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TENETS OF DESIGN FOR INFORMATION EXCHANGE FOR BOREDOM RELEIF IN PASSENGERS ON LONG AIRPORT LAYOVERS USING HANDHELD DEVICES

presented by

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TENETS OF DESIGN FOR INFORMATION EXCHANGE FOR BOREDOM RELIEF IN PASSENGERS ON LONG AIRPORT LAYOVERS USING HANDHELD DEVICES

By

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ABSTRACT

TENETS OF DESIGN FOR INFORMATION EXCHANGE FOR BOREDOM RELIEF IN PASSENGERS ON LONG AIRPORT LAYOVERS USING HANDHELD DEVICES

By

Malini Rao Raghunatha Rao Gargeshwari

The 1990s saw the emergence of a wired world, but the turn of the new century has already heralded its unwiring. In designing for wireless technologies, currently the emphasis is on overcoming technological constraints. But, the focus is also on identifying and developing new applications that were otherwise impossible to achieve.

A novel wireless handheld airport companion is proposed for design and development to cater to air travelers with long layovers between flights for boredom relief as a pre-development research. It is a common observation that people dread long layovers in unfamiliar locations probably much more than long flights itself. The layover scenario offers an opportunity to inform and entertain people in a "small universe" by providing a facility that can connect them. Connected people share tidbits of information in transient relationships that might last for just as long as the sharing of information takes place (Intranet Design Magazine: IT Advisor 2000). This concept raises a plethora of research questions and may have significant implications on design issues for this medium. These are explored in the context of a chat interaction and exchange of flight related information using simulated prototype chunks with sample users.

To the thought of making air travel fun and friendly...again (Since September 11, 2001)

ACKNOWLEDGEMENTS

Long layovers in strange airports are not always fun. Designing a potentially feasible device for boredom relief during these long layovers could have been a tedious task too but for the help of a few people that I know and don't quite know. Although inadequate, this note says a simple "Thank you!" to all these people.

I thank my thesis advisor, Dr. Carrie Heeter, for all her expert guidance, support and encouragement. She brought the foundation for this thesis to my doorstep by equipping me with books and palmtop devices to use personally. She also helped break mind blocks; channelize and scope my efforts; answered my innumerable questions patiently and endured the gaps between bursts of productivity. Without her help this thesis would have never been possible.

Thanks are due to Sulakshana Gopal, my friend and ex-roommate for being a critic for free! Many weekend hours were spent together in sticking sheets of paper on my walls and using it as a canvas for creating and rejecting ideas. This really helped to focus and scope my thesis topic.

I spent about 4 hours at the Newark international airport watching people on layovers. They probably didn't even know there was someone amongst them watching them and thinking about a non-existent fun device to help make these layovers more bearable, but without the insight I gained from this observation, none of the ideas proposed for the Airport Layover Companion would have been born. So, a big thank you to all the people on layovers in Newark that day!

I thank the Communication Technology lab for allowing me to use their conference room space for my virtual discussions with Dr. Carrie Heeter and also for helping me with video tapes and other equipment for the scenario based usability testing conducted to gather user feedback.

I am extremely grateful to Dr. Frank Biocca and Zena Biocca of the M.I.N.D lab for letting me use their usability lab equipment and lab space for the scenario-based usability testing of the prototypes of the Airport Layover Companion. They not only granted me permission to use this facility but were also very kind and flexible in scheduling the duration and times of study. Thanks also to Jerry Roll, Ping Gai and Arthur Tang who helped me setup and learn to use the usability testing equipment.

I owe very special thanks to my friend Ratnasabapathy Iyer for helping me with this thesis in many different ways. He helped in recruiting respondents for the usability testing, giving me support and company while I was typing out this thesis and getting me hooked to coffee during the breaks, proof reading some chapters and finally helping me give form to this work by coordinating between the graduate school, the bindery and me (now in California). His optimism and encouragement have helped me catalyze to finish.

I also thank all the eight participants of the usability study of the prototype of the Airport Layover Companion. Without their feedback, this study would have been incomplete.

I cannot thank Dr. Thomas Muth enough for agreeing to be the reader on this thesis and accepting the schedule for my thesis defense on such short notice.

Finally, I'd like to thank my family for supporting me through this process so tangibly and lovingly even from miles away.

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INTRODUCTION

The 1990s saw the emergence of a wired world, but the turn of the new century has already heralded the unwiring of it. If the immobile Internet was considered huge, the networked vistas of handheld computers will be far bigger.

The global market for wireless Internet devices is projected to grow from $10 billion in 2000 to $73 billion in 2005, according to Strategy Analytics (Wireless Review, Nov 2000). According to Jupiter Communications, 54.6 million smart handheld devices with Internet access will be in use by 2003. (PC World, May 1999) This figure does not seem like an over estimate when one compares America Online (AOL) and Japan's largest Internet portal NTT DoCoMo - AOL took more than 10 years to reach 20 million subscribers but NTT DoCoMo expects to reach that rarefied stratum in less than two years for subscribers of its mobile data service (Technology Review, Sept/Oct 2000).

Intrigued by the much-hyped mobile Internet and m-commerce services, many industries today are looking to harness this potential new channel and extend themselves into the wireless world. It is becoming increasingly clear however that a mere "extension" of miniature versions of the same web content is not going to offer the desired user experience or satisfy mobile computing needs. Text on a tiny, low-resolution screen of a device with slow connection speeds and weak processors is difficult to read (Ahmed and Hurst, 2000). Mobile information and transaction needs are likely to be different than the needs of people seated at a desk. So, in addition to studies on overcoming technological constraints, companies interested in wireless are also focusing on identifying and developing new applications that would be impossible to achieve without wireless

technology. Time and location specific applications like stock transactions or acquiring driving directions are now available for people on the move. People on the move can still keep in touch with others by sending e-mail or sending short messages through the SMS (Short Message Service). These services herald the emergence of nano-content and nano-relationships. Electronically connected people share tidbits of information in transient relationships that might last for just as long as the sharing of information takes place (Intranet Design Magazine: IT Advisor, Nov 2000). The concept of nano-relationships has potential commercial implications and raises a plethora of research questions pertaining to various fields from sociology to computer-mediated communication and human computer interaction.

PURPOSE OF STUDY

Preliminary Conceptualization

A systematic yet exploratory approach was taken to arrive at developing a concept prototype for a wireless Airport Companion. A critical aspect of creating a new product or service that is not already existing is the new way of working it enables for the users who use it (Beyer & Holtzblatt 1998). Based on this and starting with the idea of working on the small screen platform therefore, the preliminary design phase mainly focused on defining the domain in terms of users and the environment of use. It also defined what it could achieve for the user that could not be otherwise achieved by existing methods and how it added value to the overall context and experience.

The broad goal at this early stage was to establish new and meaningful connections between people using wireless handheld devices. Network/affinity diagrams

for three main parameters were first created based on word associations, analogies etc. (Typically answers to the question - "when I think of *this,* what comes to my mind?"). The four main parameters that were explored were - "People" (Figure 1), "Needs" (Figure 6) and "Situations" (Figure 7). A separate exercise of creating a network/affinity diagram was also carried out for the word "Connection" (Figure 11) as it was a vital aspect of the broad goal set at this point.

This exercise resulted in a host of interesting associations and possibilities that were far too numerous to be explored individually. Hence an attempt was made to group these ideas into four potential user-product domains. Quadrants were created with the purpose or function (productivity oriented and entertainment oriented) as one axis and the user type (based on how computer-savvy they were - PDA geeks and Lay users) on the other axis (Figure 12). Each of these quadrants was examined for cost and degree of features and functionality.

Some of the ideas generated and examined on this basis were then expanded in the form of imaginary scenarios. The first set of scenarios was based on the personal needs of the investigator - typically answering the question "If I had this wireless handheld device with which I could do whatever I wanted, what would it be?" (Appendix 1) In order to avoid personal bias, a few other scenarios were developed from the short-listed ideas for users far different from the investigator. These included the "Wireless travel companion for travelers", "Wireless friends for the bedridden hospital in-patients", "Wireless Connection agent for people attending trade shows and conferences", " Shopping aid", and "Virtual home and family (Appendix 2).

These scenarios were then analyzed against interaction models identified as a result of the study of existing literature (Figure 13) and the "Wireless Travel Companion" was chosen for detailed study for its promise, feasibility and potential value.

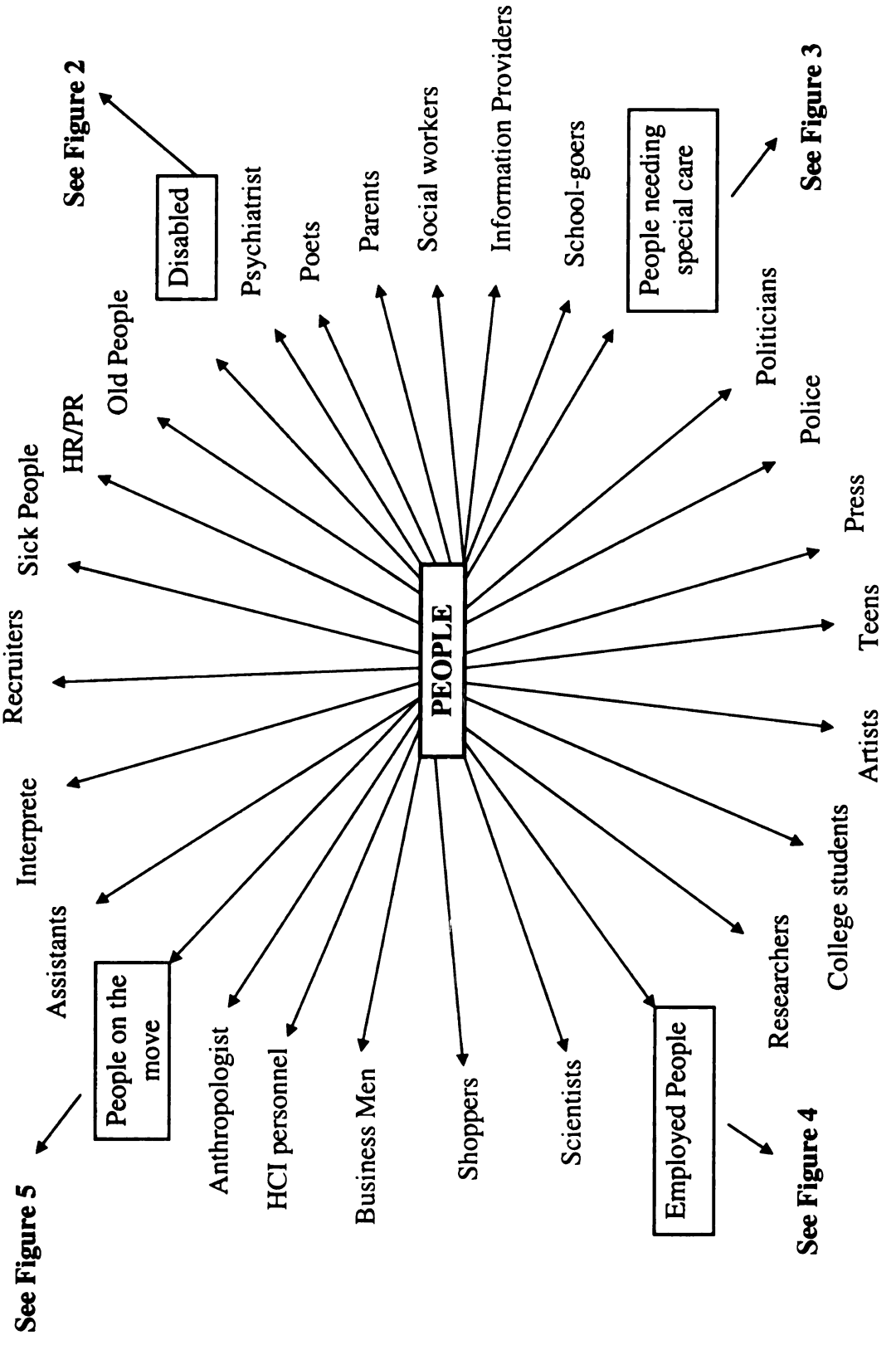

Figure 1: Network diagram for the word "People" to brainstorm on potential user groups for mobile applications

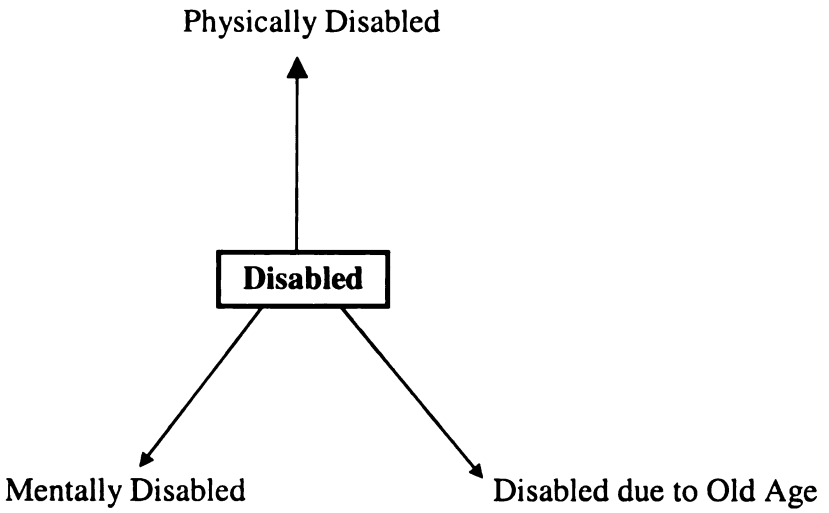

Figure 2: Network diagram for the word "Disabled" to brainstorm on potential user groups for mobile applications

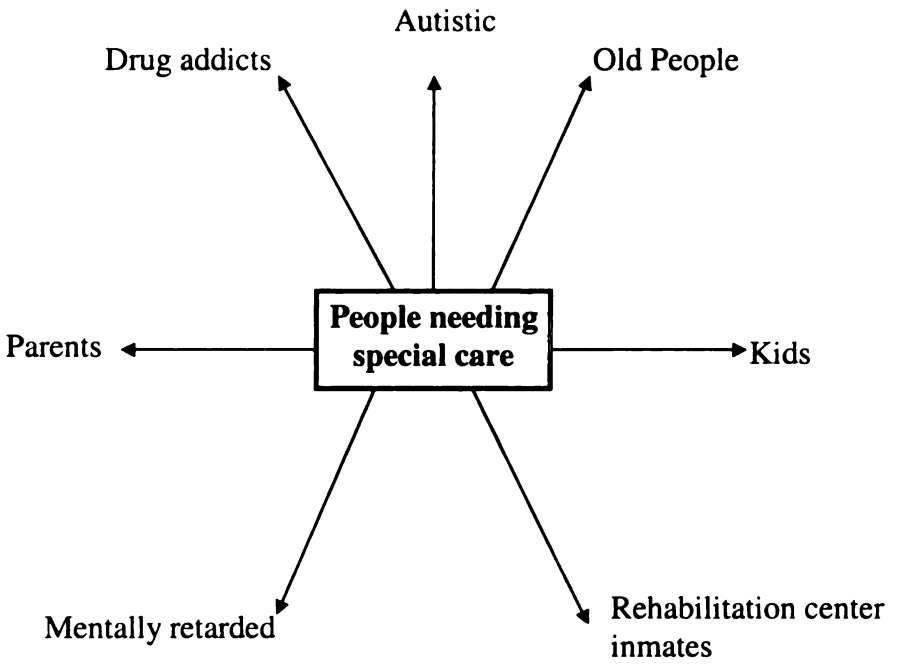

Figure 3: Network diagram for the phrase "People needing special care" to brainstorm on potential user groups for mobile applications

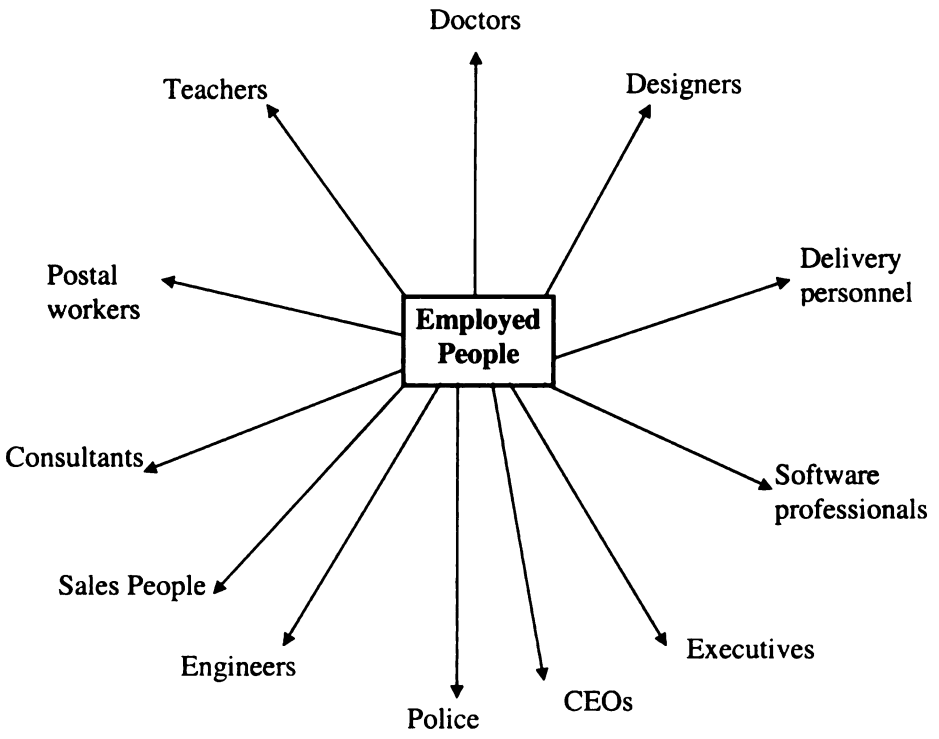

Figure 4: Network diagram for the phrase "Employed People" to brainstorm on potential user groups for mobile applications

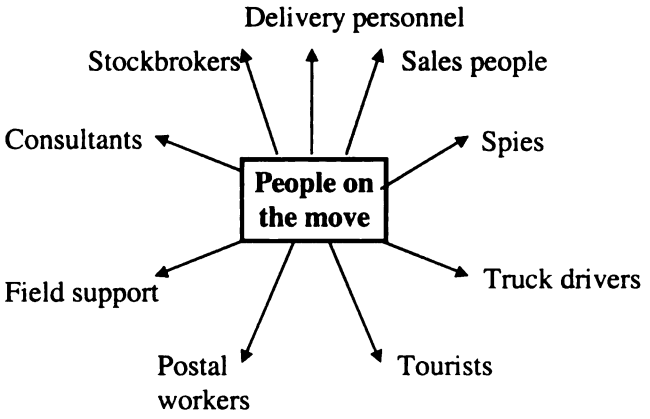

Figure 5: Network diagram for the phrase "People on the move" to brainstorm on potential user groups for mobile applications

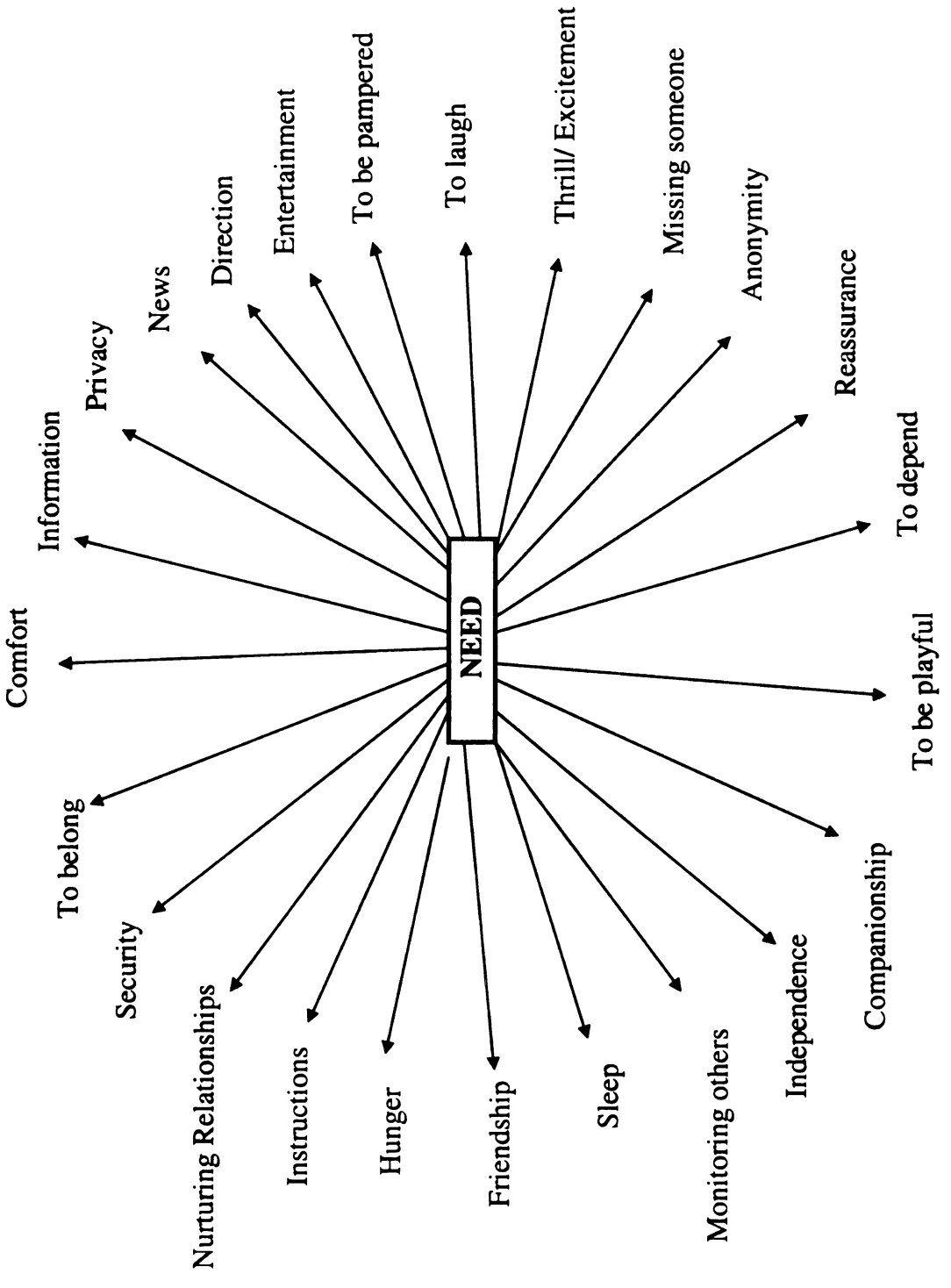

Figure 6: Network diagram for the word "Need" to brainstorm on potential needs (without restricting to a particular user type) that can be translated effectively as mobile applications

