

國立交通大學

---

應用藝術研究所

碩士論文

爲工作環境設計：賦予其情感與熟悉的溝通

**Designing for Emotional and Intimate Communication –  
Working Environment**

研究生 黃可薰  
指導教授 鄧怡莘教授

中華民國九十五年七月

為工作環境設計：賦予其情感與熟悉的溝通

**Designing for Emotional and Intimate Communication –  
Working Environment**

研 究 生：黃可薰

Student Ko-Hsun Huang

指導教授：鄧怡莘

Advisor Yi-Shin Deng

國立交通大學應用藝術研究所

碩 士 論 文

A Thesis

Submitted to Institute of Applied Arts  
College of Humanities and Social Sciences  
National Chiao Tung University  
in partial Fulfillment of the Requirements  
for the Degree of Master in Design

July 2006

Hsinchu, Taiwan, Republic of China

中華民國九十五年七月

## 中文摘要

社會結構急遽變遷，而在辦公環境裡工作的人們，所面對的則是快速發展的資訊科技和工作方式。台灣是亞洲平均工作時數較長的一個區域，隨著科技進步，原本面對面的交談，已逐漸被網際網路等新興媒體所取代。工作上溝通的方式改變了，同事間實際的互動逐漸減少，而人際關係也較過去薄弱。即使人們在同樣的環境裡一起工作，也因為使用、依賴不同的溝通媒體，而出現孤立或是分群的問題。日常的溝通從真實的世界轉向虛擬的資訊空間中發展。

同事們越來越不熟悉彼此，如何增進他們的人際關係變成一個重要的課題。也因此，對於長時間相處、一起工作的人們而言，提供一個具體並且感性，充斥著親密感、彼此存在感的工作環境是相當重要的。

本研究中，實地訪查的對象將是科技公司研發部門裡的工程師，他們負責開發新的科技製程或是軟體程式撰寫。他們目前所面臨的溝通問題，以及同事們在溝通中所在乎的一些細微感覺和需要，將由訪談和探針日誌法獲得。在了解其辦公室文化之後，不同領域專家和先前受訪的工程師將一起參與一個工作坊。就如何增進人際關係此一議題，討論各種潛在的解決辦法。並考慮如何適當的運用新興科技，來擴充人們在溝通中的知覺向度。隨著工作坊發展出來的各種概念，本研究將提出數種有著熟悉感介面的原型，除了作為聯繫人們資訊溝通的媒體，亦試圖去增進同事之間較感性的互動。隨後，再經由場域測試，評估設計概念是否符合人們在工作環境中的需求。

與他人的互動和情感聯繫使得人們感到寬慰和滿足，也使得人們的生活更有意義和完整。藉由對溝通脈絡深入的了解，若能在群體間傳遞彼此的存在感，似乎能使得人們彼此更為親密；而本研究所發展的溝通媒體，亦刺激了同事彼此之間更多的人際互動，進而探討人們的默契和不同感知的科技運用。

*關鍵字: 社會運算, 脈絡知覺, 社會互動, 熟悉感介面, 參與式設計, 探針日誌法, 場域測試*

## ABSTRACT

The structures of community are acutely changing, and people in an office environment face the rapid development of information technology and workflows. In Taiwan, a region with the longest working hours in Asia, social interactions between colleagues are gradually disappearing since most of the communications related to work is changing from in-person conversation to mediated e-mail through the Internet. This makes people in the same working environment either closely grouped or further isolated by choosing different web-based communication media. By degrees the daily communications take place in the virtual information space, rather than in a real world.

For the colleagues become by and by estranged from each other, how to promote their relationship is significant. Therefore, creating an embodied office environment with sense of emotional presence, intimacy, or closeness is definitely essential to people who work long hours together.

In this research, the field of study focuses on the Research & Development department, the engineers who explore and develop new processing technologies or system programs in Taiwan's high-tech companies. The communicating situations people are confronted with and the subtle senses or inherent needs in the social interactions between those colleagues sharing the same working place and communication channel are attained by dyad interviews and probe diaries.

After investigating those office cultures, a workshop is held with numerous engineers and designers from different disciplines, including industrial design, computer science and information engineering, mechanical engineering, visual communication. Those experts and the informants of earlier interviews have discussed the potential solution to enhance the interpersonal relationship in the working environment and consider a better application of emerging technology to broaden the directions of perception in communication. With the ideas out of the workshop, prototypes as communication installations with intimate and emotional interface are developed for various working space not only to mediate people's

informational communication but to evoke the emotional contact between colleagues. Then, through field trial and reviewing processes, design concepts to meet the needs of connecting people in the same office are explored.

The interactions and relationships with others are expected to make people relieved and satisfied, as well as make peoples' life meaningful and fulfilling. Through profound comprehension of the communication context, to convey an awareness of the presence of the community would connect them closely. In addition to that, the communication media developed in this research could also be expanded to increase the social interactions between people working together, and the application of technology to make people attuned to their colleagues in varies sense will also be discussed.

*Key words: Social Computing, Context Awareness, Social Interaction, Intimate Interface, Participatory Design, Probe Diaries, Field Trials*



## ACKNOWLEDGEMENTS

I would like to express my heartfelt thanks to the engineers, my classmates, and those who participated in this research, shared their experience of lives, and offered great opinions on the design issues. The previous study of probe dairies and interviews, and the design process, including the workshop and the field trial, couldn't be completed without their enthusiasm.

Thanks sincerely my supervisor, Professor Yi-Shin Deng, who always gave me nice suggestions and enabled me to overcome the difficulties and each kind of setback throughout the research. I specially thank Professor Jiunde Lee and Professor Ming-Huang Lin for their essential recommendations. Thanks also to Chia-Cheng Liu and Hua-Min Chang for their constructive suggestions.

Finally, I am grateful to my dear families for their firmly support and encouragement in these years.



# CONTENT

<b>Chapter 1</b>	
<b>INTRODUCTION</b> .....	1
<b>1.1 Background</b> .....	1
<b>1.2 Motivations</b> .....	2
<b>1.3 Objectives</b> .....	3
<b>1.4 Limitations</b> .....	4
<b>1.5 Outline of Thesis</b> .....	5
<b>Chapter 2</b>	
<b>LITERARY REVIEWS</b> .....	6
<b>2.1 Technology and Social Relationship</b> .....	6
<b>2.2 Connectedness</b> .....	8
2.2.1 Issues.....	8
2.2.2 Context Awareness.....	11
2.2.3 Intimate and Emotional Interface.....	13
<b>2.3 Research Methodology</b> .....	16
2.3.1 Dyad Interview.....	16
2.3.2 Probe Diaries.....	17
2.3.3 Participatory Design.....	19
2.3.4 Field Trials.....	20
<b>2.4 Summary</b> .....	21
<b>Chapter 3</b>	
<b>METHODOLOGY</b> .....	23
<b>3.1 Research Structure</b> .....	24
3.1.1 Investigation.....	24
3.1.2 Concept Design.....	26
<b>3.2 Research Issues</b> .....	26
<b>3.3 Recruiting</b> .....	29
<b>3.4 Participatory Design Process</b> .....	31
3.4.1 Workshop.....	32
3.4.2 Design and Evaluation.....	33

<b>Chapter 4</b>	
<b>FINDINGS.....</b>	<b>34</b>
<b>4.1 Interviews.....</b>	<b>34</b>
4.1.1 Factors in Social Interactions.....	34
4.1.2 Work and Leisure.....	36
4.1.3 Communication Media.....	37
<b>4.2 Probe Diaries.....</b>	<b>38</b>
4.2.1 Routine Activities.....	38
4.2.2 Communication Issues.....	39
4.2.3 Working Environment.....	40
<b>4.3 Summary.....</b>	<b>41</b>
<b>Chapter 5</b>	
<b>PARTICIPATORY DESIGN.....</b>	<b>43</b>
<b>5.1 Design Concept.....</b>	<b>43</b>
<b>5.2 Prototyping.....</b>	<b>45</b>
5.2.1 Prototype Design.....	45
5.2.2 Scenario Test.....	48
5.2.3 Preliminary Estimations.....	50
<b>5.3 Field Trial.....</b>	<b>51</b>
<b>5.4 Review.....</b>	<b>53</b>
5.4.1 Usage Circumstances.....	54
5.4.2 Perceptions of the Media.....	55
5.4.3 Customs and Trends.....	56
<b>Chapter 6</b>	
<b>CONCLUTIONS.....</b>	<b>58</b>
<b>REFERENCE.....</b>	<b>60</b>
<b>Appendix</b>	
<b>Appendix A: The Research Script for Dyad Interview.....</b>	<b>64</b>
<b>Appendix B: The Research Script for Probe Diary.....</b>	<b>68</b>
<b>Appendix C: The Research Plan for Field Trials.....</b>	<b>73</b>
<b>Appendix D: The Introduction for the Participants of Field Trials.....</b>	<b>78</b>



## FIGURE CONTENT

<b>Figure 1 Iso-phone</b> .....	10
<b>Figure 2 The relationship between social presence, awareness, and connectedness</b> .....	11
<b>Figure 3 Habitat</b> .....	13
<b>Figure 4 Left: Air, right: Passage</b> .....	15
<b>Figure 5 A probe diary</b> .....	23
<b>Figure 6 The research structure of this thesis</b> .....	25
<b>Figure 7 A probe diary includes two parts</b> .....	29
<b>Figure 8 A mind map of the colleagues’ working cultures</b> .....	32
<b>Figure 9 One engineer’s Diary. He wrote down the sentiments on communicating</b> .....	39
<b>Figure10 A working environment map drawn by Michelle, a female software engineer</b> .....	40
<b>Figure11 A bulletin board</b> .....	44
<b>Figure12 Linking Village</b> .....	47
<b>Figure13 Tree of Sound Track</b> .....	47
<b>Figure14 Fruity Air</b> .....	48
<b>Figure15 Testing scenarios with Tree of Sound Track</b> .....	49
<b>Figure16 Testing scenarios with Fruity Air</b> .....	50
<b>Figure17 Field trial in a high-tech company</b> .....	52

## TABLE CONTENT

<b>Table 1 The outline of dyad interview in the thesis</b> .....	28
<b>Table 2 Profiles of interviewees</b> .....	30
<b>Table 3 Profiles of working environment</b> .....	30
<b>Table 4 Prototypes</b> .....	46

# 1. INTRODUCTION

The culture, social structures, and interpersonal contact are acutely changing with the rapid development of science and information technology. In Taiwan, numerous people gradually get used to the novel digital media, and most of the communications are changing from in-person conversations to mediated mails or messages through the Internet and mobile telecommunication. The modernization of an office also changes the original job functions, and people in such working environment not only have to accommodate themselves with the tensional workflows with these new scientific and technical applications, but tend to get closely grouped or isolated by different choice of communication media.

## 1.1 Background

In a modern country like Taiwan, people get used to and adore some kind of life style. That life style seems to bring a distance between people since the new media through the Internet achieved by the emerging technology already changes their social manner. That distance is by and by disappearing and a sense of presence with their friends or family members becomes irrelevant to their embodied sensation. Besides, this artificial presence not only symbolizes an equidistant perception of one from others but neutralizes the people's inherent recognition of distance (Moles 1988).

Meanwhile, those opulent accessible sources of communication and interaction much surpass what people probably use in their whole lives, and overflow people's work place or home environment. People start getting used to communication depending on these new media, such as the Internet, wireless, or some kinds of mobile telecommunication. They become standoffish and unsociable since they turn into grouped or isolated by habitually using media. Therefore, an unexpected phenomenon comes out from the advent of novel communication devices. Even in a crowded workplace, the different usages of communication media could estrange people from their coworkers, and relationships between the colleagues

are frailer than those when they had some kind of embodied touch or conversations.

In a case of Research and Development (R&D) Department in high-tech companies in Taiwan, the engineers who explore and develop new processing technology or system programs get huge stress and work at fast tempo. As a result, their work might be creeping into their leisure time. Besides, the division of labor is explicit and project cooperation sometimes means to hold a team discussion once a week, but for the most part the engineers could finish their work independently. The airy interactions of coworkers seem less likely, and connections between the colleagues are quite slight actually (Diani, 1986; Tang, 2001).

It is believed as a fundamental need of humans to contact with others from time to time. Moreover, the interactions and relationships with others are expected not only to make humans feel consoled and satisfied, but enrich humans' lives. Recently, lots of research groups are devoted to enlarging the technology possibility to mediate people at a remote place by intimating interface or background awareness (Agamanolis et al. 2002; Vetere et al. 2005). However, these intrinsic needs such as subtle significance of presence or concern between people are also essential to who work in a long period of time together. Extending their research, it's been tried to conceive an emotional and familiar working environment of technologies and intimate experiences that build, maintain, and enhance the colleagues' relationships in a new way.

## **1.2 Motivations**

Along with the development of science and new technology, people are gradually used to the rapid changes of the communication media surrounding them. Especially in the regions, like Taiwan, where the digital products have gained popularity, people's culture, social structure, interpersonal activities, and values might be profoundly influenced. The social relationships in the community are therefore affected by those emerging inventions, and are needed to give a serious consideration and an inspection.

In the R&D department, engineers who work with huge stress in the high-tech companies do not have too much in-personal conversations with their colleagues for the explicit division of labour, and become isolated or grouped by the media they tend to use. That is to say, the colleagues who share the same workplace become estranged. Therefore, how to improve the gradually aloof interpersonal relationships between colleagues and make the atmosphere more cordial in their workplace is vital importance to them.

Considering the issues other fields have absorbed in, the development of new communication device to enrich people's lives could be expanded in many ways. For instance, the research field of the multimodal interface is on purpose to coordinate people's different senses, and the design issue of intimate interface is trying to express the artifact itself with some close and innermost experiences.

The ways to enrich people's lives deeply changed by the technology are quite urgent in a today's office. Therefore, one of the main issues in this research to be discussed is if the combination of these new concepts and applications of technology could create a friendly embodied working environment for the coworkers or develop a new communicating platform to stimulate the colleagues' interactions. In addition, based on the understanding of coworkers' fundamental needs in communicating, we sought to maintain the original association and friendly interactions between colleagues and to better the ambiance of their working place.

### **1.3 Objectives**

Today, with the advent of the emerging technology, the communication media change various phases of people's lives, including social manners and social interpersonal structures. In the research, via the thorough investigation into people's interaction and connection in their working place, the intrinsic need such as a subtle significance of presence, fundamental senses or feelings, and different interpersonal contact between the colleagues could be explored. Another various aspects of communicating are also examined and extended in a workshop, and those findings collected could create a lot of ideas for the design concepts of the new

communication media.

The main purpose of this research is to address on the development of design concepts and different types of communication installations to promote the intimate association of colleagues and to conceive some emotional concern. It seems very likely to increase the cordial interactions by the findings from the investigation of this research and the workshop with previous study participants and various experts of different fields.

In addition, we attempted to broaden the directions of people's perception in communication with an appropriate application of science and technology. The usage of communication is also evaluated in a workplace, and gives some ideas about the possibilities of communication technology for a future design. Besides, conducting a field trail reveals the real pictures of usage to communicate among colleagues, which might also be influenced or promoted by the prototypes.

In sum, the goal of the research is to find the ways to enhance the inherent relationships between coworkers and to make an emotional working environment comfort and to address some suggestions of the emerging technology applications and communication media design in the future.



#### **1.4 Limitations**

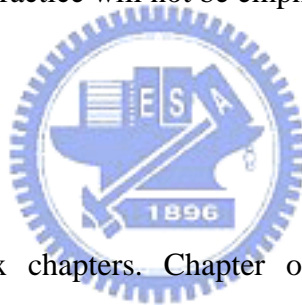
Nowadays, the ways to promote the relationships of friends or farther strangers by evolving the feelings of proximity and intimacy, or to apply new media to convey impressions of presence and togetherness between people are much essential issues. However, the advanced new technologies also change how the colleagues communicate each other. The occurrence of isolation or solitude between colleagues turns up even if they are in the same workplace.

In this research, it is focused on the engineers who work together over a long period of time in the R&D department of high-tech companies. The reasons that make the connections between these colleagues weaker are what it is aimed to comprehend. Hence, the research is

mainly limited to the investigation of the background awareness in social activities of these colleagues who work in the same place, the various phases of daily communications and the interpersonal relationship. This study mainly focuses on the promotion of colleagues' relationship, but the interactions between friends or family members out of the workplace are not examined in this study.

