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Master's Thesis
Academic Year 2019

Urban Wandering and Ambiguous Territory: An Interactive Experience of Urban Rediscovery

Keio University
Graduate School of Media Design

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

Xiaohui Lin

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Abstract of Master's Thesis of Academic Year 2019

Urban Wandering and Ambiguous Territory: An Interactive Experience of Urban Rediscovery

Category: Design

Summary

After a decade navigating the city on mapping apps and finding urban attractions through location-based social networks, our perceptions of the urban space have been shaped by a simplified virtual representation that reinforces a single consumerist ideal of urban life. Aspiring to imagine a poetic urbanscape and reconnect people to their physical complexity, this project explores how HCI design foster interpretation and communication of ambiguous matter in the context of urban wandering. To transform wandering into a connected experience of urban rediscovery, the Wanderer's Antenna, a location-based interactive tool is presented to encourage users to delve into the less noticeable or marginalized aspects of the urban environment.

Keywords:

Urban Interaction, Location-based Interaction, Ambiguity, 3D Audio, Sensory Design

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Chapter 1

INTRODUCTION

1.1. Background: The Best Destination

The emergence of location-based social networks (LBSN) have drastically affected the way we experience urban places over the past decade. Today, we can hardly imagine going on a trip without using those services.

A typical night out with friends normally starts with some planning, including pick a meeting point that suits everyone by looking at a mapping app, and choosing a fairly rated restaurant to make a reservation. Once a time and place is confirmed, a link to the map of the location would be shared among friends through chatting apps, by accessing which everyone could check the best route and estimated time to arrive. Later at the restaurant, one might "check-in" on lifelogging apps like Swarm to keep track of the places he/she has been to, post pictures on Instagram tagging the place, and towards the end of the dinner, open Foursquare to find the best rated bar nearby for another drink.

LBSNs are more than social networks plus location tags, or digital extensions of local guidebooks. The interdependency of our physical experience and online presence has created new social dynamics which are shaping our perceptions and expectations of urban places. One thing that deeply affects our decision is the notion of the best destination. We are so constantly fed with information about the "top-rated" cafes and restaurants, "unmissable" places to visit, "ultimate things-to-do" and other guaranteed good experiences that it seems irrational to go to a place without knowing the "best destination" is ahead. However, most recom-

mender systems on LBSN services are designed on the premise that the more and higher ratings a place receive, the better it is. We can certainly leverage the experiences of others to make better decisions, but it is important to note that if we blindly endorse those rankings, or even question our own feelings because of other's oppositional opinions, we are in fact allowing others or even algorithms to define what a good experience is for us while risking to loose our internal ability to explore and appreciate.

Another limitation of LBSN services is the way they represent and communicate a place. In order to provide semantically meaningful information about a place, a system has to identify a location with certain labels, which are often existing concepts of what a place could be. Google Maps provides more practical categories such as banks and gas stations, while foursquare and Yelp focus on local business such as shops and restaurants. Those labels can be effective for searching, data mining and marketing, but at the same time, they can be very restrictive for innovative ideas. For example, if a place owner wants to turn his property into a place where people can enjoy daydreaming, instead of creating a completely new concept, he might have to name the place with existing labels such as "daydreaming cafe" or "daydreaming bar" in order to be more searchable online. On the other hand, in order to find a place online, users can either search by keywords from their existing vocabulary or receive recommendations based on previous activities or current trends. Either way, the search result will more likely reinforce the their existing perception than expanding it. Moreover, as platforms that connect place owners and users, LBSNs are largely used as marketing tools to create buzz, predict consumer behavior and target potential customers. Despite their limited and sometimes manipulated representation of a city, our lifestyle and everyday activities in the city are highly influenced by the contents they create.

As the physical stage of epic stories of human civilization and millions of people's ongoing lives, a great city offers more than efficiency, convenience and homogeneous consumerist lifestyle. She is full of inexplicable places of wonder and fleeting moments of inspiration that are neither searchable nor ranked on our apps. To discover and appreciate the true beauty of a city, we must slow down, get lost, free our instinct for the beauty of life from the constant pursuit of purpose, so that we could open our eyes to the vast unknown.

1.2. Motivation: Towards a Poetic Urbanscape

At the end of *The Image of the City*, Kevin Lynch suggests that the future form of city must obtain a fluid nature—"not simply well organized but poetic and symbolic as well"— to be receptive to the continuous transformation of its meaning and function. He also believes that towards shaping such a future where cities become "a source of daily enjoyment", it is equally important to cultivate their inhabitants into "critical and attentive audience" as it is to develop the art of urban design [36]. More than half a century later, despite the the rapid evolution of the utilitarian end of our cities driven by the advance of digital technology, the poetic aspect of urban life becomes less and less appreciated. One reason for the imbalance could be our disconnection from the physical environment in the age of hyper-connectivity. Resonating with Lynch's depiction of the future, this project aspires to create a digital experience that contributes towards the reimagination of a poetic world by encouraging citizens become more attentive and reflective with their surroundings. Instead of pursuing "usefulness" and "usability" as the goals of traditional HCI development, this project embraces ambiguity as a resource for HCI design [21], exploring how ambiguous interaction can foster individual user's original interpretation and expression of a physical experience.

1.3. Urban Wandering and Ambiguous Territory

In contrast to the prevalent destination-oriented urban exploration tools, this project focuses on the act of wandering, a poetic way of experiencing a city which many great artists and writers find inspiring. As a leisure activity, to wander around the city simply means to stroll without a predetermined destination. However, instead of pursuing a sheer randomness, this project considered urban wandering as a transformative experience, a journey expanding one's urban territory physically and perceptually at the same time.

In "Street Haunting: A London Adventure," Virginia Woolf famously rambles half across London just to buy a lead pencil. She describes the fixity of our everyday identity as the "the shell-like covering which our souls have excreted to house themselves, to make for themselves a shape distinct from others." For Woolf, the

act of wandering is a freeing experience which allows us to escape the everyday physical surroundings that "express the oddity of our own temperaments and enforce the memories of our own experience." The bodily experience of wandering breaks the "shell" that shelters our internal "perceptiveness," exposing our "enormous eye" to the hidden beauty of the city, the lives and characters of our fellow men [47]. The "shell" Woolf wished to break a century ago is quite like what we call today a filter bubble, the "personal universe of information" created based on our online history, feeding only things that a website algorithm believes we want to see [39]. No matter how technology evolves, we always have to face the limitations of our own perception against the infinite possibilities beyond our existence. Woolf shows that wandering is one of the simplest way to cope with our limitations in life. All we need to do is to take a departure from our everyday routines, observe the city from a different angle with our eyes wide open and pay attention to the others—places we might never go, things we might never consider and people we might never get to know. Through wandering, we could not only gain a new understanding about our surrounding, but also have a deeper conversation with ourselves by listening to our own instinct.

This project aims to transform the act of wandering into a connected experience of urban discovery by proposing a novel location-based interactive tool, the Wanderer's Antenna. Different from existing urban exploration services or tools, instead of shops, restaurants and monuments, the Antenna is created for the less noticeable, transient or marginalized aspects of urban environment. By embracing nonverbal communication and ambiguous interaction, this design values the multiplicity and complexity of urban places and encourages users to experience the city with their own interpretation and imagination.

1.4. Thesis Organization

The upcoming chapter of literature review compares the artistic account of wandering with existing digital applications that encourage wandering or other pedestrian activities in the city, pointing out this project's contribution to bridge the artistic experience with interactive technology in the context of urban wandering. Chapter 3 presents insights and findings from the preliminary studies which

were conducted to understand the body-mind connection of urban wandering, and defines the design objective at the end. Chapter 4 describes the concept of the Wanderer's Antenna and documents each step of its development. Chapter 5 demonstrates the proof of concept, illustrating test results and findings from a qualitative user study. The final chapter concludes this thesis with discussions and provides suggestions for future development.

Chapter 2

RELATED WORKS

2.1. Wandering as An Artistic Practice

Wandering has been a crucial vehicle for writers and artists to comprehend the effects of modernization on everyday life in the city. The poetic vision of the flâneur and the Situationist theory of the dérive are particularly notable artistic practices which provide the conceptual roots for this project.

2.1.1 Flâneur

The figure of the flâneur—the passionate wanderer who acutely observes the modern society—was first conceptualized in 19th century French literature. In his 1863 essay "The Painter of Modern Life," poet Charles Baudelaire famously expresses his views of how modern life redefines the role of an artist through the portrayal of Monsieur G. Baudelaire defines modernity as "the transient, the fleeting, the contingent," as opposed to the other half of art being "the eternal and the immovable." In pursuing the transitory element of modernity that contains the constant metamorphosis of "the mysterious beauty of human life," Monsieur G's existence as a modern artist becomes less about his professional skills and the physicality of art he produces than the social condition he observes and records. Baudelaire's depiction of the modern artist as the "perfect idler" in the city, the "passionate observer" of the crowd, and "the lover of life" underlines some fundamental qualities of the flâneur—the gift of seeing, a sophisticated mind with

child-like curiosity, and a sense of detachment [7].

In his critical explorations of metropolitan life in the early 20th century, Walter Benjamin revisited Baudelaire's notion of the flâneur and defined the figure as the observer and investigator of modern capitalism "who seeks to give voice to its paradoxes and illusions, who participates in, while yet still retaining the capacity to give form to the fragmented, fleeting experiences of the modern" [8]. In *The Arcade Project*, Benjamin discusses extensively the image of a city created through the development of consumer culture. He believes that the flâneur's extraordinary talent for empathizing with the commodity and the exchange value itself can be a critical tool for interpreting the experience of modern life. He also points out the rebellious potential of the flâneur who demonstrates the expression of loitering against industrial efficiency and division of labour [9].

2.1.2 Dérive

The symbolic role of the flâneur was passed on by the following generations of artists from the early modernist, to the Surrealists and on to the Situationists. In the 1950s, Guy Debord, a leading member of the latter movement, coined the term psychogeography, a study devoted to understand the psychological effects of the geographical environment in an effort to reveal the forgotten or less visible aspects of the urban environment. He believes the future of urbanism will shift its focus from the utilitarian end of a city, such as how to circulate more automobiles, to exploring the psychogeographical possibilities of urban space [15]. In 1958, the "The Theory of Dérive" was published to introduce a technique for investigating psychogeography. Dérive is an unplanned journey in which the participants pass through a landscape, physically and emotionally engaging with varied ambiances. The key instruction for the participants to perform the act of derive is to "drop their relations, their work and leisure activities, and all their other usual motives for movement and action, and let themselves redrawn by the attractions of the terrain and the encounters they find there" [16]. By defining the purpose and establishing certain rules, the dérive transforms the aesthetic practice of the flâneur from a personal enjoyment to a collective effort with a revolutionary agenda against the functionalist nature of urbanism.

For both Benjamin and Debord, the act of wandering is motivated by certain

intention which differentiates it from the randomness of strolling. It often starts with an intuition, the artistic sensitivity to give voice to the undefined form of beauty, or the innate impulse to follow curiosity, and then evolves into the systematic investigation which examines subjectivity in its broader sociocultural context. The common goal is to detach from everyday order and mundane activity, gaining new awareness of the city to attain a higher form of reality.

2.2. Technology and Pedestrian Experience

The advance in GPS technology has revolutionized how we interact with urban space in a way that Baudelaire and Debord would have never imagined in their times. Various local-based social network (LBSN) services have particularly big influence on our everyday life. There are three major types of local-based social network services that allows us to interact with our physical location. Geo-tagged-media-based services enable us to locate media contents created in the physical world. Point-location-based services gather and provide information about venues, such as restaurants or museums by encouraging users to check in, leave ratings and reviews, post photos while or after they spend time at the physical locations. Trajectory-based services combine activities at point locations with other information such as distance, duration and velocity to capture the users' continuous experience [6]. Top service providers such as Google Maps and Foursquare strive to optimize their algorithms for better search results and more accurate user activity prediction, mainly to bring convenience and incentivize consumer behavior. On the other hand, how to create serendipitous location-based experience in a ubiquitous computing environment becomes increasingly discussed in the field of HCI [11, 28]. In this section, three types of digital applications that are related to the topic are reviewed and analyzed.