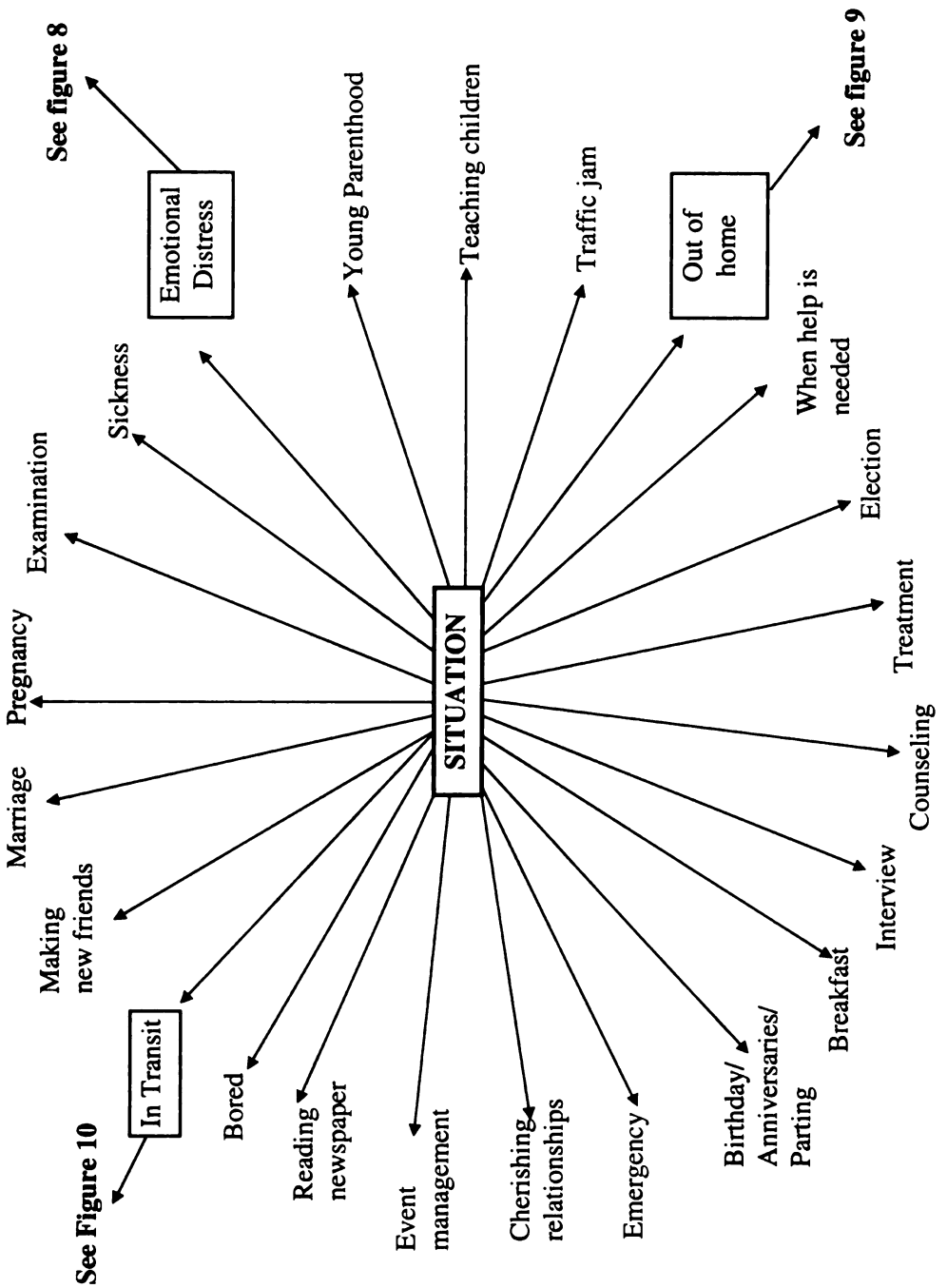

Figure 7: Network diagram for the word "Situation" to brainstorm on potential Scenarios of use (without restricting to a particular user/need type) that may effectively use mobile applications

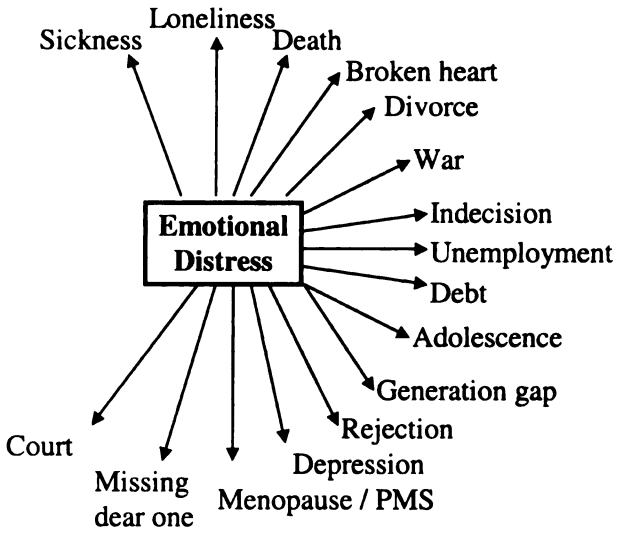

Figure 8: Network diagram for phrase "Emotional Distress" to brainstorm on potential Scenarios of use (without restricting to a particular user/need type) that may effectively use mobile applications

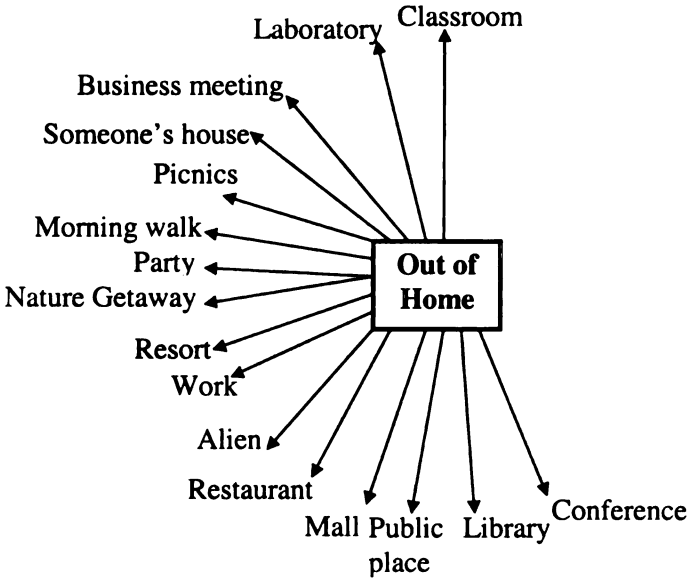

Figure 9: Network diagram for the phrase "Out of Home" to brainstorm on potential Scenarios of use (without restricting to a particular user/need type) that may effectively use mobile applications

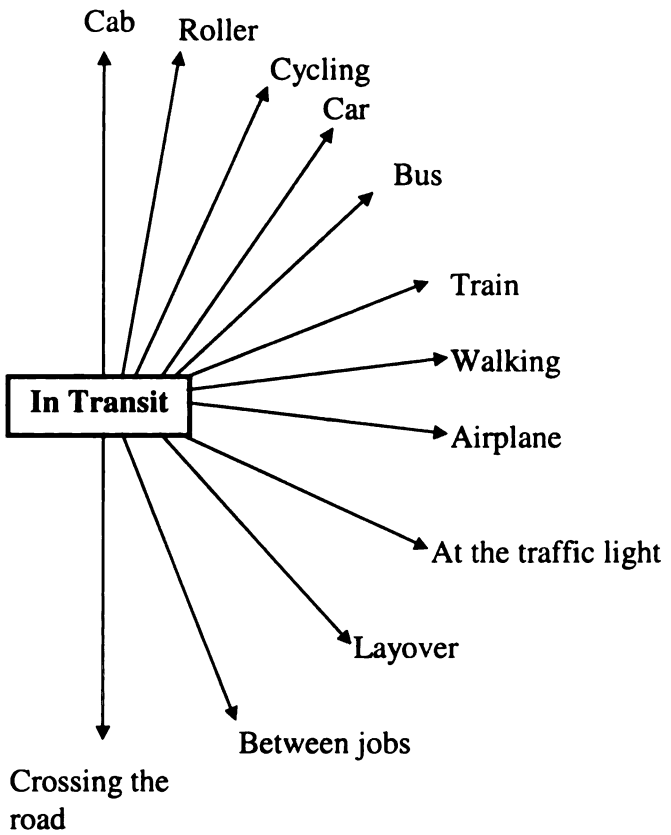

Figure 10: Network diagram for the phrase "In Transit" to brainstorm on potential Scenarios of use (without restricting to a particular user/need type) that may effectively use mobile applications

The travel companion scenario was still a very broad one with variations in type of transportation, duration of travel, purpose of travel, familiarity of route or location and time of interaction. A logical yet subjective approach was taken to narrow down the possibilities to a travel companion for use during long layovers in between flights. This scenario seemed to offer diverse possibilities particularly in an unfamiliar airport where information and personal connection needs would be far better met by a personal wireless device. (Appendix 3)

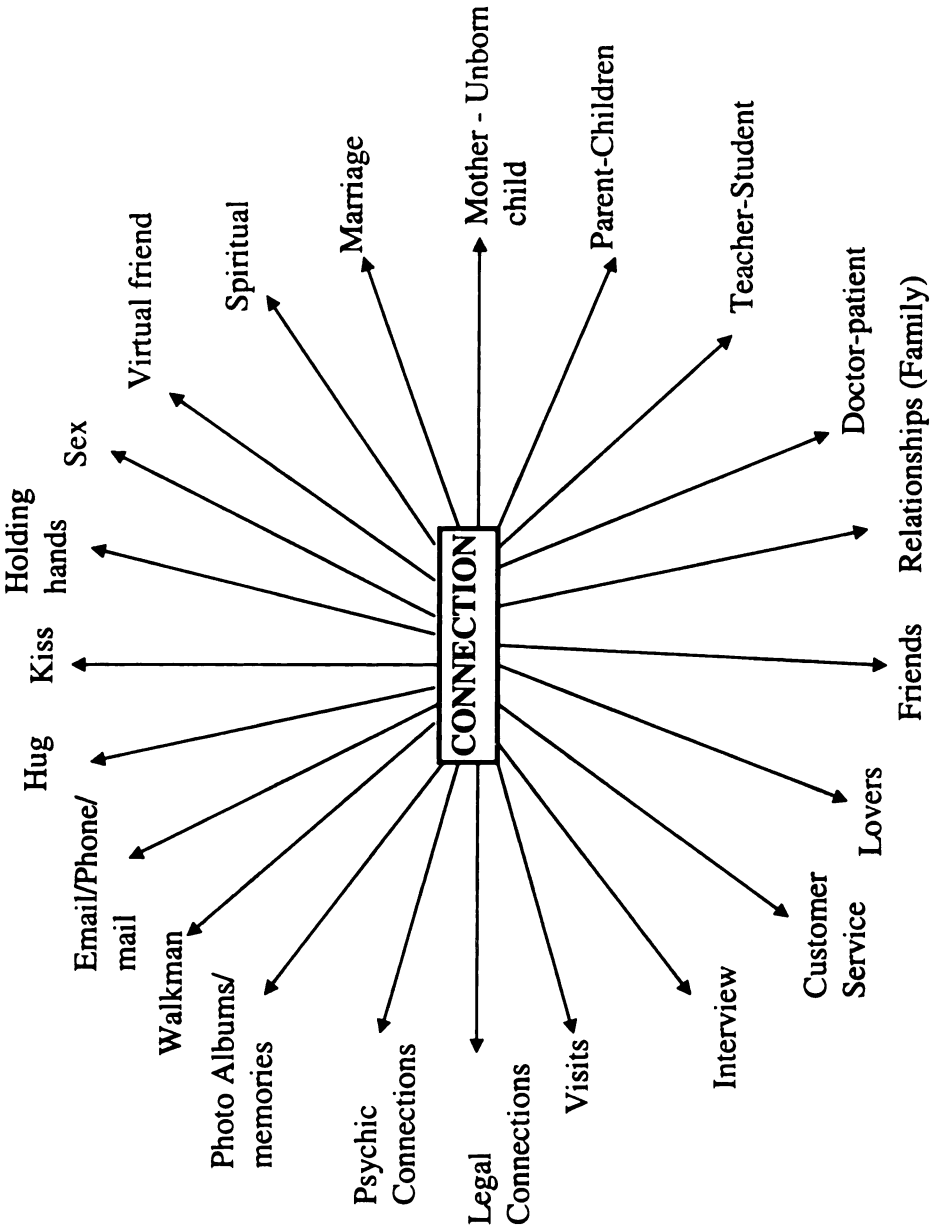

Figure 11: Network diagram for the word "Connection" to brainstorm on potential Scenarios of use (without restricting to a particular user/need/situation type) that may effectively use mobile applications to connect a human being with something or someone.

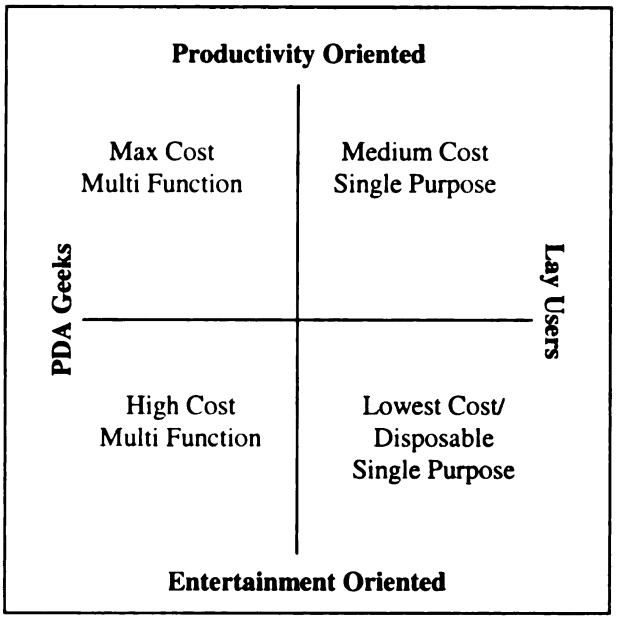

Figure 12: Matrix for Domain Definition

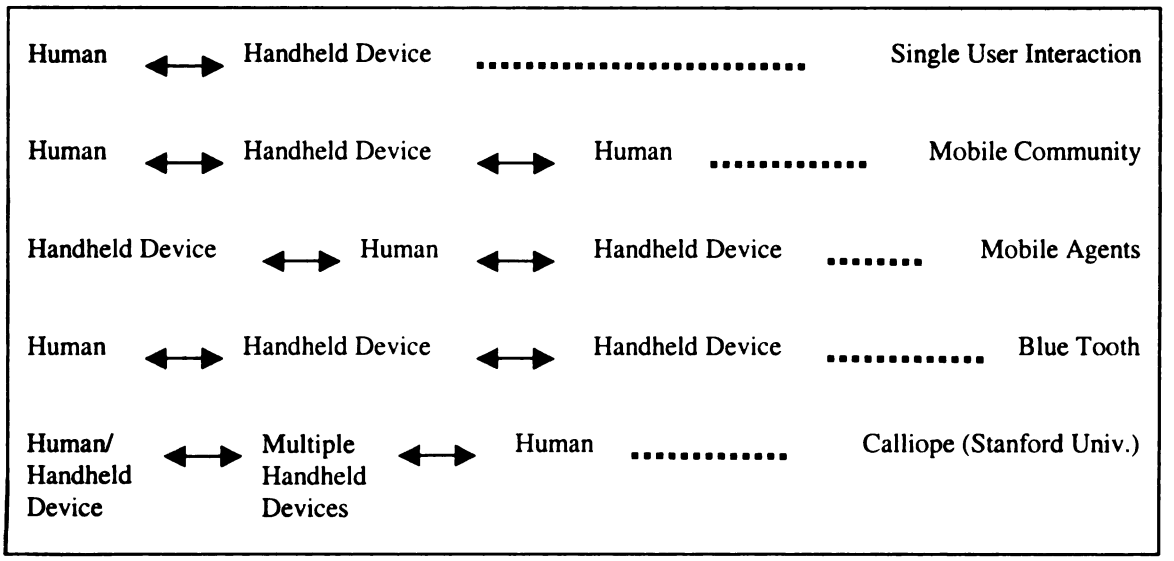

Figure 13: Interaction Models

Contextual design and observation

Contextual design is a method of defining software and hardware systems by collecting data from users and using it as the base criteria for deciding what the system should do and how it should be structured (Beyer & Holtzblatt 1998). This data can be collected in various ways - questionnaires, surveys and interviews, focus groups or ethnographic studies. One of the simplest methods is observation and this was the method used to gain insight into user requirements for this product. Observation involves a field visit. The researcher then does everything in order not to interfere with what usually happens and unobtrusively takes notes.

In this case, the researcher made a field trip to the Newark International Airport as a fellow passenger and spent her 4-hour layover observing other people on layovers at various gates. No questions were asked and notes were taken occasionally.

It was observed that most people currently indulge in certain activities during layovers- meet a friend living in that city, go to an eating place in the terminal and walk around window shopping, read a novel or some magazine. Interestingly, many people held a book at a particular page but looked around abstractly at others or were lost in private worlds, reflecting. Other common methods to kill time were people watching, shopping for travel accessories or duty free items, watching aircraft preparation, listening to music and falling off to sleep. What's interesting in all the mentioned activities is that they are deeply isolating and do not lend themselves to collaboration or interaction with others.

However, it was not as if there was no scope for interaction at all. The eating places and the bars were livelier with most of the crowds. In some bars, there were wall

mounted TV sets and there were collective responses from the crowd depending on what was playing.

Another important governing "feeling" in passengers on layovers is one of anxiety to be where they are supposed to be as quickly as possible. It was noticed that people settle down as quickly as possible at the correct gate. Once there, they don't mind venturing out to the restroom close by or to the telephone areas or the shops nearby, but all in the vicinity of their gate. So, the number of facilities that they can use naturally comes down and they eventually settle down at the gate doing one of the above-mentioned activities. The design implication from this observation was to design a feature where users can find out via their airport companions, what exactly they could do in the vicinity of their gates.

It is interesting to note how people seat themselves at the gates. People occupy seats that are farthest from the others first if they have a chance. But they also seem to occupy those seats that face the side where people move about instead of the tarmac side unless they plan to stand by the window watching the aircraft preparation on the tarmac or if they intend to sleep or read seriously. Usually, people occupy the seat next to a stranger as the gate begins to fill up and if there is still time left, then people begin talking to strangers.

In talking to strangers, people don't merely exchange information but opinions. The anonymity seems to let loose the more intense expressions. Topics include the places they like or loathe, the problems they had in the airport or the previous flight or sharing grouses on the layover or delays in their common flight. They also didn't seem to mind discuss what they did for a living and described routines.

Sharing a common predicament in a situation where nothing much can be done seemed to bond people in a strange way making them more friendly and chatty. The design implication from this seemed to be that people get down to actually talking with strangers ONLY if they have nothing else to do or if they want some specific information unavailable otherwise. Therefore, it seemed to be important to provide avenues to select the "relevant other" to chat with in order to make the facility gain value.