The design concepts for appropriate communication media to enhance the relationships of coworkers in the workplace are based on the sensational dimensions explored previously in the research and the outcomes of the workshop discussions. In the part of prototype design and trial, it is our aims to find out the activities those engineers get used to and a better interface to convey the intimacy and emotion. Owing to the limitation of time, the period of the field trial might be insufficient for exactitude. The usability and efficiency of operations and technology application in practice will not be emphasized in prototyping.

## 1.5 Outline of Thesis

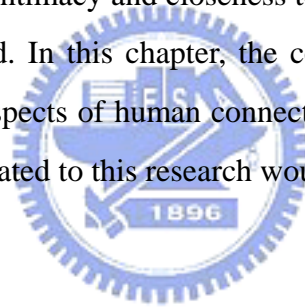


This thesis consists of six chapters. Chapter one, introduction, states the research background, motivations, objectives, and limitations. Chapter two, literature reviews, compares results from the researches in several different fields, such as human connectedness, including social relationship, emotional and intimate interface, the methodologies of user experience research, and participatory design. Chapter three, methodology, presents the research plan and the methods for research activities. In chapter four, the data of the user's experience research are analyzed and interpreted, and the findings collected are also included to assist in designing. Chapter five, participatory design, shows the process and the outcomes of the participatory design, and the design concepts of future communication devices are brought in through the field trials and reviewing processes. Chapter six concludes the summary of this thesis and some suggestions are provided for further studies on promotion design of embodied communication media.

## **2. LITERARY REVIEWS**

Interactions and relationships with others, which are essential needs for human beings, make people content and feel relieved or inspired. The development of technology has brought people convenience in communicating, such as mobile telecommunication and the Internet. That signifies a feeling of equidistance of everyone to everyone else and truly supports connections between one and his/her friends or family members at a remote place. However, these emerging media also influence the ways of social interactions, and bring some obsessions about recognition, but might have some effects of isolation on people.

Lots of research groups are studying for the issue of people's association and the way they've mediated through new technology. The way to conceive a new genre of technology and experiences, or a sense of intimacy and closeness to enhance the relationships in new way has been extensively discussed. In this chapter, the communicating phenomenon in today's society and several different aspects of human connectedness are reviewed and compared. In addition, the methodologies related to this research would also be introduced.



### **2.1 Technology and Social Relationship**

In an age of communicational opulence, people are aspiring to a way of life in which the distance existing between them and is becoming irrelevant to their realm of consciousness. A sense of presence built by technology signifies a feeling of equidistance of every from everyone else, and from one to any world event (Moles 1988). In other words, this artificial presence with friends or family members becomes unrelated to people's embodied sensation. It neutralizes the people's inherent recognition of distance. The interpersonal connections could be supported by the technology media. In addition to that, people might have at their disposal more sources of communication and interaction than they were ever able to use in the relatively short lifetime. Moles had also emphasized the fragility of this complex world continuously changed by technology between the abstract and the concrete. Technology

application must be required to conform to the programmed sensualization of the environment and reliability.

The abundant accessible sources also overflow people's lives surroundings, including their work place or home environment. In a modern region like Taiwan, many people start getting used to rely on those new media, such as the Internet, wireless or mobile technology, which supply a convenient communicating platform for the social contact. However, these emerging media not only change people's social manners, but also make them easily grouped or isolated by their customs and the different choices of the media. In such working environment, an unexpected phenomenon comes out with the advent of these novel devices. It seems that people could be estranged from their colleagues by the different usages of communication media even if they work in a crowded workplace.

With a variety of technical development since 1980s, office automation has also influenced different phases of the coworkers' activities (Diani, 1986). Even if office automation is a great liberating agent to give many technical and economic advantages, it is also as a device to reduce human freedom. What it has affected covers the changes in tasks, job profiles, relations among colleagues, organizational structure, and role of management. With information technology, most operations, procedures, and act at work become abstract and solitude, and the division of labour becomes extremely explicit. Especially in the case of today's high-tech companies in Taiwan, the project cooperation sometimes means to hold a team discussion once a week, but for the most part the engineers could finish their work alone without any interactions with their colleagues (Tang, 2001).

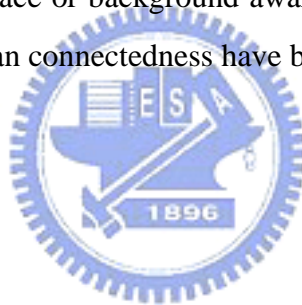
Some great influences come with technology are the cognitive pressure and accelerating tempos. Given the formalization and abstraction of the work processes inside programs, most engineers are now more isolated and independent. The airy interactions of coworkers are not too much, and connections between the colleagues are quite slight (Tang, 2001). Some kind of silent revolutions are now producing profound changes of social interactions of coworkers in an office as it affects the self-identification of individuals and groups. In addition, since the workers with huge stress in a long period of time, they might mix up work and leisure time.



The mental loads of coworkers might have direct influences upon the atmosphere of the workplace and lead to an interpersonal isolation.

## **2.2 Connectedness**

A variety of different factors apart from family and friends, might have forced people to attain a balance in the kinds of relationships that people need to have with others. It is believed as a fundamental need of humans to contact with others, and these interactions with others are expected not only to make humans consoled and satisfied, but enrich humans' lives. Recently, a lot research groups are devoted to exploring the inherent needs of people in communication and trying to enlarge the technology possibilities to mediate people at a remote place by intimate interface or background awareness (Agamanolis et al. 2002; Vetere et al. 2005). The issues of human connectedness have been reviewed and compared.



### **2.2.1 Issues**

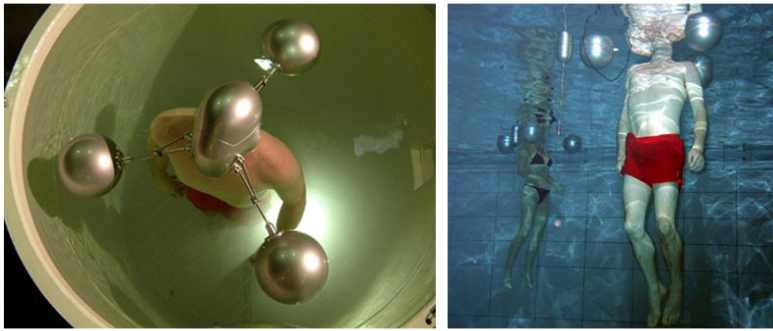
The social interactions and relationships with others are such the fundamental needs of people. They make humans consoled and satisfied, and enrich everyone's life. However, for the impact of customs and trends at a societal level, such as the widespread use of technologies that has caused isolating effects, the Human Connectedness research group have indicated that these new problems in social relations might jeopardize a human's mental and physical well-being, and the health of the communities and civilizations (Agamanolis et al. 2002).

Human Connectedness research group, a European research partner of MIT Media Lab, have been devoted to exploring the issue of human relationship and the aspects of mediation supported by technology. In a succession of their researches, they tried to conceive the possibility of new forms for social interaction to maintain and enhance the relationships. To this end, the group had an insight into the perception and activities in communicating, such as

background awareness of presence and togetherness, or a sense of intimacy and closeness. In addition, they also sought a way to support collaboration between different groups of people and new forms of cultural exchanges. Based on the understanding of sociological and psychological factors in their studies, the technological frameworks were designed to reflect the needs and sensibilities of people with the expectation of the future, such as the infinite bandwidth and processing-rich computing environments.

There are several significant themes discussed in their researches, like background awareness, social networking, cultural exchange, shared experience, slow communication, wearable computing, and intimate interface. Among the themes, background awareness and intimate interface seem to be all on purpose to enrich people's communicating interactions, and then to promote their social relationships. These approaches exactly conform to the main intention of this research, so both two themes would be introduced separately and more particularly in the following sections.

One of the special cases in their researches, such as Iso-phone (Auger et al, 2003), is a telecommunication device that builds a slow telecommunication space of heightened purity and focus by blocking out peripheral sensory stimulation and distraction. A substantial emphasis conferred here is the widespread usage of mobile phone. That has led to telecommunicating in the vain pursuit of an efficient rather than a qualitative manner. It abstracts conversation from specific social context, and lack of discretion and sensitivity of the user to decide if the circumstances are suitable for communicating. To redress the awkwardness and imbalance, the device of Iso-phone has a purpose to allow the users to concentrate solely on the conversation for quality and depth of a singular, submersion, telephonic experience, and to alter the contemporary preoccupation with efficiency and multifunction (Figure 1).



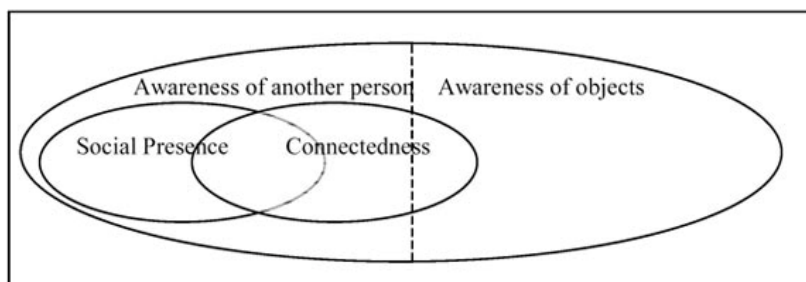
**Figure 1. Iso-phone: a telecommunication device providing a conversation of the phone and the floating tank. <http://web.media.mit.edu/~stefan/hc/projects/isophone/>**

Another particular issue in communicating is shared experience. It might evoke the collective experiences and memories of people and change itself as people's social identification with others. In the case of tunA (Bassoli, 2002), a common handheld music player becomes a mobile radio station by wireless protocol. It provides users with the opportunity to share the music currently listening while moving around, and promotes a sense of background awareness of the surrounding physical environment. Listening to music turns from an individual and isolating experience into a fun and socializing experience. Relative to this aspect, HP Laboratory research team believed and tried to demonstrate that an indirect experience evoked by a product is very important to many users (Hull, 2002). In a case study of a museum, they found that the engaging experience constituted by challenge, social interactions, or sensation with a drama, makes people's lives more relaxing and pleased. In addition, they believed that users would be able to create their own contexts for experiences using some new technology. It may influence how the emerging technology be rapidly adopted and shaped towards its eventual meaning and value.

### 2.2.2 Context Awareness

Dourish and Bellotti described awareness as “an understanding of the activities of others, which provides as context for your activity (Dourish et al., 1992).” Rettie then elucidated that “awareness is almost a simile for consciousness --- its meaning is derived from the object of the awareness...” Awareness here is used in the sense of experiencing what is believed to be external perception, synchronous or asynchronous (Rettie, 2003). Besides, background awareness is a delicate form of connection between close partners, such as a connotative sense of presence or a subtle perception of each other’s moods and emotional deeds. Awareness of daily cycle, routines, or presence is especially important in relationships among family members, close friends, and coworkers. This awareness supports people to convey reassurance and a sense of context for communication, and also forms a bond built between people by background synchronization of their rhythms (Patel et al., 2003).

Rettie also sketched logical relationships between the concepts of awareness, social presence, and connectedness (Figure 2). He found that the experience of connectedness could occur in many situations. The subtle perceptions of other’s body movement, voice, and presence, often evoke people’s experience of connectedness with others. In addition, an old post card or stored text message in a mobile phone might be accompanied by a feeling of connectedness without direct awareness of another person, although the meaning embodied in the experience is derived from that person. Hence, not only the awareness of a person, but the awareness of objects could create the experience of connectedness.



**Figure 2. The relationship between social presence, awareness, and connectedness (Rettie, 2003)**

Gaver described technologies of peripheral awareness could give information for particular work activities or relationships to provide a feeling of presence of remote lovers or intimate friends. He tried to explore new sensory and interaction possibilities to extend notions of peripheral awareness to new domains, and addressed a wider range of emotional relationship (Gaver, 2002). In translation of Vetere et al's article, Gaver identifies three typical characteristics of awareness technologies in the designs:

Making use of evocative materials,

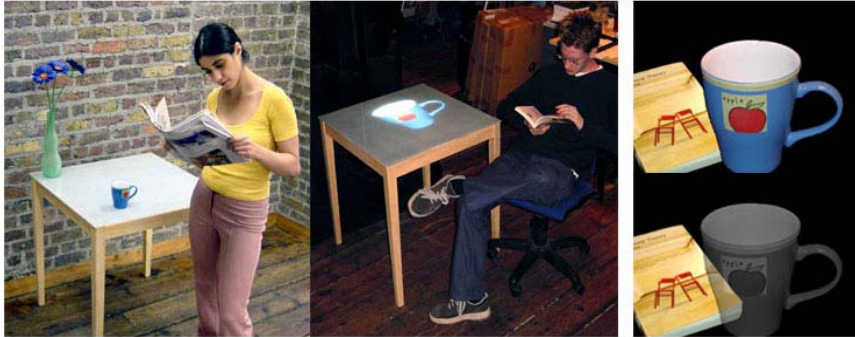
Making mapping of literary usage rather than didactic metaphors, and

Having a unique physicality as a more poetic real feature (Vetere, 2005).

The Portholes project of Xerox EuroPARC has already demonstrated that awareness can be supported across distance (Dourish, 1992). The distributed work group could be supported by media space through access to information with general awareness. In their project, the prototype could display the several different scenes of work groups at different locations together in a window at approximately the same time, and provide a view of one another in a daily work environment. It has also been found that awareness may be a useful basis for community access and for community building. In sum, the awareness can contribute a shared sense of community, and lead to informal interactions, spontaneous connections, and the development of shared cultures (Markopoulos, 2004).

In figure 3, Habitat is another design for background awareness of daily routines and rhythms between distant family members or lovers. The system consists of two networked tables at relative sites of these family members' kitchens, and each table integrates a computer, a RFID tag reader, and a video projector. All of the objects that might be placed on the table, such as cups and books, have their own unique RFID Tags. When some object is placed on one table, the other table would display a graphical representation of that object. When the items are removed, their representations on the other tables would fade away slowly. Since awareness plays an essential role in human relationships, the installation is on purpose to explore the potential of using household furniture as a network of distributed ambient display applications, which also conveys this kind of awareness between close family members or

lovers at a remote space (Patel et al., 2003).



**Figure 3. Habitat: a range of connected furniture for awareness of daily routines and rhythms between distant family members.** <http://web.media.mit.edu/~stefan/hc/projects/habitat/>

### 2.2.3 Intimate and Emotional Interface

Since communication and computing technology is progressive at accelerated pace, humans hardly to get with it. Hence, people desire an appearance good to use and an intimate connection in relationship between humans and objects. By extension of “control intimacy” from electronic musical instruments analysis (Moore, 1988), Fels suggests that the ‘intimacy’ is “a measure of subjective match between the behavior of an object and the control of that object.” Here, the object could be a person, a device, or some entity. Moreover, High Intimacy indicates that an object seems to be an extension of the person, satisfaction is derived from interacting with the object, and emotional expression spontaneously flows (Fels et al., 2004).

Human Communication Technology Research Laboratory (HCT lab) is absorbed in new human computer interaction technology and theories of embodiment and intimacy between humans and computers. The research group are trying to combine emerging technology, multimodal (Oviatt, 2002), and multimedia systems, with the enlargements of psychology, sociology and art, to enhance the communication abilities between people, or between people and machines. In the opinion of HCT lab, intimacy is an essential factor for the interface design. In addition, the research group also indicated that the contributing factors of intimacy

could be consistency, responsiveness, usefulness, learning ability, functionality, and so on (Fels et al., 2004).

Horton and Wohl (1956) have described the bond of intimacy in the personality programs. They've found that an illusion of intimacy could be created through the duplication of the gestures, conversational style, and milieu of an informal face-to-face gathering. In some of TV shows or radio programs, hosts/hostesses usually give impressions that they are responding to and sustaining the contributions to the invisible interlocutors, and an interaction, a dialogue would be created between them and the audience. Horton has called this as "an illusion of intimacy," since the relationship is actually inevitably one-side and the reciprocity between the two might be suggested. In this case, the technical devices of the media themselves have been exploited to create illusions of intimacy between the hosts/hostesses and the audience.

Intimacy has been mediated through symbols of attention such as flowers, missives and love letters for ages. Today, emerging technologies, like mobile phone and the Internet, is regularly manipulated to help people maintain the intimate relationships with family members or friends living far away. Kaye and Goulding (2004) used the notion of critical technical practice to provide a theoretical construct to understand if there is a problem for couples who try to maintain a feeling of intimacy but live far away from each other. The work of Kaye and Goulding fits the three typical characteristics of Gaver about awareness technologies. They used soft silicone as evocative materials for hand holding, exploited non-didactic metaphors and had unique physicality of an egg's shape and texture.