2.2.1 Location-based Augmented Reality Game

Many researches have indicated that human mobility pattern in urban environment is largely routinized and highly predictable [30, 38]. One effective way to break pattern of everyday activities and motivate users to explore new place is to combine a layer of intriguing digital interactions with the physical environments

by introducing gamified contents or rules to affect real life actions. Location-based augmented reality mobile games Ingress and the global phenomenon Pokémon Go, both developed by Niantic, Inc. are certainly the most successful examples of their kind. Each game has a backstory that fictionalizes the actual world where players must physically travel to expand the game's map. There are certain game areas assigned to fixed location in the physical world where players can interact. In Ingress, those areas are called "portals" whose locations are initially chosen based historical markers and public artwork mined from geotagged photos on Google. The data set was then expanded through a crowdsourcing process which invited players to nominate places that they believed should be portals. The location data of "portals" contributed by Ingress's players were later adopted by Pokémon Go as the locations of "PokéStops" [10]. Studies show that both games lead to significant increase in the players' physical activities [2], and create a large-scale shift in the players's mobility patterns [14]. However, whether the players are emotionally engage with their actual surroundings remains questionable. In fact, it is more likely that the virtual gaming aspect is overshadowing the physical experience. Since the launch of Ingress, Niantic has been facing controversy over news about players catching Pokémon or fighting for control of portals around places where people should pay their utmost respect including concentration camps such as Auschwitz, Dachau and Sachsenhausen [18, 24].

With their phenomenal success, location-based augmented reality games have certainly demonstrated new possibilities of engaging people with the physical world using digital technology. Nevertheless, it is important to note that in both games, the only role a physical place plays, despite its own significance, is to provide a location to trigger on-screen interactions. For users to truly engage with a place, the digital interactions should be designed to enhance their physical experience.

2.2.2 Digital Wandering Tool

In fact, there are many digital applications designed to bring new awareness to the urban environment by recreating the wandering experience with mobile devices. An app called Dérive[1] , as the name suggests, was developed based on the ideas of the SI's dérive technique. Dérive creates a gamified urban exploration

experience by giving simple, random instruction decks during a journey such as "follow someone wearing a hat" or "find a newspaper stand." By engaging with the task decks, users are nudged to perform differently then their every activities and see their urban spaces in a different light. The app offers several base decks of generic urban tasks that could be used in various urban settings. It also invite users to create their own decks of cards based on specific location or themes. To start a dérive, one simply needs to choose one or multiple decks of cards and follow the instruction on each card through the journey. The route of each dérive journey is recorded with time and distance travelled between one card to another. The creators of the app have been actively promoting a dérive community by holding public events and collaborating with institutions in different cities around the world.

Serendipitor [2] is an alternative navigation service developed by an American artist and scientist Mark Shepard. By typing in a destination or generating a random destinations, one can choose from multiple routes of different complexity and start navigation which is a combination of turn-by-turn direction cues generated by Google Maps API with instructions for actions inspired by Fluxus, another major international art movement during 1960s and 1970s. Here is an example of the instruction: "Head north on N 15th St toward Arch St and then head toward the river. If there is no river nearby, make one." To list a few interesting Fluxus-inspired task: "Go where it is loud(er). Take a photo of the sound." "Walk on the sunny side of the street. If there is no sun, imagine some." "Find a bar, buy someone a drink, and ask them to draw a map of their childhood. Follow this map."

Serendipitor's strategy of disrupting one's journey with random tasks is quite similar to the Dérive app but it provides more narratives to guide the users so that they could interact with the city in an artistic way. Overall, both of them are very interesting examples of the digitalization of wandering based on its artistic ideal. They also show that gamification is an efficient way to interrupt daily route and create new interaction. However, the use of digital technology is not elegant enough to bring new value to the experience. Both applications demonstrate evident efforts to bring connectedness to the experience with the website publicizing the activities and route every time a user engages with the app. Although

it is the user's decision whether to share the information, the explicit disclosure and blunt representation of one's action somehow contradicts the subtleness of each individual user's subjective experience. Moreover, both applications rely on touchscreen-based interactions for operation which inevitably compromise the seamlessness of the wandering experience.

2.2.3 Embodied Navigation

Given that touchscreen-based devices trigger head-down interactions which result in ignoring the surrounding [25, 29], many wearable solutions have been proposed to free urban explorers' attention from the screen. Some adopt visual augmented reality and audio augmented reality interface to enable the users to focus on the actual surrounding while providing complementary information [3, 12,27,31]. Many research study the possibilities of deploying vibrotactile feedback for spatial guidance, introducing wearable solutions integrated in belt [5, 17, 45], wristband [32], and shoes [20]. A pulling force has been tested as an effective way to "tempt" someone towards a certain direction. "Pull Navi" is a playful tactile navigation interface which pulls one's ears to guide movement in 3-DOF directions [33]. Without physically pulling a body part, Rekimoto proposes a handheld device made of a tactile actuator to create a illusory pulling sensation through asymmetric signal [41].

All above studies focus on developing an alternative navigation cue which provide guidance with precision and clarity. Thus, the users are perceived as passive receivers of instructions in the system. In the context of wandering, however, the wayfinding process does not require efficiency. It is more important to keep the users active and voluntary so that they can follow their own route. Wander Amsterdam app [3] provide a good example of how to keep the wanderer oriented without giving explicit guidance. Instead of generating route from the user's current location to a specific target, the app is designed as a "smart radar" that only shows approximate distance and orientation of a hidden attraction. For this project, an ideal way to lead a wanderer towards certain location needs to be a combination of fuzzy navigation cue with an embodied experience of spatial guidance.

2.3. Summary: Space, Action and Interpretation

In order to summarize this chapter, it is useful to borrow the concept of space and place from human geography. Space and place are two distinct concepts. Space is an abstract concept without substantial meanings while a place is attached with certain value created by human experience. According to Yi-Fu Tuan, those concepts embody interdependent qualities and emotions. "From the security and stability of place, we are aware of the openness, freedom, and threat of space, and vice versa. Furthermore, if we think of space as that which allows movement, then place is pause; each pause in movement makes it possible for location to be transformed into place" [46]. Back to the context of urban wandering, if we consider the repetitive everyday interaction with urban environment as a state of "pause," then wandering is what creates "movement" to free the otherwise established place with openness and evoke imagination. In other words, the emotion of wonder and the sense of new discovery someone experiences while wandering is not caused by some integral qualities of a place but the action of wandering itself. Therefore, movement in space, bodily action and the freedom of interpretation are three intertwined factors that bring magic to a wandering experience.

The reason why applications which embrace the artistic view of wandering often turn out to become the digital replicas of their precursors without addressing their contemporary sociotechnical context is because they fail to transform the critical body-mind connection of wandering into an interactive experience. Other location-based interactions which only lead to one specific outcome, such as taking certain route, moving towards certain direction or doing certain task, do not suit the purpose of this project either. In order to raise new awareness of a place, it is crucial to nudge actions beyond everyday activities while keeping certain level of openness throughout the interactive experience both for the body and for the mind. Comparing the artistic ideal of wandering with various digital applications that make an impact on pedestrian experience, it is realized that the key to the success of designing a digitally formulated wandering experience is to determine how to introduce ambiguity to the interactive experience. Gaver argues that ambiguity is a powerful source for interactive designs that are engaging and thought-provoking. By allowing ambiguity to be reflected in design, designers can engage the users without constraining their own interpretation of the situation

and the technology itself. [21] In the following chapter, the preliminary study will be described in details, addressing the experience of wandering from a behavioral point of view while analyzing its inherently ambiguous nature from a HCI perspective.

Notes

1 The Derive app: http://deriveapp.com/s/v2/
2 Serendipitor: http://www.serendipitor.net/
3 The Wander app: http://www.go-wander.com/

Chapter 3

PRE-STUDY

Despite being deeply inspired by the artistic, literary and scholarly accounts of the subject, this project requires first hand knowledge about how the act of wandering is performed by people in their real life setting in order to better understand the behavior and its broader context. The spontaneous nature of wandering makes it a challenging subject of observation. On one hand, the participants are expected to stay intuitive and make voluntary decisions. Such an uninhibited state can be so fragile that any relationship created by the presence of another can transform it into a social obligation. However, in order to capture and analyze those decisions, it is essential to observe closely and listen to the wanderer describe their choice of action at the moment. A continuous effort to construct a better wandering situation for the participants also becomes an integral part of the concept developing process. The goal of the preliminary study is to unfold the experience of wandering and define the design objective. This chapter is devoted to describe the findings and insights gained from fieldwork and interview which lead to the design concept.

3.1. Fieldwork 1: A Failed Recruiting Strategy

The first experiment "Take A Walk With Me" aims to 1) understand one's perception of the spatial environment during a trip without a predetermined destination; 2) observe how people interact with the surroundings during wandering in comparison to wayfinding. The experiment simply requires a participant to

take a walk for 30 minutes without looking at any navigation app. After the trip, he/she will be asked to draw the path, which is later compared with the actual path recorded with a GPS module.

The initial plan is to randomly intercept people at Washington Square Park and invite them to take a walk together for 20 minutes, following the assumption that if someone is interested in the research topic and be spontaneous enough to help with a stranger, he/she would also enjoy going on a spontaneous walk. After 2 hours of fruitless attempt, finally a computer science major graduate student (participant A) agreed to participate only because he happened to have 30 minutes to kill. The 30 minutes walk in the East Village was painfully awkward and by no means spontaneous. The first fieldwork might fail to provide insights about the behavior of wandering but it yielded a valuable lesson about how to design an occasion to better engage the participants.

Figure 3.1: Recruiting at Washington Square Park

Here are the main reasons why street intervention is unsuitable for having someone start wandering and some reflections on how to create a better situation for the experiment:

- **Public space is not the right place to start a spontaneous action.**

When people were asked whether they would like to take a walk, instead of rejecting, many people in fact offered to participate as long as they can continue their current activities. For example, one suggested, "you can help me walk my dogs." Another asked, "I'm heading to the classroom, why don't you join me?" Those offers might just be polite rejections but they reveal one premise of human activities in the public space: most people in the public space are occupied by certain task which drives them to leave their private territory, such as meeting someone or going somewhere. Even people who're resting in a park are carrying out the mission of not doing anything. The act of wandering, unlike watching a street performance or completing a questionnaire, requires participants to take action and travel across space. Therefore, in order to have the participants be mentally prepared, the experiment needs to be scheduled and well planned.

Figure 3.2: People refuse to participate the experiment

- **Stranger is not the right test subject.** Unlike task-oriented activities, wandering does not follow certain procedure towards its completion. Instead, the freedom of body and mind is at the core of the experience. However, if someone is given little instruction when asked to perform a task, the intended freedom will manifests itself as a sense of uncertainty which, depends on the one's personality, can cause anxiety. The additional condition of being accompanied by a stranger, the observer, certainly does not ease the tension. During the experiment, participant A seemed to feel obligated to talk to the observer and spent most of the trip asking questions

about the research instead of paying attention to the surrounding. As figure 3.3 shows, at the end of the trip, he perfectly recalled the path he took in details including how many blocks he walked before each turn. This result reveals that during the trip, participant A was not only constantly awareness of his location, but also consciously planning the route of the trip so that he could go back to where the trip started after 30 minutes. This trip brought an understanding that it requires some level of comfort and trust for someone to walk into uncertainty. In the case of this experiment, some information and a closer relationship with the observer could provide the sense of security.

