ambience through interactive interior. These are the key principles to create an ambience in an old building. An interactive interior enables them to be engaged deeper in the surrounding environment and objects. An interior fabricated with images, sounds and scents delivers authentic sensations four seasons in the ambience. And through experience of four seasons, it elicits positive emotions of inhabitants. *Shiki* creates an ambience that inspires inhabitants to be emotionally connected to an ambience of the old building.

Three components were set for proving the concept: (1) the participants perceived the ambience through the sensations of four seasons, (2) participants' emotions were triggered through four seasons as well as interactions with ambience and other participants, (3) participants felt emotionally connection towards the ambience of old buildings. Through images, sounds and scents of cherry blossoms, autumn leaves, summer beaches and winter snows, the participants realized they were experiencing four seasons of Japan. Their emotions were then triggered as they experienced different seasonal sceneries and as they explored the interactions with different body movements; they felt relaxed, comfortable, excited and happy. After experiencing the whole changing four seasons, their emotions towards the environment had changed, for they would like to stay a longer period of time with the installation of *Shiki*. These three components were proven as effective from the user studies.

The participants have realized they were experiencing seasons of Japan and perceived the sensations of four seasons through visual images, fragrance and audio. The participants were not informed that *Shiki* created four seasons of Japan before the user test; however, they soon recognized seasons of Japan as the ambience started to change. The mother from the first group was the first one who noticed that and told her family. The wife from the second group also whispered to her husband as she saw cherry blossoms. Later in the interview, the mother and father from the first group emphasized that she enjoyed the fragrance and sound of cherry blossoms filling up the room, whereas the wife from the second group

stated that fragrance of cherry blossoms was the most authentic factor throughout the experience.

The participants perceived the ambience through the sensations of four seasons.

Figure 4.6: Generating four seasons in an interactive ambience triggered positive emotions of the participants

The interactive ambience engaged the inhabitants in the experience of four seasons. Participants of user studies have showed excitement and enthusiasm in exploring the changes in ambience through different body movements. The mother from the first group had been speaking to her husband and son in an energetic and cheerful tone throughout the prototype video regarding each change. The son from the first group was leaning back to the sofa, relaxing and smiling. The wife from the second group showed a sign of pleasure as she smiled and nodded as the seasons and window size changed. The husband from the second group was mimicking the motions in the prototype video with a smile, showing a sign of

excitement. Generating four seasons in an interactive ambience triggered positive emotions of the participants; the interactions triggered the feelings of excitement and joyful, whereas the natural sceneries inspired feelings of comfort, relaxation, delight and pleasantness (Figure 4.6).

The participants' emotions were triggered through four seasons as well as interactions with ambience and other participants

According to the first proof, it shows that the participants perceived the ambience through four seasons generated through images, audios and fragrances. And it leads to the second proof that because of feeling sensations of four seasons, the participants' emotions were triggered through four seasons. In addition to that, the interactions with ambience and other participants also trigger their emotions as they explore the changes in seasonal sceneries, sounds and scents. This further leads to the third proof that ambience filled with four seasons allow the participants felt emotionally connected to the old building. All of the participants stated that they felt different, more comfortable, relaxed and happy within the environment and they would like to spend more time in this environment. They said with the installation of four seasons, they could relax more and enjoy natural sceneries they did not have in Singapore, especially living in the center of city.

The participants felt emotionally connection towards the ambience of old buildings

Three participants out of five would like to install *Shiki*, while two participants would consider installing it if *Shiki* could be improved in terms of providing more authentic experience and better varieties of selections. All the participants commented that installing *Shiki* would turn the current living environment into a more comfortable and enjoyable ambience. With the installation of *Shiki*, inhabitants would like to continue living in old buildings. The concept of *Shiki*, generating four seasons and inspiring inhabitants to be emotionally attached to an old building, is fruitful for alleviating inhabitants' emotions through the ambience of an old building in Singapore.