Vetere et al. (2005) put their attention on phenomena that are recognizably intimate, as expressions of tenderness, acts of devotion and habit of demonstrable affection. They argued the inadequacy of current technologies which support the social and personal needs in connection. They used cultural probes and technology provocation to comprehend the contextual of people's intimate lives, and gave several innovation design concepts for communication of emotion to maintain intimacy at a distance.

Similarly Ogawa et al. (2005) also focused on the scenario where two intimate persons live

in distant places, and developed Small Connection communication media to convey faint information such as light, wind and touch through the use of a robot technology (Figure 4).



**Figure 4. Left: “Air” communicates a feeling of presence to a distant partner through the light. A pair of lamps would be kept by the close friends or family members at different places. Since one of the lamps is turned on by touch, the other one would light up, too.**

**Right: “Passage” is a close proximity media space to create a connection between people in different cities or cultures. <http://web.media.mit.edu/~stefan/hc/projects/passages/>**

Their viewpoint is how to propose media for communication between two persons and let them have a feeling of each other’s presence through a simple communication installation with tangible signs and intimate interfaces. Including the concepts of ambient media, tangible interfaces, intimate technology and robot technology, their work broke down the common communication media forms of vision and hearing and extended the possibility of communication media to convey casual feelings, moods, presence, and atmosphere.

Another special case of intimate design project is Passage of Human Connectedness group (Bitton et al., 2006). It is a very particular design for media space, integrating multiple types of sensual media to connect distant places and groups of people. The significance of this installation is its intention which not only provides an intimate entry of different cities, communities, and cultures, but creates unusual relationships with strangers in different locations. Not like a departed media space design, this research team developed an engaging visual system to allow passers-by to approach extremely close to the interactive screen surface. Since a passer-by walks through the installation, the silhouette of his/ her body would be reflected on the screen. When this local participant moves in front of this media installation, the viewer could see more of the scene of the remote counterparts. Meanwhile, a silhouette of the passer-by could become an engaging and intimate interface to touch and interact with a



stranger far away (Figure 4).

## **2.3 Research Methodology**

In the following sections, the methodologies related to this research include interviews, probe diaries, participatory design activities and field trials, which would be introduced and compared.

### **2.3.1 Dyad Interview**

The differences between several familiar qualitative methods, such as focus group, several types of interviews, and ethnography methods, have been early introduced by Ireland (2003).

A traditional one-to-one interview has been generally used by most researchers especially about design evaluation. One person would be interviewed alone by a researcher with a tightly scripted or a loose outline. This kind of interview is ideal for understanding the thought, sentiments, or reflections of individuals about a topic or a design with less concern for the possible influence on others. Meanwhile, the individual interview might be appropriate for some issues involved in personal privacy.

In this research, the qualitative research methods are conducted in the primary stage of this research to profoundly uncover the connotation of people's experiences in their communicating activities, and to extend the innovative and precise perspectives on human connectedness.

In opposition to individual interviews, the dyad interview is essential research method in previous studies. In dyad interview, a moderator would follow an outline or lightly scripted guidelines to interview two persons who are friends as a pair. The procedure for dyad interviews is not such exact as that for individual interviews, and the duration of dyad interview is much longer. Dyad interviews, or "friendship pairs" interviews, are a powerful

forum to explore issues which are difficult for people to articulate their opinions and at the same time to make people interviewed feel comfortable and relaxed because they are accompanied by their friends (Ireland, 2003).

Since the two friends are interviewed as a pair, the canvass would be more animated, insightful, and very candid. The interviewees might be reminded or prompted by each other, and different aspects of some issues could be extended. Furthermore, a significant merit of a dyad interview is that it can reflect the true interactions between the two interviewees. That is quite helpful when the investigation on social relationships is conducted and communication issues are discussed.

### **2.3.2 Probe Diaries**

A diary methodology is a self-documentation in the social sciences-- a common method of ethnography through sampling and analysis of diaries recorded by respondents (DeLongis et al., 1992; Koskinen, 2002). And its process and result are often used in culture probes (Gaver et al., 1999; Horst et al., 2004).

A traditional diary is a structured self-report used in home economics, business studies, pedagogy, field studied and historical researches. Typically each page of it is similar to a questionnaire, and the respondents have to fill each page at regular intervals in a long period of research time. It is an experience sampling method, and respondents have to recode their cognitions, emotions, or activities. A diary as a research instrument could be applied to a brief or a profile of a participant, or could be a pilot study of an indefinite issue. It is also portable for a respondent to carry and record. Besides, there are several merits of diaries to support a research outside a lab:

- To increase the validity of aggregation and demonstration of multiple indicators,
- To reduce recall error in self-reports and experiments, and
- To assist in the non-access fields.

In addition, compared with other field observation, to use diaries is much efficient and low-priced (Koskinen, 2002).

On the other hand, ethnomethodology (Garfinkle, 1967) is the study of the ways in which people make sense of their social world. Ethnomethodologists assume that the social order is illusory, potentially chaotic, and a coherent pattern constructed in the minds of social actors with a series of sense impressions and experiences they confront. For this reason, Garfinkle developed methods in the past that 'breach' or 'break' the everyday routines of people's lives and observe their reactions to reveal and to interpret people's inherent activity principles to maintain the normal flow of life in social interactions.

Extending several different ethnography methods, Gaver (1999) conceived culture probes integrating the concept of ethnomethodology and the diary methodology, towards visual self-documentation for design. The researchers provide participants with several different tools, such as diaries, post cards, digital cameras, or PDAs, and also ask them to record in a period of time or fulfill some tasks. These tools might irritate participants' lives but incite them to reinterpret their experiences and impressions. Hence, the researchers could comprehend people's needs and values and have an insight into the context of their lives and cultures.

At times, the researchers could deliberate upon some issues in a field, where is private and non-access to entering for long term investigation. Since it is not sufficient for the researchers to comprehend the whole context, conducting the interviews, culture probes and diaries might be efficient to use. In the case of high-tech companies, the researchers are not allowed to enter engineers' actual working offices to do field observation, and it is also forbidden to use a camera, a video, an audio recorder, or any recording device to record engineers' lives, since the advanced high-tech research and development of a company are confidentially protected. Therefore, to perceive the real interactions and fundamental needs between the occupied high-tech engineers in communicating context, probe diaries were decided to use.

### 2.3.3 Participatory Design

Gibson (1982) and Norman (1988) ever mentioned that the perceived and actual fundamental properties of things would affect the possible usage of things, and furthermore, the pith of 'functional analysis' (Löwgren, 2000) is to find out the needed and desired aspects of an artifact. Gedenryd (1982) and Schön (1993) also emphasized that the problem setting should be done with the objects in a study since the potential usage and meaning of the product in a future situation may abound out of freedom and uncertainty. Besides, the empathy of users could be an inquiry into a purpose.

Product designers and developers detected the benefits from direct consumer feedbacks, and launched into a new qualitative user-centered approach, to which consumers or objects of study could participate. In addition, they work upon the design through out the whole product development process, and then could involve in making consistency between what they thought and what consumers reflected (Sanders, 1994).

In order to meet the needs and desires of users, at the initial stage of problem setting in a research, several methods, such as interviews, field observations, focus groups, or preceding introduced culture probes are commonly used to explore the issues in truly usage situations. Then, in the design prototyping sections, workshops with the development methods like brain storming would be carried out. Sometimes development panel, a kind of representative group, would be asked to work with the designers and researchers to make a collage or prototype.

On the other hand, co-design method (Sander, 2000; Westerlund et al, 2003) is also considered as a kind of participatory design. Not only the objects in a study participate and influence the whole design process, but the experts and scholars of different disciplines, such as ethnography, psychology, computer science, industrial design, and interaction design, would investigate together and give their own opinions on the design issues. Westerlund et al. (2003) programmed such a process find out the specific problems in a field and get hold of the reasonable and meaningful design ideas from these different field experts.

If an artifact is meaningful, it would be determined by a well usage, fitting into the existing environment, or other memorable perceptions. Therefore, It is crucial to gain the opinions from users and experts together, and then to have the stimulation in real settings to discover users' needs and desires.

#### **2.3.4 Field Trials**

Usability tests with user involvement made beforehand sometimes could not manifest the real situations where people will use the products. Even if ethnographic user research methods, which Contextual Inquiry (Beyer et al., 1998) and others (Ireland, 2003) used at the beginning of the development process, could give some ideas about the usage of the current technology. The methods also provide the values people may already have, but they hardly anticipate in completely new technologies or to unprecedented media. Most field studies in work related to environment are effective to explore some essential findings for redesigning or product development. However, such field investigations or field estimations invariably need much time, costs, and efforts (Gaver, et al., 1999; Browne et al., 2001; Jääskö et al., 2003).

Until people use the products actually in their own environments, designers or researchers wouldn't comprehend on the possible meanings of new product concepts. Mäkelä, et al. (2000) described the significance and effect of field trials. They stated that field trial methods, prototypes had better to be tested in a real field, which helps researchers or designers to gain the unanticipated product concepts in a real setting. In a design development process, field trials not only give a way to evaluate if the design matches the users' requirements and perceptions, but reflect lots of different aspects of product prospective usability and possible values. For subsequent redesigning, field trial would also be an effective and economy method to review decisions made in design development, and aid researchers or designer to have more conceptions of the real usage situations.

## 2.4 Summary

The influences of accelerated development of technology on society, interpersonal relationships, cultural values, environment and personal perception become critical. Today, scholars and experts of different fields pay much attention on the issues of human connectedness and interpersonal interactions from their diverse aspects, and try to improve the existing communication media or address new application to enrich people's lives through communication. Technologies like the Internet or mobile telecommunication exactly give people the possibility of connection with others separated in the distance, however, the growth of technology media usage has led to communication being practiced in an efficient procedure rather than qualitative activities. It seems that a lot of subtle, sensual, or embodied perceptions might be insignificant but actually important in communication. Through these fine and slight physical signals to which people are attuned over a period of time, such as a body movement, a facial expression, or voice quality, they are concerned about others and themselves as well. Hence, the theories of intimacy, social presence, emotional interface, or multimedia and multimodal technology, are on the purpose to integrate these sensual perceptions to improve the profundity and quality of communication, and let the communication media answer to the human requirements and fundamental needs.

In fact, the problems of communication not only exist between family members, lovers, or close friends, who are apart from each others, but people who work or live collectively in the same office under unaccommodating circumstances. Therefore, providing new concepts of communication media or improving the technologies existing, seems crucial to maintain people's relationships. However, in the case of today's modern offices, interactions between colleagues are disappearing because the embodied conversations are now replaced with e-mails by only hitting the key board. Different usage of communication media and over dependence on the Internet could induce these colleagues to become isolated. In conclusion, it is the intention of this research to expend the perspectives of these researches on human connectedness, broach those concepts of the office design issues, and then enrich people's lives.

Today, the colleagues who work together long hours become gradually estranged from each other, and how to promote their relationships is definitely essential. Therefore, there're several qualitative methods used in this research to thoroughly perceive the real interactions and fundamental needs between colleagues in communicating context. In addition, through participatory design process with real users and experts, design concepts to create an office environment with emotional presence and intimacy could be addressed, and the prototypes were also evaluated in field trail to gain the opinions from users.



### 3. METHODOLOGY

In this research, the emphasis is focused on the workers in R&D Department in high-tech companies. The engineers who explore and develop new processing technologies or system programs were selected and participated in this research. Since it is hardly to get permission to enter these types of companies to perform field observation, dyad interviews and probe diaries (Figure 5) are used to investigate the fundamental and emotional needs of these coworkers.

After investigating the office cultures, design concepts to meet the needs of people working in the same office are explored from workshops with participants, and prototypes such as communication installation are designed for various working spaces to mediate people's informational communication. Then, through the field trials and reviewing processes, design concepts are also expanded to enhance the inherent relationships between coworkers.



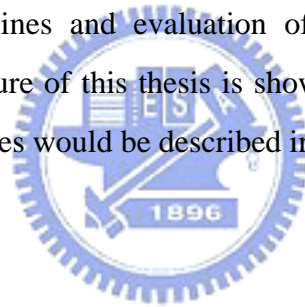
Figure 5. A probe diary as a self-documentation used in this research.



### **3.1 Research Structure**

In this research, the particular people's communicating contexts in their working environment are attained by interviews and probe diaries. Further, via the workshop with real users and experts of different disciplines, the design process began, and the prototypes were evaluated by field trials. It is hoped that through the stimulation in a real setting more notions of communication media design in the future could be given.

This research could be separated into two stages. The first stage is the investigation procedure to understand the colleagues' social interactions in communication, and to explore their inherent needs for the media and interpersonal connectedness. The second stage is the concept design process, including development of several types of communication media with experts from different disciplines and evaluation of the prototypes in the real working environment. The intact structure of this thesis is shown in the figure 6, and more details of the participatory design activities would be described in section 3.3.

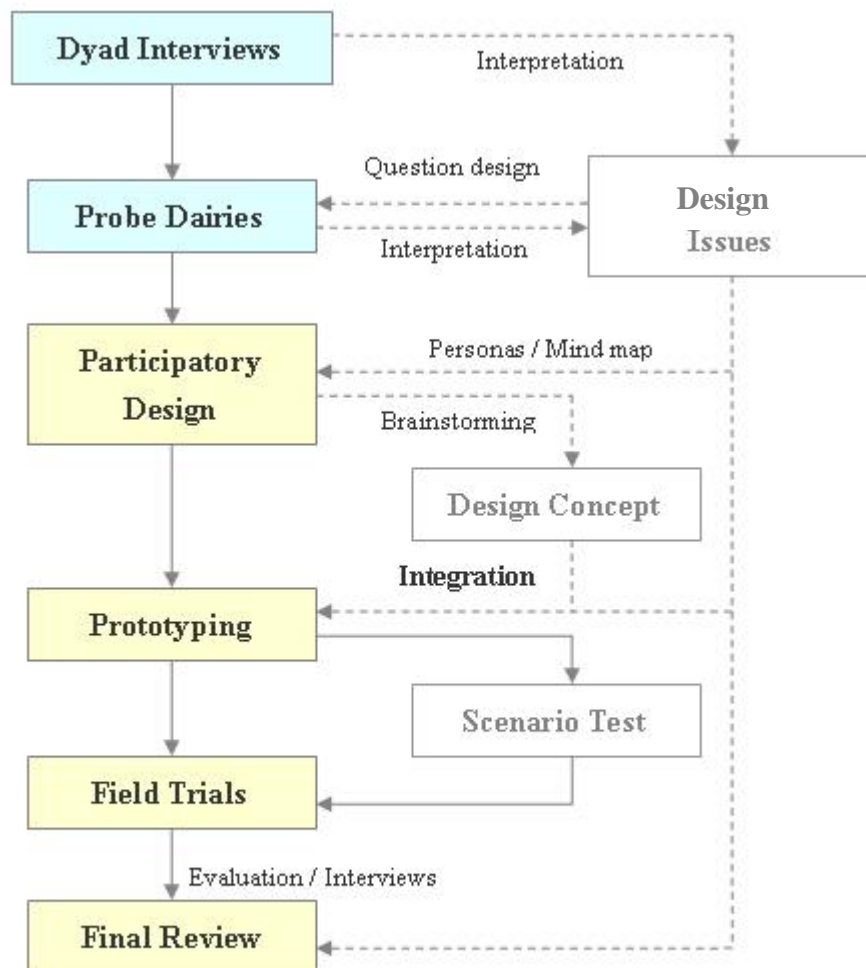


#### **3.1.1 Investigation**

In this research, the emphasis is placed on the engineers in R&D Department. However, exploring the needs and desires of engineers the occupied high-tech engineers seemed difficult. The major problem is that the researcher wasn't allowed to enter their actual working offices to do field observation. Most high-tech companies control their personnel's activities in a very high rigid way since the advanced high-tech research and development of a company are confidentially protected. To orientate the restrictions, this research has been conducted alternatively by using dyad interviews and probe diaries.

At the outset, to investigate office cultures, the outline of the engineers' lives was rendered by a pilot individual interview. On the basis of this initial understanding, the traditional one-to-one interviews were replaced with dyad interviews to have the discussions more brisk,

liberal, and delightful. The informants in dyads were three associate pairs who shared the working environment with each other. They worked in three typical high-tech companies in Taiwan, and were interviewed for at least 2 hours. The interviews were interpreted and categorized into several orientations, which the questions design of probe diaries stood on. The results of interviews and diaries were reinterpreted and integrated into a mind map, a set of the various design issues including main factors which might affect engineers' personal relationships and social interactions. In view of entire understanding of their office culture, two personae are also portrayed for the representation of the engineers' typical lives.