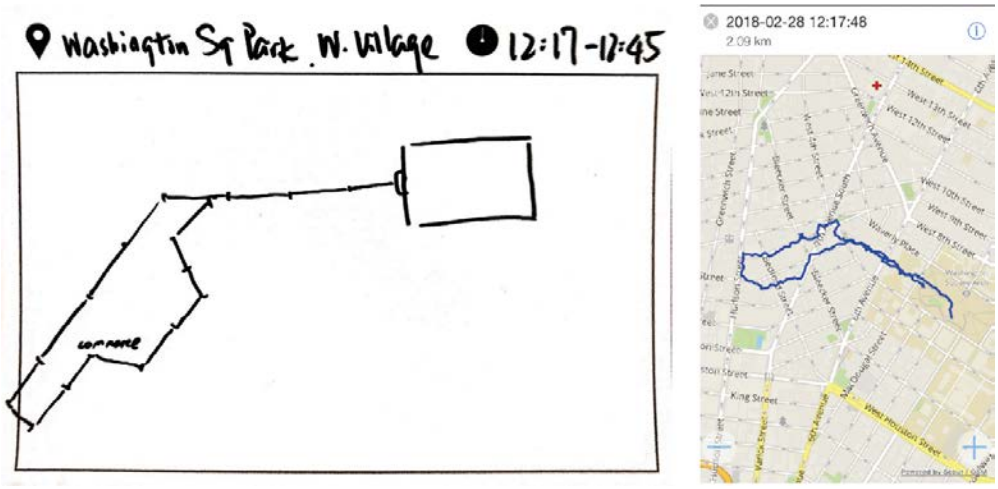

Figure 3.3: Participant A's hand-drawn route vs. GPS recorded route

A failed recruiting strategy led to the realization that it requires deliberate effort to provide certain conditions for people to engage in ambiguous situations, especially in public settings. The difference between a professional artist and someone with nine-to-five job is that while the artist is constantly searching for inspiration beyond everyday life, the latter needs a switch or a permission to start an extraordinary experience. Sometimes it can be a ticket to show or an exhibition. Sometimes it is special occasion constructed by decorations and costumes. A sense of ritual is essential for communicating such a experience even if, in the case of wandering, the experience itself requires spontaneity.

3.2. Fieldwork 2: Unfamiliar Place

Based on the reflections described above, the experiment was revised and framed as a Facebook event inviting participants to explore an unfamiliar neighborhood in New York. Social media was used as the recruitment platform to avoid the formality of a structured research session and create a sense of occasion at the same time.

3.2.1 Participants and locations

Three participants signed up for the event, one PhD student in social psychology and two master students in design. All three participants had spent time along with the observer before and felt secure and relaxed enough together in an unfamiliar place. Three neighborhoods, Williamsburg, Long Island City, and Prospect Height, were chosen to conduct the experiment, attempting to avoid the typical Manhattan's rectangular street grid.

3.2.2 Procedure

The major revision of the experiment is to separate the wandering phase from the returning phase, given that otherwise participant would tend to form a circular path instead of exploring freely. The procedure consists of meeting the participant in an unknown neighborhood, taking a 30 mins walk with the participant without looking at any navigation app (the wandering phase), and then return to the starting point after confirming the location (the wayfinding phase). The entire trip was guided by the participant without the observer interfering.

3.2.3 Findings

Wayfinding is the ability to process spatial information by making deliberate mental effort to learn the structure of the route, identify landmarks or choice points while interacting with the physical environment [23]. A emotionally engaging wandering experience requires a conscious decision to liberate oneself from such effort and fully focus on experiencing the moment. From the fieldwork, it was observed that one's emotional engagement during a wandering experience is

largely determined by three physical actions, each represents a different spatial interaction as well as a specific mental state associated with the environment.

Figure 3.4: Participant B in Long Island City (left: following a dog, center: walking into a yellow taxi rest place, right: a tall building as landmark)

- **Browsing:** Browsing is carried out by a combination of walking and head rotation with the eyes expanding the space. Without having to reach a predefined destination and locate specific landmarks for wayfinding purpose, one can randomly lay eyes on various aspects of the environment, taking in as much information as possible. The action implies curiosity, attentiveness and eagerness.

- **Gazing:** The act of gazing means one's not only interested in something but also willing to have a closer observation. With steps paused and the eyes locked, it signifies a shift from motion to stillness, expansion to focus. Physical characteristics (color, sound, smell, texture, plant, etc.) or visual information (storefront, text, poster, graffiti, etc.) on the surface of a place are often where one's attention was drawn to. Sometimes moving objects like a fancy car, or cute animals also attract one's attention but in a shorter span.

- **Turning:** In comparison with the motion of inertially walking forward, making a turn requires conscious decision which is often caused by attraction and the urge to investigate. By making a turn, one enters a new territory with a different volume of visual information. Taking frequent consecutive turns can cause a sense of disorientation while encountering physical borders

such as river, railroad, highway or prominent landmarks help regain a sense of direction.

From the experiment, it was also noticed that while routing plays a big part in one's perception of wayfinding, it's less relevant during wandering. As the drawings (Figure 3.5) show, the route of the wayfinding phase is simpler that that of the wandering phase and the participants recalled their route of the wayfinding phase better. For the wayfinding route, the participants can quickly define the spatial relationship between the starting point and the destination as well as the route that connects them. A wandering journey, on the other hand, is defined by a series encounters with points of interest, which are often recalled in terms of their fragmented qualities, such as color, shape, texture or atmosphere rather than specified the name of the place. Each individual turn was also identified based on one's subjective experience (eg.,"we made a turn after a cafe with red wall") in which the actual scenery and physical experience was better recalled than a cognitive representation of the space.

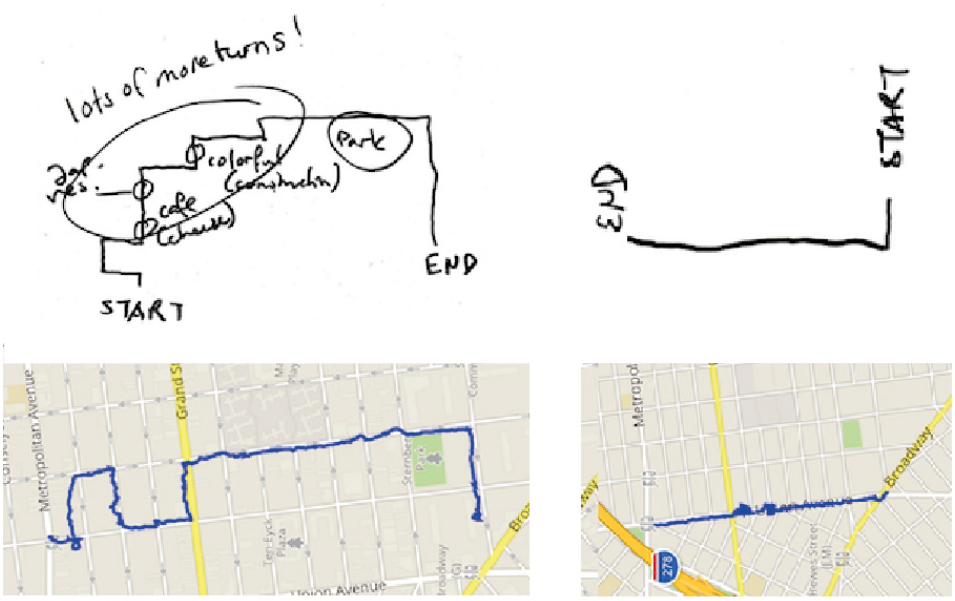

Figure 3.5: Participant C's hand-drawn route vs. GPS recorded route (left: the wandering phase, right: the wayfinding phase)

3.3. The Emotional Reward of Wandering

The fieldwork revealed that while some people are willing to actively break their everyday wayfinding habit, others take the act of wandering as a way to relax and avoid making complicated routing decision. Those who are drawn by unfamiliar atmosphere, and who actively investigate the environment often gain more joy and inspiration from the experience. Whereas those who restrain themselves from taking unusual actions tend to be less engaged. In order to further understand what distinguish an active wandering experience from an aimless strolling, semi-structured interviews were conducted in London, New York, Tokyo, Singapore and Stockholm with artists, designers, scholars who take wandering as a source of inspiration. From the interview, it was concluded that the act of wandering could provide three main sources of emotional fulfillment.

- **A sense of awe and wonder.** Standing beneath an ancient tree in front of Tokyo National Museum, a prominent Shanghai-based contemporary artist/photographer said he often found himself lost in the city. His way of finding inspiration in a city is to pay tribute to everything around us, respecting things with a sense of awe, listening to the history they witness and feel the emotion they carry.

- **The joy of discovery.** The chance of walking into something unexpected and the privilege to claim something as one's own discovery is a common source of pleasure. One researcher in Stockholm described his experience walking into a record store in Tokyo where he ended up spending an entire day. The sense of discovery gives something ordinary an special value that exclusively belong to oneself. And the joy manifested itself through one's the extra attention and expressiveness when describing the encounter.

- Time in solitude. Many people enjoy wandering because it allows them to spend quality with themselves. Without any purposeful conversation, dedicated attention or any social obligation, physical wandering help their to let their mind wander.

The above emotions are what elevate the experience of wandering from an aimless

walk to a mindful practice. Whether the design can trigger those emotions will be a key criteria for evaluation.

3.4. Design Objective

The preliminary study reveals that there is a gap between the general notion of wandering, which is the same as the act of an aimless strolling, and the artistic practice of wandering characterized by a conscious effort to absorb and comprehend. Existing digital wandering tools discussed in Chapter 2 fail to fill such a gap because they are mainly targeting users with a fair understanding about the intellectual and critical aspect of the activity. The goal of this project is to introduce the artistic aspect of urban wandering to a broader audience. To achieve so, the experience must be enjoyable and rewarding. Therefore it is more important to engage people emotionally with intuitive interactions than informing them intellectually with words. While there are individual differences in factors such as sensitivity and imagination which determines one's perception, based on the findings of the fieldwork, it was hypothesized that one can generally discover more about the environment by having more physical interactions, vision-related actions such as browsing, gazing, and turning in particular in the context of urban wandering. To sum up, the design objective of this project is to create an interactive walking experience which inspires the users to look at the city in a different light by triggering vision-related actions.

Chapter 4

DESIGN

Wanderer's Antenna is a location-based interactive tool created to transform the act of wandering into a connected experience of urban discovery. Based on a preliminary study of the wandering behavior, an interactive wandering experience enabled by the Antenna was designed to encourage people to delve into the less noticeable or marginalized aspects of the urban environment. The Antenna is created for everyone who is passionate about life and new discovery. Artistic individuals who have more experience in urban wandering like writers and photographers can use it as a wander-logging tool and share their inspiration with others. Urbanites with all other backgrounds can also wear it to explore different aspects of a city in a playful way.

The design of the Antenna involves a location-based interactive technique, a wearable solution and a backend system for recommendation and personalization, while this project is devoted to the development and evaluation of the interactive experience. This chapter describes the design processing following the steps below:

1. Imagining a future scenario in which the urban fabric is designed for wandering, raising questions to define the design challenge.

2. Depicting user scenarios by suggesting two possible ways of rediscovering the city through wandering.

3. Introducing the Wanderer's Antenna, illustrating its key features.

4. Refining the concept and each interactive steps through a iteration process.

4.1. A City of Wanderers

In 2050, we are living in a city where the utilitarian dimension of the urban space becomes more and more invisible while the visible turns into a mythical jungle. E-services encompass the full gamut of our everyday needs, allowing us to be fed and entertained without leaving home. Efficiency has lost its charm. Public transportation hubs are lifted up in the air. Business centers dissolve into virtual space. Shops and services becomes more symbolic or ritualistic as their functionalities are increasingly detached from their actual location. Public space can be constantly redesigned for spontaneous events, performance rituals and other social gatherings. Nature fights its way back to the cities and merges with the artificial and the virtual, growing into obscure forms of urban biota that continue to flourish into wildness, creating ever changing life forms. Regular street patterns which endow physical places with clarity and stability have been replaced by a new system that is fluid, intricate, and procreative for unpredictable directions and surprising encounters. As for us, the citizens, hyper connectivity and advanced autonomous transport systems have eliminated the need of walking from one place to another. The only reason for us to be outdoor is to explore, to get lost, to search for excitement and inspiration—we all become wanderers.

This future vision of an urban space designed for wandering echos the Situationists' labyrinthine urban dreams [15] and Foucault's idea of the heterotopias [19], characterized by its aimless structure and representation of hyperreality. In such a capricious future city where physical space no longer serves standard utilitarian purposes, how do we perceive the notion of destination? How do we navigate the intricate space? Maybe different kinds of urban attractions would become sources of nutrition or energy which are so essential to our lives that we have to constantly search for them. If so, do we search collaboratively or individually? How do we communicate with each other or ourselves? Or maybe they would become spiritual destinations that guide us to find them with some supernatural force? In that case, how could we sense the spirit of a place?