Notes

1   Hennink, Hutter, and Bailey 2010 *Qualitative research methods.* Sage, 2010, pp. 16-21

2   Costello, Muller, Amitani, and Edmonds 2005 "Understanding the experience of interactive art: Iamascope in Beta_space." in *Proceedings of the second Australasian conference on Interactive entertainment,* pp. 49-56. Creativity Cognition Studios Press, 2005.

Chapter 5

Conclusion

5.1. Conclusion

The purpose of this research is to demonstrate *Shiki* inspires inhabitants to be emotionally connected to an old building. It creates economic value by providing a system with low cost to reconstruct the ambience within a space. In Singapore, old buildings bind a mix of ethnic groups to live together as communities. They house not only the people but they provide them a sense of attachment to the homeland, Singapore. However, owners of buildings try to increase the economic value by refurbishing buildings into luxury hotels, art galleries, museums, restaurants for entertainment and leisure purposes. This can be seen in Boat Quay and Clark Quay, where a characterless internationalism has taken over the originality of ethnic buildings. The Singapore government tries to encourage locals to maintain life activities in the historical buildings in order to preserve the ethnic identities in the historical areas. With the objective of imbuing pre-1970s buildings with contemporary value whilst maintaining ethnically diverse communities, and the buildings' own unique characters, this research utilizes the human scale size of the interior spaces to create an ambience. Taking all these factors into account, the novelty of this research is to design an ambience within the space in an old building through sensations of four seasons – that is *Shiki*.

Through *Shiki*, human scale interior spaces of old buildings are given a pleasurable ambience. Ambience is the atmosphere, mood, feel and character of a place, formed through the space, lighting, openness and transparency. It is cre-

ated from the images, words, sounds, sights, smells or pictures. The uniqueness of the ambience relies on people's perceptions. Old buildings enrich the perception of ambience with their human scale size, historical architecture, and their elaborate images of cultural enclaves. In Singapore, the predominant aesthetic value of old buildings is the unique ambience they possess. A variety of ethnic origins creates a unique phenomenon mixed with fragrance of traditional spices, cultural cuisine or perfumes, sound of different languages, or sceneries of ethnic groups carrying out their daily activities. In Chinatown, a group of Chinese merchants call out to customers in Chinese and English, while a group of Indians dressed in saris head towards a Hindu temple, located in the center of Chinatown. Around the area of Bugis, mixed communities of Indians, Arabians, Chinese and Malays also carry on their life activities together: shopping at the local grocery stores or purchasing colorful clothes. These kinds of ethnic enclaves also exist in public housings, such as Pasir Ris, one of the oldest communities in Singapore. Within the same apartment blocks, families of Chinese, Malays, and Filipinos live together on the same floor, visiting their neighbors with holiday greetings and celebrating cultural events in the community centers and common areas. Given the cosmopolitan of the population, the ethnic culture and communities are the heart of Singapore. The old buildings are the essence of the phenomenon that creates the unique and imitable ambience. Old buildings in Singapore are also ideal for implementation of ambience design, given their spacious interior, the height of ceiling, as well as the structure of the interior made for human scale.

Shiki inspires inhabitants emotions through an ambience filled with sensations of four seasons. As discussed above, summer is the dominant season covering a major part of the year in Singapore, with no distinct changing of seasons. The tropical weather has a strong impact on Singaporeans' lifestyle, such as making them prefer to stay in air-conditioned shopping malls or indoor facilities. In contrast to the scorching weather outside, Singaporeans browsing in winter clothing shops in the high-end shopping district show the Singaporean population is looking for alternative climatic experiences. As Singapore is one of the wealthiest countries in the world, Singaporeans are affluent enough to enjoy overseas recreation. Japan is one of the most popular destinations for them to experience something they do not have in Singapore – that is, Japan's famous four seasons.