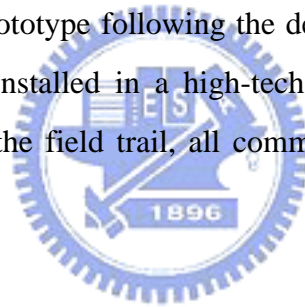


**Figure 6. The research structure of this thesis**

### **3.1.2 Concept Design**

In the stage of the participatory design, a workshop was held by prior interviewees and many a researchers from different disciplines. The mind map and the stories of personae were rendered to delineate the different phases of engineers' real lives, and all participants in the workshop brainstormed for hours in developing new design concepts to enhance a cordial atmosphere for this typical working environment.

The design concepts derived from workshop were integrated with the previous design issues and then the prototypes were devised for the appropriate solutions, such as a better application of emerging technology to broaden the directions of perception in communication or an intimate device to increase coworkers' social contact. Later, several testing scenarios would be appended to each prototype following the design procedure, and then one of these prototypes was selected and installed in a high-tech company for evaluation. In the end, compared with the results of the field trail, all communication issues of concern would be particularly discussed.



### **3.2 Research Issues**

The issues of personal relationship and communication are involved in different aspects of people's lives. In the beginning, it was tried to find out the engineers' communicating context, clear-cut routine activities, and the perception of the media they use. The complex real situations of those engineers' daily lives in various phases were delineated lucidly by dyad interviews and probe diaries.

In dyad interviews, it mainly focused on the context of communication and interactions between the colleagues. What factors might influence these colleagues' social activities and personal relationships would be found out in this stage. At the same time interviewees' impressions, usage situations, or expectations of the communication media to their

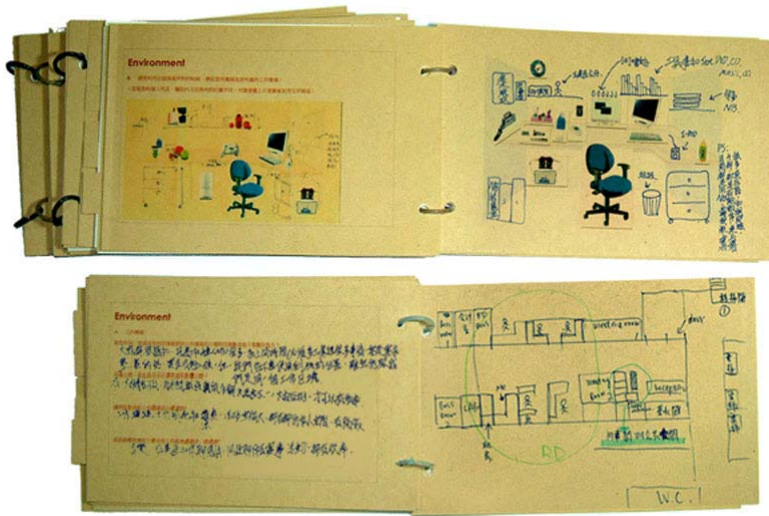
surroundings were also interpreted for the future design development. By following a lightly scripted outline, dyad interviews progressed in a candid and delightful canvass. Because each pair of interviewees might be reminded of or prompted by their company, different aspects of the discussing issues could be unceasingly extended. The outline of the dyad interview consisted of five parts, shown in Table 1.

For profound comprehension of the interactions between colleagues and their feelings of working environment, it is essential to enter the real field to do observation. However, it is difficult for observers to get into the engineers' workplaces, so the probe diaries were decided to use based on the rudimentary results of interviews. The participants were asked to write down three-day self-documentation. Through the analysis of these self-documentation records, rich information on the engineers' daily activities, interactions between them and embodied environment, and their social relationships was attained, and the aspects of participants also helped to form the following design process.

The probe diaries were divided into two parts: the first part, similar to the traditional ethnography diaries, the engineers are requested to take down their daily activities, including work and leisure, communication interactions between colleagues, and the media they used three times a day. The second part was that the engineers sketched their working environments including the spaces of work and leisure activity they have (Figure 7). Describing the working environment, four key points have indicated: the location of a participant and his/her close friends, the actual distance of the map, the places where his/her colleagues may chitchat together, and the places frequently used by them.

**Table 1 The outline of dyad interview in the thesis (more details refer to Appendix A)**

Issues	The factors that might influence social relationships
Communication	Communication behaviors and activities
Context	Communication media Perceptions of presence or other awareness between colleagues Customary using communication media Special communication experiences
Working Environment	Atmosphere and social relationships in the working environment Isolation and Grouping in the working environment Appearance of the working environment Responding the working environment
Work and Leisure Life	Activities of work and leisure Balance of work and leisure
Expectation	Perplexity and hazards of communication device Significance of communication Expectation of future communication
Sentiments of Different Media and Interfaces	Some communication media achieved by several research teams are shown to the interviewees to allow them to discuss and give their sentiments or opinions.  1. What do the interviewees think about the application of background awareness in communication media? 2. Which kind of interfaces of communication media the interviewees prefer? 3. Are there any sentiments on communicating activities? 4. Are there any sentiments on the application of emerging technology?



**Figure 7. A probe diary includes two parts: one part is for recording the trivial things about what happens in the workplace and how the recorder feels, and the other part is for sketching the environment. (More details refer to Appendix B)**

### 3.3 Recruiting



In the dyad interviews, there are six participants since three associate pairs recruited (Table 2). All of these recruiters are engineers of R&D department, and respectively belong to three typical high-tech companies in Taiwan (Table 3). Each of these interviewees has working experience over half a year in the high-tech company, shares some open space with colleagues in his/her working environment, and tends to use a high-tech communication device, such as mobile phone, MSN, e-mail, and so forth.

The objective of the investigation is to find out the context and experience of daily communication between colleagues, and in addition, to have an insight into the fundamental and emotional needs of coworkers in the same working place. In dyad interviews, it is concentrated in constructing the context of communication and detecting the different factors that might influence the relationship between colleagues. Hence, these three pairs of colleagues were asked to talk about their daily activities in the workplace and the ways to use communication media or channels. Both the way how the colleagues might be mediated by

the media and the way how they applied the emotional senses to enhance the awareness of the presence was also discussed in this research.

**Table 2 Profiles of interviewees**

Interviewee/ Company	Ages (yrs) and gender	Working time (Am / Pm)	Function	Leisure Activities
A , C1	25 Female	9:30/ 8:30	IC examination	Browsing webs, having light refreshments
B , C1	25 Female	9:30/ 11:00	Software programming	Browsing webs, having light refreshments, talking on MSN, and playing exercise
C , C2	25 Male	8:00/ 10:00	IC simulation and analysis	No leisure activities
D , C2	23 Female	8:00/ 8:30	Logic simulation	Gossiping, playing exercise, and having light refreshments
E , C3	25 Male	9:30/ 9:00	Software programming	Taking a walk, gossiping, playing exercise, and having light refreshments
F , C3	22 Female	10:00/ 6:30	Software programming	Listening to the music

**Table 3 Profiles of working environment**

Company	Working environment	Properties: average age/ the ratio of males and females/ connectedness
C1	30~60 employees in an office with partitions	around 30/ unequal, a few females/ less contact after work
C2	300~400 employees in an office without partitions; 200 employees in an office with partitions, and seats connected to functions	around 30/ extreme unequal/ no contact after work
C3	40 employees in an office with partitions, and seats connected to functions	around 30/ extreme unequal/ no contact after work

After analysis and interpretation, the results of dyad interviews, the more information and different aspects of communication issues were unfolded. To increase the reliability of demonstration of previous interviews and to obtain the occasional social interactive event, another thirteen R&D engineers were recruited, working at different high-tech companies to participate the probe diaries. These participants recorded their office routines three times a day, took down some sentiments about communication issues derived from interviews, sketched their embodied working environment, and indicated the interactions which might occur between them and in their workplace.

In this stage, the backgrounds of those engineers were similar to those engineers in dyad interviews, but the range of ages is fairly extensive from 23 to 37 years old.

### **3.4 Participatory Design Process**

After the previous investigation, the colleagues' inherent needs for the communication and social contact were delineated. The stage of participatory design process includes a workshop, prototyping, and a field trial.

In the workshop, different solutions to enhance the interpersonal relationship were discussed and were integrated into varied types of design concepts. Later, several prototypes as communication installations were addressed based on the design issues and concepts from workshop, which were on purpose to convey intimacy and to enlarge the directions of perception in communication.

Owing to the limitation of time, only one of our prototypes would be selected for field trial. Here, a proper prototype with several scenarios was tested in the real environment to evaluate if the design concepts match the users' requirements and to catch the possibility meaning of the new communication devices.



### 3.4.1 Workshop

The workshop was held with the interviewees of the previous study and many participants from different disciplines, including industrial design, computer science, mechanical engineering, and visual communication. In the beginning, the explicit findings and design issues collected from the dyad interviews and diaries were shown in a mind map (Figure 8). To elucidate most engineer's office cultures and daily lives, two personae were also given:

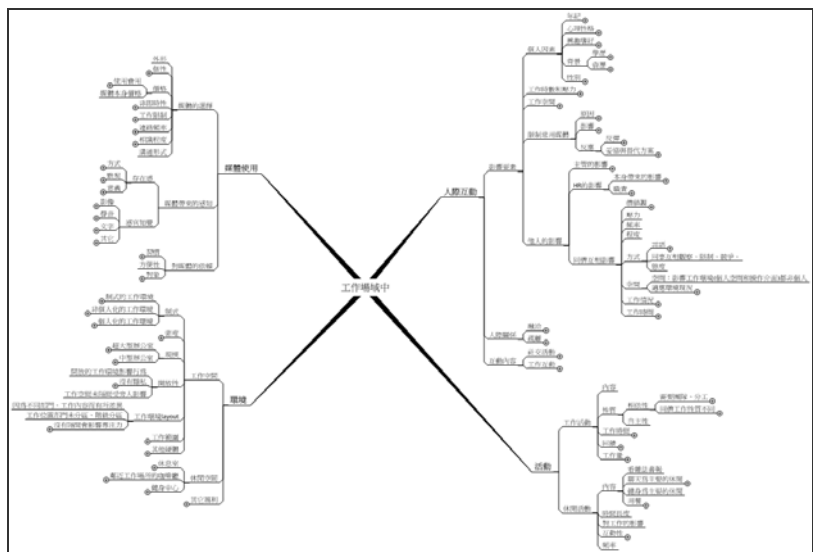


Figure 8. A mind map of the colleagues' working cultures

- Tom is an unhappy engineer working in a strict company with huge work stress, and he works on his own. The work schedules of most colleagues are very different from his. He doesn't have much embodied interactions or conversations with his colleagues. He highly depends on communication via the Internet instead.
- Lisa, a software engineer, really cares about the environment where she works. She sometimes takes a break with her colleagues after hard works, or just goes around and releases the work stress.

These two stories were described specific, and they might represent typical high-tech engineers' life styles in Taiwan. After that, a brain storming session based on the stories and

the issues integrated in the mind map was expanded with the participants to explore the potential solutions to enhance the interpersonal relationships in such working environments. In the workshop, the discussion was out of limitation. All the participants could freely give their own opinions, and the concepts which were various from glamorous products and special activities, to some kind of company service. The results of workshop were related explicitly in the section 5.

### **3.4.2 Design and Evaluation**

With all design issues augmented by the investigations and the opinions out of the workshop, several interesting and practicable ideas were selected to develop our prototypes. Hence, three prototypes as communication installations with intimate and emotional interface were designed for various working spaces not only to mediate people's informational communication but to evoke the friendly contact between colleagues.

These prototypes were typical of different communication platforms, and each of them was given assorted testing scenarios. Because of the time limit, only one of the prototypes was chosen for the field evaluation. In the trial, the eclectic prototype has been arranged in a high-tech company to anticipate the potential values of these unprecedented media and review the unexpected application concepts with the real usage situation.

In reviewing processes, the design concepts were examined to fulfill the expectations of coworkers. With these new thoughts, the interactions and relationships with others are expected not only to make people relaxed and comfortable, but also make peoples' lives meaningful and substantial. In conclusion, the new design concepts raise an awareness of the presence of the community and bring coworkers closely through digital technology. In addition to that, the communication media in this research could be expanded to enhance the inherent relationships between coworkers, and the application of technology to make people attuned to their colleagues in various senses has been also discussed.

## **4. FINDINGS**

In the beginning of this research, the dyad interviews and probe diaries are used to catch on the outline of engineers' communicating context and routine activities in their working environments. A great deal of information are revealed, and these ideas of the engineers' life-styles are quite different from what it could be imagined in advance.

### **4.1 Interviews**

In dyad interviews, several topics for these pairs to discuss were given: context of communication between their colleagues, emotional or physical perspectives of the working environments, routine activities of work and leisure, and sentiments of all communicating media they tend to use. In the interviews, the issues were extended with the prompts they gave to each other. These couples of engineers were unrestricted and ardent to share their experiences of communication with others, their work stress, the way to take a break, and the media they chose and were fond of.

In sum, the factors that influence the interpersonal relationship in an office are classified and integrated into several phases, as social interactions, routine activities of work and leisure, and the usage of communication media, which would be described in the following sections.

#### **4.1.1 Factors in Social Interactions**

In accordance with aloofness and unfriendliness in working environments, the informants complained incessantly about their company institution, the strict limitation of media using, and the stress from superintendent or colleagues that made them nervous, anxious, and unhappy. Here, the engineers related their perspectives on social contact between colleagues and the situations they faced.

The informants expressed that one's characteristics, including age, personality, habit, background, and gender, might directly affect his/her behavior and attitude toward social contact. The colleagues, who are of the similar age, recruited by the company at the same time, or have similar backgrounds, often have more subjects to talk and support each other reciprocally. On the contrary, the difference between ages might lead to generation gap, and the social contact and manners of a single or a married are quite distinct. In addition, a colleague with specific hobby might have better association with others, since he/she could share lots of information and experiences with others. Hence, those colleagues with interests and tastes in common always have more interactions.

As individualities, gender difference is another significant effect upon the social interaction, which is more notable in such high-tech companies with extreme unequal ratios of males and females. The informants mentioned that the female colleagues had better Interpersonal competence and tended to make friends with others actively, which might conduce to a positive social relationship. On the other hand, a male colleague seems a bit unconcerned and detached in a working environment.

Another obvious factor in social relationship is the influence of managers or colleagues. The work stress mainly comes from the managers of higher positions. Since some managers are very strict with the teams they administer, the workload and work stress of the team members would increase. An informant also complained that the strictness of his manager made him feel no achievement and satisfaction. Besides, these engineers' behaviors and emotions are also influenced by the values and attitudes of the same generation, since most engineers exert themselves on the works, which also makes stress on others and invoke the competition between colleagues.

As the aforementioned, these engineers are pushed by arising workloads and huge stress from their managers and colleagues. With the competitive nature, most people do not have patience to be concerned with others or cotton to their colleagues.

#### 4.1.2 Work and Leisure

Almost all engineers are engaged deeply in their own work and their work is cannot be interrupted and highly independent with the explicit division of labour, so that, in this situation, engineers' working hours and leisure time become much different from others members in the same company, and the interactions between colleagues invariably occur on business. Therefore, most of the engineers not only work by themselves, but take a rest by themselves as well, except the meetings, usually held once a week. Meanwhile, engineers are hardly in communicating with other colleagues.

In addition, the working-hour of an engineer in the high-tech company is extraordinary longer than that of other occupations, and the average working time might be over ten hours a day. Sometimes, these engineers have to finish their own projects at the cost of the rare holidays. Hence, it is another factor that makes the engineers less in contact with their colleagues after work. These stern working conditions had brought about several problems in domesticity, society, psychology, and physiology.

It is believed that having proper leisure for releasing work stress could bring up a cordial atmosphere in their workplace and develop friendly relations with others. However, completely independent leisure activities hardly enhance these colleagues' relationships. In the interviews, the informants' favorite leisure activity is having light refreshments with colleagues. These afternoon tea parties, which take place once or twice a week, are the important opportunities for these colleagues to associate with their colleagues. Even so, most leisure activities of these engineers are independent without disturbing others: they might take a walk, play exercise or listen to music by themselves.

### 4.1.3 Communication Media

Owing to different requirements, as convenience, privacy, custom, or constraints in the workplaces, e-mail, Windows MSN Messenger, VNC, Skype, BBS, webpage, internal-line telephone, mobile phone, and the Internet are general communication media that most engineers depend on. Other elements that may influence one's choice of media are the conditions of acquaintance, contact frequency, and the features of media. The informants also mentioned about the non-immediateness is quite an important advantage of high-tech media, such as e-mail and MSN Messenger, which provided a possibility that the occupied engineers need not to respond others greetings or communications at once.