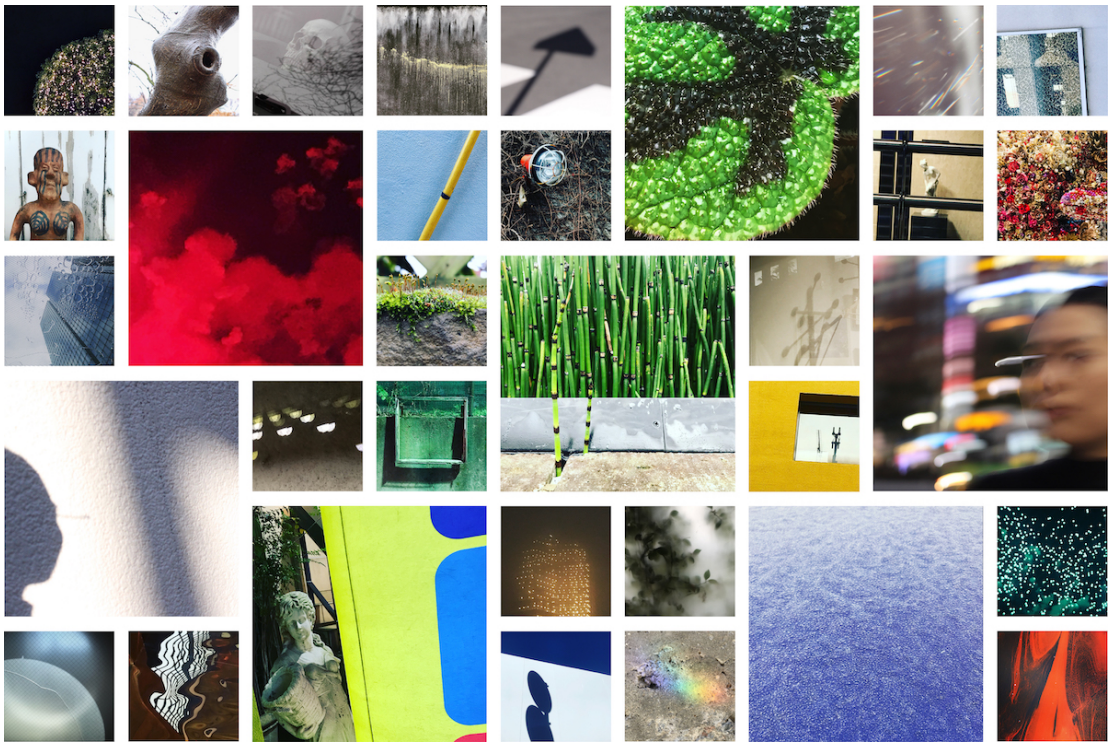

Figure 4.1: Photo collage of futuristic urban attractions

4.2. A Journey to the Ambiguous Territory

Back from the future, walking down the street where everything seems too familiar to hide any mystery, what else can we learn from our everyday environment? Is it possible to get lost at a place where we can always find our way? For Rebecca Solnit, the author of *A Field Guide to Getting Lost*, to get lost is to allow the unfamiliar appear, to acknowledge that "the world has become larger that your knowledge of it." It is not a matter of not knowing but the art of "letting go" [43]. The true beauty of an urban space lies in the fact that we can never know enough about it. As a built environment filled with innumerable artifacts and symbols created throughout different period of history, urban space not only manifests our collective needs and desires as a community, but also mediates stories and self-expressions of countless anonymous others. To get lost in familiar places, all we need to do is to make new connections with our imagination. For starters, here are two ways to shed new light on an everyday environment that

can be easily adopted.

- City as an art museum. Picasso's 1942 sculpture *Bull's Head* is made from a leather bicycle seat and the bicycle's handler bars he found discarded on the street. What makes it a celebrated piece of art work is the artist's extraordinary ability to bring a visual metaphors to the ordinary. We are not all Picasso but most of us have experience looking at artworks in a museum. Try examine the surface of the city as if every single inch of it is a piece of art. Observe the color, shape, structure, and texture of an object as if it is carefully crafted by the hands of a sculptor. Find a spot, take a moment to imagine how Monet or Renoir would paint the view in front of you.

- City as a theater. As Patrick Geddes remarked, "a city is more than a place in space, it is a drama in time" [22]. A bench under a tree or an old bicycle, everything stays where it is for a reason. Find the most trivial object, try to picture it as someone's dearest treasure. Take one street corner, imagine it as a stage of an act of a play as if everything is set up deliberately just to tell a story. Or we can learn from Georges Perec's "attempt to exhausting a place" [40]. Forget the plot. Salute all the insignificant fragments with a full second of attention.

There are countless ways to experience the city with a different perspective. In any case, the ability to observe closely and think beyond the immediate reality is indispensable. Aspiring to have more people become artistic and creative in their everyday life, this project is about enabling people to unveil the less noticed side of a city by designing a fun wandering journey. The unique design challenge is to provide an interactive framework for a subjective perceptual experience, to respond to which, a sensory mechanism for attraction detection is introduced in the coming sections.

4.3. Wanderer's Antenna

Wanderer's Antenna is a head mounted sensory augmentation device that transmits "energy" between wanderers and places. Metaphorically, the move-

ment of each wanderer is detected by the Antenna which then generates currents in the space, forming attraction zones around the places of a target location. At the same time, the Antenna allows wanderer to receive signals from a nearby attraction zone and guides him towards the location. Technically, the device needs two functional components:

- **a detector** which locates the nearby attraction, calculate distance and compass bearing based on the user's real time location and heading;
- **a receptor** which transforms those information into sensory feedback, sending the user navigation cue sand proximity alerts.

There are three main interactive steps lead the users to new discoveries: searching, approaching, and identifying, each designed with two principles to encourage active engagement.

- **Create movement and foster bodily experience:** The Antenna ought to trigger physical actions that expand the possibilities of the wanderer's interactions with the environment, including choosing a different path, walking into a new area, taking irregular actions, looking at different things, etc.
- **Allow maximum freedom of interpretation:** All the unusual actions mentioned above need to be empowered by one's own thought and imagination in order to lead to new awareness and discoveries. Wanderers observe in solitude. And the freedom of mind is what keeps solitude alive in a connected world.

4.3.1 Detector

As stated in Chapter 3, the wanderers create meaningful connections with the surroundings through walking and gazing. Given that the vertical head movement is correlated with walking velocity [26] and that head orientation provides reliable clues about one's visual attention shifting [1, 4], the Antenna can read many information about a wandering experience from one's head movement data paired with geolocation, such as estimating the wandering state (browsing, wayfinding,

Figure 4.2: Conceptual imagery

gazing, etc) and identifying one's spatial relationship with certain location. The current is a a visualization of detected head movement, represent how wanderers interact with the space overtime. Instead of transforming one's behavioral data into semantically meaningful information to determine the significance of each action. The currents are created solely based on one's movement. Previous study shows that walking speed during casual strolling can be analyzed to predict one's real time curiosity level [42]. The Antenna captures not only one's walking speed but also the direction of one's gaze. The wanderer's gaze gathers "energy" around a place, forming an attraction field. The longer a wanderer look into something, the stronger the attraction field becomes.

4.3.2 Receptor

The preliminary study concludes that the best wandering experience requires external intervention to nudge people into "randomness" and a certain level of

ambiguity to allow free-will and develop intuition. Destination-oriented turn-by-turn navigation provided by most GPS devices is too restrictive for a wandering journey. The energy sensing and attraction alert mechanism is conceptualized as an alternative wayfinding solution which requires the wanderers to actively find their way towards certain locations and at the same time allows some level of freedom so that they can make their own discoveries.

The concept of this mechanism is inspired by the use of trail pheromone in the ant colonies' foraging behavior which allows randomness in individual behavior to contribute to a collaborative effort. The foraging process starts with individual "scout ants" going into random environment searching for unknown food sources. Once a source is located, the scout ant starts heading back to the nest and marking pheromone on its way. Upon its return, fellow ants will notice the discovery of a new food source and depart their own food searching journey by tracing the pheromone signal. Instead of receiving information about the exact location, ants have to read the signal and determine where to go based on their own experience. Since pheromone evaporates over time, the shortest and most visited path between the nest and food source will have the strongest signal and attract more nearby ants to join a food transporting army. Whereas in an area where the pheromones are scarce, individual ants resume random action until they find a new food source [35]. The foraging network of ants demonstrates how random action and organizational communication interact in a well-established optimization process. Three features of the trail pheromone are especially enlightening: First, trail pheromone is secreted onto the surface leading to the food source and only detectable from immediate environment. The advantage of adopting such a passive signal in the context of wandering is that, in order to pick up signal from the space, one has to actively move the body to create more physical interactions with the environment. Second, as a communication tool, pheromone is more of a trigger of action than a vehicle of meaning. It does not contain any personal expression, but simply reflects the sender's physical state, allowing the receiver to create meaning solely based his/her own understanding of the situation. Third, the trail is constantly renewed. Wanderers' attention can be attracted by many things that are less permanent such as a street performer, a funny-shaped cloud or a dog lay in the sun. Having some signals fade and others intensified over time

will allow the Antenna to function in an organic network of attractions that better reflect the environment.

Combining those features, the Antenna enables a unique attraction finding process in which the technological intervention remains minimal until the wanderer physically approach a potential point of attraction. Through the Antenna, one can detect signals from a nearby attraction zone and sense its location. Instead of guiding one's attention towards a specific object, the aim of the alert is to motivate closer observation. Without being told what exactly the intended attraction is, the assumption is that after receiving the notification, one will try to identify the target by looking around and pick out something they appreciate the most with their own interpretation. The attraction alert also introduces other's subjectivity into one's wandering experience, offering a unique opportunity for the wanderers to look at a place through other's eyes with one's own imagination.

4.4. Iteration

Based on the initial concept, digital solutions were proposed for each interactive step. The optimal solution was determined through rapid prototyping and testing. This section documents the iterative process and discusses new inspiration and insight which led to a refined concept.

4.4.1 Detector

While movement detection and data mining techniques are not the main focus of this project, it is important to first confirm whether a wanderer's point of interest can be identified using head movement data and consider the possibilities of how to represent the city through the wanderer's movement.

Prototyping

A rapid prototype was created to conduct a pilot experiment, using an iPhone, and an iPhone pouch sewed on a cap. The iPhone was installed with a sensor data collecting app "snsrlog" to record GPS and compass data with its onboard sensors. The pouch was fixed on top of the cap, aligned to the center so that the iPhone

can correctly detect one's compass bearing. Figure 4.3 shows the components and implementation of the prototype.

Figure 4.3: Motion detection prototype

Testing

A experienced wanderer Y was invited to take a wandering trip wearing the movement detector. After the trip, she was asked to first list everything she finds interesting on her way and then identify the locations of those places using Google Street View. At the same time, the GPS and compass data recorded from her trip were visualized into an animation, showing the horizontal head movement during the trip and a heatmap, showing the length of her gaze on both side of the street.

Findings

The animation and the heatmap each represents the dynamic and static view of a wandering experience. By looking at the animation, even though no explicit geographic information was presented, Y was able to recall her action at specific moment solely based on the movement. And for the others, animation shows

certain relationship between the wanderer and the space, provokes imagination associated with the urban landscape. The heatmap, on the other hand, better reflects the overall experience. By comparing the locations pinned on Google map and the gaze density on the heatmap, it was encouraging to find that all previously stated points of interest were reflected (see figure 4.5). There were two points of higher gaze concentration that are not listed as attraction. One was the starting point where Y was adjusting the movement detector. Another one reminded her that she was watching the train for a while.

This experiment led to the conclusion that the prototype was effective for movement logging purpose. A head mounted compass sensor with GPS could not only provide valid information for identifying one's points of interest but also have potentials to reveal many other human environment interactions during a wandering experience.