But it was kind of evident that people would rather communicate and get in touch with people they know when they have time on their hands in airports. People seem to throng phone booths almost always to let loved ones know where they are. In the more comfortable booths with seats, there were people sorting out emotions and relationships! Handheld computers didn't seem too common but mobile phones definitely were in great use. Obviously people don't like the idea of not "talking" for 4-5 hours and they enjoy these means of communication.

The atmosphere is filled with sounds in an airport terminal - frequent paging and arrival-departure and flight schedule announcements, whirring escalators and moving walkways, people drawing their strolleys and the sound of people shuffling along or walking, kids screaming and laughing, people on their phones, airport buggies with their ringing bells requesting people to make way, the clang of cutlery at the bars and restaurants. But despite this it was observed that people are capable of cutting themselves out these sounds when they get involved in a given activity. The obvious design implication from this observation was that subtle sounds are best avoided for communication or alerts.

A novel wireless handheld Airport Companion is proposed to alleviate boredom and provide flight and airport information for air travelers with long layovers between flights. This study is mainly a pre-development research towards that end. It is a common observation that people dread long layovers in unfamiliar locations probably much more than long flights itself. Airports are increasingly beginning to provide facilities like restaurants, gyms, duty free shops, art galleries etc., for boredom relief. Dallas/Fort Worth International airport in a partnership with Wayport Corp., and has begun offering wireless Internet access to people with devices that can use this facility (Smart phones, PDAs and other wireless devices) throughout its terminals and auto rental areas since this spring. (Air Transport World, Spring 2000) Blockbuster Inc. has started a DVD rental chain in many airports across the country. Lack of information is one of the main reasons travelers get so frustrated with airlines. In this regard, United Airlines has planned a service that includes installation of 112 touch-screen kiosks at check-in counters to ease out long lines and high-definition TV screens to display flight information. The expected date of completion of these changes is late summer or early fall of 2001. United has also planned to provide personalized updates on flight times, delays and rebooking, pushing information to Palm devices, office e-mails and other modes that fliers select (Armstrong, 2001).

The extended layover scenario offers a great opportunity to use wireless services to alter the "nothing-to-do" dilemma by informing and entertaining people in this "small universe". Connecting people is a dimension not yet explored by developers of applications and services for airport layovers. The most popular mobile devices have been communication devices designed to keep people on the move connected with others,

although the connections have been with people they already know. When Quios, a telecommunication services company, launched a wireless messaging service called Planet Quios, the messaging community grew from 100,000 users at the beginning of this year to more than 1.1 million today. Quios CEO Vanlerberghe says,

> *"Only about 20% of our alerts that we currently send out are content driven, including Planet Quios. Of the 500,000 messages we send everyday, about 100,000 are content and 400,000 are messaging."*

Vanlerberghe refers to "content" in this context as all information other than those generated between users in the form of messages. These include but are not limited to ads, news, information updates on weather, stocks etc.

In a survey conducted by the company, users indicated that they wanted "extremely relevant and personal information" and " interactive communication with each other" (Wireless Review, Nov 2000).

Proposed Scenario

The proposed research aims to study whether a wireless service might facilitate enjoyable, informative connections between people in airport terminals during long layovers. It proposes a new facility of connecting people on long layovers using wireless technology within a given terminal. This facility is called the wireless Airport Companion. If passengers had requested for this facility when they booked their tickets or at check-in, then towards the end of their first flight, the steward/stewardess distributes an airport companion packet to them. This packet contains a palmtop wireless device and a small handbook describing the device and its features. Passengers learn that this device is designed for boredom relief and to gain important flight/airport related information and

updates. For boredom relief, they can connect to other people in the terminal to either chat or play games. There is also a GPS facility that will help them find their way around the terminal.

When the machine is first turned on, a welcome screen appears with a greeting in the passenger's name and it then plays a tutorial on how to use the various features. The device is therefore fed with the available information about the passenger from the airline records even before it is handed to the passenger.

Passengers use a stylus to select items on the screen, the jog dial or the stylus to select items on a menu list and a keypad to type in text. On the last leg of their journey, the airport companion device is collected back from them before they leave the aircraft.

Areas of research focus

Specifically, the study will investigate if the possibility of choosing one's chat partner according to one's own interest or motive (making him/her the "relevant other" and not just anyone) will add value to the chat experience especially in the context of chatting between strangers in a layover. This study also tries to examine if there is a preference on the nature of information exchange – informative or entertaining - given the circumstances of the layover. The study also seeks to glean design tenets for designing a chat type interaction on handheld small platforms by observation and questioning in scenario based usability testing.

Focus areas for chat interaction for boredom relief

The main focus area in examining chat interaction for boredom relief was to understand if users consider defining a "relevant other" an important aspect that makes the chat user experience pleasant and satisfactory. In this regard, characteristics of an

ideal partner(s), topics of chat and number of people available for chat were issues that were considered worthy of probing. Issues of privacy, especially in the light of chatting with strangers were weighed against the need to find the "relevant other" to make this chat interaction more meaningful. It was also part of the purpose to find out if there was a threshold point beyond which users considered the task of finding the "relevant other" too overwhelming. Finally, it was also intended to examine if users felt the need to retract or block someone if they felt they made a mistake in choosing that particular person.
Also of interest in this study was the purpose of the chat interaction. Specifically, the study aimed to investigate if bored people in a layover would feel more satisfied with the chat experience with strangers if they chatted with an informational motive or if they chatted just for fun.

In designing the chat interface, the study also considers issues on how the chat actually takes place. Would users like to have options of chatting in groups? Would they want smileys, emote icons and other shortcuts to typing to enhance their chat expression, would they want to chat with more than one person at a time or be accessible to others when they are already chatting etc. Another important issue of interest in this study was how users responded to interruptions in their chat interactions and if there was a difference if these interruptions were chat requests or flight related information.

Focus areas for communication of airport/flight information

Four types of information were identified as potentially interesting and relevant to passengers on long layovers - Flight status information, Airport facilities and services information, General information such as news, weather etc., and advertising/commercial information about duty free shopping. This study tries to validate if these categories of

information are indeed valuable to passengers and if so, which type of information is preferred to be sought by the user and which type would the user prefer to have delivered without query.

This study also looks further into detail about user response to interruptions caused by the delivery of such automatic information. It investigates if the degree of information push in the form of alerts, auto screen focus shift etc. is acceptable and if so, in what circumstances.

Although not the main focus, this study skirts the issue of users finding value in being able to communicate to airport officials, the mode of communication for this purpose and the circumstances in which they would find this useful.

This study will examine potential users' reactions to a specific Airport Companion wireless service prototype. The findings should be of interest not just to companies who might offer this service but also to those seeking insight into new communication needs of mobile individuals as well as design tenets for the wireless platform. Decisions based on this study could aid in the creation of a useful airport application that would not just enhance the image of airports and airlines in the eyes of the customers but also ease managerial and operational problems such as long queues at the check-in and information counters. Furthermore, this service can prove to be an added source of revenue.

CONCEPTS, DEFINITIONS AND CONSTRUCTS

Boredom: A complex phenomenon

Although enjoyable and/or useful connections between people through their computers is at the core of this study, the underlying motivation for this proposed service is boredom relief. Thus, an understanding of the construct "boredom" is required.

> *"Boredom may be defined as the suspension of intentionality, fidgety indifference, frustration, and painful estrangement from a reality experienced as meaningless. Normal boredom emerges in specific environmental situations (reactive boredom) and quickly dissolves, while pathological boredom, arising unrelated to external circumstances (endogenous boredom) and causes mental suffering as pervasive and long-lasting cognitive-affective state (chronic boredom) and causes mental suffering as well as functional and social impairment." (Maggini, 2000).*

The construct of boredom has been researched from a variety of philosophical, sociological and psychological perspectives. However the only consensus has been that this is indeed a very complex phenomenon. There are a few psychological theories and social control theories that try to explain the causes of boredom (Caldwell, Darling, Payne & Dowdy, 1999).

In the psychological perspective, boredom stems from (a) a lack of awareness of stimulating things to do in leisure (Iso-Ahola & Weissinger, 1987); (b) a lack of intrinsic motivation and self-determination to act on the desire to alleviate boredom (Iso-Ahola & Weissinger, 1987; Weissinger, Caldwell, & Bandalos, 1992), and (c) a mismatch between one's skill and the challenge at hand (Csikszentmihalyi, 1990). This mismatch is also known as the under-stimulation model of boredom (Larson & Richards, 1991).

From a social control perspective, Steinberg (1990) suggests that boredom may be a response of resistance to external control, such as the influence of parents or other adults. In other words, boredom may arise when one cannot resist or evade the inevitable control someone or some situation exercises on one. In these instances there is acceptance of the control but with a sense of listlessness. In this context, the layover itself is a forced situation on which the passenger has no control. Layovers are determined by travel itineraries that one can customize only to a certain extent. Also what can be done during the layover in the airport is limited by what is available. The boredom in this case occurs when the passenger is unable to exercise autonomy and at the same time is unable to physically leave the situation and do something that he/she finds more agreeable/useful. In such circumstances, the passenger might disengage psychologically through the experience of boredom.

Leary, Rogers, Canfield, and Coe (1986) argue similarly that people feel bored when they must make a concerted effort to maintain their attention on a particular stimulus. In the layover context, people try and keep their attention on the chosen means of activity, but since this is an adaptation to a forced situation, they quickly begin to feel bored. For example, people reading books stare blankly or watch others while being stuck to an open page or people watching others suddenly look for a change of scene and walk about and return once again to the same activity.

This study concerns itself with boredom arising out of specific situations, in this case, long airport layovers. This boredom is a transitory state and is technically known as reactive boredom.

Handheld computers

The airport-layover companion would use wireless handheld devices. There are numerous brands and categories of handheld devices flooding the market today. Some of the brand names include 3Com's Palm, Cassiopeia, Niño, Blackberry and Compaq Ipaq. Some of the categories of handheld devices include PDAs (Personal Digital Assistants), Connected Organizers, PC Companions, Palm-sized PCs and H/PCs. The Airport Companion assumes a screen size comparable to at least 160x160 pixels. Most of the products mentioned have this average screen size and the next generation of smart phones (hybrids of mobile phones and PDAs) are promising to retain this size if not increase it. Most of these devices currently support merely monochrome displays. The Airport Companion too will use monochrome displays. It will not include mobile phone capabilities.

Target Audience

The target audience for Airport Layover Companion was derived through a comparison of demographic profiles of the typical air traveler on long distance trips with potentially long layovers from commercial (Adsmart), airport (Oakland airport) and research (American Travel Survey 1995) sources.

The average age group of passengers is between 25-54 years of age. The average household income falls in the range of $60K-$70K annually. This will be an international audience with a majority of passengers holding a college graduate degree. Business travelers are likely to use the layovers to catch up with work, and travelers with companions can be otherwise engaged in activities that they can do together. Hence this

service for boredom relief during long layovers using the wireless Airport Companion is targeted primarily at travelers on non-business related trips traveling alone.

THESIS OUTLINE

This introduction aims to set the context for the design of the Airport Layover Companion and also presents the concepts and their definitions that are basic to this proposed service.

Chapter 2, 3 and 4 are literature reviews. Chapter 2 "Review of literature on existing mobile devices" looks at the history of handheld devices briefly with a focus on changing trends and important design and user experience related lessons learnt in the process of evolution.

Chapter 2 "Review of literature on existing mobile devices" takes a brief history of handheld computing devices starting from their precursors – the electronic organizers. The chapter also identifies some important lessons learnt from most of the products' success or failure.

Chapter 3 "Review of literature on design issues" examines design issues that have challenged designers, developers and eventually users. It discusses the constraints of wireless handheld devices due to technological issues, diversity in the range of devices and systems, HCI models and the small screen real estate. It also looks into new focus areas characteristic to this medium – the importance of "context" of interaction of the application/service; the increasing paradigm shift to single activity devices as against multipurpose devices and the emergence of a new social relationship type that is ephemeral but nonetheless valuable.

Chapter 4 "Review of literature for functionality of handheld devices" focuses mainly on two areas – perception of computers by people and chat and game functionality in these devices in the light of social interaction theories.

Chapter 5 " Design Implications" presents implications for the design of the layover companion based on the chapters of literature review. They also serve as pointers to glean design heuristics for the small platform that are further substantiated or supplemented in Chapter 8 "Data analysis".

Chapter 6 "Methods and design process" briefly outlines the various methods used at various stages in the design process. Methods used include User, task and functional analysis, parallel and participatory design, prototyping, and scenario based usability testing. The chapter also outlines the procedures of data collection.

Chapter 7 "The Airport Layover Companion - Proposed Design" describes the planned functionality in detail and the accompanying screen shots show its actual implementation.

Chapter 8 "Data analysis" presents the insights and results gained analyzed and derived by observation and feedback gained through scenario based usability testing of the simulated concept prototype of the layover companion.

Chapter 9 "Conclusions" draws out specific recommendations for the next steps in the iterative design of the development of the layover companion device. It also attempts to draw out a set of broad heuristics for designing for the small screen.

REVIEW OF LITERATURE ON EXISTING MOBILE DEVICES

A handheld computer, as is most popularly known today, is a device that usually consists of the following components - the case or outer shell, a processor, batteries, computer memory, an operating system, applications, human interface (handwriting recognition, voice recognition, word prediction), connectivity to the PC, printer or other products (Wegberg, 1998). Usually, the applications include organizer type address books, alarm, note taker and to-do-lists. Additional applications may include a voice recorder, clock, word processor, spreadsheet etc. This thesis focuses on developing an application for a new scenario and need and does not deal with the design of the outer shell or technological feasibility details. However, the proposed design will be based on what is feasible technologically currently or in the next two years based on logical assumptions and trends.

HISTORY OF HANDHELD COMPUTERS

A chronology of handheld computers is presented in Appendix 4. Wegberg (1998) classifies the evolution of handheld computers into three stages - 1989-1992: Electronic organizers, 1993-1996: Experiments, 1996-: Connected computers.

Electronic organizers

Atari introduced its Portfolio (Figure 14) handheld computer in 1989. This was a fairly bulky machine using MS-DOS and had agenda and note-taking functions as well as some computer like functions like a spreadsheet (Personal Computer World, 1998).

In 1990, Hewlett-Packard, Casio and Sharp launched small machines with tiny keyboards and extremely small screens and memories. Functional limitations resulted in these gadgets being little more than electronic versions of paper organizers except that they had the advantage of sounding alerts and could be used for more than one year. The

Figure 14: Atari Portfolio – Considered to be one of the earliest PDAs

advantages didn't counterbalance the significant additional cost and the market was limited.

Two products launched in 1991 became icons in the history of handheld computers. These products were HP 95 LX (Figure 15), a small micro based on MS-DOS

Figure 15: HP 95 LX

with a full version of Lotus 1-2-3 embedded and Psion 3 (Figure 16) which pioneered the concept of the

handheld as a fully-functional computer, with a reasonably good keyboard, built-in programming language, word processor instead of just a note-taker, generic database, and spreadsheet.

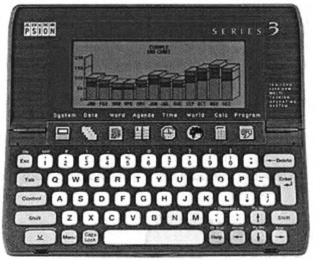

Figure 16: Psion Series 3

Experiments

1993 saw the turning point in the evolution of the handheld computer with the launch of Apple's Newton Message Pad (Figure 17). It pioneered a new user interface that included handwriting recognition and intelligent user-friendly software. The use of the touch screen enabled point and click interactivity instead of typing long commands. The Newton also allowed scribbles and drawings on the surface of the screen. Pen-based interactivity heightened the analogy of the notebook or agenda. With this device, Apple

launched the concept of the Personal Digital Assistant (PDA) as a product with increased functionality over the first generation of electronic organizers and note-takers.

Although the Newton stands as a turning point in the evolution of handhelds, it also is considered one of the greatest fiascoes. Its failure has been attributed mainly to poor handwriting recognition. Besides this, the big size, unsatisfactory synchronizing facility with the desktop computer, and high cost caused the premature demise of the product. Also, the Newton tried to be all things to all people instead of doing one or two things brilliantly (Brandel, 1999). The Palm computers that are hugely popular learned this lesson from the case of the Apple Newton and restricted functionality to a few features performed well.

At the time when the Apple Newton was launched, other experimental products

Figure 17: Apple's Newton Message Pad

tried to integrate voice and data communication functions, such as a mobile telephone or e-mail, with a handheld computer. These were called Personal Communicators. Some examples of such devices are IBM's Simon, Motorola's Marco and AT&T's EO (Figure 18). This vision has governed many of the handheld devices of today and is shaping the next generation smart phones etc.

Figure 18: AT &T's EO Personal Communicator

Connected computers

In 1996, U.S.Robotics (later acquired by 3Com) launched the PalmPilot handheld computer and Microsoft launched Windows CE, a specialized OS for handheld devices. These handhelds are fully functional, up-gradeable computers with mature 32-bit operating systems. Some of these devices like the Palm computers have introduced practicable forms of handwriting recognition like Graffiti. Some other devices also introduce new functions including voice-recording functions.

One important difference of these computers over the first generation devices is the better connectivity with information and information appliances that people carry and use. For example, the Nokia 9000 Communicator (Figure 19) is a second-generation attempt to develop a personal communicator or smartphone and the handheld computer is embedded in a GSM mobile telephone. Connectivity seems to be the buzzword in the devices that are being developed today. Handhelds are being connected to PCs, mobile

Figure 19: Nokia 9000 Communicator

telephones, GPS global positioning systems and digital photo cameras. It's a paradigm shift. People don't need portable computers but portable information with instant access at any time (Wegberg, 1998).

Learning from the past, handheld computers are becoming more and more function specific. Now, fast user experience is considered more important than having

more processing power. A few important features performed well and simplicity of use are key (Ferranti, M., 2000).

As a result, the market today is flooded with devices for different needs - the NEC MobilePro 400 for those who want the closest thing to a laptop in their pocket; the HP OmniGo 120 Plus for those who need a device to track expenses while on the move; the Sharp Zaurus ZR-3000 for best value for ergonomic design; the Psion Series 3C for business needs, ebooks for those who want to read when on the move; and the Pilot series for those who just need a daily planner requiring low maintenance (Quain, 1997).

Figure 20: Palm VII from 3 Com

The RIM Blackberry is a device specifically meant for reading and sending e-mail on the move. Unlike the Palm.net that is used for the e-mail feature on the Palm VIIs (Figure 20), the RIM Blackberry (Figure 21) is completely integrated with desktop software like Microsoft Outlook. The device uses the same Microsoft Exchange server

Figure 21: **RIM Blackberry**

and therefore when a mail is viewed on the RIM, it is the original mail seen and when a reply is sent, the mail on the desktop computer too displays the changed status of "replied mail" and a copy is automatically sent to the sent mail folder (Alsop, 2001). It also uses a tiny keyboard and a jog dial for menu choices allowing the user to type with his/her thumbs faster than the palm style handwriting recognition that is still prone to errors. This way, it takes user experience one step further than the Palm as far as the e-mail feature goes as it makes it the primary function of the device.

Another function specific device that was introduced in 2000 and died soon after was the Modo (Figure 22). Modo was a wireless information appliance that looked like a high-style pager with a floppy tongue. Instead of relying on the Internet, it made use of

"data broadcasting" where identical data are sent to a multitude of devices at once, typically overnight when cheap bandwidth is abundantly available. In this way, the device is full of fresh information that users can use without hooking up to the Internet. This in essence made it like a daily local e-magazine meant to be carried around in pockets and purses. This device was targeted on the youth. The Modo had several well-designed and usable features.

Figure 22: Modo

For instance, this device could be operated with just one hand leaving the second hand free for carrying a briefcase, holding on to a strap on the bus, or some other purpose that makes two-handed use less convenient than it is in an office setting.

Like magazines, the Modo was to be funded by advertisements that appear on the bottom fifth of the screen in the form of a banner. On pressing a button, the ad would fill up the screen. This is a significant portion of the screen real estate considering the fact that the screen allowed only 25 words at a time (Manes, 2000). This might have been one of the reasons for the early demise of this device. Studies have shown that advertising does not work on traditional websites, where there is a big color screen and the ability to follow a link to an advertiser's fully featured site. Mobile use is much more time-critical and provides a much more scaled-back environment with less room for ads and less willingness on the part of the users to tolerate interruptions (Nielsen, 2000).

Looking into the future, a whole generation of wearable computers is being developed. Devices are clearly getting more and more specialized and they are also getting smaller. User experience will therefore become a critical factor in the development of these devices and without it, these gadgets will be mere toys.