Even most engineers pointed to that they are strongly influenced by the media accessible around them, those opinions about being influenced are very different. It's Windows MSN Messenger, which many engineers are pooled tightly with. "I like MSN! It is private and convenient to talk," one engineer said. "A key point of using MSN is that I don't need to answer it immediately, I can keep working without interruption. I can reply to the message while I am waiting for the results from my program testing." In addition to that, there are a few engineers who also give more opposite views on this. They mentioned that using MSN Messenger in the workplace would affect the concentration and efficiency of work, which may damage one's relationship with others.

The acquaintance with others also influences one's choice of communication media. The informants explained the difference between Blog, BBS, and MSN Messenger. They usually used messenger to chat or make contact with close friends, since it provided a private space to share personal information and emotion. On the contrary, BBS or Blog supplied another ways for people concerned with their unfamiliar friends.

To convey an awareness of presence is one significant merit supplied by these emerging technologies. The states of a person, like "busy," "on-line," or "off-line," which reveal through the Internet, might let his/her friends feel accompanied by a feeling of their connectedness without directly disturbance. Most informants considered that the diverse

perceptions integrated and conveyed by the technologies, like sounds and images, could enrich the communication experiences. However, a few of the engineers also expressed that they were uncomfortable to disclose their personal information with others, and the video or voice systems are short of privacy.

## **4.2 Probe Diaries**

After the interviews, the outline of the engineers' daily lives has been drawn and some different aspects have also been shown that might influence the interpersonal relationship in their working environment. The probe diaries were used to perceive the more details about the interactions of the media they used, the colleagues they touched with, and the environment they involved in.

### **4.2.1 Routine Activities**



To increase the validity and to reduce the recall error in the previous interviews, thirteen enthusiastic engineers working in different high-tech companies are recruited to complete the diaries in their workplace. The questions of diary were focused on communicating interactions, media usage, and the way they relieve their work stress, according to the information collected from the interviews. The recording interval of the diary took a week, and the deep perceptions of interpersonal relationship and the subtle things that could influence an engineer's emotion were revealed in the probes.

## 4.2.2 Communication Issues

In addition to the routine activities, these engineers also took down their different opinions about communication issues. It is believed that the sentiments these engineers expounded in their work context at the moment are specifically profound. In figure 9, one engineer said that he wanted to have a communication media which integrate a schedule list, a notebook, and an e-mail system with a nice and humanistic interface. He also believed that the management style of a team leader or a director will deeply affect the interaction between colleagues. Even though he is a new employee, gossiping about the fault of the company seems his main interaction with colleagues.

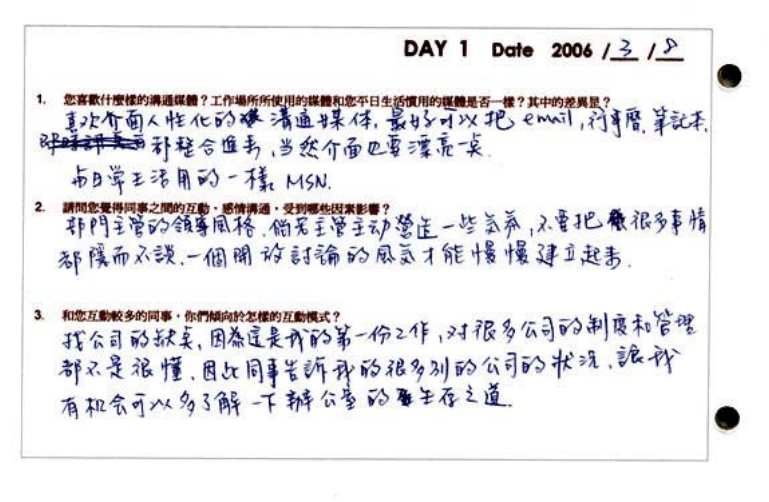


Figure9. One engineer's Diary. He wrote down the sentiments on communicating.

The records of those engineers' routine activities confirmed the communication situations and issues discussed in the interviews. In these probe diaries, some of the recorders yet described their company institutions and the stress from superintendent and colleagues. An engineer rarely had chance to get in touch with other colleagues and has to do his/her jobs all alone. For the most part, the atmosphere in the working environment is serious, dreary, and tedious, and it is quite deficient in friendly relations and interactions between colleagues.



### 4.2.3 Working Environment

The engineers also sketched their working environments including the spaces of work and leisure activity they have. In fact, these engineers do not have too much personal private space in these high-tech companies even if some of them have inclinations to arrange or decorate their workspace. Since most working environments are quite open and formal, it is considered that the individualized behaviors might influence other colleagues. However, a formal workplace also decreases a sense of ownership of these coworkers.

The diaries also revealed the information about the layouts of their offices and the leisure places where these engineers like to chitchat together. In figure 10, the plan was sketched with lots of messages by Michelle, one participant of this research. She described that the broad French windows in her office is her favorite place, and the scenery of a high floor pleases her and her colleagues. She also mentioned that sometimes colleagues would bring the special desserts back and put them on the table out of the meeting rooms if they visited some places. She also pointed out her best friend's and the director's locations in the office, the size of the blocks and their office, and the places where her colleagues may chitchat together.



Figure 10. A working environment map drawn by Michelle, a female software engineer.

### 4.3 Summary

It seems that most engineers are strongly engaged in their own work, and the work is usually very independent and cannot be interrupted. In general, participants' working hours and leisure time were much different from each other. Depending on personal habit and different work schedule, the ways of these engineers to relax are also distinct.

Besides, the average ratio of males and females in those high-tech R&D departments is quite unaccustomed. For example, in one case there are only 3 female research engineers in a 300-engineer department. The uncommon community structure might influence the normal social behavior, formal, and interpersonal interactions between colleagues.

By reinterpreting and analyzing all information revealed in the investigations, the profiles of engineer's daily lives are integrated into a mind map, which was already shown in section 3.4. In substance, the varied phases of interpersonal contact and communication issues that people might concern could be categorized into personal characteristics and backgrounds, job functions, personal customs of media usage, and physical environments. These internal differences and external factors, as work pressure or job restrictions, had great effects on social interactions.

According to the extensively discussion on communication issues, the most potent occasion of an emotionless environment or the unfriendly relationship in an office could be imputed to several phases:

- personal characteristics
- work stress
- independence of work and leisure
- different media usage
- the management style of a boss or leaders
- the ratio of males and females

The relationships among colleagues were deeply influenced by one's emotion and the atmosphere of his/her working environment. These engineers' lives are also influenced by the media accessible around them. Most people used to digital media; even so, there are a few engineers mentioned they still preferred an embodied interaction with colleagues, the old, direct, immediate ways, such as talking, sharing something, having an afternoon tea with colleagues, or just passing a note and leaving a message. They all appreciated these kinds of face-to-face communications, but contradictorily they also complained that face-to-face communicating would interrupt their work.



## 5. PARTICIPATORY DESIGN

### 5.1 Design Concept

The workshop started with a mind map and two personae stories, which offered the outlines of most engineers' daily lives and reflected the aspects of social contact in their working environments. The design issues throughout the investigation stage and the key phases were extended successively in the workshop.

Since the participants were from different disciplines, the design concepts were enriched in varied ways. The ideas they gave are very interesting and delightful, and most of them have the same purpose to release the stresses from work or to promote the interactions between the colleagues. The ideas could be simply divided into four categories:

#### a. Decoration and Improvement of Environment

To release the work stress, some engineers might take a work outside the office and have a breath of fresh air. Here, to create a comfortable environment or a cozy space for rest is essential to these occupied engineers. The participants conceived several ideas, such as making their environment green by planting, setting a special room close to their offices for relaxation or social contact, or changing the appearance of environment from a traditional official style into a leisure home style.

#### b. Information Exchanging

Through a bulletin board or a blog on-line, engineers could share any information to their colleagues, including typical news, their personal experience or interests (Figure 11). A space to share information or to show colleagues personal identity is an effective way make people have acquaintance with each others and close their friendly rations. Through such information changing channels, people could have more opportunities to be concerned with their colleagues. In addition, communicating indirectly as leaving a message has a merit to ward

off disturbing the colleagues on the hop.



Figure 11. 'A bulletin board' to promulgate personal interests and special association activities

### c. Periodical Arrangements of Group Exercises

A company could arrange some group exercises or special activities to inspire its colleagues and to improve a cordial atmosphere of the working environment. These activities would be interesting for fun and liberation like a costume party, for healthy like a sports meet. These activities should be on purpose not only to improve the colleague's fitness and mental health but to enhance the group cohesiveness and companionship of colleagues.

### d. Company Services

According to the previous investigation, colleagues really need some services to release their tightly work stress and reduce their workload. For example, a company could provide colleagues free refreshments for afternoon tea, or plan some service areas for different requirements.

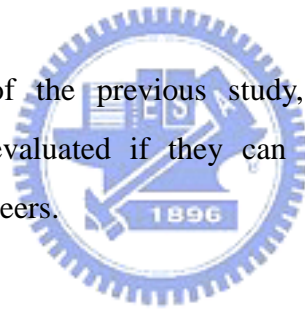
Most participants proposed that the relationship among colleagues is deeply influenced by someone's emotion and the atmosphere of his/her working environment. On the side, there are numerous different opinions on communicating interactions. Even if most engineers are used to digital media, some of them expressed strongly that they have missed the old communicating ways, such as passing a note or leaving a message. They all appreciate

face-to-face communicating, but contradictorily they also complained that face-to-face communicating would interrupt their works.

The engineers call for a better interpersonal relationship, on the side, they are worried about a radical change of environment to improve relationships with colleagues might influence or interrupt their work. Therefore, in the workshop discussion, the reasons to cause a good mood or relieve one's stress and the ways to support intimate experience and interactions without disturbance might be the distinct key points to develop a solution. After analyzing and consolidating those different opinions, the ideas which were achievable to be practiced in field trails were selected, and the complete communicating scenarios for testing were made.

## **5.2 Prototyping**

Following the outcomes of the previous study, some of these designs have been substantiated concepts, and evaluated if they can work meaningfully and improve the relationship among those engineers.



### **5.2.1 Prototype Design**

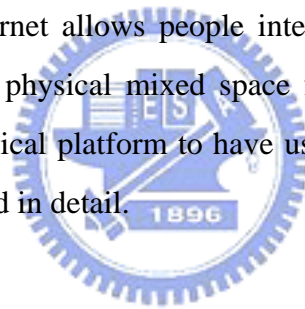
Those prototypes were followed the concepts out of the workshop and the expectations of engineers explored in the earlier study. In addition, the issues on communication media we had introduced before, including intimate interface and background awareness supply, were also addressed and considered thoroughly when these design concepts were developed.

First of all, the goal of these concepts is to enhance the chatter and interaction behavior between colleagues in a way but not interrupting their work, such as non-real-time communicating. Besides, the quality of rest time is those engineers' major concern. Further, the behavior of sharing, such as a book, photos, a good song or wonderful experiences, with colleagues not only brings colleagues closer, also enriches each others' understanding at the

same time. To this end, an emotional and intimate interface was quite applicable to improve their embodied visual environment, and a rendering of background presence had a nice chance of supplying non-immediate communication. Furthermore, we tried to think over and reproduce the quality and the subtle percipience which existed in the past embodied, in-personal contact. Hence, the media we brought up later would be achieved in unusual ways with different perceptual directions to increase the interactions between colleagues.

In order to further discover people’s reception and valuation with different types of media, the prototypes were respectively framed as a communicating system on the Internet, a digital device, and a non-tech implement in the working environment (Table 4).

On the basis of solutions discussed in the workshop, each of the prototypes could convey the colleagues’ presence, emotion, or personal information, and took on the intimate interfaces. The system based on the Internet allows people interacting in a virtual space. The digital device provides a virtual and physical mixed space for the users to experiencing on. The non-tech setup plays as a physical platform to have users to communicate on. As following, the three concepts are explained in detail.



**Table 4 Prototypes**

Prototype	Frame	Descriptions
Linking Village	on-line system	a virtual space to allow people exchanging information
Tree of Sound Track	digital device	a virtual and physical mixed space have users experience on
Fruity Air	non-tech implement	a physical platform to have users to communicate on

Prototype Design 1: *Linking Village* (Figure 12). *Linking Village* is a cross-platform information sharing system. It integrates common media formats, and users could easily share interesting information and watch the latest news posted by colleagues through the visualized dynamic display on line. The sharing information would be classified into several types, such as sports, entertainments, economy, or experience sharing. Besides, everyone has his own personal icon with information of hobby or association to introduce himself to others.



Figure12. Linking Village

Prototype Design 2: *Tree of Sound Track* (Figure 13). The tree is planned to be installed at the corner of the tea room, a space where all engineers would use and have a rest. Since everyone's working hours and leisure time is different from others, these engineers might use the tea room without meeting someone else. The main concept of this design is to let people have perception of others by listening to others' sound tracks. Changing the pleasurable experience of listening to sounds of nature with cosy emotion under a tree, this device provides a chance for people to percept the subtle traces left by their colleagues.

This tree with simple contour randomly plays the music and people's emotional voice previously recorded from the same context, such as laughing or cheering. People also could record a message into the tree at the moment, or download the music he/she likes.

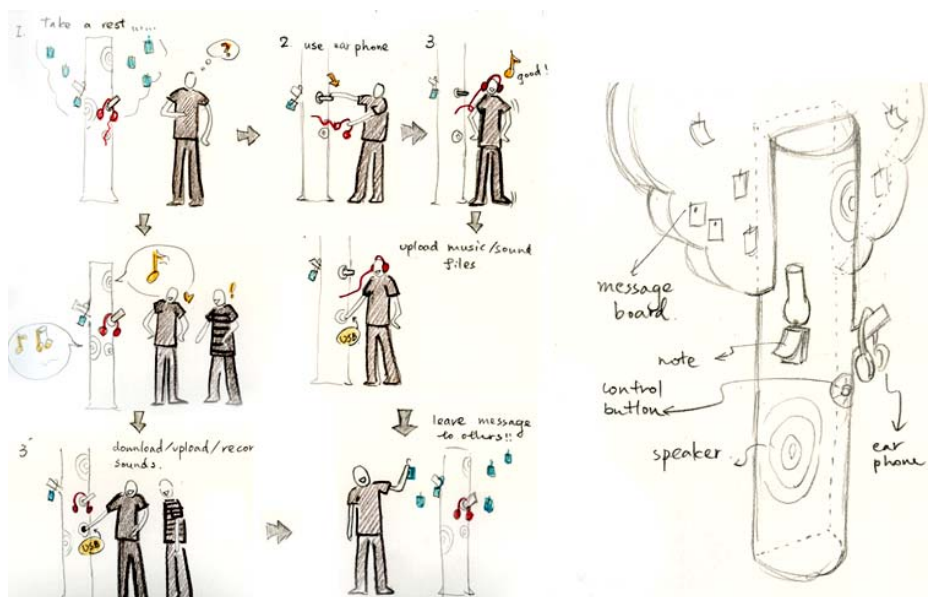


Figure 13. Tree of Sound Track



In addition, there is a bulletin board on the top to reveal the messages colleagues left and the provider of the broadcasting music.

Prototype Design 3: *Fruity Air* (Figure 14). *Fruity Air* looks like a cute shrub with ripe fruits moving in the office passages. It is a bidirectional-open cabinet running from seat to seat. Since a drawer was full of stuffs that people sharing followed by some subjects, for instance travel photos, guidebook, or video tapes, the drawer shining turns from green to orange and attracts more people to take it.