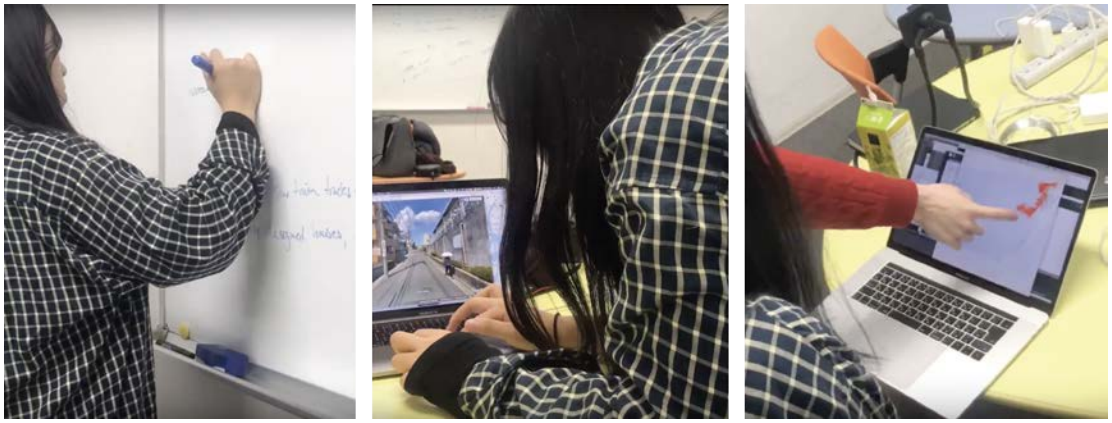

Figure 4.4: Motion detection test

4.4.2 Receptor

To enable the wanderers to receive signals from a nearby attraction zone, the Antenna needs a digital receptor to transform one's spatial relationship with the target into comprehensible sensory information. Two solutions were considered and tested.

Figure 4.5: Heat map of gaze concentration created by Hiroyuki Kondo

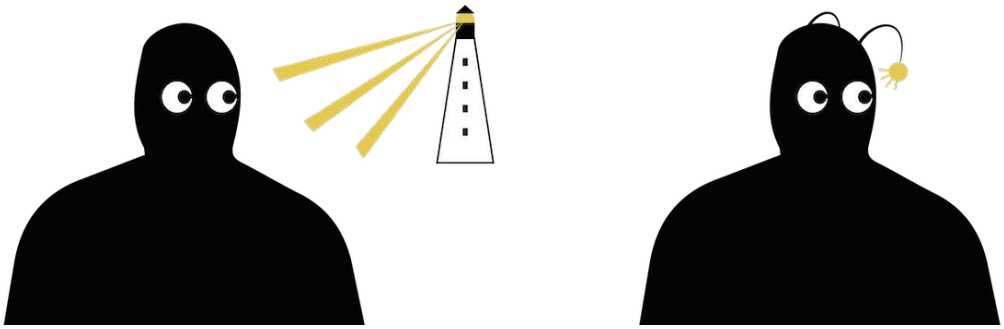

Figure 4.6: Peripheral light as a personal lighthouse

Peripheral Light: Personal Lighthouse

Although vibrotactile signal has been tested as an effective navigational solution, research shows that while tactile cues led to faster arousal times, visual cues stimulate faster attention shift speed [44]. Therefore, it was first considered to provide peripheral vision cues on both side of one's head as the interactive signal receiving solution. The peripheral cue is imagined as a personal lighthouse directing the wanderers towards new discoveries through a sense of adventure. In this prototype, the "energy" of a place is transformed into light. Based on one's real-time geolocation and compass bearing collected by the movement detector, the Antenna will determine whether an approaching target object is on the wanderer's left or right and send a flashing signal accordingly to shift his/her visual attention naturally towards the target place. The closer the target is, the faster

the light flashes.

Prior to any further development, a rapid prototype was created to test whether the peripheral vision cue is effective in an outdoor environment and how the interaction might affect the sense of discovery. The prototype is shaped as an actual pair of antennae made with aluminum craft wire attached to each side of the temple. The main circuit consists two digital RGB LEDs, an Arduino microcontroller and a BLE module produced by Adafruit. The LEDs are fixed at the tips of the antennae, connecting to the controller fixed at the back of the cap. Paired with a Bluefruit IOS App, the LED lights can be controlled wirelessly from a distance.

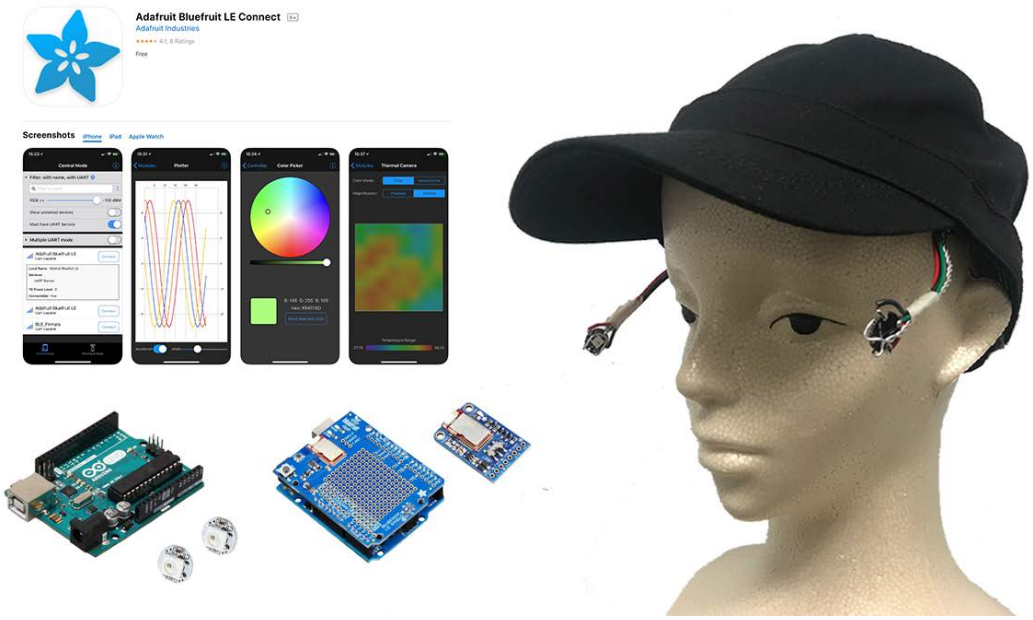

Figure 4.7: Peripheral light prototype co-developed with Hiroyuki Kondo

After some testings, it was concluded that peripheral light is not the ideal solution for the "energy sensing & attraction alert" interaction in the context of urban wandering for following reasons:

- One can clearly recognize the flashing signal when standing still, but the light becomes less noticeable as one starts walking especially while glancing at the other side. One possible reason is because that both the light and the surroundings are in motion which makes the light less distinguishable from

the background. The state of daylight or whether one is in the sun or not also largely affects the reception.

- The peripheral cue arouses immediate attention shift. The action of turning one's head is bonded with the expectation that after reacting to the cue, there will to be a prompt confirmation. Due to the lack of precision of GPS and the ambiguity required by the wandering experience, the interactive experience and the goal of this design seem to be incompatible.

- Engaging people to actively interact with the environment is one of the goals of this design, but the physical response created by the peripheral cue is more of a reflex than an active action. Moreover, the signal creates a left-or-right situation which allows less freedom.

Figure 4.8: Peripheral light testing

Although the idea of creating a personal lighthouse did not work out as expected for this prototype, it triggered some new thoughts that led to the second prototype. A lighthouse is a powerful navigational aid because for navigating the ocean where there is no street structure for turn-by-turn instruction, it is important to have a stable and constant reference point for mariners to adjust their own heading directions. In our everyday lives, we mostly receive navigational information suggesting direction responses and actions that are independent from the environment, such as "go straight for two blocks and turn left." This method of navigation is known as sequential egocentric strategy which relies on landmarks

and specific choice points to make directional decision. The egocentric spatial processing sees the world shifts every time the body turns as opposed to its allocentric counterpart which views the world as the constant and adjust the body accordingly. While urban space in an everyday context is defined by the sequence of events (go to the station and then take the subway to school), for wanders, it is very much like an ocean where they can explore freely. Therefore, instead of using linear representation of space as the "energy sensing" signal, the second prototype explores an allocentric navigation mechanism by introducing sound.

Binaural Audio: Audible Lighthouse

The second signal receptor prototype "Audible Lighthouse" is created to convert one's distance and angular rotation to a target location into audio signals. Like how mariners interact with the lighthouse, instead of receiving a sequence of directional cues, one has to read the signals and actively rotate their body to finally face the right direction.

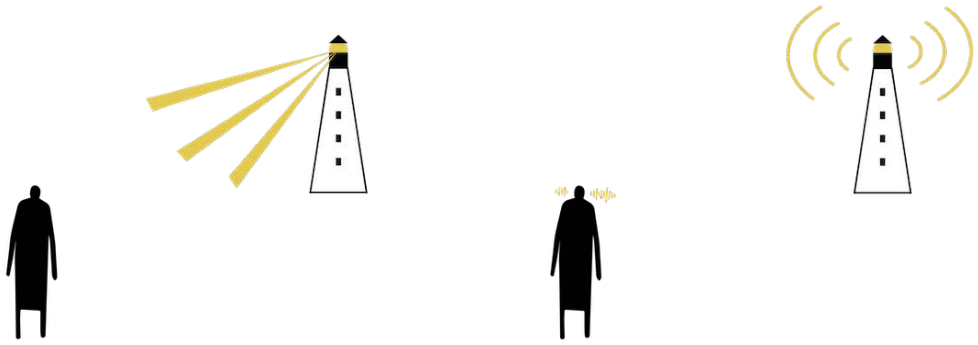

Figure 4.9: Audible lighthouse

To test whether one can identify the right direction solely based on nonverbal audio signals, a simulation computer program was created to control the sound by sending OSC message from Processing to Max. With the movement detector created previously, real-time data collected from the compass sensor are sent to Processing through an OSC app over wireless network. The data are then visualized as a rotating quarter circle at the center of a two-dimensional graphic representing the geographical space. A target place can be created by clicking the

mouse anywhere within the frame. After calculating the rotation angle between the one's heading and the target place, the Processing program will first determine whether the target is on the wanderer's left or right (left if the angle of rotation to the target is under counterclockwise 180°, right if under clockwise 180°), then send the OSC message through one of the two routes, signalL (signal for the left ear) and signalR to the port that is connected to MAX accordingly. The MAX program was created to generate a two channel audio output. It receives a numeric input from OSC and uses it to set the oscillator frequency of a periodic cosine wave which creates the sound.

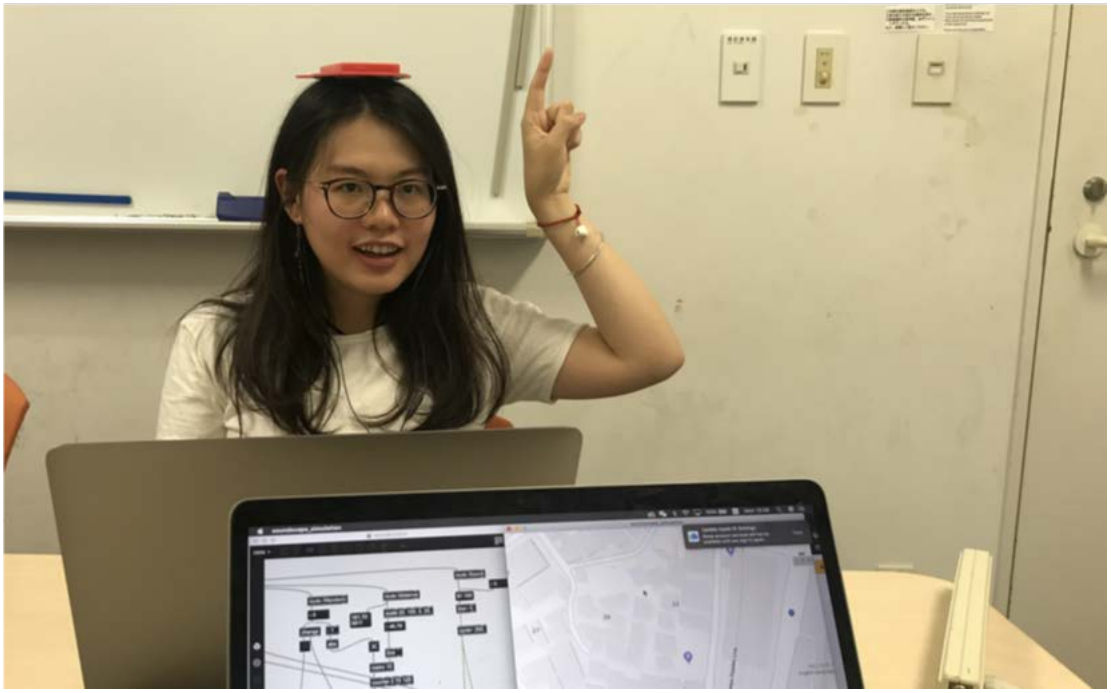

Figure 4.10: Binaural audio testing

Wearing the movement detector and earphones, one can hear a one-tone sound from one side of ears indicating which way to rotate the head. The pitch of the sound changes from high to low as one gets closer to facing the target (as the angle of rotation approaches 0°). Once the sound disappears, it means the target is straight ahead. 10 participants were asked to try the prototype, all of them can identify the rough direction of an assigned target after getting used to the system. Some people adjusted faster than the others. The performance of three different

types of headphones, in-ear headphones, bone conduction headphones and ambie sound earcuffs[1] , were also tested to understand how audio output devices affect the sound quality and user experience. The test proved that sound can be used as a reliable feedback for an allocentric navigation system. It also revealed some problems that need to be improved in the next prototype.