Figure 23: The hard interface for the Airport Layover Companion

INSIGHTS FOR THE AIRPORT LAYOVER COMPANION

Detailed implications for the layover companion are discussed in chapter "Implications from the Literature Review". But, briefly, the Airport Companion will be in its hard interface a hybrid of the Palm and RIM Blackberry devices. This thesis does not attempt to create an original product design or device styling. It will instead simply suggest that the layover companion will incorporate a keypad for typing and will also have four main buttons for the four basic functions - Flight information, Chat, Games and GPS. However this thesis concerns itself only with the Chat and Flight related Information modules. These will have limited functionality with an easy and effective interface and aim for pleasant user experience. Besides the keypad entry, a pen stylus input facility will also be available on a touch screen. The device will not have mobile phone capabilities but will be capable of sounding alert chimes. The screen will be monochrome at the 160x160 pixel dimension (Figure 23).

REVIEW OF LITERATURE ON DESIGN ISSUES

With the development of wireless communication systems, there is an increased capability of interaction for mobile handheld devices allowing wide-ranging and continual access to computing resources in a variety of contexts. As these technological changes enable progress in functionality, human-computer interaction, and usability become more central in mobile handheld design and development (Johnson, 1998).

Just as it was in the case of designing websites and online applications, where designers tried to apply print and graphic design principles to the new media, currently, there have been efforts to apply website and online design principals to the creation of pocket -PCs, mini-desktops and mobile Internet/web. As the names suggest, they are almost miniature versions of what is already there digitally but these fail miserably due to the many new constraints of handheld devices.

DESIGN ISSUES

Constraints of wireless handheld devices

Wireless handheld devices suffer from two main constraints - the device's physical interface and the network technology. Both of these constraints will improve over time, but as of today, they represent major limitations.

Since these devices are mobile and used on the move, they have to be light to carry and must be operable by one hand. So, these devices cannot grow beyond a certain size and weight. In order to conserve battery power, these devices use slow and weak processors. This helps keep the cost of the product down. As a result the functionality

offered is limited and media-rich content is not yet reasonable to use on these devices.

Handhelds typically have limited memory and tiny screens with poor resolution. In order to be pocket-sized, it is unlikely that even with technological advances, the screen size will get much bigger than the current 6cm x 6cm of the Palm series. Again, to conserve battery, the resolution is also poor and very few of these devices have color (Ahmed and Hurst, 2000).

Current wireless data transfer rates are very slow and are advertised at around 9.6 kbps but because of congestion and other technical factors, are actually much slower. This is less than half the speed of a 28.8kbps dial-up modem.

Users will only purchase and use wireless devices and services that efficiently and easily add some value to their lives. This has become painfully clear by the growing backlash against Wireless Application Protocol (WAP - an open, global specification that empowers mobile users with wireless devices to easily access and interact with information and services instantly) in Europe. For success in this medium, the service should either offer a better experience than what the users get in non-wireless features or should let people do something hitherto impossible without the technology.

The problems of usability in the context of mobile interactive applications is four-fold (Johnson, 1998) -

- Accommodating the diversity and integration of devices, network services and applications
- The current inadequacy of HCI models to address the varied demands of mobile systems
- The demands of designing for mobile users, their tasks and contexts

- The demands of evaluating mobile systems

The discussion of the first of these problems listed above is not a major concern for this thesis. Specifically, the proposed airport companion device is a stand-alone service provided by the airline and therefore the issue of uniformity in the types of devices and network connections across users is not relevant in this context.

Design issues due to diversity in devices

The need to control the presentation and content of the information to be communicated has always been the crux of design issues. For instance, HTML was not conceived as an interactive language but as a display language. It allows browsing through hypertext by invoking new pages. But its use had to be distorted by adding structures to it to give the publishers/designers some control over what the page looked like. Now, what we see on web pages are more or less determined by those who design it and this has degraded the original display flexibility to some extent (Haskin, 2000).

In the case of wireless handheld devices the range of display devices is wide, not allowing the designers to fine tune details of the layout across the various types. As XML becomes popular, the power is no longer on the publisher's side but on the receiving side - Each device has to have a method of extracting the formatting and content information that is required and to display it. This leaves little control in the hands of designers but invests a lot of power to control appearance and interaction in the device designer. Nevertheless, integration of the soft and hard interface of the applications running on the device is bound to be key in designing for the small platform.

Since replicating the desktop experience doesn't work on small platforms, a wireless service on a handheld device must provide a user experience that is *different* and

hence more satisfying than existing alternatives. This has significant impact on the content presented on these platforms. Users of WAP phones rarely use their devices to access the news headlines, weather reports, and sports scores that make up the bulk of what is currently offered as WAP content (The Standard, 2000). This type of content is easily available through many other channels such as newspapers, radio, television, web sites on PCs and e-mail. The potential differentiating factor that could make such content appealing on wireless is the precision with which this content can be delivered at a hyper-personalized level (Haskin, 2000).

A good example of an application that has been successful on the small platform is SMS (Short Message service) or wireless text messaging in Scandinavia. This service has been extremely popular with teenagers in part because using the SMS is much cheaper than making a call. There has been a 800% increase in the usage of SMS in Finland in 1998 alone. This success is also because SMS is easy - all it involves is typing in the message, selecting the recipient from the address book and hitting the "send" button without the need to dial into a wireless Internet service provider. This type of service can be made possible for an internal wireless system within an airport terminal for the proposed layover companion device. Another hugely popular wireless-specific content is the Bandai cartoon characters in Japan. For one dollar per month, Bandai sends its customers a new cartoon character everyday. This service wouldn't succeed on the web since no one would pay to receive a tiny graphic on the web. However on the wireless small platform, customers have been enthusiastic and this service has over 700,000 subscribers (Economist, 2000).

HCI models and mobile systems

Over the last decade, there has been a good understanding of how to design and evaluate forms of human-computer interaction in "fixed" contexts of use where the user always uses the same computer in a single domain and undertakes tasks alone or in collaboration with others. In the case of mobile computing, the computer is on the move and interweaves in many varied ways into everyday life. Newer models that describe the interaction between humans and these computers have become necessary. Many times, these models are extremely context specific but a few models currently being developed are discussed here.

One model on which significant research is currently taking place is the "mobile agent" model. Mobile agents are software abstractions that can migrate across the network representing users in various tasks (Milojicic, 2000). So, the user can query a system or set his or her requirement and then the software takes care of finding the relevant information and notifies the user that it has been found. The user on the move spends time only to start the process. Some variations of this model include a file sharing interaction model where the software returns a list of users who have the relevant information thus allowing them to collaborate.

The Mosquitonet group at Stanford University is developing another model for HCI for mobile systems called Mobile People Architecture. The paradigm shift in this model is that people become the end points in communication instead of the devices (MPA, 1999). People use a number of devices - computer hosts, pager terminals, telephones etc. The key challenge on the move is to have access to humans than to be frustrated by devices that are turned off or immobile. With this objective a prototype

router called Calliope has been designed for person-level communication. This router acts like a tracking agent and maintains a list of devices or applications through which a given user is accessible. It also serves as a message handler that attempts to translate messages into a format that the addressee can currently access.

Exploiting Context for Mobile Systems

With the increase in ubiquitous computing and the advent of wearable computers and augmented reality, the context sensitive nature of mobile devices is gaining importance. In contrast to fixed-location computers, the very nature of mobile devices sets them within a multifaceted contextual matrix - They may be closely meshed with both the physical environmental settings as well as the context of the task being achieved and the interaction itself (Rodden, Chervest & Davies, 1998).

Personal Digital assistants are now offering basic organization tools and also access to e-mail and the web. The emergence of mobile telecommunication standards such as GSM and the increased availability of these services has led to the development of a range of devices that are actually a merger of computer and communication facilities. Some of these devices have also been combined with the use of GPS technologies to result in devices that are aware of their position or location. This allows physical context to play an important role in the interaction with the device and a whole new range of context-aware applications. An example is the mobile multimedia guides like the Lancaster Guide where visitors tour around with the help of these devices (Davies, 1998). The interaction is no longer solely the property of the device but rather it is strongly dependent on the context in which the device is used (Rodden et al., 1998).

The Free online dictionary of computing defines context as "that which surrounds,

and gives meaning to something else". Rodden et al. (1998) discuss five types of contexts that are significant in designing for wireless systems. These include - *Infrastructure context* in which the design of the application needs not only to reflect the semantics of the application and features it supports but also the variability of the supporting infrastructure and how it impacts the user interaction. Designing content to be displayed on various PDA browsers would be an example of a situation considering infrastructure context. *Application context* entails the need to explicitly identify the nature of the work being supported and the practicalities of this work. For example, an organizer functionality on a PDA may have some features in common with a word processing functionality on the same device and maybe designed with consistency for both applications. Yet, the emphasis on the various available features will be different because of the difference in the nature of the activities that these applications help to complete. Mobile devices are intended to be readily accessible and of use to the community of users that the system supports. Consequently, the highly situated nature of this interaction gains importance and developing a clear understanding of what people do in practice along with their relationship with technology becomes paramount. The consideration of the system as a whole gains importance in mobile systems as the functionality often does not reside in a single device but is spread across the system. This is the *System context.* A good example of this would be the Bluetooth technology that is gaining ground in recent times. The official Bluetooth website describes a usage model where at home, a phone functions as a portable phone (fixed line charge) and it functions as a mobile phone (cellular charge) when on the move. When the phone comes within range of another mobile phone with built-in Bluetooth wireless technology it functions as a walkie-talkie (no telephony

charge). *Location context* has already been discussed in fair detail earlier in this chapter with the Lancaster Guide description. This is the awareness of the device of its location and the possibilities of this fact on interaction. *Physical context* is the context in which the object is physically placed. It can either be aware of or embedded into its physical surroundings. The latter is also called pervasive computing. This is the idea of geocoding signs and having animated special effects to populate the real physical space on what is called WorldBoard channels. WorldBoard is a proposed global infrastructure to associate information with places and ultimately to provide people with enhanced information perception services. For example, a user would enter the airport and see a virtual carpet leading to his gate or there would be property lines or underground buried cables on the ground, or on a nature trail one would see virtual signs near plants and rocks or the night sky would display not just the stars but also the outline of constellations etc. (Spohrer, 1999)

Periods of interaction are much shorter than in traditional mobile settings like the use of notebook computers in a temporarily stationary setting. Consequently, the time to set up an application must be significantly shorter than traditional mobile settings. Also, since the applications are mainly used while doing something else, there is a need to reduce the explicit human-machine interaction and a shift towards implicit HCI. With context sensing technology, Schmidt (1999) explores the construct of context in mobile systems in terms of input and output contexts. Due to the small sizes of most of the palmtop devices, there is very limited space for a keyboard often resulting in solutions that have bad usability. Graffiti and other handwriting recognition technologies have been developed but they lack the speed and accuracy ideal for the typical user scenarios.

Situational context can help in this regard to limit need for input. For example, information captured by the context will not have to be entered/re-entered by the user. Context sensitivity can further reduce input required in making selections by reducing the selection space by offering only the appropriate options in the given context. Situational context can help solve certain output issues peculiar to small platforms by adapting the font size, volume, brightness, privacy settings etc. based on the current environment. It can also help in unobtrusive notification mechanisms by finding a good time for interruptions and by reducing the need for interruptions. For example, there is no need for a reminder to go for a meeting if the user is already in the meeting.

The Impact of Small Display Screens on User Interaction

As mentioned earlier, due to the need to keep the mobile devices small and inexpensive and due to technical limitations, it is unlikely that display size is going to change in the near future. This raises several design issues. Key amongst these is the issue of consistency. Consistency is a commonly accepted design goal but also the most problematic issue. Many times external and internal consistency conflict and the best solution in these circumstances may be inconsistent in both respects (Hjelmeroos, Ketola & Raiha, 1999). Although people are highly adaptive to new platforms, their previous experiences play a critical role in shaping their expectations (Norman, 1988). A chat-type interaction should be reasonably similar to what is available in desktop computing and other environments to ensure external consistency. At the same time, for internal consistency, the application should be in harmony with the other applications built for that platform and ideally integrate seamlessly. Thus instead of a set of heuristics that are diligently followed, designers would have to make judgments based on the tasks involved

and the users using it.

The impact of screen size on reading and comprehension has been investigated thoroughly during the 1980s and early 1990s. In a study considering the effect of window height and line widths on reading, Duchnicky and Kolers (1983) observed that the full width display was read 25% faster than the screen which was 1/3 the width. The impact of varying the display height was not as dramatic. It was observed that very small windows gave very poor performances and the optimal length was about 4 lines.

The results from these studies pertain only to the act of reading chunks of text on a small screen and do not involve interaction. However, it has been observed that users reading from small displays interact with the display window much more often than those who read off a larger window (Dillon, Richardson & McKnight, 1990). Users paged back and forth through the text much more on the small screen probably to orient themselves better and to gain a sense of the context as they progressed reading. As a result they made significant use of the scrolling and paging mechanisms. In another study by Jones, Marsden, Nasir, Boone & Buchanan (1999), it was observed that most of the scrolling actions were scroll down or scroll right. This leads to the possibility that scrolling was used to a large extent to move the user linearly through the pages, to see things they could not view previously. In fact, there were very few backtracking scroll actions. Nielsen's design advice of designing screens that fit the screen for WebTV seems applicable to handheld devices since WebTV too has smaller display space than conventional monitors due to the relatively low resolution quality of the TV screen and the distance at which it is viewed. Scrolling can also be reduced by placing the navigational features near the top of pages in a fixed place and by placing key information right on top of the pages. Further,

content has to be clear, concise and task focused rather than verbose.

The Dillion et al. (1990) study also revealed that 75% of users who attributed screen size to dissatisfaction or difficulty in reading a chunk of text had used the small screen display. In terms of time, they had actually performed almost comparably to those who had read the same text off a larger screen. This suggests that although performance may not be severely affected, first time users may perceive the systems with small screens as less good than conventional platforms. It is also probably for this reason that users don't seem to care too much for graphics or animation on the small screen and want to get to the text information directly and quickly (Hjelmeroos et al., 1999).

A wide range of studies have been conducted on menu-based systems on small screens. These studies suggest that unless the screen is very small, for simple menu selection tasks the impact of the small screen will not have catastrophic effects. However, it was found that searching for menu items on a single line display screen was three times slower than when a conventional display was used (Han & Kwahk, 1994).

In a content-intense application or site on a small display, the search facility assumes greater significance. In the Jones et al. study (1999), 80% of small screen users began interaction by using the search option of the site. Small screen users also selected the search facility twice as many times as the large screen users. Across pages, the navigational tendencies varied based on the screen size - the large screen users showed a greater tendency to follow paths while the path lengths for the small screen users were much shorter with the users returning to the search facility frequently. This suggests that small screen users seem to prefer direct access strategies over less directed methods of browsing.

Links are an important means of navigation. While designing for the small screen it is desirable to integrate the organization of the links with the physical interface of the device. For example, the user must be able to navigate across links using the buttons on the product for this purpose. Also, just as it is important to design concise content, it is necessary that the text links be designed to fit in the product's display. Predictability of links also gains importance on a small screen because although users are willing to wait to get to the information they are seeking, they'd rather avoid the frustration of downloading useless pages especially if it is streaming content arriving at a low data transfer rate. It is therefore essential to use descriptive links with clear link naming policies (Hjelmeroos et al., 1999).

Ahmed & Hurst (2000) suggest the "inch-scale thinking" while designing for the small platform. Post-it notes, Palm Pilots, and cell phones are all handheld devices and are considered to be on the inch-scale. Their small size allows mobility but data input is limited to one hand while the other holds the device. Therefore simplicity in design becomes necessary. In fact, in evaluating applications on these devices, Ahmed et al. suggest asking two questions. 1) Is this a task that customers can accomplish on a post-it note or on a device as small as that? If the answer is "yes", then the question that arises next is - 2) will customers *want* to accomplish this task on this specific device or platform? Inch-scale devices are fast, simple and focused. Databases, spreadsheets or word processing applications are all complex and poorly suited to the inch-scale. The inch-scale constraints coincidentally work well with the physical device constraints mentioned earlier because inch-scale tasks should be quick and simple and these devices are constrained to be quick and simple because of their weak processors. These scale and

technology constraints also match the low expectations of users from these devices (Ahmed & Hurst 2000) and these constraints can guide in creating a good user experience on the small platforms.

Some novel methods of countering the lack of screen space have been tried with innovative interfaces by using sound in the form of non-visual navigational elements and sonically enhanced widgets (Brewster, Leplatre & Crease, 2000). Brewster et al suggest that sound, particularly non-speech sound can be used to overcome some of the limitations due to the lack of screen space. Non-speech sounds have advantages over speech in that they are faster and language independent. Using sonically-enhanced widgets (such as buttons, scrollbars, etc.) means that information can be moved off the graphical display and put into sound, thus freeing the display for the most important information. In one of the experiments in this study, the visual highlight from graphical buttons was removed and replaced with sound. The sounds told users when they were on the button and when they had pressed it correctly (which can be hard to see and causes users to 'slip-off' a button and think it has been pressed when it has not). It was observed that sounds overcame these basic interaction problems with buttons and increased usability. Users had no problem with the lack of graphical feedback. As a result, this study suggests that this could also allow widgets to be reduced in size, thus saving space on a limited graphical display but without compromising usability. The idea is that even if the buttons were small and the tip of a pointing device was obscuring it, the sounds would confirm if the button had been pressed correctly, whereas the limited amount of visual feedback from the small graphical button would be easily missed.

PDA screens are constrained by low readability and usability due to low screen

resolutions. Therefore, if the device's screen renders text and images too small, the PDA ceases to be useful. Kamba et al developed a scheme of semi-transparent controls with the idea that text would dominate the entire screen, but a layer of interaction widgets (such as copy/paste or back/forward as we is seen in standard web navigation) would share a portion of the screen as well. These tools would be displayed in very pale colors, so that the text layer would be easily readable, and the underlying controls would be easily accessible. A timing mechanism is used to alternately fade one portion so that the user can determine which portion he/ she is accessing. This is especially key when the text layer has interaction capabilities (such as hyperlinking). This work shows one way in which components can share space in attempting to maximize the usability of the application using that space. (Kamba, Elson, Harpold, Stamper & Sukaviriya, 1996).

Multipurpose to single activity devices - a paradigm shift

The fad to create little gizmos that do everything and more than a normal desktop computer is fast changing, resulting in a whole range of special purpose mobile devices that are carried, embedded and worn. Each of these devices is specialized to perform one or a few simple activities really well, often designed to communicate with other devices fulfilling a more complex task. The constraints of mobile devices are expected and so instead of not meeting expectations on par with a desktop, these devices try to provide services that desktops can never provide. These devices are useful in receiving very specific bits of information. Devices are now being conceptualized around activities instead of functionality. These are devices designed to perform a set of activities that go together naturally. These devices are based on observing activities of people and understanding their needs and trying to discover interactions in them. A good example is

ebook devices like Hiebook set to be released later this year (Sellers, 2001). Unlike the Microsoft Reader software that enables ebooks to be read on pocket PCs, this device is primarily designed for the activity of reading books. So, it packs all those features that naturally go with reading of books in one device - it includes an eBook reader, an MP3 player, a digital audio recorder, simple PDA functions, and games into one item. The device is designed from the ground up for reading eBooks -- it sports a 5.6-inch diagonal back-lit touch screen LCD capable of displaying text and graphics at a resolution of 320 X 480 pixels for easy reading. Ebook devices also usually have features like annotation, notes, book marking etc.

Nano-relationships in mobile systems

There have been many manifestations of online communities in the recent past in the form of MUDs, MOOs and IRC. Yet no formula has been gleaned to form successful online communities because responses are spontaneous, subjective and strategic to one's actions. The tendency with most of these virtual worlds is that they are visually compelling but are not as effective in fostering social interaction. Many of these systems have more in common with lonely museums than with vibrant communities they hope to create (Kollock, 1998).

In spite of the apparent lack of understanding of what makes successful online communities, there have been numerous studies establishing heuristic guidelines towards this objective. One such set is Godwin's (1994) principles, which include -

- Use of software that promotes good discussion
- Don't impose a length limitation on postings
- Front-load your system with talkative, diverse people

- Let the users resolve their own disputes
- Provide institutional memory
- Promote continuity
- Be host to a particular interest group
- Provide places for children
- Confront the users with a crisis

Most of the heuristics mentioned above may not be directly applied to people connecting through mobile systems. With all the device, network and situational constraints, communities on mobile systems cannot currently compare with conventional online communities especially if they are transferred directly to the wireless small platform. Specifically, the small screen and limited text entry on these devices make it difficult for people to exchange meaningful amounts of information with other participants. Nevertheless, wireless can add value to *existing* communities by allowing people to keep in touch when they are on the move (Ahmed & Hurst, 2000).