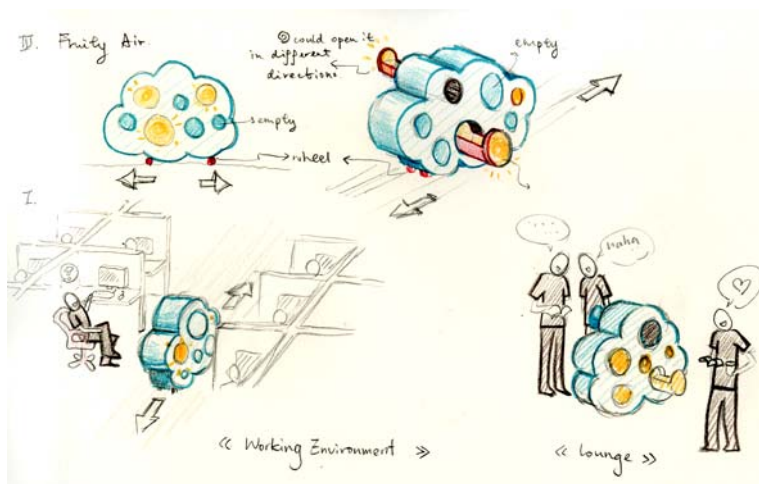


Figure 14. Fruity Air

## 5.2.2 Scenario Test

To evaluate our design concepts in the later field trials, *Tree of Sound Track* and *Fruity Air* were both given more than two testing scenarios that might happen in the real field for potential users to exam. Here, four representative scenarios are as follows:

Testing scenarios with *Tree of Sound Track* (Figure 15):

- Engineer Leon comes to the tea room by himself. He has a coffee in front of the tree and listens to the music shared by Julie. At the same time, he's watching the messages and sentiments written by his colleagues on the message board. He likes the music

very much, he writes down some words for Julie. Before he leaves, he downloads the music and uploads his favorite songs to others (the left of figure 15).

- Julie, Grace, and Joanne come to tea room together, and talk about the conversation on the message board. At the some time, background music is played lightly. They record a birthday bless with the music for their colleague Tim. Another day, Tim and Leon come together and get the sound message from their colleagues (the right of figure 15).



**Figure 15. Testing scenarios with Tree of Sound Track**

Testing scenarios with *Fruity Air* (Figure 16): This bidirectional-open cabinet moves from seat to seat in the office passages, and it also could be placed in the lounge near to the office.

- Joanne wants to have a rest and is attracted by the orange light of shining drawer. She opens all the drawers and leafs over the stuffs with the notepapers. Then, she leaves some travel photos taken last week with family to follow the country guidebook provided by Julie. She also pastes a recommendable heart badge on the biggest drawer (the top of figure 16).
- After lunch, Joanne, Julie, and several colleagues chitchat in the lounge, they talk about the books shared in the cabinet, and change the sentiments. Julie writes something about how she got her favorite novel on a notepaper, and shares that novel

to others (the foot of figure 16).



Figure 16. Testing scenarios with Fruity Air

### 5.2.3 Preliminary Estimations



In the preliminary estimations, numerous engineers gave us many thoughts according to the plots of the scenarios and operations of the prototypes. Most of them liked the interfaces of our prototypes very much, and gave us lots of positive reflections about the workplace atmosphere the prototypes might influence. “Never thought about an interactive music player would appear in the tea room like this. It looks very charming, and the atmosphere there becomes very cosy, cordial, and delightful. The messages left on the board must be very interesting,” one engineer said. The background sounds, messages or stuff sharing on the *Tree of Sound Track*, *Linking Village*, and *Fruity Air*, extend the subjects of a talk and interactions between colleagues. What is most important of all is these interactions with colleagues won’t interrupt their work, but relieve some work stress. Later, these prototypes we designed from on-line program to a daily article will be put into a high-tech company further for field trials, to estimate the influence of them in the actual working environment.

Through the research activities at present, it is shows that a contented and delightful

working environment with a virtual or physical interesting promoter of airy interpersonal interactions could release one's work stress and make the colleagues closer. Besides, most people subconsciously cherish the slow and leisurely communicating ways, such as sharing a book, a special experience, or leaving some messages, which are not pressing but kind and intimate for the coworkers.

### 5.3 Field Trial

After a development session, to manifest the real situations of usage and to evaluate if the design concepts match the users' requirements and perceptions, the prototypes had better to be tested in a real field. The prototypes developed in this research were respectively framed as a Webspaces, a digital device, and a non-tech implement. The digital device, *Tree of Sound Track*, with a virtual and physical space was selected for the field trial since the webpage system could be easily evaluated on-line without researcher's intervention afterward and the non-tech cabinet is only on purpose to increase colleagues' sharing activities, which might take a lot of time in observing.

To have primary estimations from and responses to the design concepts, *Tree of Sound Track* was tested during the field trail, which offered a testing scenario above-mentioned and several functions to the users:

- Uploading, downloading, and recording sounds; the users could record a message or a laugh into the sound at the moment.
- Browsing the message board; the board would show the information of the playing sound, including the sound name, the colleague who shared this, and the commons or sentiments that other colleagues gave.
- Sharing information and leaving messages; in addition to the information about music or sounds shared by the colleagues, the users could take down any words they want to say or share their interesting experience on the digital message board.

- Bulletining the company newly activities and special service; the dispatch sent by the company was also showed here.

The prototype was put into a high-tech company, arranged at a passageway opposite the elevators and out of offices (Figure 17). There were about sixty engineers would pass there and see it whenever they got out from the elevators, entered their offices, had a couple of tea, or went to a restroom. However, owing to the time limit of the research, the testing period was reduced to one day. The prototype could not exactly record the voice from the passers-by or let the colleagues upload sound files, but randomly play some light music. The users could use the earphones at choice, and leave the messages to others with the notepaper. (More details of the installation and the complete plan for field trial refers to Appendix C)

Before the testing was taken, ten out of the sixty engineers were informed about this estimation, and the detail introduction of this prototype was given (Appendix D). However, the others didn't know about this estimation and prototype, until they went to work and saw it. Most engineers were attracted by the *Tree of Sound Track* at first sight, and some of them expressed highly interests to understand what it was and what it could do. When those engineers took a rest, they could come to the prototype and played with it, and the functions



**Figure 17. Field trial in a high-tech company: an engineer got out from the elevator and was attracted by the prototype. He came to the tree, put on the earphones, listened to music, and took down some words on a note to respond to the message left by his colleague.**

and scenario were introduced. If one engineer had an inclination to share his/her sentiments and opinions, there might be a short interview about ten to twenty minutes.

The outcomes of the field trial were stimulated. Most engineers related to this new installation. “It is engaging. People can’t help to be attracted by its special out looking and the background music. I believe the work mood could be influenced if hearing some lovely music or seeing an interesting message on the bulletin board,” one engineer said. “It’s nice. If I discover an excellent restaurant, I can post the news here and ask if anyone wants to go with me after work. It could bring the colleagues together. ” In addition to that, there were a few engineers who also gave more different points of view about the appearance of the prototype, the place where it could be located, and the potential usage and service it might accommodate with.

#### **5.4 Review**



Through the investigation and participatory design, we tried to conceive some better ideas of having the communication media match what people need and to supplement the insignificant perceptions which are neglected in today’s social interactions.

Through comparing the viewpoints and requirements of users with the social issues we deliberated before, it is unfolded that the usage of communication media could be related to many different conditions, like external restrictions, one’s personality, price, appearance, or efficiency. The choice of communication media might influence interpersonal relationship further. Here, in accordance with different situations, several notable considerations of developing appropriate communication media would be discussed below.

### 5.4.1 Usage Circumstances

The choice of communication media is tightly interrelated with the usage circumstance. In another word, to develop a communication implement should consider the real usage situations and limitations.

A noticeable case in our study is the requirement of non-immediateness. Most communication media is developed for efficiency and prompt response. However, in a case of such working environment, since the coworkers have to extremely concentrate on their work, an immediate conversation seems inappropriate to have. The occupied engineers expressed that they might have a little trouble with the interruption of their colleagues, even though a face-to-face conversation is much clearer than other communicating ways to discuss their official affairs.

Another usage situation of these engineers is the company restrictions on security. Some of the high-tech companies do not allow their workers using external e-mail or messenger systems. The workers' behaviors would be changed, since the allowable communication channels in their working environment are quite different form what they tended to use. Hence, it is very essential to consider how to encourage the workers to use the constricted communication application and to maintain their original social contact.

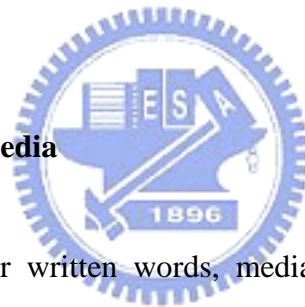
Even if technology had supported opulent accessible sources of communication, people still face a shortage of proper media yet. In the study, a couple of engineers, who work together in the same office, had to use VNC (Virtual Network Computing, a desktop sharing system) and telephones for a discussion at one time, since both of them couldn't leave their own seat for other routine work but had to watch and deliberate with some information displayed on the monitor. The same inconvenient situation also exists in a video conference between two cooperative groups at different cities.

In the research, through the profoundly understanding of the engineers' working cultures, it is shown that these engineers' special requirement of non-immediateness. Hence, each of the

prototypes in the research was designed for non-immediate communication. Linking Village is a synthetically interactive web page for people to share their own information and to be acquainted with others at one time. Through sharing sound experience and leaving messages, Tree of Sound Track was designed to release the engineers' stress and enhance the social relationship. In the same way, Fruity Air also increases the interactions between colleagues by the behavior of sharing. Those non-immediate communication media was designed specially for the occupied engineers to understand or to be concerned with their colleagues without face-to-face conversation directly.

The situations of a location or an environment to set up a communication device should be seriously considered. Hence, through a field study, the thorough comprehension of the special requirements of different circumstances would be significant to develop communication media.

#### **5.4.2 Perceptions of the Media**



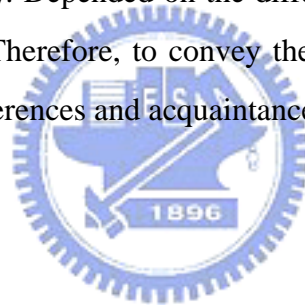
Through images, sounds, or written words, media could give people different sensual perceptions in communication. And a video or sound based media, as Skype and MSN messenger, make the communication more intimate than the text based ones. Most interviewees were of the opinion that both of voice or image could render some kind of reality and provide an awareness of presence. Compared with sending a mail, talking on the phone seems much sincerer, and the expression of written words is a little bit weak.

Most people believe that communication media with the integration of various perceptions could make the conversation more specific and more persuasive. For example of web camera, some people preferred to use it very much. Through the camera, people could share any visual stuff to others, or convey some information about their own environment to create a communication context. However, in the research, some people expressed that they do not like to disclose their own information or situations to others and would be uncomfortable to use multimodal media.



Through perceiving a sense of presence, people could be concerned with others without disturbance, and increase the consensus themselves. As the aforementioned, a sense of presence could be supported by different media. For example, MSN messengers could show one's real situations. The awareness of presence makes people feel accompanied by their friends, and also satisfies peoples' requirements to care for others.

The prototypes in the research were also designed to convey different perceptions in communication. Both of the personal dynamic icon shown in Linking Village and the sound message left in Tree of Sound Track could deliver a sense of presence and make people feel accompanied by others. People are always supported and encouraged by friendship, and the presence of these friends also makes people relaxed and comfortable. However, to integrate these subtle senses into communication media is not always appropriate, since some people are particular about the privacy. Depended on the different personal characters, requirements and tastes would be distinct. Therefore, to convey these senses in media application should also refer to the individual differences and acquaintance of the community.



### **5.4.3 Customs and Trends**

In this research, the new forms of communication media were addressed to solve the social problems, such as the isolation phenomenon caused by habitual usage of media. Hence, the prototypes were respectively framed in three different types for the later evaluations.

People's dependence and tendencies of their customary communication media reflect on their acceptance of new types. In field trial, all engineers were very curious about the exceptional forms of Tree of Sound Track, and most of them had positive reflections on it. It is notable that the engineers, who are especially fond of this installation, are over the age of thirty, and rarely rely upon the Internet. In all brief quizzes after field evaluations, one of these interviewees expressed that he already got used to communicating or receiving information through the Internet, and he also thought that the system of Tree of Sound Track should be framed as a webpage, which for him was much convenient to access.

Through the investigations and prototype evaluations, it is revealed that most people greatly rely on the technology media they use. Parts of interviewees expressed that they would be anxious and nervous if they forgot to bring their cell phones with themselves or had no internet access. People already have a custom to receive information on a constant channel or through the same media. Once there is something different or changed of their customary media, they might be persecuted and unaccommodated. However, the habitually usage of media is the main factor that cause the people isolated or grouped. Therefore, to develop new communication media for improvement in social relationship, the acceptance of different groups and people's customary usage should be under consideration.

In the research, to attract the people who are grouped by habitually usage of media, Tree of Sound Track and Fruity Air are both offered intimate and novel appearances to engage people to approach and use. In terms of the results, Tree of Sound Track attracted the engineers indeed, and gained lots of positive response.



## 6. CONCLUSIONS

The interactions and life-style of Taiwanese high-tech engineers are revealed with interviews and probe diaries. Meanwhile, the reasons that cause the colleagues isolation were also explored. Through the participatory design, we tried to bring up several guidelines to improve the interpersonal relationship between colleagues.

Such issues like communicating and interpersonal relationship are involved in many different aspects of people's lives, from personal characteristics to culture, so the research and design work have to consider extensively, not only focus on the operations between people and interfaces of artifacts, but the people's subtle emotional perceptions of their environment, personal connectedness, and the detail limitations that might effect the communicating activities.

Through the investigations, the interpersonal relationships between colleagues in this research seem cordial no more. Most interviewees and probe participants complained about the situations of discord and isolation in their working environments. They also mentioned that it seemed impossible to make friends if there were competitions among colleagues. The various factors that might affect the social interactions in the working environments were considered as the personal characteristics, huge work stress with fast tempo, the management style of the companies, and the extreme unequal ratio of females to males. However, such a circumstance as management style, provoking the competitions between colleagues, seems a current trend and is impossibly reformed in this short-term research.

In the participatory design session, design concepts were enriched by the participants from different viewpoints. Most of participants believed that releasing people's stresses from work and encouraging their interactions are quite effective ways to enhance their social relationships. Especially through the activities of sharing, colleagues could become closer and friendlier.

In the research, the prototype was developed based on the findings of investigations and the

workshop, and the emotional and intimate interface is applied to improve their embodied visual environments. The prototypes developed in the research have received lots of different reflections through the field trails, and most participants had the positive opinions on our design concepts. However, to get into people's real habitual lives of communication will be a significant challenge in the future.

In the past, there were lots of ways to convey one's concern, which are direct, plain, and perceptual. In such issues to enhance the interpersonal interactions and social relationship, there is an approach to extend the possibility of technology from people's activities and circumstances they engaged in. In the research, we did not to request the engineers to connect with others straightforward, but promote the social contact and raise the concerns between of colleagues through other behaviors, like sharing one's experience. In addition, there are a lot of research groups devoted to address a prototype background communication device that aims to create a sense of emotional presence between two people who are separated by space or time.

Even though technology will never replace the physicality and immediacy face-to-face contact, there exist different limitations of reality. In fact, technology and artifacts could bring people closely together by sharing with the idea of intimacy, experience and their emotions, and convey some kind of awareness between family members separated by a distance. We hope our study could promote the connectedness between people and make people's lives abundant in the future.

## REFERENCE

1. Agamanolis, S. (2002) "Designing Displays for Human Connectedness." In *Proceedings of CSCW Workshop, Community and Situated Displays*, New Orleans.
2. Auger, J., Loizeau, J., and Agamanolis, S. (2003) "Iso-phone: a total submersion telephonic experience." ISICT 2003 International Symposium on Information and Communication Technologies, Dublin, 24 - 26 September 2003.
3. Bassoli, A., Cullinan, C., Moore, J., and Agamanolis, S. (2003) "TunA: a mobile music experience to foster local interactions." In *Proceedings of UbiComp 2003 Fifth International Conference on Ubiquitous Computing*, Seattle, 12 - 15 October 2003.
4. Beyer, H., and Holtzblatt, k. (1998) "Contextual Design." *Defining Customer-Center Systems*. Morgan Kaufmann Publishers, Inc.
5. Bitton, J. (2006) "Distance and Sexuality: where HCI meets convenience and affinity", position paper for the workshop "Sexual Interactions: Why We Should Talk About Sex in HCI", CHI 2006 Conference on Human Factors in Computing Systems, Montréal, 22 - 27 April 2006.
6. Browne, H., Bederson, B., Plaisant, C. and Druin, A. (2001) "Designing an Interactive Message Board as a Technology Probe for Family Communication" (Verified 10 May 2004) Available from URL: <<http://www.cs.umd.edu/local-cgi-bin/hcil/rr.pl?number=2001-20>> [Accessed 2006 April 3rd]
7. DeLongis, A. K., Hemphill, J., & Lehman, D. R. (1992). A Structured Diary Methodology for the Study of Daily Events. In F. B. Bryant et al. (Eds.), *Methodological Issues in Applied Psychology*. New York: Plenum Press
8. Diani, M. (1986) "The Social Design of Office Automation." In *Design Issues IV*, 1 & 2, Chicago.