- Most basic headphones come with a frequency response of 20 to 20,000 Hz, which is accepted as the average audible frequency range to human ears. However, the audibility of a certain frequency actually various largely depending on how the sound is transmitted to the ears. With the in-ear headphones, one can generally start hearing the change in pitch from 30 Hz. With the open-ear headphones, the frequency has the be set above 50-60 Hz.

- Instead of perceiving the sound as high or low, participants described it in terms of being loud or small. Although the participants identified a point of silence faster, they instinctively moved towards the louder sound and considered the loudest point as the right direction of the target.

- The switch from one ear to the other sounded abrupt because of the crackling noises caused by sudden changes in electric currents inside the earphones. To avoid interrupting the flow of the experience, the audio feedback has to be seamless.

4.5. Concept Revision

Developed upon the initial proposal of creating an interactive wandering experience with an intuitive attraction detecting mechanism, the concept of the Wanderer's Antenna was revised to incorporate sound as the sensory feedback. Combing the motion detector and the binaural receptor, the Antenna enables an immersive urban attraction seeking experience through an interactive audio system. Following the established design principle of engaging bodies and allowing freedom of interpretation, each interactive steps are redefined as below:

- **Attraction searching as an allocentric navigation experience:** Instead of providing turn-by-turn instructions towards a target place, the Antenna enables an allocentric navigation experience by transforming one's real-time distance and bearing to a nearby attraction into binary audio signals. The "energy" of a place is represented by the volume of sound. By actively moving and turning in the space, one can sense the "energy" and eventually arrive the designated area following the sound.

- **Undefined attractions:** An attraction zone is defined as a circular area within a customizable distance from a predefined location. When entering an attraction zone, the wanderer will receive an alert sound, and continue to hear the sound until he/she left. By representing an attraction as a zone instead of a point, wanderers are given more time and space to observe. Without explicitly specifying the target place, the Antenna allows the users to define their own attractions.

- **The wandering soundscape:** An Antenna can be tuned into different broadcasts or channels like a radio player. Each wanderer can receive signals from a existing channel, contribute to the channel by sharing movement data, and create original channels to share with others. The theme of a channel and the design of the sound should echo the ultimate mission of the Antenna, allowing the multiplicity of interpretation of a poetic urbanscape.

4.6. Final Prototype

The final prototype is developed to be used in an outdoor environment. Before mapping the actual locations of attractions, several adjustments and refinements were made to create a better orienting experience.

4.6.1 Sound

To avoid the problem of each audio output device having different individual frequency response, this prototype uses volume as the variable that changes according to one's movement while setting a universally audible frequency as the

constant. Each attraction zone is represented by a different frequency so that one can recognize the shift from one target to another.

Distance

Another variable in sound was introduced to represent distance. An effect of a humming sound going back and forth was created by oscillating the volume at a certain rate control by the distance. The closer one gets to the attraction zone, the faster the oscillation becomes.

Bearing

The audio feedback was smoothed out by altering the signal generating algorithm. Instead of dividing the space into two hemisphere and having each ear receiving signals separately, the new algorithm determines the 360° spatial relationship of both ears in relation to the target place simultaneously. In order to have the volume change in a seamless cycle, the peak and the valley of the cycle are first determined. For the right ear, the peak with the highest volume comes when the angle of rotation from one's heading is 90° to the target clockwise, which means that right ear is at its nearest point to the target. When one's facing the exact opposite direction, both ears receive the lowest volume. According to one's heading, the volume of the sound for each ear increases from the valley to the peak and fade to the valley, generating a 360° seamless audio feedback.

Attraction alert

Approaching the attraction zone, one first hear the oscillation accelerating followed by a a brass bell like "ding" sound, notifying the entrance to an attraction zone where a premarked attraction can be found. This specific sound effect also aims to accentuate a sense of joy at the moment of discovery. The sound echoes for three time and repeat every 10 secs until one leaves the field to create the feeling of being in the zone. Regarding whether to leave an attraction zone detectable after being visited, there were two narratives that support each side of the argument. On one hand, if an attraction zone is considered an integral part of the landscape like the nature or a monument, it should send out signals continuously. But on

the other hand, if we see it as a treasure whoever finds it can take it away, it should be hided so that one can move on to the next target. Both scenarios were tested in an outdoor environment and the results are discussed in next chapter.

4.6.2 Mapping & Signaling

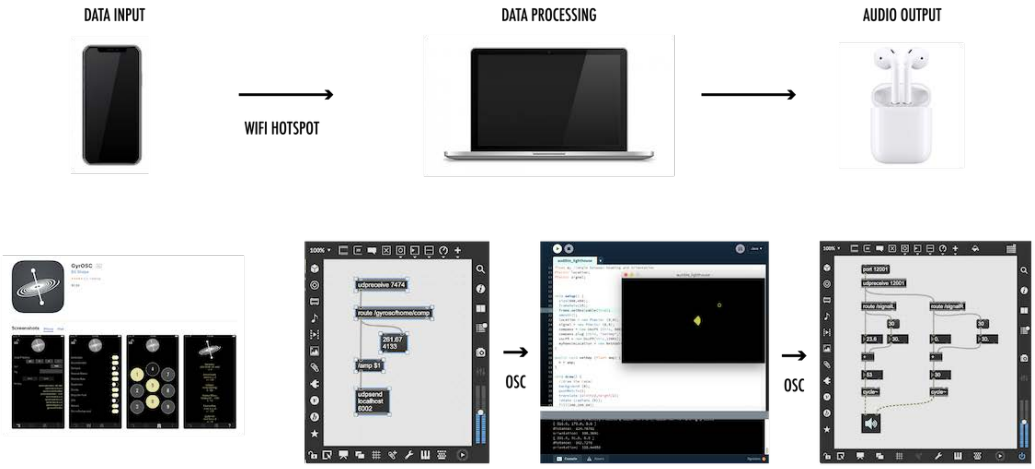

Figure 4.11: System overview

A map of an actual urban area is displayed on Processing. The size of the map is defined by the coordinates of the northwesternmost and the southeasternmost location of a given area. A list of coordinates of existing attractions within the area can be imported onto the map, displayed as a circle with a radius that can be adjust according to the scale of the map. With the GPS and compass data received from the movement detector, the real-time movement can be monitored on Processing while the sound signals are generated and sent to MAX through OSC. The information of whether a wanderer is in the circle of attraction zone is sent to MAX as a binary message, trigger the toggle object that turns on/off the attraction alert sound. The sound of the energy sensing feedback is tuned down while the wanderer stays inside the attraction zone and tuned up again otherwise.

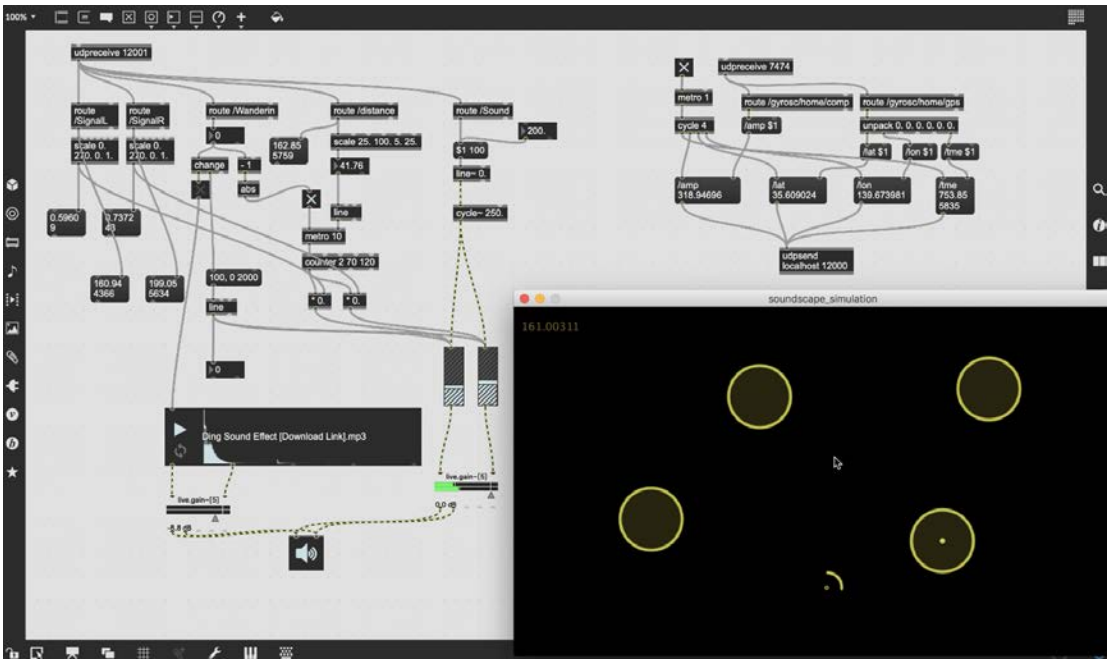

Figure 4.12: Final prototype sound control system

4.6.3 Mobile Solution

A mobile kit was made to conduct experiments outside. The iPhone used in the movement detector provides Wi-Fi hotspot for OSC connection. A laptop which runs the MAX program is connected to the hotspot and put on a "no sleep" mode to operation in a backpack. The final prototype adopts the open-ear headphones as the audio output device so that the wanderers can also hear sound for the surroundings.

Figure 4.13: Final prototype

Chapter 5

EVALUATION

As an alternative solution to turn-by-turn guidance systems, audio-based implicit navigation has been proved as an effective way to allow people to explore a place of their own free will. The concept of "audio scents", proposed by Komninos et al. and Stefanis et al. [34] and the "locative audio“ platform[1] are similar approaches using sound both as a guidance system and a narrative expression to augment place perception. While previous research mainly focuses on the routing decision and/or aural perception during a navigation experience, the Antenna is designed to trigger physical action through sound. By engaging not only visual and auditory senses but also the body, it provides a unique platform to study the connections of the body and the mind or action and perception of urban wandering as a perceptual experience.

Through the iterative process, the interactive functions of the Wanderer's Antenna were proved to be effective with a indoor simulator. This chapter describes the experiment which reevaluates its performance in an outdoor environment with actual urban attractions and discuss the results, particularly focusing on how the Antenna affects participants' actions in public open space and their perceptions of urban attractions.

5.1. Measures of Success

The goal of this design is to trigger physical interactions that leads to discoveries through an interactive wandering experience. The effectiveness of the final

prototype of the Wanderer's Antenna is validated with following criteria:

- Whether it can guide one towards a intended location.
- Whether it creates unusual movements in the urban space.
- Whether it leads to new discoveries.
- Whether the overall experience is enjoyable and thought-provoking.

Besides assessing the performance of the prototype, the experiment also intends to use the Antenna as a tool to study one's perception of the urban environment by analyzing each participant's interpretation of urban attraction.