Mobile communities are characterized by another important aspect - transience. People connected through these mobile devices may share extremely meaningful relationships that hold value for not more than a few seconds. It is for this reason that these increasingly fleeting relationships are called nano-relationships. It is also for this reason that the heuristics identified for online communities may not hold good in mobile settings. For instance, Axelrod's (1984) famous tenet for co-operation described as the Prisoner's Dilemma in his book on the Evolution of Cooperation states that it must be likely that two individuals will meet again in the future and if this is not the case, there will be a temptation to behave selfishly. Although this heuristic is not void in mobile

settings, relationships of value can still exist between strangers unlikely to meet again if the "selfishness" can be nurtured by making the users either knowledgeable informers or receivers of valuable information tit-bits. In this scenario, who users connect with and what they discuss will determine if the relationship has any value. One example of an application that uses this strategy is the ICMAS'96 Mobile Assistant (Nishimura, 1998). This project was conducted to facilitate the forming of a new community among the participants of an international conference - ICMAS'96 - and increase the opportunity of real meetings. It facilitated the communication among the participants like e-mail and to provide various information needed in the conference.

Transient relationships will seem more meaningful if the nodes in the relationship are important and relevant or chosen deliberately. Thus, the choice of the "relevant other" gains significance and methods that help in making this choice are considered with value. In the ICMAS'96 Mobile Assistant project, a community viewer feature was designed which dynamically visualizes the interactions among participants to encourage further interaction. Using a party room metaphor, each participant of the community is represented by a face mark. These icons change based on the various interactions taking place thus allowing others to choose who to interact with based on their own inclinations.

Another approach towards the same goal is the SpeechSkimmer (Arons B., 1997). The SpeechSkimmer interactively skims speech recordings. This service uses speech-processing techniques to allow user to hear recorded sounds quickly, and at several levels of detail. In this way, the SpeechSkimmer reduces the time needed to listen by incorporating time-compressed speech.

Online chats have been popular but have also been plagued by the "Is everyone

asleep in here?" effect. These interactions become inane, meaningless exchanges between disembodied strangers in a chat room and usually end up with no one responding. However, this is generally also because the chat partners are indiscriminately or randomly chosen. Chatscan is a service that attempts to alleviate this problem. This service allows one to search more than 1,000 Internet chat rooms from within one's web browser using various search parameters, thus allowing a more meaningful choice of partner quickly and easily (Hamilton A., 2000).This type of chat scan activity is even more important on the small screen platform because the chunks of information processed in each screen will be far lesser and the fatigue factor will consequently be higher. The importance of finding the "relevant other" for chat for boredom relief and for information is one of the focus areas of this dissertation.

INSIGHTS FOR THE AIRPORT LAYOVER COMPANION

Detailed implications for the layover companion are discussed in chapter 5 "Implications from the Literature Review". But, briefly, the layover companion will be designed as a single purpose device enabling all those activities that might be useful or entertaining on a layover. Specifically, it will include access to personalized flight and airport information, chat and games functionality and a GPS feature.

In designing specific interfaces for the chat and information access modules, the layover companion will explore features that reduce typing and combined usage of various input devices. For instance, care will be taken not to combine pen stylus input and typing input alternately on various entries on the same screen.

Screens will be designed to fit with minimum scrolling and the study will also

investigate what seems overwhelming on a small screen in these activities.

REVIEW OF LITERATURE FOR FUNCTIONALITY

PERCEPTION OF COMPUTERS AND PEOPLE

Not much research has been conducted on the perception of handheld devices in particular but there is a wealth of information on the perception of computers in general.

A fascinating, well-documented perspective is the Media Equation (Reeves and Nass, 1996). The central claim of the "Media Equation" is *Media = Real Life*. The Media Equation suggests that people treat computers as if computers were intentional social actors instead of tools. This response is instinctual and does not go away as people become more expert users because our responses to media are fundamentally social and natural. Turkle reports in her study that children perceive computers as "psychological devices" (Turkle, S., 1984). The Media Equation shows adults feel the same way too, but they do not admit it consciously (Reeves and Nass, 1996). Weizenbaum's (1974) study reported that people related in a very intimate and personal way to the plain text interface of ELIZA, a "virtual therapist" interactive software program which engages the user in therapeutic dialogue simply by repeating what the user types either with transformed word order or in the form of a question (Wolfe, 1991).

The Media Equation claims that predictions on people's behavior towards a computer system can be made by simply replacing the word "human" with "computer or other technology" in various theories. Many theories on Interpersonal Communication state that people feel uncomfortable with strangers. Applying the Media Equation, people feel uncomfortable with strange computers. But perhaps if people seek boredom relief with personal handheld devices that look and feel like their own handheld computers,

they will be more comfortable interacting with their airport layover companion. Also, they would have spent some time in the airplane getting used to it, thus increasing the comfort level. Extending even further, perhaps a familiar airport companion interface will ease the unfamiliarity of communicating with strangers.

Leveraging a social dynamic called the "rule of reciprocity", Fogg & Nass (1997) demonstrate empirically that users worked longer, performed higher quality work, and felt happier when using a computer that had helped them previously than a different computer. Personal handhelds are predominantly used as Personal Digital Assistants (PDAs) or Personal Information Managers (PIMs) to ease out and organize hectic everyday lives. Hence, these devices, which will closely resemble other available handheld devices in the market, may be perceived as friends to help alleviate boredom. Also, the layover companion might be perceived as a friend because it helps the user with important gate, flight and airport information.

The Media Equation also states that people view computers as teammates. If the human user and the computer are trying to solve a problem together, then this statement holds good. If on the other hand, the human user and the computer are competing against one another on a particular task, then the computer must be perceived as an opponent. So, this Media Equation statement can be extended to state that in the chat activity, the handheld device will be viewed as a teammate in finding an interesting person to chat with but in a gaming situation, it can either be perceived as a friendly opponent with whom it is fun to play games with or a teammate with whom a game is played with another human user and his/her machine.

A study by Burgoon et.al (2000) shows that in a decision making, task oriented scenario,

"computers were more influential than human partners but the latter were rated more positively on social dimensions of communication than the former."

This suggests that people would probably prefer to get specific and critical information (e.g. gate/flight related information) from a machine source they trust but would rather chat with strangers via these handheld devices. In support of the potential desire of people wanting to connect to others for chat even if they are strangers, the Internet and Society survey (Nie & Erbring, 2000) reports that 73.5% of people participating in chat rooms or message boards are doing so to talk to others they just met for the first time. This study will assume that other humans make more desirable chat partners than an intelligent agent.

SOCIAL INTERACTION THEORIES IN THE CONTEXT OF FUNCTIONALITY FOR AIRPORT COMPANION

Chat and Game Functionality: Social Interaction and Game Theory

Sociology of science and technology is becoming more and more important as people use technology not just to work efficiently but to find friends and lovers, pursue interests, get information etc. As Dvorak (1996) puts it,

"The sociologists are going to love the next 100 years."

Online social interaction is interesting because it brings to light new aspects of social relationships arising out of the paradigms associated with the media. Online discourses (long chat type interaction), for instance, may be useful and engaging to the

participants even if they share no lasting relationship, no common values, and know that they can't count on one another. Chat may be of value even if the interaction is not repeated ever again with the same person because in most cases, the interaction and the shared informational artifact created by the participants is what brings value and satisfaction, not necessarily the perceived bond among the participants in the communication (Erickson1997). According to Weinberger (2000), wirelessness will change the nature of peer groups.

> *"The wireless web will encourage more social interaction, but among more transient groups - any set of people who have some reason to associate for whatever fleeting moment, ranging from people on a 14 day cruise to people waiting online so long that they bond their anger, not to mention the guests in a hotel, the people in a hardware store,..., even the ultimate nano-group: your car and the one that just cut you off."*

So, even though given time and repeated interactions, lasting relationships are possible, it may not be required. This is especially relevant in the scenario of long airport layovers. Given the time available (part of it spent in getting to the right terminal/gate and relaxing) and the fact that people are probably never going to meet again, people looking for boredom relief are unlikely to interact with the same person for too long. What they would be looking for is a break from boredom, a good time and perhaps insider information about their destination city. Anyone who would provide these things would be an acceptable chat partner.

The Uncertainty Reduction theory (Berger & Calabrese 1975) suggests that for the development of personal relationships in computer mediated communication (CMC),

uncertainty must be reduced. This is why most CMC chat type interactions spend a significant part of the initial interaction on trying to reduce uncertainty. The dynamics of when to disclose, and what to disclose comes into play. People feel discouraged to express personal feelings to strangers and so it becomes necessary to rely on implicit behavior to infer how the relationship is progressing. Social information processing suggests different rates and patterns of impression development in CMC. Thus it takes longer to find enough information to be able to form impressions via CMC (Chenault 1998). Inspite of this, anonymity and remote contact makes CMC less personal and reduces social distance. Therefore, it seems that it is easier to approach a stranger via CMC for a chat than face-to-face in real life. Also, it is possible to learn about what people are doing without feeling obligated to them and accrue a social debt. Erickson (1996) gives an example and says,

> *"If I contact someone I don't know and request a paper, there is now likely to be an expectation that I will read the paper, and perhaps comment on it. The difficulty is that I may not have time to comment on it, or I may glance at it and find it uninteresting, and so I am left in an awkward position."*

People would take the effort only if they saw value in it or had something important to gain from it and that seems unlikely in the airport layover scenario. Hellerstein (1985) found that heavy users of e-mail and electronic conferencing in university settings used CMC to meet social needs while light users tended to build relationships in other ways. The air passengers with layovers may be a good mix of heavy and light users and we cannot infer directly from the above mentioned study that these people will prefer chat type interaction. However, if the person is allowed to choose a

chat partner who is in some way a "relevant other", then the entire scenario might be viewed differently and the chat activity will gain interest and value.

The Internet & Society survey (Nie & Erbring 2000) presents in its findings that chat rooms are for the young and the anonymous. It also states that while $1/4^{th}$ of the Internet users claim that they have used chat rooms, this activity decreases substantially after the age of 25. Since the majority of the target audience are over 25 years of age, it is unlikely that these people are going to prefer regular text chat type interaction with strangers. According to a study conducted on the leisure activities of the middle-aged (defined as ages 35-70) (Havighurst 1957), the upper and upper middle class middle-aged prefer more autonomous activities which is not merely a time killer but something that results in development of skills/talent and results in enjoyment. Physical energy input is desired especially in men and it is preferred that the leisure activity is not related to their work. A certain degree of novelty is also desired in this class of people and more habituated, repetitive activities are preferred by lower classes. In summary, the higher classes need vigorous, active, pleasure seeking activities. Chat type interaction can be stimulating and may be considered more active and less related to their work especially if there is the element of thrill associated with talking to total strangers who might still have something valuable to offer.

Jodi O'Brien, in her chapter on *Writing in the Body: Gender (Re)Production in Online Interaction* says that gender is a central issue for organizing interpersonal relationships and that people take a lot of effort to reproduce gender in online interaction. She points out that the question "Are you male or female?" is so common in chats that it

has long been abbreviated as "RUMorF?". This process of discovering in itself can be a source of fascinating passage of time.

The playing of games fulfills the need for autonomy when the game is played against a machine. But even in the event that the game is played with other people, the user operates in the framework of Game theory (McKinsey 1952). The Game theory is a formulation of goals in a situation within which the user operates more than in anything else. In this realm of self-interest, the user is not bothered by the larger segment of behavior and social interaction (Bernard 1954). Thus, it becomes easier for people to play games with strangers than to socially interact with strangers and therefore be bound by social norms.

Contests involving skill or chance are of deep interest to all classes of society and both sexes to an almost equal degree. Research shows that this goes back for the most part to the instincts developed in the struggle for food and rivalry of mates in prehistoric times (Thomas 1901). Thomas further elucidates that though it is popular belief that moral and cultural views and interests have superseded our animal instincts, the cultural period is only a span in comparison with prehistoric times and the pre-human period of life. This does not mean that all games that we play can be accounted by our origins. The prehistoric ancestral habits persisted because they answered to the psychological demand for rest on the part of the nervous organism. This is a feeling of "rest" because these contesting habits are more or less automatic, and thus demand a minimum of attention to establish the co-ordinations necessary to perform the acts they demand (Gillin 1914).

> *"The nervous energy required for their performance* (contesting habits born from the instinct of struggle for food and rivalry) *flows along brain-tracks well worn*

by the habit of the ages. That fact makes such actions pleasurable in their effects on the nervous centers, whether they are advantageous to that person or not." (Gillin 1914).

This suggests that in addition to or instead of chat interaction, a game facility may be a welcome component to the airport layover companion for boredom relief.

In the context of chat interaction, the ease of use of input methods will probably influence the rate at which people get tired of using the facility. Most handheld wireless devices have a pen stylus input interface with handwriting recognition capabilities along with a few embedded physical interface as part of the device in the form of buttons. This is similar to ATM interfaces where the content on screen corresponds to buttons on the physical device and therefore the physical buttons replace "soft buttons" on screen saving space for more content. Though the idea of handwritten input is appealing, it is offset by the need to correct recognition errors. There are also dissimilarities between human perception and machine recognition which can cause frustration when handwriting recognizers behave in ways the user does not understand. Usability research has shown that the fatigue factor for inputting text using these interface elements is high and the accuracy level is not extremely satisfactory. A 97% accuracy in recognition is required for acceptability in note taking and memo applications and in a study conducted in 1995, the average recognition level was 87% (Frankish, Hull & Morgan 1995). On the other hand people are habituated to the use of small devices with button interfaces to play video or computer games. So, the airport companion will incorporate hard interfaces in the form of a keypad and other buttons in its product design/ styling. However the design of the

product's shell or exterior is out of the scope of this thesis and the prototype will only use a make-shift shell design.

Chat as a Phenomenon in CMC: Social Interaction Theories

The Cues-Filtered-Out theory argues that text-based CMC lacks physical and social cues, making it lack social norms and standards (Sproull & Kiesler 1991). In contrast, the Social Information Processing theory asserts that in CMC, message senders portray themselves in a socially favorable manner in order to draw attention of message receivers and foster anticipation of future interaction. Message receivers too tend to idealize the image of the sender, overvaluing minimal, text-based cues. (Walther 1996). This idealized perception and self-presentation intensifies the feedback loop, thus rendering the relationship hyperpersonal, actually exceeding face-to-face interactions in intensity. This intensified observation on either node of communication becomes very effort intensive in group CMC where each user has to carefully build impressions of the other.

Any conversational interaction involves taking turns in sending and receiving information. In online discourses or any interactive chat-type exchange, these turns can occur very rapidly one after the other, thus allowing the conventions that underlie the interaction to be shaped, reinforced, or re-negotiated much more rapidly than in traditional genres (Erickson 1997). Anonymous synchronous CMC is characterized by an element of ambiguity that leaves the user unprepared of what to expect next. So, unless the user gives it full attention, it is easy to lose track of who is contributing what in a group conversation (Coleman, Paternite & Sherman 1999). As mentioned earlier, wirelessness might herald a host of nano-relationships that last for fleeting amounts of

time. (Weinberger 2000). Given the fleeting nature of the exchanges and the pace of exchange, it would seem likely that group CMC would be less satisfying as attention is divided amongst group members. In any case, predicting group behavior may be more difficult than just one person's behavior in the short time. Established groups however may find better success than ad hoc groups such as those in the proposed airport scenario as they discuss topics on an established foundation of identities and relative familiarity across the group in terms of behavior etc. (Mannecke & Valacich 1998). This is supported by the Uncertainty Reduction theory (Berger & Calabrese 1996) because an established group has already worked on reducing the uncertainties concerning the group. This study also states that members of an established group felt more satisfied than members of ad-hoc groups using CMC.

Another theory that is useful in explaining the cognitive and behavioral changes commonly seen in CMC is the Deindividuation theory or Social Identity Model of Deindividuation Effects (SIDE Model) (Postmes, Spears & Lea 1998). According to this theory, participants in CMC are significantly more immersed in a discussion than participants in face-to-face discussions. So, the CMC participants tended not to perceive their team members as individuals (Coleman, Paternite & Sherman 1999). "Identity" is considered as a basic building block of social interaction in many theories of Interpersonal Communication.

> *"All our interactions, even those with strangers, are shaped by our sense of with whom we are interacting."* (Kollock and Smith 1998)

We depend heavily on non-verbal clues which are stripped away in online interactions. In online chats, people depend on the participant's words and other

indications such as use of emoticon symbols ("smileys" etc.) instead of relying on physical cues. Identity enhances satisfaction in CMC and deindividuation results in a reduction in identity. So, this theory seems to support the possibility of one-to-one CMC as potentially more satisfying than group CMC for chat interactions as it is less probable to establish identity for each member of the group given the time and device constraints.

Another consequence of deindividuation as group size increases in CMC, is that people begin to be more impulsive in their expression and exhibit uninhibited behaviors due to the relative decrease in private self-awareness, thus affecting normal retrieval of social standards with which to compare one's behavior (Prentice_Dunn & Rogers 1982). In analyzing the circumstances surrounding the murder of Kitty Genovese in the presence of 38 witnesses, Latane and Darley (1970) formulated a theory called "the bystander effect" around why no one helped in response to her pleas. According to this theory, three processes must occur before the bystander helps - audience inhibition which makes people inhibited to help in the presence of others for the fear of being evaluated negatively by other bystanders due to his/her behavior; social influence that occurs when a bystander sees that no one else is helping and finally diffusion of responsibility which reduces the psychological cost associated with non-intervention. Translated into the interactive chat scenario, this is probably the reason why many online chats with multiple participants ends up to be boring and insipid with far and sparse responses in the conversation. Each member of the group would wait for a response from the other and the conversation loses spontaneity resulting in a lack of satisfaction. On the other hand, response rate increases when users are specifically addressed (Markey 2000) as the burden of responsibility to respond is completely on them.

Usually, a typical chat interface consists of a list of participants, a text history window, and a single line of text entry (Vronay, Smith & Drucker 1999). The average screen size of a wireless handheld device is less than 160x160 pixels (Walker & Brewster 1999; Jones et al. 1999). This small screen real estate imposes a severe constraint in designing complex interfaces such as those required for chat. In the event of having multiple users and long conversations, the participant will have to perform complex actions to achieve simple requirements like scrolling through to see the chat legend or keep track of who is talking. Screen size and effort needed to add messages suggest that perception of satisfaction in boredom relief will be higher in one-to-one communication mode than in group communication mode for airport layover companion chat interaction.

INSIGHTS FOR THE AIRPORT LAYOVER COMPANION

Detailed implications for the layover companion are discussed in chapter 5 "Implications from the Literature Review". But, briefly, the layover companion will be positioned as a companion to passengers on a layover. Hence personalization will be given emphasis in content and its presentation. For instance, not only will there be personalized flight related information, it will also be delivered to the user addressed by his/her name by the device.

The layover companion will have flight/airport-related information, chat, games and GPS facility. However, this thesis will focus on the flight/airport related information and chat functionality only.

Chat on the layover companion will be one-to-one with an option to choose one's chat partner based on their profiles and specific parameters. Parallel chats will not be

possible but a system of alerts will be provided to inform users of other chat requests and important flight related announcements.

IMPLICATIONS FROM THE LITERATURE REVIEW

An extensive literature review has been discussed in the preceding chapters. The implications from the product, design and functional aspects are discussed here in this chapter.

IMPLICATIONS FROM REVIEW OF PRODUCTS LITERATURE

A review of literature on existing palmtop and handheld devices helped in deriving broad implications such as feasible overall system models to specific interface and interaction implications.

Two products that have influenced and shaped the current trends for palmtop and handheld devices are the early Newton and the presently popular Palm computers by 3Com. The Newton was one of the most hyped devices in its time but it also failed as dramatically because it tried to be all things to all people instead of doing just a couple of things brilliantly (Brandel, 1999). The Palm computers learned a lesson from this and these handhelds focus on a faster user experience than having more processor speed and they are designed to perform a few important features well. *The implication here is of limiting functionality in favor of simplicity in the layover companion. Faster user experience is important because people don't need portable computers but portable information with instant access at any time* (Wegberg, 1998).

Related to faster user experience is how steep the learning curve in using a new device or technology. Learning curves for temporary or fleeting use of devices such as the Layover assistant/companion has to be very low for people to want to use it and to

sustain interest. Too much diversion from the expected responses in interaction would create bad user experience. *Therefore, the layover companion has to have a very low learning curve with an intuitive and easy interface that does not deviate drastically from what is established and accepted as interface norms for interactive content.*

Users are also less willing to tolerate interruptions (Nielsen, 2000). Hence content like advertisements will be rejected unless they bring a very big value addition. The Modo is a prime example of failing due to an impractical business model of having advertisements on an inch scale screen to allow content to be made available free to users. *It is therefore clear that users don't want to see content they did not request. In the layover companion, it is likely that users will not welcome advertisements or any other form of commercial material to interrupt their interactive experience or occupy precious screen space.* This is also related to the fact that wireless technology is at present is expensive. What this also implies is that users would expect to be able to accurately predict what they expect to see if they click on any link. If the result of clicking a link is not what they expected, they are bound to rate the user experience low. *Therefore consistency and clarity in describing links are of paramount importance. This is especially true in specific contexts in the layover companion when users are faced with alternate options in the way they can choose chat partners or in the labeling of buttons.*

At present most handheld and palmtop devices have small memories and weak processing capabilities to allow them to be small, light and mobile. As a result, the screen sizes are small and the resolution poor. Many of the studies in the literature review of existing products demonstrate the use of sound augment or overcome the lack of visual space. *In the context of the layover companion, although sounds cannot be used as*

primary interface elements due to the numerous ambient sounds characteristic of airports, specific sounds can be beneficial as alerts to critical flight-related information or announcements.