As demonstrated above, *Shiki* seeks to use this desire for different climatic experiences by utilizing the interior elements of Kanazawa City, where the old houses possess a comforting ambience and share similar human scale size as old buildings in Singapore. Derived from the theoretical background discussed in Chapter 2 and previous fieldwork research, the four seasons are presented through the Japanese concept of "Shakkei" or "borrowed scenery," with the borrowing of seasonal sceneries of Japan to Singapore. In an interior that is transformed into a Japanese-style room, inhabitants experience sensations of seasonal sceneries of Japan through images, sounds, and scents, while engaging in the interactive ambience through different body movements. *Shiki* furthermore transformed the interior into a Japanese-style room comprised of tatami flooring, a narrow wooden passageway (Engawa), Japanese windows and a set of furniture embedded with speakers and aroma generators. Three sets of sensing devices, a projector, and speakers are also fabricated into the walls. The experiment of interaction design was conducted to determine the basic five body movements, which allow the inhabitants to trigger changes of sceneries. Positions of sensing devices for identifying inhabitant's motions were also tested to decide the placement of the installation in the interior.

The practicalities of the system were tested in a user study of *Shiki*, delivered through a prototype video, demonstrating the whole experience from the perspective of the inhabitant walking into the interior and exploring the seasonal sceneries through interactions based on five body movements and triggering changing of sceneries with other inhabitants. This video was shown to five participants fitting the target user group in Singapore and evaluated through qualitative research method, which included an in-depth interview and video observation for understanding their feelings, beliefs, actions and behaviors. According to the interview and video observation, this research proved that *Shiki* was effective based on three components for evaluation: (1) Four seasons elicited inhabitants' positive emotions. (2) Inhabitants perceived an authentic experience of four seasons through the ambience. (3) Inhabitants felt emotionally connected to the ambience of the old building. *Shiki*, therefore, is fruitful for alleviating inhabitants' emotions through the ambience of an old building, and it allows the inhabitants to enjoy a different lifestyle with sceneries of four seasons at home.

Shiki could contribute to creating new value in redesigned old buildings as well as allowing inhabitants to improve their quality of life in old buildings and old public housing. As areas such as Chinatown or Bugis witness the wholesale transformation of their historical buildings into modern conveniences, it is vital to encourage locals to maintain life activities in order to preserve the ethnic identities possessed in the communities. *Shiki* could also be applied to old public housing, which include Tiong Bahru or Pasir Ris, where the units are more spacious and the locations of public housing sites are better, compared to the ones in new housing estates. As more people tend to move into new public housing estates, they lose their attachment to the old buildings, and thus the old community spirit disappears. *Shiki* could be adapted to various old buildings for providing sensations of four seasons and attracting inhabitants to live in old buildings.

5.2. Further Discussion

This research aimed to create an ambience within an old building in Singapore. For future developments, engaging the users deeper in the experience of seasons is vital. Incorporation of networking into the system and an online platform that provides various selections of seasonal sceneries would allow for automatic system updates and access to refreshed contents. This would enhance inhabitants' experiences and continue alleviating their emotions through originality of sensations.

This research utilized the main seasons of Japan, including the spring cherry blossoms, the summer beaches, autumn leaves and winter snows. Considering that there are 72 defined seasons in Japan, future work could incorporate the design of those. In addition, demonstrating seasonal activities matched with visual contents would also allow users to have a more realistic experience of seasons, for instance, the activities of cherry blossoms viewing (Hanami) in the parks or snow boarding on the mountains covered in snows. The current system, *Shiki*, generates four seasons mainly through images, sounds and scents; however, in the future, a better integration with the five senses, such as the incorporation of wind and temperatures, could also be taken into consideration in order to provide more authentic experiences.

In terms of the interaction system, applying sensing devices that accurately

identify complex gestures and motions would recognize inhabitants' needs and analyze inhabitants' emotions in order to provide the contents that elicit emotions or relax the inhabitants under different situations. Furthermore, a unified design of system that integrates projectors, speakers, and aroma generators as a whole would improve the installation in different architecture interiors.

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