5.2. Experiment Settings

5.2.1 Location

The Antenna is designed to be applied to many different scenarios. Since the goal of this project is to understand how it creates an experience that is different from everyday activities, this particular experiment was conducted in Hiyoshi, Yokohama, a place that is familiar to all the participants. The neighborhood homes Keio University's Hiyoshi campus, a residence area and a shopping area with a department store and many small businesses. The test area is mapped with Hiyoshi Motomachi 1-Chome Park[2] as the northwesternmost point and Keio Athletics Field[3] at the southeasternmost point.

5.2.2 Conditions

To understand how ambiguity affects the experience, 8 participants were tested under two different conditions. 4 participants experienced the Antenna without any explanation about the attractions or any theme. The rest of the participants were given the options of two themes which describes the attractions in an ambiguous way. Each condition has a selection of three attractions, some are eye-catching and others less obvious.

Condition 1: Unknown attractions

Three attraction spots were selected with some level of subjectivity for their subtle but unique qualities:

1. A bar with an orange facade. There is an ashtray on its outdoor window bar counter. In the morning, when the bar is not opened yet, many people who's probably heading to station stop there for a cigarette break.

2. A road that does not exit on the map. A path connecting two streets is formed on a slope covered by a mini jungle between two building which is a view that's rarely seen in a city.

3. A seemingly ordinary street with a traditional Japanese garden on one side and a European styled house on the other side.

Condition 2: Themed attractions

The two themes are created with the same principle, a universal subject matter elaborated with an ambiguous quality so that all participants can relate to the theme but interpret their findings based on their own understanding. The first theme "Nature always finds its way" features the coexistence of the nature with its urban environment:

1. The mini jungle path described above.

2. Ivy connecting a white building with a utility pole.

3. Weeds growing through crack in a concrete wall.

The second theme "Color me happy“ intends to encourage the participants to connect colors on the street with their own emotions. The three spots are:

1. A stair painted with pastel colors.

2. A sky blue house with a pink garage door.

3. A bright yellow door with geometric decorations.

Figure 5.1: Theme 1: Nature always finds its way

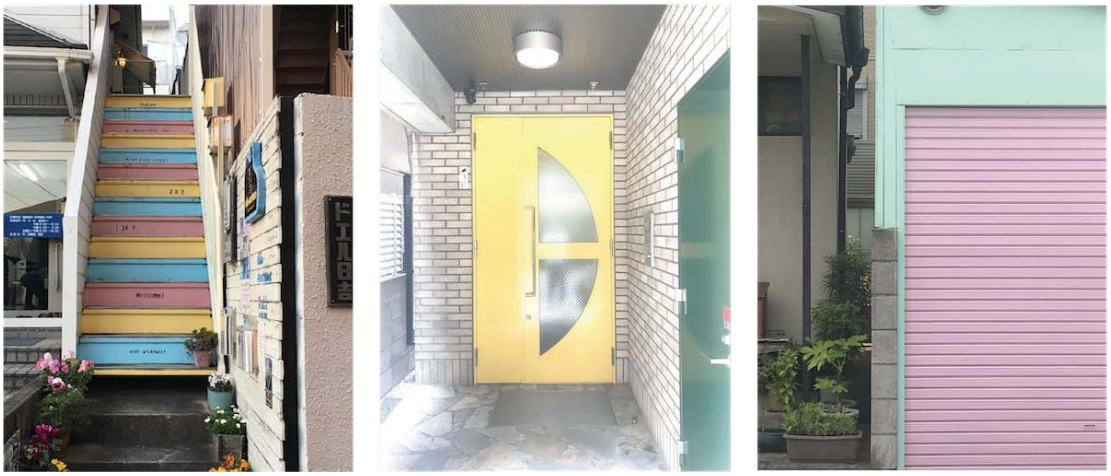

Figure 5.2: Color me happy

5.3. Procedure

5.3.1 Pre-experiment instruction

Before the experiment, participants received different instruction. Those who were tested under condition 1 were told to explore freely and use the Antenna as a hint for new discovery. No further information was given about the attractions. In addition to the instruction, a pre-experiment interview was conducted to understand what aspects of urban environment attract each participant the most

when they walk on the street.

For condition 2, participants were presented with a written description of the Antenna: "Wanderer's Antenna is a location-based interactive tool created to transform the act of wandering into a connected experience of urban rediscovery. Each wandering journey is provided with the theme featuring certain aspect of the urban environment. A theme can be something tangible, like an object, a symbol, or something abstract, like a mood or a poem. Each theme is a curated collection of location where wanderers found attractions that resonate with the theme." As well as a step-by-step instruction about their upcoming journey: "1. Select a theme and start your journey with the Antenna. 2. During a trip, the Antenna will pick up signals form the nearest attraction and guide you towards it. 3. When you enter an attraction zone, you will hear the sound of discovery. Observe carefully and take a picture of your own attraction. 4. This journey is not just about finding the attractions. You can take pictures of things that draw you attention anytime during the trip, share your own attractions of the same theme and create your own themes for more discovery."

After the instruction, all 8 participants were demonstrated with the indoor simulator and explained what each sound signal indicates and then guided to the starting point of their journeys where an outdoor orientation was conducted to help the participants adjust in the actual urban environment and set the system volume. Before departure, participants were equipped with the mobile kit and asked to prepare their own cellphone to take pictures of what they believe to be the intended attractions and set a 15 minute timer. During the trip, participants were observed from a certain distance.

5.3.2 Post-experiment interview

After the experience, a semi-structured interview was conducted. The interview questions and procedures are same for all participants: 1. Draw a map of the journey while describing it. 2. Identify each energy zone on the map and describe the attraction. 3. Describe the experience in 3 words or phrases. 4. Share new discoveries and new understanding. 5. Review each interactive step.

5.4. Results and Discussion

Based on close observation, data collection and interview. Results and insights are summarized to respond to the previously stated validation criteria.

5.4.1 Effectiveness as a Navigation System

The first participant N was tested with a sound system which adopted the narrative of the energy field being a constant quality of a place. After left the first energy field, he tried to find the next one, but ended up coming back to the same place for three times (see figure 6.1). After left the place for the second time, he tried to walk away further from the place, but several turns later he found himself walked into the same block again. After the experiment, he said he felt trapped and lost going back to the same place over and over even though he walked the same street almost everyday. For the third time, he did not realize he was heading back to the same place until he was only one block away.

Figure 5.3: Participant N coming back to the same place

The effect of having people coming back to the same place despite their effort to move on was unexpected but fascinating. It proves the Antenna's interference in the everyday spatial reckoning. With further development it might lead to other interesting applications, but for this experiment, it is more important to guide the participants through multiple targets. After the first participant, the sound system was switched to the other narrative in which only undiscovered attractions are detectable. After the adjustment, 6 out of 7 participants were able to find two or three fields in 15 minutes with different routing. At the beginning

the trip, participants spent more time pausing and reorienting but appeared to be more comfortable with the system towards the end of the trip. 2 participants mentioned that they had difficulties reading maps but find it more intuitive to navigate with sound. The results have not only proved the effectiveness of the interactive audio system designed for this prototype in an urban context, but also demonstrated its potential for various other spatial guidance applications.

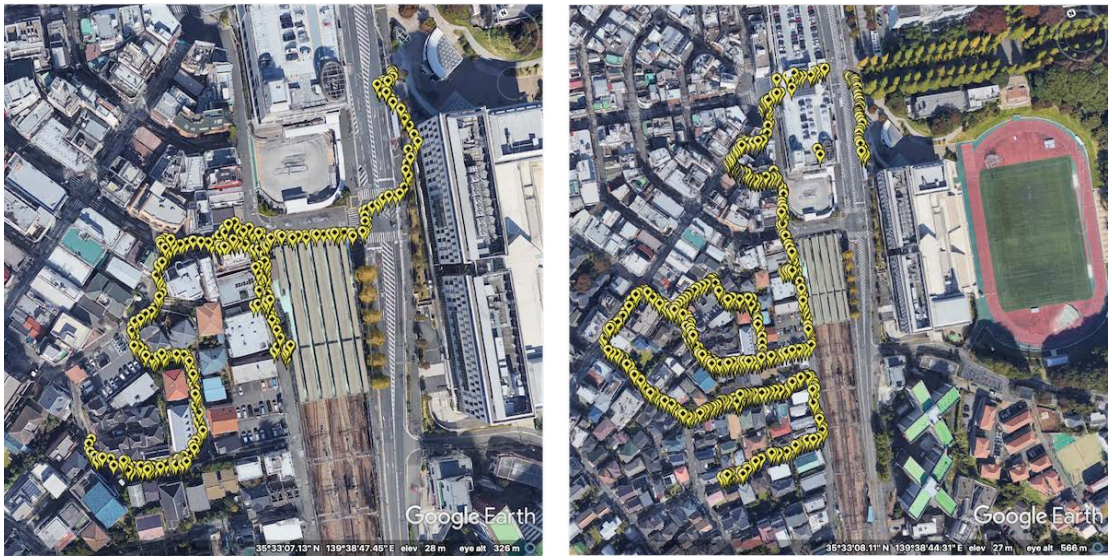

Figure 5.4: Tracks by two participants who experience the same map.

5.4.2 Movement and Action

As a part of the wayfinding effort, participants have to rotate their head and turn their body frequently to reorient them selves. Different from a turn-by-turn navigation which only requires directional decision at each crossroad, the Antenna provides an audio feedback that is independent from the street structure. As a result, many unusual behaviors were observed. For example, in a situation as figure 5.9 shows, when the participant was only one block away from a target attraction, as she passed the point where the attraction was straight to right, she heard a strong signal from the right the with intense oscillation. So she suddenly stopped in the middle of the street and faced the wall of the building next to her as if she could penetrate it. The same reaction occurs repetitively

for many participants especially when there was no easy access to the other side of a block. The urge of going to the other side also led the participants to some routing decisions that one might not make in everyday life like a small valley or a dead-end street (see figure 5.6).

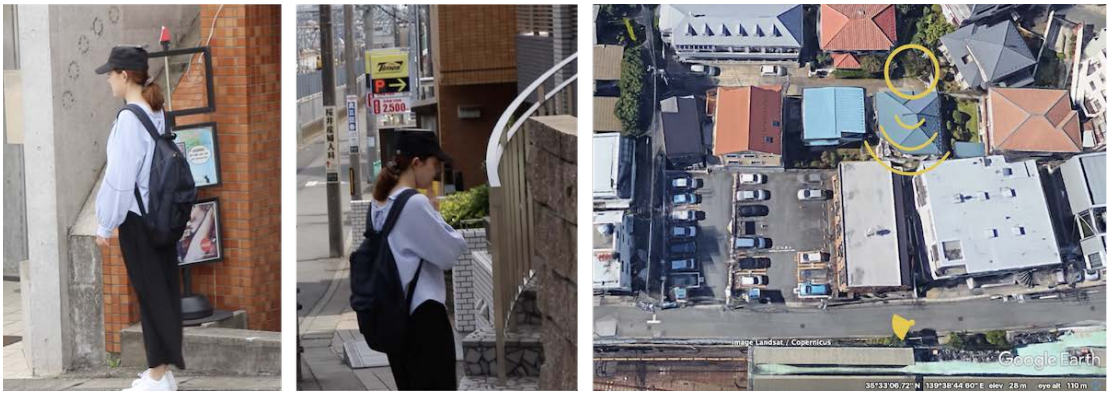

Figure 5.5: Participant M orienting towards a nearby attraction

Figure 5.6: Participants walk into unusual paths

Another interesting finding was the participants' interactions with the others in the public space. Unlike a touristy area, Hiyoshi represents the kind of the urban environment that stages people's everyday life. The actions of pausing and turning in the middle of the street, gazing at mundane things, or taking pictures of random objects made a sharp contrast with the dynamic around and brought certain attentions to the places they interacted with. Figure 5.10, for example, shows a group of teenagers gathering around some flowers after a participant took

a picture of them. During the interview, 4 participants specifically mentioned that they felt special wearing the Antenna. One participants said normally he would feel obligated to act the same as others in the public, but with the Antenna, he felt he was allowed to behave differently. Adding to the original vision of uniting the wanderers into connected force of urban rediscovery, this experiment shows the performative quality of the Antenna and it's potential to influence others by endorsing hidden attractions through the wanderer's action.