The need to minimize typing input has been a constant endeavor in the evolution of PDAs. Touch screen technology has been introduced specifically to use point and click interactivity instead of typing long commands. However, due to the poor input recognition of the present technology, it is not advisable to adopt this technology for an input intensive interactivity like chatting. *Hence the design of the layover companion should suggest alternative input interfaces like keypads in the hard interface and also possible shortcuts, automatic word completion options or auto text features in the software.*

IMPLICATIONS FROM REVIEW OF DESIGN LITERATURE

Device constraints have significant design implications. Users use services on a small platform either if the experience is better than existing non-mobile services or otherwise services that were hitherto impossible to access in other forms without the medium. In terms of design, therefore, *it is imperative to evolve a new idiom to suit the new requirements and circumstances and not create scaled down versions of existing desktop or other services.*

The literature review briefly examines various new HCI models being tested for this new mobile medium to address mobile user needs. For instance, the agent HCI model suggests the reduction of user involvement in intermediary steps and instead suggests processing them in the background so that the mobile user needs to attend to this device

only at critical points in interaction while in fact getting a need fulfilled with minimum effort. Periods of interaction are typically much shorter. So, the time to set up an application must be significantly smaller. *Hence, there is a definite need to reduce the explicit human-machine interaction and shift to a more implicit model.* The Mosquitonet group at Stanford University is developing the Mobile People Architecture model for HCI on mobile systems. This model makes people become the end points in communication instead of the devices that connect them (MPA, 1999). *Therefore, the need to make the interface as transparent and seamless as possible gains a new emphasis.*

Mobility poses several design constraints too but this very aspect can be used to advantage by the use of fairly simple heuristics for this medium. *Interactions should be kept as simple as possible because layover companions are likely to be used by people on the move* encumbered by coats or briefcases even contextual/environmental constraints. The literature review examines the success of Short messaging Service (SMS) briefly and this service is marked by its simplicity of interaction. The focus in this context shifts from single multi-purpose gizmos to a device that has limited functionality but performs brilliantly to simple interaction models. *The layover companion will have limited functionality allowing passengers to check their updated flight –related information, chat or play games with others in the terminal and logged on to the system and use the GPS technology to find their way around the airport.*

Mobile devices are carried around by one individual and hence become more personal than desktop computers. Literature shows that an important differentiating factor in satisfactory user experience is hyper-personalized content (Haskin, 2000). "Natural" use and familiarity characterize the use of personal objects and devices. *So, it becomes*

imperative that these hyper-personal information carriers do not demand a steep learning curve but in fact integrate seamlessly with other similar interfaces and services so as to leverage existing knowledge in users. The paradigm shift as Wegberg (1998) states – "People don't need portable computers but portable information with instant access at any time." This is especially true in the context of devices like the layover assistant that is designed for personal use for a short period of time. *The derived implication here from the design perspective is to shift emphasis from standards and heuristics to contextual judgments based on tasks involved and the users using it.*

With mobility, users need to know when new information reaches them. In this regard notification mechanisms gain importance and are a special design concern. *Notifications have to be strong enough to make sure users don't miss important information but not become a source of irritation or cause for interruption in any given user experience. In the Layover assistants, notification mechanisms are especially important for updated flight related information.*

Another aspect that gains focus due to mobility is the "Context". "Context" as a construct takes on various connotations in the light of designing for this medium. In terms of situational context, the context of interaction determines suitability of interfaces and interactions more than standard design heuristics, thus giving rise to the now popular concept of designing context-specific interactions. Contextual inquiry has also gained importance for designing for mobile systems on the small platforms. The highly situated nature of most mobile scenarios like the airport layover in the case of the layover companion demands a clear understanding of what people do in practice along with their relationship with technology.

The literature review also briefly examines some studies on how the small screens affect interaction. Certain implications derived from these studies are as follows –

Ahmed & Hurst (2000) advocate the "inch-scale thinking" while designing for the small platform. *Simplicity is key in this approach and only what is most important is included in the design, stripping out all frills and trappings.* Another study by Hjelmeroos et al (1999) shows that *on the small screen, graphics and animations are not as important as text information available and accessible immediately. The layover companion will use the bare minimum graphics in the form of icons, symbols for the overall interface and emoticons additionally in the chat interface.*

It is best to design pages to fit the window screen because it is extremely easy to miss information in these screen dimensions and scrolling is clearly not preferred. If this is impossible, care must be taken to at least place the navigational features near the top of the page in a fixed place. Similarly, it is also advisable to place any key information in the top of the page. The design of the interface for the layover companion incorporates these implications as applicable.

It is best to avoid a toggle between the various possible input interfaces like scrolling with the pen stylus, keypads and the hard buttons on the body of the device as it tends to demand intermediate actions and lengthens the interaction making the user experience less pleasant. *Care has been taken to avoid as best as possible to use more than one input interface in any given screen in the layover companion.* In single purpose devices especially, or as possible in other devices, it is recommended that the organization of links be integrated with the physical interface of the device as was attempted in the Nokia9000 browser. *In the layover companion, this is not possible*

across the various functionality modes as each mode has different interface requirements. However, the layover companion proposes to incorporate frequently used buttons like the "send" button in the chat functionality within the keypad on the physical device.

Small screen users seem to prefer direct access strategies and it has been observed that path lengths are typically much shorter on small screens than on normal screen resolutions and dimensions (Jones et al., 1999). For this reason, *it is also a good idea to provide a search facility in a prominent part of the screen. However, most of the functionality available on the layover companion does not involve browsing through too much depth of information and hence the search feature does not hold the same degree of importance in this context.*

Content for the small screen has to be clear, concise and task focused. The text should also not be presented in narrow text boxes. It is also recommended that a text block should at least have four lines to ensure good readability (Duchnicky & Kolers, 1983). In using menu lists, it is important to allot enough space for the items on the menu lists and not have them broken down into a couple of lines as it slows down interaction (Han & Kwahk, 1994). Similarly, text links should also be designed to fit the display size. Further, they must be predictable of the information they would lead to in order to avoid the frustration of unnecessary interaction and the effort of downloading useless pages especially as it is not really inexpensive to use wireless technology. Hence clear nomenclature and descriptions for links is of paramount importance.

IMPLICATIONS FROM REVIEW OF FUNCTIONALITY LITERATURE

The Media Equation (Reeves and Nass, 1996) claims that the same predictions on people's behavior towards others may be applied to their behavior towards computers as people treat computers like other people. Based on this theory, we can conclude that if the device is similar to the familiar personal assistants with a simple interface, then it is likely that people will view it as a "friend" for the layover and an useful one at that. This is especially true if the layover assistant resembles the PDAs as they are usually perceived as devices designed to help organize and ease out complicated lifestyles. The Media equation also states that people view computers as teammates. *It would thus be apt to name this new facility for passengers on long layovers as the "Layover companion" or "Layover assistant".*

Still at the product design level, most PDAs have a pen stylus input interface. However, for a chat type interaction, which is input intensive, the pen stylus interface is offset by the need to correct recognition errors. *Therefore, a keypad interface is suggested.*

Literature on the effects of the small screen on usability and design suggest that rapid conversational turns and fleeting interactions may be rendered unusable because of the small size of the screen. *As a result, chat rooms or group chats are best avoided.* This study focuses on one-to-one chat interaction.

Just as people are more comfortable with others with whom some norms and interaction protocols have been established, *people will feel more inclined to use the layover assistant if it leverages their existing knowledge of the use of interface elements*

like buttons and menus. To enhance the friendly aspect of the device, it will also be useful to keep the help and tutorial components readily available and accessible at any time.

Besides a chat type interaction, Game theory (Thomas, 1901) and the relatively recent social conditioning of man as compared to survival tendencies suggest games as another important service for boredom relief. But this is not at the focus of this study in research or the design phases.

Many theories of interpersonal communication consider "identity" as a basic building block of social interaction. *In this light, it would be useful to promote features that enhance this sense of identity and personalization by the use of symbols, smileys or expressive icons in the chat and also specifying the gender in the chat profile.* More specifically, it has been observed that response rate increases when users in a chat forum are specifically addressed (Markey, 2000). *Establishing identity will help in this regard as well.*

Based on a study by Burgoon et al. (2000), it is noticed that personalization is not so important when people are looking for very specific information. Also, at this time very heavy processing and hi-technology is required for a meaningful chat conversation to take place between a human and a computer. *This suggests that people would probably prefer to get specific and critical information (e.g. gate/flight related information) from a machine source they trust but would rather chat with humans (even if they are strangers) via these handheld devices.* In another study by Erickson (1996), it was also observed that anonymity and remote contact makes CMC less personal and in fact reduces social distance because it is possible through this medium to learn about others without feeling obligated to them and accrue a social debt.

Erickson (1997) observed in a study that any shared informational artifact created by participants in an online interaction brings value and satisfaction in that activity. This fact taken into consideration with the basic need to kill time and alleviate boredom in passengers on layovers seems to suggest that there is no need to encourage long lasting relationships or repeat contacts through the chat type interaction. People just want to have a good time and their expectations from mobile devices too are usually rather low (Ahmed & Hurst, 2000). *Thus, if the device allows effective interaction where some time can be spent and information can be exchanged easily, then users are likely to find satisfaction with the experience.*

While users fighting boredom might welcome a diversion, they would likely not make the effort to use the layover companion if they do not see any value in it. It is in this context that *this study focuses on the importance of choosing the "relevant other" to chat with so as to make the interaction meaningful and hold value.*

According to a recent study by the Cahners In-Stat Group, users of wireless Net devices want to pull down information when they want it and don't want information pushed at them at regular intervals during the day (allNetDevices 1999). Chat interactivity can be considered to be semi-push type of information delivery, since the request to initiate a chat can originate with either party. Of course accepting or rejecting the invitation is a matter of choice but *the design of the interaction will have to accommodate easy and polite rejection.*

RESEARCH METHODS AND PROCEDURE OF STUDY

"If necessity is the mother of invention and you don't know what users need, you can't invent" (Dan Bricklin 1998). Designing innovative interactive applications to facilitate a better experience in contexts where a real need is identified, is always a complex challenge and can be confounding in the absence of systematic methodology.

RESEARCH METHODS

Contextual Design and Observation

Contextual design is a method of defining software and hardware systems by collecting data from users and using it as the base criteria for deciding what the system should do and how it should be structured (Beyer & Holtzblatt 1998). This aspect of the methodology has already been discussed in detail in chapter 1.

Affinity Diagramming

Affinity diagramming is a categorization method where users/ designers sort various concepts into several categories. This method is used to organize a large amount of data according to the natural relationships between the items (Arthur, 2001).
The affinity diagram helps break old patterns of thought, reveal new patterns, and generates more creative ways of thinking. The affinity diagram helps organize thoughts most effectively when –

- Issues seem too large and complex
- There is a need to break out of old, traditional ways of thinking
- Everything seems chaotic

- There are many user requirements. The affinity diagram and relationship diagram offer interesting tools for gathering and organizing the information gathered from the user (especially written or verbal comments).

This more organic and creative approach to understanding the user's needs is also a useful tool for object-oriented analysis.

In this study, the observations from the contextual design phase served as the starting point. Post-it notes were created for each unique observation. 6-10 groupings were then made by moving these notes on a large sheet of easel paper. A headline or group header was given to each group. Some post-it were duplicated to populate more than one group. These groups were further consolidated in some cases with a word or phrase that captured the intent of each group and placed as its header card (Appendices 5, 6, 7, 8).

User, Task and Functional Analysis

The target user for this product is defined as the non-business traveler in the age group of 21-40, traveling alone with a layover of 4 or more hours. Observing typical users in the real life setting revealed that this is a broad-spectrum group with users of various work experience, educational level, computer experience etc. To cater to a common denominator, the design implication from user analysis was to limit the complexity of user interaction in the proposed application.

Task and functional analysis has been considered essential as an early input to system design. With the user's overall goal in mind, how they tackle their task currently is studied with an eye for their informational needs and how they deal with exceptional circumstances or emergencies (Neilsen 1993). In the context of this study, the existing sources of boredom relief in airport terminals were identified and gaps in modes of

communication between fellow passengers and between passengers and the airport officials were identified. For example, currently, there is no easy way that a passenger running towards the gate to his next flight can actually convey to the gate authorities that he is trying to make it or there is no way in which a person can actually talk to another passenger in the terminal and still maintain his/her privacy or distance currently. These gaps were addressed in the design of the proposed airport companion.

Parallel Design

Parallel design process involves working out preliminary design alternatives before settling in for any one approach to the interface and develop it further (Neilsen 1993). Alternative interfaces were designed as necessary in this study based on the design implications drawn by observation, task analysis and functional analysis.

Participatory Design

Involving users in the design process early in the development of a new interaction idea has been a common norm in human factors studies. Although users are not designers who can think from scratch, they are very good at reacting to concrete design ideas and gauge if it will work for them in a given context or not. To facilitate involvement in users, ideas are presented in the form of concrete and visible prototypes. In this study a few screen designs are used to prompt user discussion. Such simple, guided discussions have known to be very useful (Neilsen 1993).

Prototyping and Scenario based testing

Since building any software content involves a lot of investment in time and money, early usability evaluations to check if the design is on track is conducted on prototypes of the final system. Neilsen (1993) describes two approaches to prototyping -

the horizontal and vertical prototyping. Horizontal prototyping involves the creation of the surface layer and cutting down on the level of functionality. Vertical prototyping in contrast cuts down the number of features to be exposed to the user and builds a narrow system that includes in-depth functionality for only those features.

This study however uses the scenario based testing method. This is a minimalist prototyping method with the limitations of both horizontal and vertical prototyping. Neilsen (1993) defines a scenario as an encapsulated description of an individual user using a specific set of computer facilities to achieve a specific outcome under specified circumstances over a certain time interval. Although this method sounds limited, it in fact offers a sharp and focused insight into how the user will interact with the future system without the expense of constructing a running prototype.

PROCEDURE FOR THIS STUDY

For this study, eight pre-recruited subjects, one domestic and seven international graduate students of the Michigan State University, in the age group of 21-35, who had traveled long distance by air and had experienced long layovers and who had used mobile phones were invited to the laboratory.

Appointments were made with subjects in advance. Each session lasted approximately 1.5 -2 hours. A single researcher conducted these sessions. The entire study spanned 4 days. The sessions were video taped for analysis.

After a brief introduction to the research, consent forms were signed. Subjects then filled out a general demographic questionnaire along with a few general questions on

the idea of having a wireless airport companion device for boredom relief during long layovers.

The subjects were then led to a cubicle with a computer terminal. Simulated prototype chunks of the layover chat and the airport/flight related information exchange was shown sequentially followed by a set of verbal questions. The simulated prototype chunks were demos of typical interactive scenarios created in Macromedia Flash. The subjects were asked to comment unaided by the researcher first in most cases. Then, the researcher walked through each demo and presented the context to the subject and probed for specific issues. The prototypes were not fully working models and therefore subjects' direct interaction with the interface was minimal. Alternate interfaces were presented where necessary and subjects were asked for their preference with reasons.

THE AIRPORT LAYOVER COMPANION – PROPOSED DESIGN

As part of this thesis, the chat and flight/airport information functionality were designed and developed as simulated concept prototypes using Macromedia Flash. This chapter describes the planned functionality in detail and the accompanying screen shots show its actual implementation.

WELCOME

When the airport layover companion is first turned on, it welcomes the user by name and introduces itself as the Airport Layover Companion (Figure 24). It also presents a tutorial, which has not been designed or tested as part of this thesis.

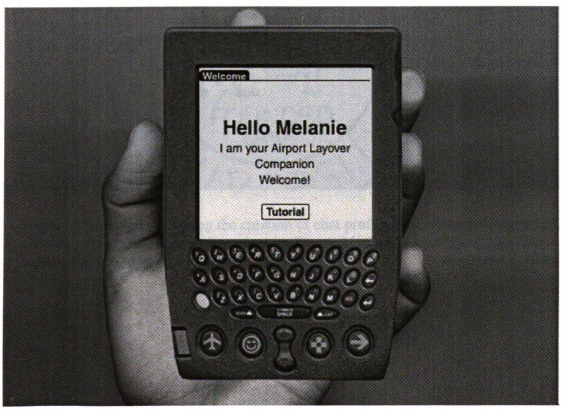

Figure 24: Welcome screen of the Airport Companion

CHAT FUNCTIONALITY IN THE AIRPORT LAYOVER COMPANION

Creation of chat profile

When the chat button is pressed for the first time, a screen comes up to prompt the creation of a chat profile (Figure 25). The system does not allow the user to chat unless he/she creates a profile (Figure 26).

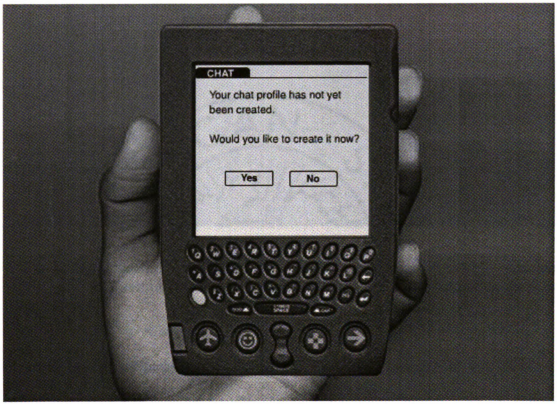

Figure 25: Screen prompting the creation of chat profile in the Airport Companion. Clicking "No" takes user to the screen on Figure 26. Clicking on "Yes" takes the user to the screen on Figure 27.

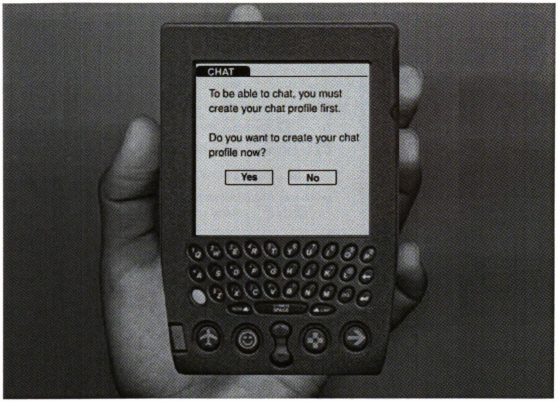

Figure 26: Screen prompting the creation of chat profile in the Airport Companion. Clicking "No" terminates the interaction. Clicking "Yes" takes the user to the screen on Figure 27.

The creation of the chat profile involves three steps (Figure 27, 28, 29). The first screen comprises of basic personal details and a question of whether the user would be interested in finding a date over the layover (Figure 27).

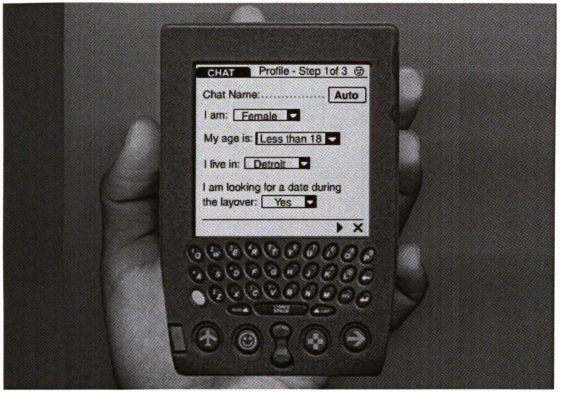

Figure 27: Creation of chat profile – Step 1 of 3 in the Airport Companion.

Users are allowed to omit any of the form entries except the chat name by choosing "omit" in the drop-down menu. The user then clicks on the next or forward button to reach step 2 (Figure 28).

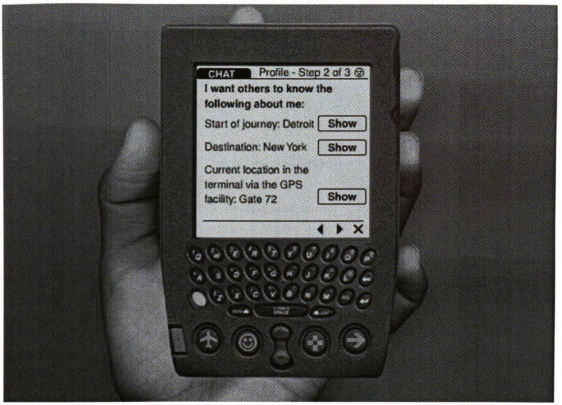

Figure 28: Creation of chat profile – Step 2 of 3 in the Airport Companion.

This step consists of hiding or revealing certain preset information about the user drawn out of the ticketing records such as start and destination of journey. It also allows the option of displaying the current location of the user to others. The users choose to show or hide any of these pieces of information by clicking on the buttons that toggle between "show" and "hide".

The last step in creating the chat profile consists of a list of chat topics of interest that the user can select with check boxes. Multiple selections are allowed (Figure 29).