9. Dourish, P. and Bellotti, V. (1992) "Awareness and Coordination in Shared Workspaces." In *Proceeding of ACM CSCW Conference*, 1992, 107-114.
10. Dourish, P. and Bly, S., (1992) "Portholes: Supporting awareness in a distributed work group." In *Proceedings of CHI 1992*, ACM Press: 541-547.
11. Fels, S. Sidney (2004): "Designing intimate experiences." In: Nunes, Nuno Jardim, Rich, Charles (ed.): *International Conference on Intelligent User Interfaces 2004*. January 13-16, 2004, Funchal, Madeira, Portugal. pp. 2-3.
12. Garfinkle, H.(1967) *Studies in Ethnomethodology*. Englewood Cliffs, NJ: Prentice Hall.
13. Gaver, B., Dunne, T., and Pacenti, E. (1999) "Design: Cultural probes." In *Interactions*. Vol VI, No.1: 21-29
14. Gedenryd, H. (1998) *How designers work: making sense of authentic cognitive activities*. Ph.D. dissertation. Jabe Offset AB, Lund, Sweden.
15. Gibson, J. (1982) *Reasons for realism*: Lawrence Erlbaum Associates Press.
16. Horst, W., Bunt, T., Wensveen, S., Cherian, L. (2004) "Designing Probes for Empathy with Families" In *Proceedings of the conference on Dutch directions in HCI*, ACM Press
17. Horton, D. and Wohl, R. (1956) "Mass Communication and Para-Social Interaction: Observations on Intimacy at a Distance."
18. Ireland, C. (2003) "Qualitative Methods: From Boring to Brilliant", In *Design Research*, London: MIT Press, 23-29
19. Jääskö, V. & Mattelmäki, T. (2003) "Observing and Probing." In *Proceedings of the International conference on Designing pleasurable products and interfaces 2003*, ACM Press: 126-131.
20. Kaye, J. and Gouldin, L. (2004) "Intimate objects." In *Proc. DIS'04 Designing Interactive System*, Cambridge, MA, New York, NY: ACM Press: 341-344

21. Koskinen, I. (2002) Presentation about “Self-documentation in the Social Sciences.” In Probe-workshop, marraskuu, 2002, Taik, Helsinki. Available from URL: <  
[http://smart.uiah.fi/luotain/pdf/probes-seminar/self-documentation-social-sciences\\_koskinen\\_ilpo.pdf](http://smart.uiah.fi/luotain/pdf/probes-seminar/self-documentation-social-sciences_koskinen_ilpo.pdf)>  
 [Accessed 2005 May 4th]
22. Löwgren, J., Stolterman, E. (1999) “design Methodology and design Practice.” In *Interactions*, Vol VI, No.1: 13 -20.
23. Mäkelä, A., Giller, V., Tscheligi, M., Sefelin, R. (2000) “Joking, storytelling, artsharing, expressing affection: A field trial of how children and their social network communicate with digital images in leisure time.” In *Proceedings of CHI 2005*, ACM Press: 458-555.
24. Markopoulos, P., Romero, N., Van Baren, J., Ijsselsteijn, W., De Ruyter, B. and Farshchian, B. (2004) “Keeping in touch with the family: home and away with the ASTRA awareness system.” In *Proceedings of CHI 2004*, ACM Press: 1351-1354.
25. Mhóráin, A. N., Agamanolis, S. (2004) “Aura: an intimate remote awareness system based on sleep patterns,” Media Lab Europe.
26. Moles, A. (1988) “Design and Immateriality: What of it in a Post Industrial Society?” In *Design Issues IV*, 1 & 2, Chicago: 25-32
27. Moore, F. R. (1988) “The Dysfunctions of MIDI.” In *Computer Music Journal*, vol.12, num.1, pp. 19-28
28. Norman, D. (1988) *The psychology of everyday things*. New York.
29. Ogawa, H., Ando, N., and Onodera, S. (2005) “SmallConnection: Designing of Tangible Communication Media over Networks.” In *Proceedings of the 13th ACM International Conference on Multimedia*, pp. 1073-4, 2005
30. Oviatt, S.L.(2002) “Multimodal Interfaces.” In Jacko, J. A., and Sears, A. (Eds) *The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications*. Mahwah, NJ: Lawrence Erlbaum & Associates, 286-304.

31. Patel, D., and Agamanolis, S.(2003) “Habitat: awareness of life rhythms over a distance using networked furniture.” In *Proceedings of UbiComp 2003 Fifth International Conference on Ubiquitous Computing*.
32. Rettie, R. (2003) “Connectedness, Awareness and Social Presence.” In *Presence 2003*, 6th Annual International Workshop on Presence.
33. Sanders, E. B.-N., and Nutter, E. H. (1994) “Velcro-modeling and projective expression: Participatory design methods for product development.” In *PDC ‘94: Proceedings of the Participatory Design Conference*. Chapel Hill NC USA: CPSR
34. Sanders, E.B.-N. (2000) “Generative tools for co-designing.” In *Proceedings of CoDesigning 2000*. London: Springer.
35. Schmidt, K. (2002) “The Problem with Awareness”, *Computer Supported Cooperative Work 11*: 285–298.
36. Schön, D. (1983) *The Reflective Practitioner, How Professionals Think in Action*. New York: Basic Books.
37. Tang, Ying-Man (2001) *Sell One's Soul to the Work--The discussion about the life style of the semiconductor industry engineers in HSIP*: National Tsing Hua University Press.
38. Vetere, F., Gibbs, M., Kjeldskov, J., Howard, S., Pedell, S., Mecoles, K., and Mueller, F. (2005) “Mediating Intimacy: Designing Technologies to Support Strong-Tie Relationships.” In *Proceedings of CHI 2005*, ACM Press.
39. Westerlund, B., Lindquist, K., Mackay, W. & Sundblad, Y. (2003) “Co-design methods for designing with and for families.” In *Proceedings of the European Academy of Design 5*, Techne. Barcelona.





## Appendix A: The Research Script for Dyad Interview

### 訪談進行流程與提問重點

研究主題：Communication in the Working Environment

研究人員：黃可薰

指導教授：鄧怡莘

#### 一、說明與介紹 (5 mins)

- 自我介紹、介紹彼此(受訪者與訪問者)
  - 訪問者姓名、年齡、職業 (參考 基本資料)
  - 生活型態、檔案測寫
- 說明研究內容與目的
  - The objective of this investigation is to find out the contexture and experience of daily communication between colleagues, and in addition, to have an insight into the fundamental and emotional needs of coworkers. Through the understanding of the behavior and customs of communication media or channels that mediate between people and their work partners, the way the emotional senses affect the awareness of the presence may be emerged. After, a new communication media design concept based on this research outcome might be expanded to enhance the inherent relationship between people working together, and the application of technology to make people attuned to their colleagues in varies sense will also be discussed.
- 保密與配合
  - 可否錄音
  - 可否拍照、合照？ (訪談結束後進行)
  - 有無其他需要配合的地方
  - 說明訪問內容僅做研究參考，絕對不會外流
- 準備錄音器材、準備開始訪談 (閒聊、避免疏離感)

## 二、訪談進行(40 mins)

- **溝通脈絡**

\*就針對溝通議題，再沒有的話也要試著尋找可能是互動行為的切入點

- 溝通行為：物、內容、時間點、時間長短、頻率、場合、媒體。
- 虛擬以及實體：實體對話與虛擬溝通的對照、兩者的不同比較。
- 對於工作夥伴的存在感：對於察覺、存在感，感知、知覺的向度。
- 慣用的溝通媒體：對象、使用情況和方式、其所給予的感知向度。
- 溝通的經驗：原因、動機、結果、滿足感。（特殊的或是日常情況）

- **工作環境**

- 工作空間中人際關係、氣氛：受訪者或同僚的經歷。
- 工作空間的孤立或是分群問題：受訪者或同僚的經歷。
- 工作空間外觀：受訪者描述並加以詮釋感受、缺點如何改進、和人際有無關係。
- 與工作空間之間的互動：使用、頻率、缺點如何改進、和人際有無關係。

- **工作與閒暇**

- 平衡。
- 活動內容？閒暇活動是否透過媒體？頻率、時間長度、對象？人際影響？

- **溝通期望**

- 溝通工具的缺點：介面、操作：複雜性以及使用上的困擾、無法被滿足的需求。
- 溝通的意義：受訪者對溝通的看法和其所帶來的價值。
- 期許：對於未來溝通上有所展望？

- **結尾：關於現階段其他研究的看法（參考 附錄）**

\* 給他們看目前有的一些研究成果，問他們對其的看法。我們可以設定一些議題和他們討論

- **Passages** (Background awareness: presence/ Intimate interfaces/ encounters with stranger/ shared experience/ full body interface/ public space)
- **Habitat** (Background awareness: reassurance & presence/ sense of context for communication/ ambient design)
- **Aura** (Background awareness: presence/ Intimate interfaces: intuitive and visceral way/ keepsake of the future)

- **iCom** (Background awareness: presence/ interpersonal communication)
- **Iso-Phone** (Intimate interfaces/ interpersonal communication/ slow communication/ full body interface)
- **One2One** (Background awareness: presence/ keepsake of the future)
  - 對於感知的開發和應用有什麼看法、喜歡的方式、或是想到其他形式？
  - 請問您對這些溝通工具的看法觀點、希望深入探討或是有興趣的地方在哪

### 三、詢問臨時想到的問題或先前未考慮的問題(5 mins)

### 四、結尾(5 mins)

- 是否有哪些與人溝通或是和工作環境有關的事項並未含括在訪問內容中？若有，能否請你說明一下
- 訪問過程中是否有任何事情讓你覺得不愉快，我們需要改進的地方？
- 檢視所有記錄的文件並詢問受訪者是否同意我們帶走
- 致贈受訪費，請受訪者簽領據
- 感謝受訪者接受我們的訪問




訪談進行流程與提問重點  
附錄




研究主題： Communication in the Working Environment  
研究人員：黃可薰  
指導教授：鄧怡莘

關於現階段其他研究的看法

**A. Passages** a very close proximity media space  
space / intuition / relationship/ intimacy



- feel
- self awareness
- movement within a space
- perceive the other and the world
- encounter and elaboration of relationships
- trace

Media Lab Europe  
Human-Computer Interaction  
Human-Computer Interaction group  
http://www.hci.mcgill.ca

**B. Habitat**  
A range of connected furniture for awareness of daily routines and rhythms between distant family members.  
space / presence / relationship






- Background awareness: reassurance & presence
- sense of context for communication



Media Lab Europe  
Human-Computer Interaction  
Human-Computer Interaction group  
http://www.hci.mcgill.ca

**C. Aura** an intimate remote awareness system based on sleep patterns  
space / intuition / intimacy/ keepsake

- Background awareness: presence
- Intimate Interfaces: intuitive and visceral way
- keepsake of the future

Media Lab Europe  
Human-Computer Interaction  
Human-Computer Interaction group  
http://www.hci.mcgill.ca

**D. iCom** a multipoint awareness and communication portal for connecting remote social spaces  
space / presence / intimacy



- Background awareness: presence
- interpersonal communication



Media Lab Europe  
Human-Computer Interaction  
Human-Computer Interaction group  
http://www.hci.mcgill.ca

**E. Iso-Phone** a total submersion telephonic experience




- Intimacy
- interpersonal communication
- slow communication
- full body interface





Media Lab Europe  
Human-Computer Interaction  
Human-Computer Interaction group  
http://www.hci.mcgill.ca

**F. One2One** a toolkit for creating personalized ambient media links for conveying togetherness over a distance  
Background awareness: presence  
Keepsake of the future







Media Lab Europe  
Human-Computer Interaction  
Human-Computer Interaction group  
http://www.hci.mcgill.ca

## Appendix B: The Research Script for Probe Diary

### 場域觀察——日誌問題

研究主題：Communication in the Working Environment

研究人員：黃可薰

指導教授：鄧怡莘

#### 一、基本資料

姓名		年齡		工作地點	
性別		職業		工時	
工作內容					
工作環境					
同事關係					
閒暇活動					

#### 二、Diary 第一天的內容

<b>DAY 1</b> Date 2006 / /
早上 所記錄的時段 : 00 ~ :00
1.1.1 就您觀察，今天早上工作環境的氣氛如何？有哪些工作以外的互動？ (請您例舉，若環境或溝通的方式特殊，請稍作描述。如：一早辦公室的氣氛很熱絡，大家在傳閱小張旅遊的照片。之後又收小陳的 Massage，稍微聽他抱怨工作上的事情。)
1.1.2 若有所互動，這之間有沒有哪些特別的，或是令您愉快或不愉快的事情？ (請你簡述內容，或是該環境、溝通的方式。)
1.1.3 請問您早上工作狀況如何？是否受到環境影響？ (如：在會議室用視訊和台北的公司簡報，有些喧鬧，所以稍微浮躁。)
1.1.4 請問您早上公事上和同事的互動有哪些？有什麼影響？(如：接到電話討論公事，正在進行的工作被打斷。)
1.1.5 請問您今天早上是否有某個時段進行休息？是否與環境或同事有所互動？這樣的休息有紓解你的壓力嗎？(如：在休息室和小張小王一起吃早餐，稍微聊一下昨天職棒的結果。工作之中坐在隔壁的小張偶爾會講一些笑話。)
下午 所記錄的時段 : 00 ~ :00
1.2.1 請問您最喜歡午餐方式？您今天午餐時段，同事之間的氣氛如何？同事間之間是否有互動？
1.2.2 今天午餐時段您是否有愉快或是不愉快的溝通經驗？(請簡述地點環境、對象、方式、互動等等)

1.2.3 就您觀察，今天下午工作環境的氣氛如何？同事間之間是否有互動？有沒有哪些令您愉快或不愉快的事情？（請你簡述）

1.2.4 請問您今天下午工作的狀況如何？是否受到環境影響？是否與同事之間有所互動？

1.2.5 請問您今天下午是否有某個時段進行休息？是否與環境或同事有所互動？

1.2.6 請問您今天下午是否使用了一些溝通媒體？（對象、內容、時間點）對於這媒體有沒有喜歡或是不喜歡的地方？

**晚上 所記錄的時段**    -- : -- ~ -- : --

1.3.1 請問您最喜歡晚餐方式？您今天午餐時段，同事之間的氣氛如何？同事間之間是否有互動？

1.3.2 今天晚上您是否有愉快或是不愉快的溝通經驗？（請簡述地點環境、對象、方式、互動等等）

1.3.3 就您觀察，今天晚上工作環境的氣氛如何？同事間之間是否有互動？（例舉）

1.3.4 請問您今天晚上工作的狀況如何？是否受到環境影響？

**DAY 1 心得感想 Date 2006 / \_\_\_\_ / \_\_\_\_**

1.4.1 您喜歡什麼樣的溝通媒體？工作場所所使用的媒體和您平日生活慣用的媒體是否一樣？其中的差異是？

1.4.2 問您覺得同事之間的互動、感情溝通，受到哪些因素影響？

1.4.3 和您互動較多的同事，你們傾向於怎樣的互動模式？



**三、Diary 第二天的內容**

**DAY 2 Date 2006 / /**

**早上 所記錄的時段**    : 00 ~ : 00

2.1.1 就您觀察，今天早上工作環境的氣氛如何？有哪些工作以外的互動？

2.1.2 若有所互動，這之間有沒有哪些特別的，或是令您愉快或不愉快的事情？

2.1.3 請問您早上工作狀況如何？是否受到環境影響？公事上和同事的互動有哪些？有什麼影響？

2.1.4 請問您今天早上是否有某個時段進行休息？是否與環境或同事有所互動？這樣的休息有紓解你的壓力嗎？

**下午 所記錄的時段**    : 00 ~ : 00

2.2.1 請問您今天午餐，同事之間的氣氛如何？是否有令您愉快或是不愉快的溝通經驗？

2.2.2 就您觀察，今天下午工作環境的氣氛如何？是否有令您愉快或不愉快的事情？（請你簡述）

2.2.3 請問您今天下午工作的狀況如何？是否受到環境影響？是否與同事之間有所互動？

2.2.4 請問您今天下午是否有某個時段進行休息？是否與環境或同事有所互動？

2.2.5 請問您今天下午是否使用了一些溝通媒體？（對象、內容、時間點）對於這媒體有沒有喜歡或是不喜歡的地方？

<b>晚上 所記錄的時段</b> -- : -- ~ -- : --
<p>2.3.1. 您今天晚餐時段，同事之間的氣氛如何?同事間之間是否有互動?</p> <p>2.3.2 今天晚上您是否有愉快或是不愉快的溝通經驗?(請簡述地點環境、對象、方式、互動等等)</p> <p>2.3.3 就您觀察，今天晚上工作環境的氣氛如何? 同事間之間是否有互動?(例舉)</p> <p>2.3.4 請問您今天晚上工作的狀況如何?是否受到環境影響?</p>
<b>DAY 2 心得感想 Date 2006 / ____ / ____</b>
<p>2.4.1 您是否承受某些工作壓力? 壓力主要是來自哪?</p> <p>2.4.2 您會藉由一些休息方式來紓解壓力嗎?最常的休息方式是?</p> <p>2.4.3 就您所知，您的同事較常、較喜歡採取哪些休息方式?</p>