Figure 5.7: Left: photo provided by the participant. Right: teenagers look at the same flowers.

5.4.3 Perception of Attractions

Each participant's perception of attractions and sense of discovery was analyzed through the map the draw, the type of attractions they discovered and the language they used to describe them. The purpose of structuring the experiments with two conditions is to test how freedom and constraint affect one's observation and interpretation.

Condition 1

The pre-experiment interview shows that four participants are attracted to different things when they take a walk in the city. N likes parks and nature. H pays attention to shops and flowers in the spring. C enjoy looking at stickers

and posters. A does not have a specific interest but find herself drawn to the overall atmosphere or view of a place. Their personal interest was reflected in their choices of attraction. Except for A who believed decided not to follow the audio signal at all, all other participants entered the first "energy field" where the ash tray on the window bar was. N identified the attraction as the ajisai (Hydrangea) flowers on the other side of the street. He was quite sure the ajisai was the intended attraction because in Japan it was the season to see ajisai. H did not find anything interesting around the place but thought it might be the used bookstore although it was closed at the time. She said if the bookstore was open she would like to walk inside. C was not sure what the attraction but found a stair between two buildings intriguing. She also spent sometime reading the menu of the restaurant next to the bar. H and C both arrived the street with a Japanese and an European house. H noticed both the Japanese garden and the European style house and described a tiny orange flower she found in a garden which she never saw before. C on the other hand, paid less attention to the houses but found a bicycle parked right below a "No Parking Bicycle" sign where ironic and interesting. Only C found the mini jungle and told herself that must be one of the attraction before hearing the alert.

All 3 participants said that they were led the place that they have never been before and discovered something new during the trip that surprised them. Except for things they discovered in the "energy zone." N was surprised to see a welding mask under the traffic light. C was attracted by a well-designed modern apartment. H was excited about a designer leather goods store and said she never expected to see a designer store in Hiyoshi. To the contrary, instead of following the Antenna, A repeated her routine walk and visited a pet shop she like. She did not find anything new and said that's because she know Hiyoshi too well.

Condition 2

Condition 2 aims to study how the theme affects one's perception of a place and how each participant contributes to the theme. Participants J and M chose "Nature always find its way", they both first found the mini jungle. J described it as a place which looked abandoned but in fact was carefully kept in balance with the house and the shop next to it. M was excited about a ladybug she encountered

saying it was the first time she saw a ladybug in years (see figure). Unfortunately at the beginning of the trip, M spent longer than the others to get used to the sound, her experiment ended while she was heading to the second attraction. J on the other hand, discovered many attractions on his way from the first attraction to the second. During the interview, both J and M said they were surprised by the coverage and diversity of plants in Hiyoshi. J was especially interested in the relationship between nature and the households in the neighborhood. He found many people were out in their garden watering their flowers at that time of day. Through observing gardens, he also paid attention to different styles of houses and garden decor.

Figure 5.8: Photos by two participants at the same location

Participants O and S chose "Color me happy" and both of them completed all three attractions. The colorful stairs were identified by both while S also found a sky blue car nearby. The second target was less obvious so both participants pointed out something different. a mural painting and a red mail bike. S actually

noticed the yellow door because yellow was her favorite color but the sound came after it so she did not think it was the intended target. For the third target, S identified the building with a pink garage door while O was attracted by some ajisai flowers. Both O and S knew Hiyoshi very well but felt the experiment gave them a refreshing perspective. O saw many mural paintings and graffiti. She also paid attention to all different kinds of flowers and realized people live in Hiyoshi might have a special passion for gardening than other place. S who lived in Hiyoshi 30 years ago and currently work there said she used to picture Hiyoshi mainly as a place with the university and many restaurants, but through the experience, she discovered the other side of Hiyoshi, a lovely place with many cute houses. During the trip S was also reflecting about the colors she like and realized in every period of her life, she had a different favorite color and the society as a whole also had some preferable colors.

Figure 5.9: Photos taken by participants

Freedom Vs. Constraint

For both condition, the Antenna was able to draw the participants' attention to less noticeable aspect of a city. Many identifies attractions that are different from commonly perceived urban places. Some are temporary or seasonal like flowers or cars, some are situations (bicycle under the sigh) instead of objects. Condition 1 allowed participants to explore more freely but in a less reflective way. With zero clue, participants follow their own interest instead of trying to decipher what the attraction is. In this case, the Antenna was effective in leading the participants

to new place and increasing physical interaction, but it was up to the participant to create meanings to their own discoveries. Condition 2 give each participant a focus which challenges their overall impression about a place and leads to some new understandings. Targets of larger scale and more obvious connection with the theme are easier to be identified whereas smaller or more subtle targets encourage longer stay and more observation. While condition 1 reveals more about one's personal interest, condition 2 was more successful at encouraging active meaning-making. The experiment demonstrated how freedom and constraint complement each other in defining an ambiguous quality of a urban place. It is important to incorporate both to foster a creatively engaging experience.

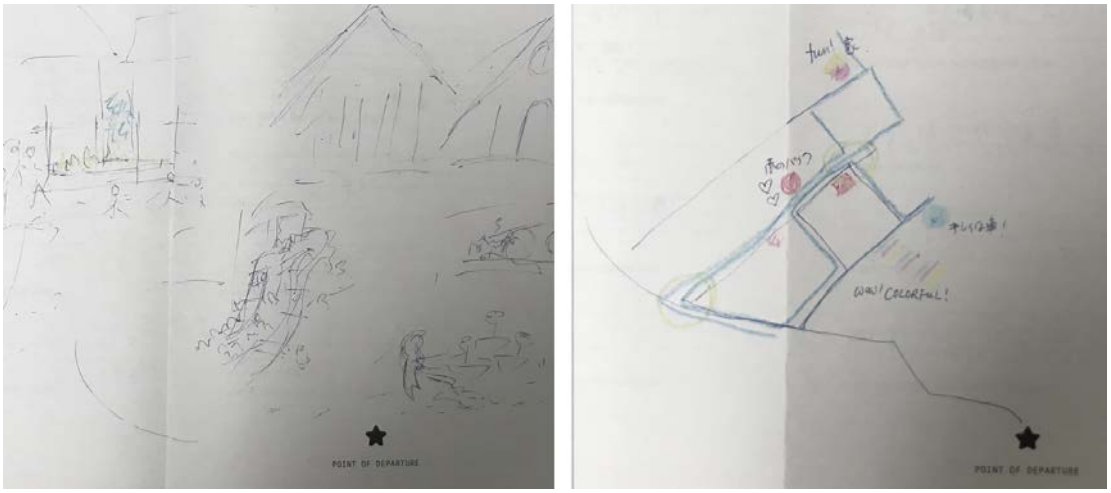

Figure 5.10: Drawings by the participants

5.4.4 Interactive experience

Attraction searching

The audio guidance was positively received and described as special sensory experience. One participant mentioned gaining a broader vision by rotating himself. Another described the sound as a pulling force that accentuated the act of searching. However, many found themselves too concentrated on the audio signal. On one hand, the concentration was what makes the experience different from an everyday activity. On the other hand, it may distract people from their

visual experience. The audio feedback for this experience was programmed in a way that participants constant receive signal to make sure they all reach multiple attractions in a limited time. For a better experience, it could be improved by increasing the numbers of attractions and restricting the distance of signal reception for each one. Many also suggested to use music or ambient sound instead of the single tune sound. Although sound was intended to be kept as a neutral sensory input in this experiment, sound design will certainly be the focus of future development.

Attraction Zone

The "attraction zone" with the attraction alert sound effectively encourage people to stay longer and pay closer attention to their environment under both condition. But the joy of discovery was stronger for condition 2 than condition 1. The experiment showed that the timing of the first "ding" sound is very important. The intensified oscillation gradually builds up the expectation and gets one excited. And the sound will maximize the joy of discovery when participants were visually attracted to something at the same time. Both O and S saw the colorful stair almost simultaneously as they heard the "ding!". The perfect timing and the obvious matching made them believe that must be the attraction. M found the ladybug the moment she heard the "ding" sound. Although she understood the ladybug was probably not the intended target, the sound affirmed her own sense of discovery. O said that not knowing the border of the "energy field", she was scared that she might exit the zone before finding the attraction. On the other hand, S and J mentioned that there were times when they saw something that perfectly matched the theme, they wished they would hear the sound. The unspecified attraction invite each participants to interpret freely and contribute with their own observation and understanding. Most participants preferred not knowing the intended target but would like to know it and other people's attractions afterwards. Participants were also positive towards the idea of being able to contribute and share.

Overall experience

Each participant was asked to described the experience with three words or phrases. 5 out of 8 participant expressed the joy of the experience using the word "fun“ or ”happy“ or both. 5 out of 8 described aspect of their experience as "unfamiliar","refreshing","rediscovery". 1 participant found the experience confusing but also described sound of her encounters during the trip as "unexpected". Other words include "contrast", "focus", "personal time", "leisure" , "sound", etc. Many of those words demonstrate feelings that are related to the three main sources of fulfillment of wandering discussed in Chapter 3 – the joy of discovery, a sense of awe and wonder, and the luxury of being alone.

In order to understand whether the Antennae communicated its mission, participants who experienced the themed condition were asked to create their own theme. Here is a list of what they proposed:

1. Scavenger hunting games for children.
2. A theme which lets adults to experience what children found exciting in the city. We might find out that the rumors are true, there are things that only children could see.
3. A trip to see Japan through foreigner eyes.
4. Places with good view.
5. Places where one can hear natural sound.
6. Places where one can rest and relax in public.
7. Places where people can find beautiful Noren.
8. Places to find interesting materials in the public.
9. A network to locate homeless people so one can support them with daily necessities.

All the proposals echo the design objective of encouraging people to delve into the less noticeable or marginalized aspects of the urban environment, which proved the Antenna's effectiveness in communicating its own concept through the experience.

Notes

1 http://locativeaudio.org/

2 1-12-23 Hiyoshihoncho, Kohoku-ku, Yokohama-shi, Kanagawa-ken 223-0062

3 2-1-7 Shimodacho, Kohoku-ku, Yokohama-shi, Kanagawa-ken 223-0064

Chapter 6

Conclusion

6.1. Conclusion

Aspiring to bridge the artistic experience with everyday life, this project has been a continuous journey exploring how to use HCI technique to foster interpretation and communication of ambiguous matter in the context of urban wandering. Knowledge and insights about various aspect of the act of wandering have been gained through the design process, which not only laid the groundwork for this design but also led to a deeper understanding about how body and mind co-create meanings by interacting with the environment.

This thesis presents an effort to transform urban wandering into a connected experience of urban rediscovery. In order to enable the experience, a sensory augmentation tool, the Wanderer's Antenna was designed through an iterative process which defined the optimal solution for each interactive step. The key concept of Wanderer's Antenna is to create an experience which activates the body and frees the mind so that the users can rediscover their physical surroundings with their own interpretation. The experience is enabled through a interactive technique which transforms one's real-time location and heading into binaural ambient sound feedback. The concept was evaluated with a working prototype under two conditions, using the Antenna to search for unknown attractions and themed attractions. The promising results have shown that under both condition, the Antenna is an effective tool for breaking daily routine, encouraging observation and evoking original interpretation. The experiment also revealed that incorpo-

rating freedom and constraint is the key to stimulate active meaning making under ambiguous situation.

Figure 6.1: Participant in the attraction zone

6.2. Future Works

The Antenna is created as a highly customizable interactive platform. Towards a marketable product, content development will be the key to its success. Through the experiments, the Antenna has demonstrated its performance and narrative potential which led to the idea of developing the product as a tool for immersive theatrical experience in an urban setting. By seeking collaboration with performing artists or theater company, the next step will focus on designing customized maps, interactive sound effects and different combination of physical actions based for specific environment or story. Regarding the future development of Antenna as a location-based social network platform rather than a terminal

device, the project will continue exploring the role of ambiguity in HCI design and extend the investigation from physical interactions to the representation and management of both personal and shared information.

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