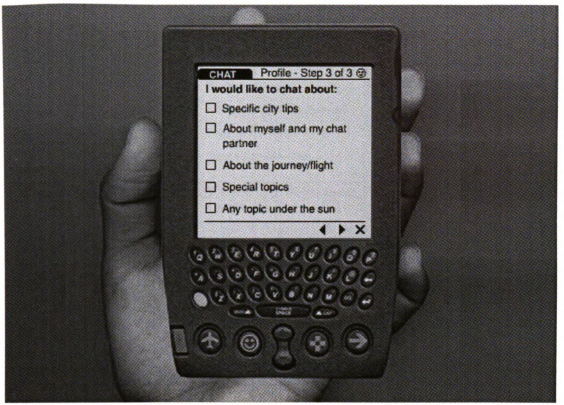

Figure 29: Creation of chat profile – Step 3 of 3 in the Airport Companion.

Choosing chat partners

When the user clicks on the next or forward button after making his/her selection, he/she reaches a screen of options that allow him/her to choose a chat partner in different ways (Figure 30). "Browse for my chat partner" allows the user to view the profiles of other people logged on to the system and choose to chat with them. "Suggest my chat partner" let's the system find a suitable chat partner based on the user's profile and starts the chat automatically. "Start a random chat" simply links up the user with the first available user with no matching of profiles. In this thesis, only the "Browse for my chat partner" approach is explored in detail. This screen also provides the facility to modify

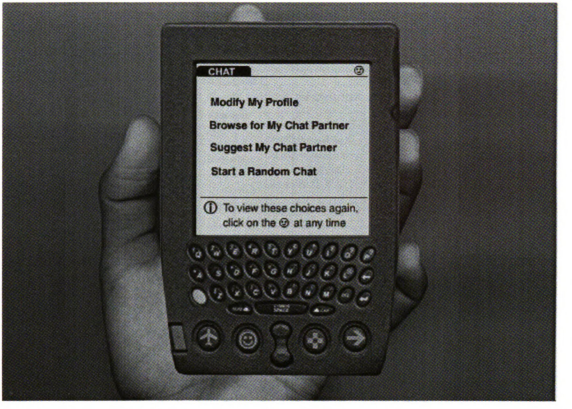

Figure 30: User options screen to selecting partners to chat with using the Airport Companion.

one's profile. An instruction at the bottom of the screen informs the user that these options will be available at any time during the chat session through a smiley icon on the top right hand corner of the screen.

A couple of alternate interfaces were developed for the "Browse my chat partner" feature. The first interface directly takes the user to an alphabetical listing of users and their profiles with an indication of the total number of users listed (Figure 31). Short profiles are available on clicking the user's name in an inset box within the same screen. This is designed to allow users to get a quick first impression of the people available for chat. The user can then click on the "details" button in the profile inset box to view

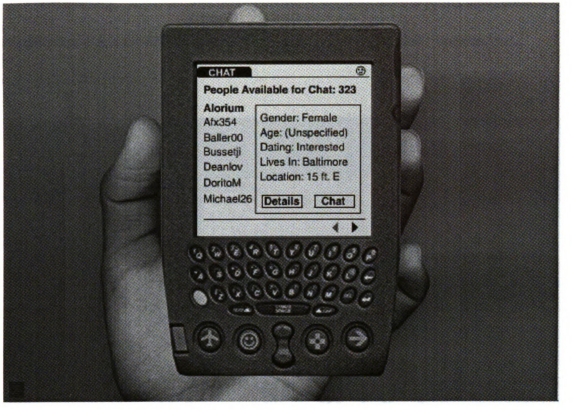

Figure 31: Browse for chat partners – Scheme 1: Alphabetical Search. Clicking on "Details" would take the user to a screen providing more details. Clicking on "Chat" would lead the user to the screen on Figure 35.

further details about the partner of choice. To begin chatting with a person, the user clicks on the "chat" button, which sends the other user an invitation to chat.

The alternate interface for "Browse my chat partner" involves an additional step of first specifying the parameters with which users would want to browse for their chat partners (Figure 32). Users can choose multiple parameters. This narrows the number of people to browse making the task possibly less overwhelming.

On clicking "Browse", the user encounters a screen similar to the alphabetical listing screen. For the purpose of testing, only the parameter called "Vicinity" was developed in the prototype.

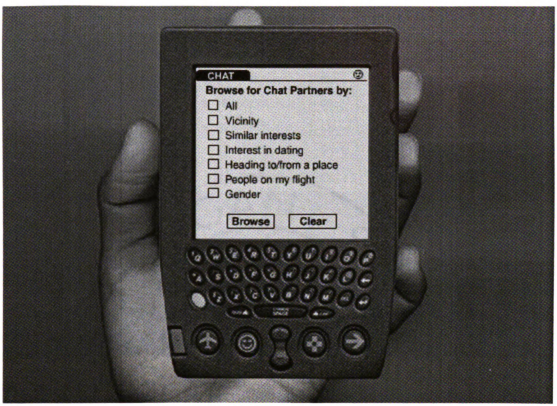

Figure 32: Browse for chat partners – Scheme 2: Categorical Search. Checking "Vicinity" and clicking "Browse" leads the user to the screen on Figure 33.

By choosing "vicinity" as a filter to narrow down the number of available chat partners, users are provided with an option of hiding or revealing people located at different distances with respect to their own current location (Figure 33). The interaction element in this case is again the "show/hide" toggle button. Circles of varying sizes precede each distance range – smaller the circle, the farther the user is from the potential partner. The resultant browse screen is again similar to the alphabetical listing of users

and their profiles but additionally displays the different sized circles alongside each user name to provide a graphic overview of relative distances in the list (Figure 34).

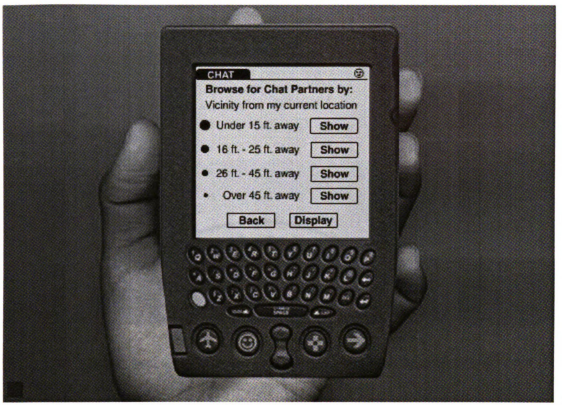

Figure 33: Browse for chat partners – Scheme 2: Categorical Search detail. Clicking on "Display" leads the user to the screen on Figure 34.

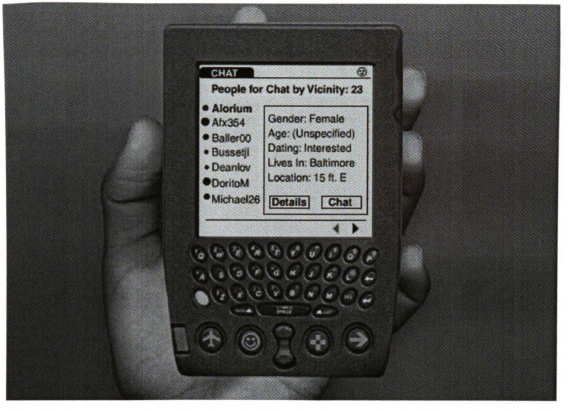

Figure 34: Browse for chat partners – Scheme 2: Categorical Search listing.

The chat interface

Two alternate chat interfaces were developed as prototypes for testing. The first interface scheme was designed for a simple text-based chat with areas to type, view the conversation and also an animated indicator of the response status of the partner with the animation occurring whenever the partner types (Figure 35). Users would type and send using the keypad.

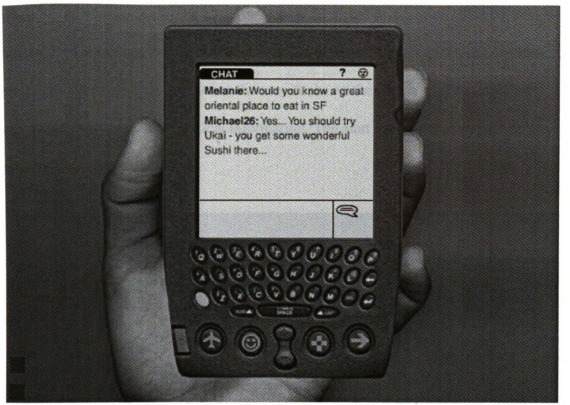

Figure 35: Chat Interface – Scheme 1: Plain Text Chat.

Another chat interface was developed with a focus on enhancing the user experience by the use of emoticons to enrich the chat expression and also by providing the facility of word and phrase shortcuts to avoid typing to some extent on the small keypad (Figure 36). The pen stylus is used to choose these emoticons and word/phrase shortcuts from the drop-down menus on screen. These features are made available in the form of a vertical panel on the right hand side of the screen and the rest of the area is divided into the typing area and the chat conversation view area.

In both these interface schemes, a system of alerts are proposed to indicate the arrival of a new chat request or updated flight-related information. A small part of the screen is delegated for this purpose close to the typing area so that users have a lower

probability of missing it (Figure 37). The alert is displayed as a labeled, flashing button preceded by a small symbol to indicate if it is a chat request or a flight related information update. The flashing stops only when the user clicks on the button so as to ensure that users do not miss potentially critical information. The alert is also accompanied by a chime for the same purpose.

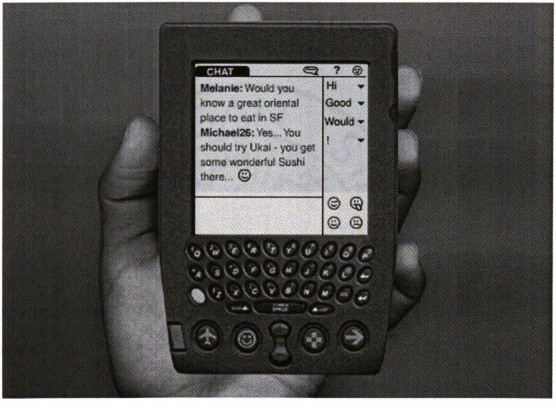

Figure 36: Chat Interface – Scheme 2: Chat with pictorial enhancements and typing shortcuts.

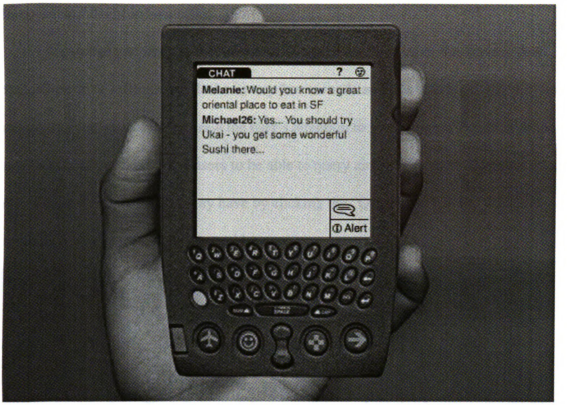

Figure 37: Alert indication on the lower right hand side of the chat interface.

FLIGHT/AIRPORT INFORMATION ON THE AIRPORT LAYOVER COMPANION

The updated information available on the airport layover companion is of three types – "My info" (personalized flight information), "Airport info" (information about airport amenities etc.) and "General info" (information about the weather, local news and news at the destination city etc.) Each of these facilities is available when any one of them is accessed.

Personalized flight information

A summary of flight, itinerary and gate status is presented in this screen. Any changed piece of information flashes every few seconds and it is also highlighted in bold and is preceded by a bullet to draw the user's attention to itself (Figure 38). In addition to this, there is also a facility for users to be able to query airline and airport officials about any of the concerns that they may have by clicking the "Questions" button. It is proposed that these questions will be answered by via a chat message.

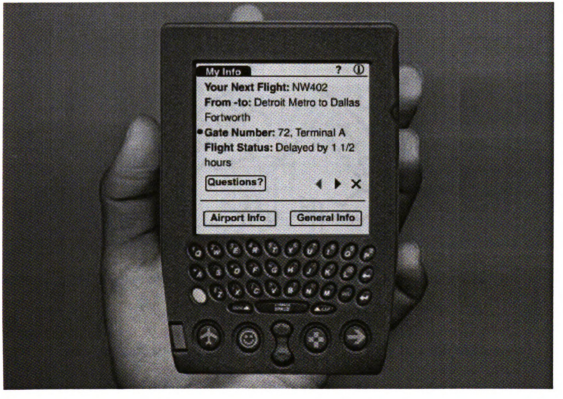

Figure 38: Personalized flight related information on the Airport Companion.

Information about airport amenities

Airport amenities are listed with options for selection and display by relative location - those that are close-by or all there is available in the entire terminal (Figure 39).

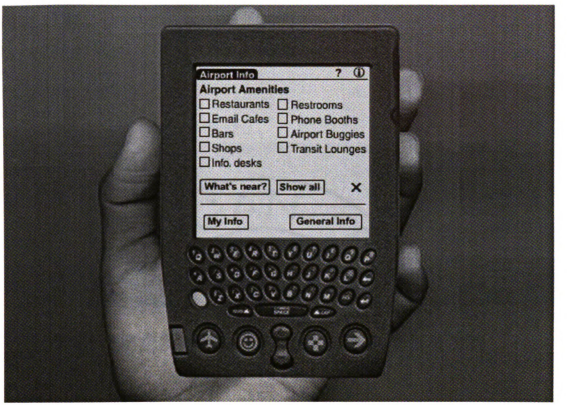

Figure 39: Display of available airport amenities on the Airport Companion.

Users navigate sub-categories (Figure 40, 41, 42) and find information and directions to get there using the GPS facility available as a button on screen or by using the hard button on the physical device.

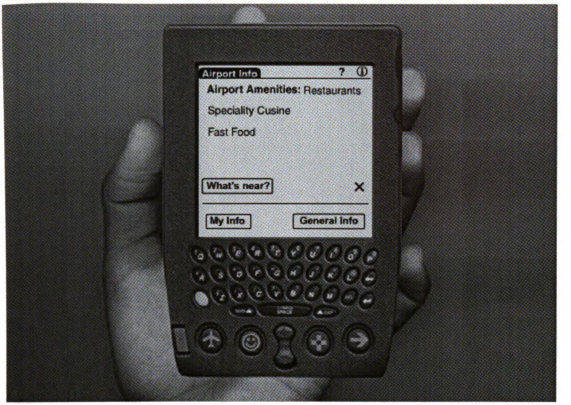

Figure 40: Menu based selection of chosen airport amenity on the Airport Companion.

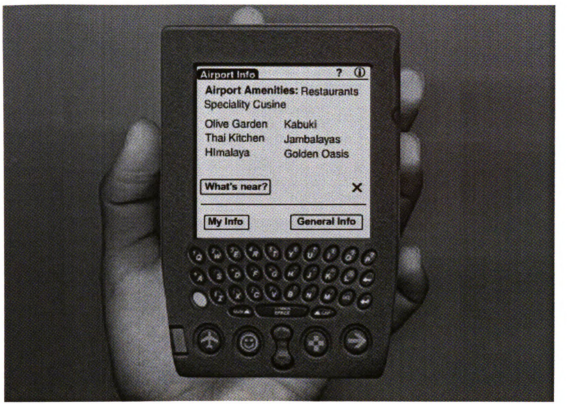

Figure 41: Further menu based selection of chosen airport amenity on the Airport Companion.

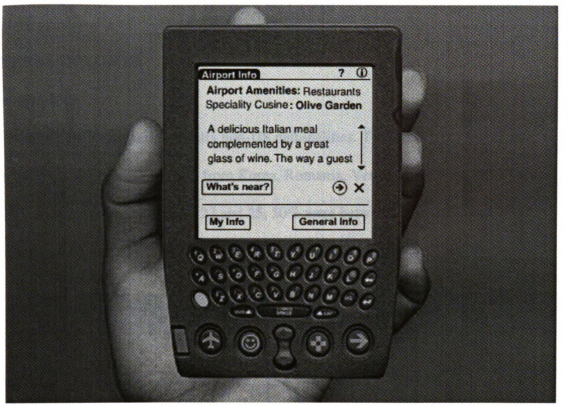

Figure 42: Details on chosen airport amenity on the Airport Companion with a link to the GPS facility.

DATA ANALYSIS

GENERAL INSIGHTS

Demographics

The respondents were predominantly non-US nationalities. Two were from India, two from the Philippines and one each from Korea, Romania, Venezuela and the U.S (Table 1). 25% were between the ages of 22 and 25, 50% were between 26 and 29, and 25% were between30 and 33 (Table 2). 75% of the respondents were male (Table 3).

Nationality	Percentage (%)
India	25
Korea	12.5
Philippines	25
Romania	12.5
USA	12.5
Venezuela	12.5

Table 1: National origin (n=8) of participants for the concept and usability study of prototypes of the Airport Companion.

Age Range	Percentage (%)
22-25	25
26-29	50
30-33	25

Table 2: Age range (n=8) of participants for the concept and usability study of prototypes of the Airport Companion. Average age of participants = 27.

Gender	Percentage (%)
Male	75
Female	25

Table 3: Gender (n=8) of participants for the concept and usability study of prototypes of the Airport Companion.

Familiarity of respondents with mobile technology

Only one respondent did not own and had never used a mobile phone. 50% were somewhat familiar with mobile phones (they did not own but had used one) and the remaining 25% owned a mobile phone and were thus very familiar with its use (Table 4). None of the participants owned a palmtop computer. One respondent had used a palmtop and was somewhat familiar. The other seven had never used one (Table 5). This degree of familiarity with mobile technology in the respondents was ideal, as in reality passengers will have different backgrounds with respect to familiarity with new technology. But

seven out of eight people had experience with using mobile phones and so they can be considered as subjects with the right priming for exposure into this new technology.

Familiarity with Using a Mobile Phone	Percentage (%)
Very familiar (own one)	37.5
Somewhat familiar (don't own but used)	50
Not familiar (Don't own and never used)	12.5

Table 4: Familiarity with mobile phones (n=8) of participants for the concept and usability study of prototypes of the Airport Companion.

Familiarity with Using a Palmtop Computer	Percentage (%)
Very familiar (own one)	0
Somewhat familiar (don't own but used)	12.5
Not familiar (Don't own and never used)	87.5

Table 5: Familiarity with palmtop computers (n=8) of participants for the concept and usability study of prototypes of the Airport Companion.

Layover experiences

50% of the respondents experienced layovers at least once a year and as much as 25% of them experienced up to five layovers in a year (Table 6). The average length of the longest layover experienced by the respondents was in the range of 6-7 hours (Table 7). This matches the range in terms of duration that the Airport Companion was designed to be used in.

People seem tolerant towards layovers. Although the average length of the longest layover that the respondents had experienced was 6-7 hours, the majority of respondents said they were only somewhat bored. Those respondents that experienced only a couple of hours of layover did not even complain of boredom (Table 8). It is probable that most of these couple of hours is spent in getting to the right gate, eating, freshening up etc. Overnight layovers were considered very boring and layovers of about 3-6 hours were perceived as somewhat boring. In the case of longer layovers, people run out of things to do. One respondent said, " I'd like something that will entertain me with different things every few minutes."

None of the respondents expressed any strong feelings, positive or negative, about the facilities currently available for passengers' entertainment and comfort during long layovers (Table 9). The number of respondents indifferent and stoic in their acceptance of what was available were equal to the number of respondents that were either somewhat satisfied or somewhat dissatisfied (people with no strong views).

No. of Layovers in the Last Year	Percentage (%)
1	50
2	12.5
3	12.5
4	0
5	25

Table 6: Number of layovers experienced in the last year (n=8) by participants for the concept and usability study of prototypes of the Airport Companion. Average range of layovers experienced in the last year - 1-3 times.

Length of Longest Layover in Past Year (In Hours)	Percentage (%)
1-2	12.5
3-4	37.5
5-6	25
Overnight (9-12)	25

Table 7: Length of longest layover (in hours) experienced in the last year (n=8) by participants for the concept and usability study of prototypes of the Airport Companion.

Degree of Boredom during Longest Layover	Percentage (%)
Extremely bored	12.5
Somewhat bored	62.5
Not particularly bored	25

Table 8: Degree of boredom during longest layover experienced by participants for the concept and usability study of prototypes of the Airport Companion (n=8)

Degree of Satisfaction with Airport Facilities Available for Layovers	Percentage (%)
Extremely Satisfied	0
Somewhat Satisfied	25
Neutral	37.5
Somewhat Dissatisfied	25
Extremely Dissatisfied	12.5

Table 9: Degree of satisfaction with airport facilities available for layovers as perceived by participants for the concept and usability study of prototypes of the Airport Companion (n=8).