**四、Diary 第三天的內容**

<b>DAY 3 Date 2006 / 2 / 13</b>
<b>早上 所記錄的時段</b> : 00 ~ : 00
<p>3.1.1 就您觀察，今天早上同事之間的氣氛如何? 是否有令您愉快或是不愉快的溝通經驗?</p> <p>3.1.2.請問您早上工作狀況如何?是否受到環境和同事影響?公事上的互動有哪些?</p> <p>3.1.3 請問您今天早上是否有某個時段進行休息?</p>
<b>下午 所記錄的時段</b> : 00 ~ : 00
<p>3.2.1 請問您今天午餐，同事之間的氣氛如何? 是否有令您愉快或是不愉快的溝通經驗?</p> <p>3.2.2 就您觀察，今天下午工作狀況如何?是否受到環境和同事影響?公事上的互動有哪些?</p> <p>3.2.3 請問您今天下午是否有某個時段進行休息?是否與環境或同事有所互動?</p>
<b>晚上 所記錄的時段</b> -- : -- ~ -- : --
<p>3.3.1 您今天晚餐時段，同事之間的氣氛如何? 是否有令您愉快或是不愉快的溝通經驗?</p> <p>3.3.2 就您觀察，今天晚上工作環境的氣氛如何? 同事間之間是否有互動?</p> <p>3.3.3 請問您今天晚上工作的狀況如何?是否受到環境影響?</p>
<b>DAY 3 心得感想 Date 2006 / ____ / ____</b>
<p>3.4.1 對於您的同事之間的人際關係，就你的感覺如何?</p> <p>3.4.2 就您所了解的其他類似性質的工作場域(RD)，您所知道的人際氣氛又是如何呢?</p> <p>3.4.3 對於增進同事間的感情、改善溝通模式，您是否有其它想法呢?</p>

## 五、工作環境

<b>Environment</b> Date 2006 /   /
A. 請在右頁空白處，大致畫出您所在工作環境的平面圖，並標上您與同事之間的距離。
B. 請您利用日誌後面所附的貼紙，標記您所處描述您所處的工作環境。
C. 工作環境：
4.1 就您所知，您或是您的同事都對於工作環境有什麼特別喜歡或是不喜歡的地方？
4.2 同事之間，彼此是否存在著相當的影響力呢？
4.3 請問您對您的工作環境有什麼喜好？
4.4 或是說哪些情況下會令你工作起來最愉快、效率高？

## 六、工作環境日誌樣本

<h3>Environment</h3> <p>A. 請您利用日誌後面所附的貼紙，標記您所處描述您所處的工作環境。</p> <p>(若是您的個人用品、擺設的方式與所附的圖不同，可隨意畫上示意圖或是用文字描述)</p> 
---



## Environment

B. 請在右頁空白處，大致畫出您所在工作環境的平面圖，並標上您與同事之間的距離。

圖例：

- a. 請標示出同事最常聚在一起聊天的地方 ⊙
- b. 請依序標示出您或同事使用頻率較高的公共空間：1,2,3...



## Appendix C: The Research Plan for Field Trials

### 【聲音的痕跡—實驗規劃】

研究主題： Communication in the Working Environment

研究人員：黃可薰

指導教授：鄧怡莘

#### 壹、 研究簡介：

本研究的主題探討工作空間中的人際溝通，希望藉著前端研究的發現與結果，提出一些概念藉以增進人與人之間的距離，並且促使工作夥伴之間的感情能更為融洽。

本實驗裝置的設計，緣由聆聽各種聲音是普遍的休息方式，可以和緩工作緊張的步調，釋放壓力並調適身心；並且藉由分享生活中的各種聲音，能了解工作夥伴所喜愛的音樂或是各種愉快經驗。外觀上簡潔的樹木外型，給人舒適、洗鍊的感覺，能放鬆心情，希望能提供忙碌工作者不一樣的感官經驗。期望此裝置能成為促進工作者之間情誼的媒體。

#### 貳、 實驗目標：

了解工作者是否能藉由聲音的分享和交流、觀看同伴訊息，紓解工作中的壓力，並且因而產生更多彼此之間直接或間接的互動，促使感情更融洽。探討非同步的對話方式（留言、交換聲音等），是否較即時性的方式（電話、聊天等）造成較小的困擾，以及本實驗裝置的外觀造型在工作環境中所能造成影響之看法。

#### 參、 實驗裝置：

聲音的痕跡：分享樹。這棵樹座落在休息空間裡，簡單如同剪影般的線條給人從容、閒適的感覺。忙碌之餘來到休息空間的工作者，可以在樹下享受片刻的休憩。樹上有著小型的揚聲器，播送著之前曾在樹下休息的人，留下的各種聲音足跡，可能是談話聲、笑聲或是他們想分享給其他人的音樂。

本實驗的模型樹，不能實際的使用及操作：包括上傳、下載聲音檔等等，只能隨機的播放預先錄製好的音樂。期望能藉由模型，表達本設計概念，以及測試工作者在休息之餘對本裝置所營造模擬情境的觀感。

### 實驗裝置以及記錄相關物品：

#### 1. Low-tech Probe：

- 紙板做的 demo 樹裝置，其上附 CD Player 一台、喇叭一組、耳機一付。
- 留言版、便條紙、鉛筆：可為分享的聲音標上分享者的註解、或是寫下感想、留言等訊息，在樹上有附一個便條紙箱，附在裝置樹上。
- 指示訊息標籤：標明本裝置的各種功用，附在裝置樹上。

#### 2. 數位相機、錄影機（觀察記錄使用，不會使用於訪查空間以外的地方）

#### 3. 其他：保密協定暨同意書（一式二份）、學生證或名片（證明為交大學生）

### 肆、實驗需求：

#### 4.1 實驗參與者：

\*參與者需十名以上 RD 等工作人員，在實驗當天選擇自由時間模擬操作本實驗裝置（約五到十分鐘左右）；並願意接受實驗後二十分鐘左右之訪談（可以依其需求選擇任何時間），或是電話、E-mail 等替代之訪談方式。

#### 4.2 實驗場域及時間：

\*休息室或是茶水間，大部分的工作人員休息時會經過或停留的場所。

時間	2006 年 4 月 21 日（星期五）、24 日（星期一）
地點	
聯絡方式	
實驗場域 外觀概述	

### 伍、實驗流程：

#### 1. 第一天：

時間	2006 年 4 月 21 日（星期五）
1.1 實驗裝置 架設確認	1. 實驗裝置架設及確認：將小樹放置於參與者所提供、工作人員休息時會經過或停留的場所，並確認其上裝置之正確。 2. 觀察裝置架設及確認：數位相機及攝影機的架設和運作確認。

<p>1.2 實驗介紹 實驗說明</p>	<p>3. 介紹：對各參與者做自我介紹及研究主題說明（促進辦公場域的人際交流）。</p> <p>4. 實驗主題說明：介紹本實驗內容，包含說明主題、目標（參考：壹、簡介；貳、實驗目標）。</p> <p>5. 實驗裝置說明：介紹本實驗裝置所欲模擬之功能和操作(附錄 1：情境劇本)，並說明實驗流程（參、實驗裝置；伍、實驗流程）。</p>
<p>1.3 實驗說明 提醒</p>	<p>6. 實驗過程之說明及提醒：</p> <ul style="list-style-type: none"> <li>● 詢問所有參與者是否有任何需要配合的地方（例如，因為我們的來訪所造成的影響、壓力，需要我們改進的地方，或是其他必要的限制）。</li> <li>● 提醒參與者實驗進行時所採取的紀錄和觀察方式（攝影或拍照）。</li> <li>● 說明所有研究結果僅供學術研究，不會公開參與者之資料。</li> </ul>

## 2. 第二天：

時間	2006年4月24日（星期一）
2.1 實驗進行	<p>7. 時間為正常工作日，早上九時至下午四時三十分。</p> <p>8. 在實驗進行中，研究參與者可以選擇任何自由休息時間操作或親近本實驗裝置，並由我在旁協助介紹操作和模擬情境，使參與者感受本裝置。操作方式為留言給其他工作夥伴、聆聽音樂等等，並可選擇使用耳機或是喇叭，播放聲音之大小可做調整（時間約為十五分鐘）。</p>
2.2 觀察方向	<p>9. 觀察工作者與聲音播放裝置、留言板之間的互動以及實驗設計的外觀造型在工作環境中所能造成的影響。</p>
2.3 實驗訪談	<p>10. 在實驗進行中，參與者可以選擇任何自由時間接受簡短訪談：<b>休息之餘、經過本實驗裝置時給予一些建議或心得感想</b>，或是日後接受電訪（時間約為十五分鐘，參考附錄 2：訪談概要）。</p>

<p>2.4 實驗收尾</p>	<p>11. 回收實驗器具：實驗結束後（四時三十分至五時），回收實驗裝置、留言板上之留言等等。</p> <p>12. 收尾：</p> <ul style="list-style-type: none"> <li>● 詢問實驗中是否造成參與者困擾的地方，以及可以改進的地方。</li> <li>● 檢視所有記錄的工具之檔案及文件，並詢問參與者是否同意我們帶走。</li> <li>● 感謝所有參與者。</li> </ul>
---------------------	--

## 陸、附錄：

### 附錄 1、情境劇本：



#### Case 1:

- 1.1 In the left, Engineer Leon comes to the tea room by himself. He has a coffee in front of the tree and listens to the music shared by Julie.
- 1.2 At the same time, he's watching the messages and sentiments written by his colleagues on the message board.
- 1.3 He likes the music very much, he writes down some words for Julie.
- 1.4 Before he leaves, he downloads the music and uploads his favorite songs to others.

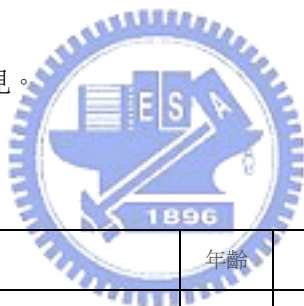
#### Case 2:

- 2.1 In the right of figure, Julie, Grace, and Joanne come to tea room together, they talk about the conversation on the message board. At the same time, background music is played lightly.
- 2.2 They record a birthday bless with the music for their colleague Tim.
- 2.3 Another day, Tim and Leon come together and get the sound message from their colleagues.

## 附錄 2、訪談概要：

依照參與本實驗的工作者之意願，在工作休息之餘做簡短的訪談。藉由訪談，希望了解「分享」在工作夥伴間是否促進了互動、是否能有效的凝聚感情。再者，關於休息之餘的「聆聽」，是否能使得紓解工作忙碌的疲勞和壓力。最後，藉由簡單的問答期望能知道工作者對於本裝置的看法，以及給予本裝置一些建議。工作者是否能藉由聆聽各種聲音以及觀看同伴訊息，紓解工作中的壓力。

1. 工作者，對於藉由聲音的分享和交流、觀看同伴訊息，是否能夠紓解工作中的壓力。
2. 工作者，對於藉由聲音的分享和交流、觀看同伴訊息，是否能產生更多直接或間接的互動，促使感情更融洽。
3. 非同步的對話方式（留言、交換聲音等），當談話主題與工作無關的情況下，能否較即時性的方式（電話、聊天等）更不打擾工作夥伴。
4. 工作者對於實驗設計的外觀造型在工作環境中所能造成影響之看法。
5. 其他關於本裝置之意見。
6. 其他關於本實驗進行之意見。



## 附錄 3、實驗訪談記錄：

姓名(暱稱)		年齡	
性別		職業	
工作地點		工作時數	
工作內容		聯絡方式	
意見			

## Appendix D: The Introduction for the Participants of Field Trials

### *Tree of Sound Track*

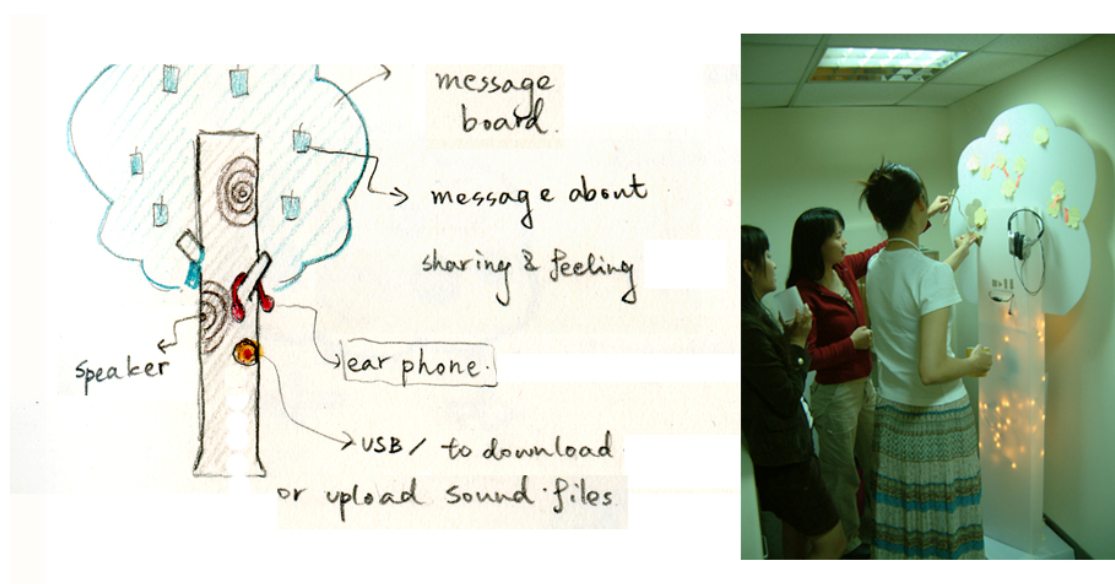
研究主題： Communication in the Working Environment

研究人員：黃可薰

指導教授：鄧怡莘

#### **Tree of Sound Track** Non-real-time Interaction & Information Changing

聲音的痕跡—分享樹。這棵樹座落在休息空間裡，簡單如同剪影般的線條給人從容、閒適的感覺。忙碌之餘來到休息空間的工作者，可以在樹下享受片刻的休憩、暫時舒緩疲憊的身心。樹上的小型揚聲器，播送著之前曾在樹下休息的人，留下的足跡，可能是談話聲、笑聲或是他們想分享給其他人的音樂。



**功能** 分享樹有著簡單的聲音播放系統，可以上傳、下載、錄製各種聲音，同時也可以依照需要選擇使用揚聲器或是耳機來聆聽這些聲音。在使用者來到休息空間泡茶或是小憩的時刻，每位在樹下片刻休息的人都可以聆聽別人所留下的各種聲音，或是分享自己所喜愛的一段聲音，像是有趣的對話、笑聲、各式各樣的音樂歌曲。訊息板上除了顯示正在播放的音樂資訊，也可以張貼和回應各式各樣的留言對話，可能是關於音樂等資訊分享的心情感想，或是生活中的點點滴滴。

## 操作

情境一：(1)使用者 A 獨自來到休息室，他被小樹的音樂所吸引。(2)爲了清楚的聆聽音樂，他選擇使用耳機。(3)聽音樂的同時他可以隨意的觀看訊息板上的留言，訊息顯示這是同事 B 所提供之音樂。(4)使用者 A 決定下載同事 B 所提供的音樂，並且上傳自己喜愛的音樂分享給大家。(5)使用者 A 離開休息是之前，留了一些訊息給同事 B。

情境二：(1)使用者 A 來到休息室，他被小樹的音樂所吸引。(2a)同事 B 也被音樂吸引過來，伴隨著小樹放的背景音樂，兩位同事閒聊。(3a)兩位同事另外上傳了一首生日快樂歌，並當場錄製了一段語音訊息，祝福同事 M 生日快樂。(5) 使用者 A 離開休息是之前，寫下了一些生活中小事感想。

## 情境圖例