DEVICE INSIGHTS

Envisioning an ideal layover device for boredom relief

The Airport Companion is like a small computer designed to entertain users in more than one way – it matches the ideal envisioned by respondents reasonably well. Most people are very practical about layovers. Most people had problems even imagining out of the box. This suggests that any new service will probably be welcome and interesting provided it does not affect their privacy, safety and is not in any way threatening. When asked to make a wish for an ideal layover device in an airport, the participant's wishes were not too unrealistic. Most of them wanted a computer to surf the net or e-mail people they knew. Something about exploring a computer seems to be capable of keeping the mind occupied and free from boredom. One respondent said just exploring the device, playing games on it and fiddling with GPS to get directions will keep him engaged. Another respondent said that in using a device like the Airport Companion, his interest is not in just what the device offers but in that something new that he can fidget with. For this reason, users would like to be faced with a few challenges and not be taken directly to a chat conversation or their goals. *Users expect the various features on the Airport Companion to be entertaining but they also perceive the process of discovering the product itself entertaining and a powerful means of boredom relief.* Other wishes included means of making oneself comfortable and entertained (in different ways every few minutes). These included better places to eat, sleep, watch movies etc. Two things that stand out from the user feedback to the question of an ideal device for boredom relief during layovers –

- People want to be entertained or be occupied

- People perceive the computer as a good means to do that

INTERACTION INSIGHTS

What kind of layover chat profile is best?

People come in with preconceived ideas from previous experiences

Most of the respondents first thought of the chat facility on the Airport Companion in terms of a chat room with group chats. It is also common practice to create a chat name to be able to chat in most forums. Hence, all of the respondents thought they would not be allowed to chat unless they created a profile or at least a chat name. So, unless they were sure that they would not like to take part in a chat conversation, most respondents chose to create a chat profile. *It is important to set expectations of users by giving them a synopsis of what to expect either in the tutorial or in the welcome screen for the chat functionality.*

Respondents expect to be allowed to chat regardless of whether they create a profile

Respondents had diverse expectations of what the system would do if they said they did not want to create their profile. Some thought they would be logged in as a guest with no personal information about themselves or access to other people's information. Others thought that they'd be let into a chat room to merely "observe" the conversation but would have to create a profile to actively contribute to it. *A device designed for boredom relief should allow people to have a good time with the least input or effort from them.*

Information chat is perceived as different from chatting for boredom relief

Users recognize the value of exchanging relevant information such as information about a destination city and welcome it as a useful option. However, not all respondents seek that kind of information and hence do not see value in the additional steps they need to wade through to begin chatting. Creation of a detailed profile is considered valid only if it will aid them in any given specific way – in this context, in gaining information that is important to them. They feel it is unnecessary to trade personal information for just killing some time. *The chat functionality in the layover companion can begin with a screen that queries the user if he/she wants to chat for fun or find a partner to gain specific information (fun chat or informational chat)*

Short and quick chat profile creation is not perceived as annoying even if mandatory

Users expect and do not mind certain basic questions like chat name, age, and gender. Users also expect to see questions about their interests. But all respondents were unanimously uncomfortable with the question about interest in finding a date during the layover. Most respondents were also very uncomfortable about revealing their current location to the extent of wanting to terminate the process. Some respondents were not comfortable with revealing the start and destinations of their journey. Some respondents felt that if these "unnecessary" and discomfort causing questions were removed, the process involved in the creation of chat profile would be shorter. One respondent felt the duration of one's layover and information about what part of it was remaining was more pertinent and should be part of the profiles available. *Users want the process of creating the chat profile to change based on the motive with which a person wants to chat. Therefore, the chat functionality in the layover companion can begin with a screen that*

queries the user if he/she wants to chat for fun or find a partner to gain specific information (fun chat or informational chat). A random chat partner can be assigned if the user chooses chat for fun. Fun topics to choose from could be an optional step for these users. For users interested in a more serious informational chat, the profile creation can start with the user specifying what kind of information he/she is seeking by checking some categories like "specific city tips" or choose "other" and type in a keyword. The remaining steps in the creation of the profile could be based on the choice made on the first step. This could be followed by the option to browse for a chat partner or chat with a system assigned chat partner.

Protecting anonymity is considered essential

Most respondents preferred to chat anonymously especially because the chat using the Airport Companion involved chatting with a stranger. Besides safety, other reasons for this preference included safeguarding privacy and the perception that there was no significant positive role of establishing true identity in a chat for boredom relief. The degree of preference for anonymity differed across the respondents- a few preferred to divulge no details and go with a pseudo name while others did not mind giving out their initials and a few details. None of them said they would use their real name.

Negative aspects of anonymity are recognized

One respondent expressed concern over the misuse of the system due to anonymity and associated a potential for lack of responsible behavior with it. He said he would feel safer in using the system if he knew that despite the anonymity, users could be tracked by a central system if required based on their device's IP address or if there was some kind of moderation possible. Another respondent was concerned about people lying

about their age etc. and felt children could misuse the system, as the topics discussed were not restricted. *This service could be made available only for passengers who are 18 years or older. Although tracking is possible, monitoring and moderating innumerable chats might be an extremely difficult task. People expect to be polite but want technology to allow them to block weirdos. So, if the users reported that person to authorities, that person could then be traced and penalized appropriately.*

Need for social norm despite wariness to chat with strangers

Respondents want to reveal as little as possible about themselves in their chat profiles but learn as much as possible about their chat partners before beginning chatting. They also say they would refrain from personal topics to protect privacy. Further, they welcome features like blocking a person from contacting them as a protection from weird, persistent or "bad" people. However, they still want to cherish all those things that make the experience more personal and courteous. They welcomed features like the emoticons to enrich chat expression and vetoed automated opening and closing lines. They also said they would seldom use the option of automatically terminating a chat but would instead do it themselves as politely as possible. However, they preferred to have the option for the odd weird person on the other end.

A personalized chat name is preferred over an auto-generated name

Respondents liked to have control over how they'd be known to others. Reasons for this were diverse – the name was probably the source of first impression and so they wanted to have the chance to make it as conservative or spunky as they wished. They also feared that if they chose to have an auto generated name, then it would be an irreversible process. Also, they had no idea if the device would simply put in their real name form the

travel records or assign a name that was too close to their real name. Similarly, in choosing a partner, the name was the first point of attraction. A "real" sounding name or an interesting assumed name would therefore have a better chance of being chosen rather than an auto-generated alphanumeric string.

Users' expectations of learning information about others is comparable to amount of information they are willing to divulge about themselves

Some skeptics did not want to reveal anything about themselves other than an assumed name and did not want to know anything because they could not be sure if the information they received was true in the first place. Other than these people, in chatting with strangers, respondents wanted to leave out personal details from their profiles and did not expect too much either from the profiles of others - " I am not going to have a talk personal and so the less I know the better."

While all respondents were unanimous in the importance of the name in a chat interaction, some preferred an assumed name for themselves while others were comfortable in revealing part of their names or even their full names without any other significant details. Similarly, in choosing a partner, the name was the first point of attraction. A "real" sounding name or an interesting assumed name would therefore have a better chance of being chosen rather than an auto-generated alphanumeric string.

Other than an interesting name, users seem to want to know the gender and age of their partners. This information is considered basic to determine if they want to chat with that person or not. Male respondents liked to know gender information because they would prefer chatting with a female and would also behave accordingly. Female

respondents wanted to know the same information because they felt more secure chatting with other females.

Age was considered an important piece of information because it influenced possible topics for chat and also the tone and mood of the chat. One respondent said based on his mood he would choose a person of his own age if he wished to just have some fun but would choose someone older if he wanted to talk about more serious topics.

The only dichotomy in what respondents were willing to reveal about themselves vs. what they wanted to know about others was the fact that they would *ideally* want to know more than they wanted to reveal. However, they recognized privacy issues and hence did not really expect such information to be made available. However, information regarding profession and interests/hobbies were considered welcome as it helped build a slightly better picture of the potential chat partner.

Respondents also wanted to know some practical details about potential chat partners. The duration of the layover and what was left of it as well as their chat status (if they were already chatting or not) were considered useful pieces of information in making a choice of the chat partner.

People's ideal chat partner mirror themselves

Friends and known people make ideal chat partners but in this layover scenario, respondents felt that a stranger, who resembled people they knew or were like themselves, seemed less threatening. It also seemed that a greater potential for a good chat conversation existed amongst people sharing some characteristics. Hence, *people in the same situation, of similar age and sharing common interests were considered ideal for chat partners.*

One's current physical location in the airport is a sensitive issue

Most respondents were very uncomfortable about revealing their current location to the extent of wanting to terminate the process of creating the chat profile or even the chat experience itself. However others felt that revealing this information did not matter as it was of no use unless identity was already established.

"Vicinity" was not amongst the more popular methods of choosing chat partners amongst the respondents. Some respondents were uncomfortable with the thought of people playing a guessing game of who they might be chatting with or whose profile they are viewing especially in the cases where they were physically close. A few respondents however felt it might be a useful tool so that one could be sure that the chat partner is far away or close depending on one's choice. One respondent viewed this device as a starting point for interaction and said that he would choose only those that were close to him in location (although he might have naturally chosen other parameters of partner selection) as it would offer him a chance of face-to-face interaction. *The GPS feature can help in finding the location of one another if chat partners feel comfortable about revealing their current location. This feature can be dropped from the profiles creation and selection, as it is not adding too much value besides bringing in a novelty value in a hi-tech manner.*

Searching for a chat partner

Actual design of the various approaches to find a suitable chat partner matched user expectations but lack of consistency across the nomenclature for these approaches can lead to confusion.

Respondents guessed the difference between the three approaches -"Browse for chat partner", "Suggest my chat partner" and "Start random chat" - to finding a chat

partner. However, since the last approach has no reference to a "partner", some respondents thought that the former two approaches led to a one-to-one chat while a random chat was a group chat on a proposed topic with people joining in randomly. *The "start a random chat" approach can be renamed as "Find a random chat partner".*

Maintaining an identity seems to be important even when chatting with strangers and it is not natural for users to change their profiles often.

Most respondents said they would not change their profiles once they had created it. Respondents also mentioned they hate going back or re-doing things. So, if they did, it would be for one of the following reasons - 1) Because they remembered they made a mistake 2) To increase or change the people they can access (based on their own profile) 3) to erase all information. Respondents felt there was not much that they could change either since the options were not too many and it was unlikely that they would change their mind on the answers if they had been honest in the first place.

Most respondents prefer browsing and finding their own chat partner to chatting with a system suggested partner and they prefer chatting with a system suggested partner to chatting with a random partner.

Respondents felt they had more control when they chose their partners for themselves using the "Browse for chat partner" facility. However, they said they might try "Suggest my chat partner" if they are either too bored to search for themselves or for the novelty value on an extremely long layover when they are tired of finding their chat partner on their own. However respondents are skeptical about using the "suggest my chat partner" facility if it brings up just one profile and forces them to chat with that person. They were more amenable to the idea of having a much shorter list to choose from where

the system had done a significant amount of filtering based on their profile and presented only about 5-10 profiles. One respondent also suggested that browsing for a chat partner was in fact involved more effort and this approach of the system suggesting a partner could be valuable if the system suggested one profile and the user could accept or reject it and the system would then lead the user to a chat or suggest another profile. All respondents were reasonably comfortable with the "suggest my chat partner" route as they felt the system was matching profiles based on the requirements or profile they created themselves. This was also the reason almost all of the respondents were either unwilling or uncomfortable with random chats as there was no matchmaking basis to the pairing or finding of partners. *Random chat can be dropped completely or at least dropped from the informational chat.*

All respondents preferred users with conservative/normal/real or interesting names and at least a few basic details in choosing their potential chat partner.

Respondents felt that a conventional or real name made a person seem less fictitious, more normal and safe. Interesting chat names were attractive choices. However, all respondents said they would choose a profile with no name or an alphanumeric name if it had details such as age, gender, location and interests in that order of importance. None of the respondents said they'd choose a profile which neither had an interesting name or any details. With precedents in cryptic e-mail ids and pass-codes, respondents did not seem to mind the absence of an interesting custom name in comparison to not having any details. Respondents pointed out that in the absence of the helpful hints in face-to-face interactions, these details and the name were the only clues to making a judgment. Some respondents on viewing such profiles said they'd probably go back to

make amends in their own profile if they had been too cautious and not revealed any information at all. Respondents said they'd have to have reached the height of their boredom or have no other choice of partners, if they had to chat with such people. Or, they would probably try to "figure" such a person out if they had a long layover and the mood to spend a long time on this device.

Browsing for a chat partner

While the importance of finding the right chat partner is recognized, respondents prefer the option of easy and quick trials and switching partners to spending a long time in finding the right one on the first try.

Finding the right chat partner is especially important in a one-to-one chat interaction for safety, privacy and a good experience. However, respondents preferred a compromise between time spent in looking for a partner and the experience with the chosen partner. In chatting with strangers, respondents feel they can only learn a very little about potential partners from their profiles (assuming they are in fact honest). So, they preferred a quicker process of choosing a partner. They laid more emphasis on the facility to be able to terminate a particular chat and quickly look for another chat partner and also to be able to block people so that they can be safe even if they landed up with a "bad" partner. Most respondents mentioned that they'd give every chat a few minutes to gauge how they feel about it and try at least 3-4 people in pursuit of a good chat experience. If this didn't help, some respondents said they would either make changes in their own profile or change the category of search for chat partners to see if other interesting profiles came up. This clearly shows that users are willing to put in some effort into the activity and hence it should be of some importance to them.

The amount of time spent in looking for a chat partner seemed to be a function of the duration of layover, how many people were available for chat and finally their threshold of patience. On an average the respondents gave 10 minutes in an hour for finding a chat partner and about 5-7 minutes in each chat to check if they wanted to continue or terminate it. Respondents felt that they would check out all profiles if the list were as small as 7-10 names. However, if the number of people available for chat was huge, then they'd make quick decisions as they were assured of finding others if the current choice didn't go well. Patience overruled all these factors because respondents felt that if they were tired after a journey, they would give a maximum of 10-15 minutes for this service to capture their interest and any tedious aspect to it would make them want to give it up. One respondent said he would give himself about 15 minutes to find a suitable partner and if he didn't succeed, he'd simply pick the first available person just to try out the experience and based on that experience he would either carry on or give it up altogether.

All respondents felt that it could be overwhelming to see the entire list of chat profiles available and preferred some means of categorical search or filtering.

Respondents felt that in a huge airport like O'Hare or Heathrow, it was likely that the sheer number of people using this service would be overwhelming and it would be even more overwhelming to browse through their profiles. This would unnecessarily increase the duration of the pre-chat process and test the patience of already tired passengers who might have had a long, tedious flight and waiting for another one. So, a method of filtering this huge number into something more easy to handle was always welcome. One respondent presented a different perspective by stating that she would not

mind the huge number because like people-watching, the very act of reading up profiles of strange people and clicking repeatedly would keep her engaged for a while. Besides the large number causing information overload, it was quite likely that people with chat names beginning with "W" or "Z" did not even have a slim chance of being chosen from the long alphabetical list displayed at around seven names per screen. Respondents were satisfied with the search categories or filtering parameters but felt that "Age" could replace "Interest in dating".

Time saving strategies in browsing for chat partner desired.

Although respondents were satisfied with the facility of applying filters to result in smaller lists to browse for chat partners, they also preferred further assistance to reduce browsing time. All respondents liked the idea of previewing the profile summary and then accessing details if interesting. One respondent suggested displaying more chat names per screen (two columns of chat names instead of one) as interesting names attract users' attention at first glance. However, with the small screen real estate it is impossible to display any more chat names if the profile summary has to be retained on the same screen. This summary could be displayed on click overlapping the other names or on a new screen but this increases the number of clicks and makes the simple and clearly understood interface (as it exists now) to become complicated. *1) Results to the categorical search could be displayed in the degree of relevance or matchmaking so that the probability of finding a suitable chat partner is increased in browsing the first 5-7 profiles. 2) The chat profiles can be customized to the requirements of the user. For instance, if the user had mentioned in his/her profile that he/she is not interested in dating, then that information is not relevant to him/her when he/she browses other*

profiles. So, this can be omitted from the profile, making it shorter and less time consuming to skim through. 3) On returning to the "Search chat partner" menu after a chat session, users can be directly taken to their results list with those names they blocked removed and those names they already chatted with clearly marked and relegated to the end of the list.

Although disrupting a chat conversation is not preferred, users seem to want to have the option of accessing others who are engaged in a chat and also be accessible to others when chatting.

Some respondents preferred to access only those people who were free and available for chat either because they did not want to disturb those who were already engaged in conversations or because this was yet another way to filter down the list of profiles they had to browse through to choose a chat partner. Although none of the respondents said they would want to actually disrupt an ongoing chat conversation, some of them said they would like to have the option of accessing everyone. To some of them, knowing how many people were using the system or this service was an important piece of information. These respondents wanted to have an indication within the list of those that were already chatting so that they did not inadvertently interrupt a chat conversation. For some others, access to people already engaged in chats meant that they could target specific types of people especially if that type/group was an extremely small part of the list of people on the system (for instance, list of people from MSU and heading to Lansing from O'Hare). Some respondents also thought that access to everyone should be allowed as it is possible that such interruptions may be welcome if they were anyway bored with their ongoing chat conversation.

Most respondents considered interruptions as sources of annoyance especially if it was unimportant. So, whether a chat request that came in when one was already chatting would be considered important depended on how the ongoing chat was progressing. If the respondent was having a good time, he/she would rather not be disturbed. Respondents also felt that they would feel more annoyed by these interruptions if they disrupted the ongoing activity completely. They wouldn't mind these interruptions as much if they presented themselves less obtrusively. However, having the option of being accessed was reasonably important. *A "do not disturb" facility can be made possible and this facility can be turned on or off by the user at will.*

Chatting in groups versus chatting One-to-one

Respondents prefer chatting in groups especially because of the fact that the chat occurs between strangers. However, small screen constraints are recognized and most of them feel one-to-one chat is best for this device.

Respondents seemed to prefer groups because they were more familiar with chat rooms on the Internet. They also felt that in groups, they had the option of observing a session and jumping in only when they wished and were comfortable without having to really reveal much about themselves. Some respondents also felt that whether they preferred groups over one-to-one depended on what they wanted to talk about. If they had some specific query or information they needed, they felt one-to-one chat with someone knowledgeable was best. Otherwise they felt "more the merrier". However, some others pointed out that it was important to define a topic in a group chat especially on a device like the layover companion as the small screen would not allow the possibility of sub-groups discussing various topics. Respondents felt that on a layover and when they were

bored, it was unlikely that they wanted to talk on anything particular. Some respondents suggested that the system should just rope in groups of people and let them chat for a certain amount of time in groups to aid in choosing a suitable partner who could then branch off on a one-to-one chat. Inspite of most of these comments, most respondents recognized the limitations of the small screen and felt it was probably best to chat one-to-one on this device.

Speed of communication and transmission was considered of great importance in maintaining interest in a chat conversation.

Although users expect a reasonable amount of time for typing out messages on the small keypad, they said they would tire of the system if it transmitted the messages very slowly. *Indication of the chat partner's activity (typing or idle) helps in the user maintaining his/her patience level. Restricting to a one-to-one chat mode is also helpful in reducing time lapses without activity. The system should also be based on a technology that allows instantaneous transmission of the chat messages.*

Typing on a small keypad is considered a major deterrent in the success of this service. Aids designed to reduce typing received lukewarm response from respondents.

Most respondents were put off by the small keypad that would serve as their input to type in a chat interaction. Some of them said in using the layover companion, they would prefer games to chat interactions as it was less threatening as an activity to be done with strangers and also possibly less cumbersome in its usage of the keypad. Most respondents did not fancy the chat interface designed to reduce typing with the use of commonly used words, phrases and punctuation drop down menus. Many of them thought that this feature just occupied precious active screen area and did not add much

value as they just offered words that saved typing a few characters while they would anyway have to type the rest of the sentence. Respondents were neither sure that the device was capable of storing millions of phrases or sentences nor did they want the device to supply them with their language of communication, thus preferring to type on their own. Respondents also vetoed automated opening and closing lines as well as automatic chat session terminators as they thought these were not personal, polite or interesting. However, they liked the use of emoticons as it enriched a chat conversation and made it more fun and personal. Most respondents preferred to pick these symbols off the screen with the stylus, as they did not want to further clutter their keypad or make the key sizes any smaller. But respondents said this feature would be useful only if they were distinct and comprehensible at the low resolution and small size. For this reason, some respondents said they'd prefer just a smiling face and a non-smiling face instead of a whole array of expressions that were so small that they could not be seen clearly. In the light of the small scale of the soft and physical interface, respondents felt they would prefer a voice chat interface to typing. *A voice chat interface could be explored as a separate design exercise. This could use the display to just add novelty and enrich the conversation by the use of animated funny emoticons that display in large sizes over the entire screen.*

Respondents were much more tolerant to interruptions caused by flight or baggage updates than to frequent chat requests during an ongoing chat session.

Respondents said they would be annoyed by interruptions of any kind if they were enjoying the ongoing chat session. Their annoyance would be greater if these interruptions actually caused them not to continue with their chatting and demanded their

attention irrespective of how important they were. However, respondents also worried about missing important flight or baggage related updates and did not mind the initial annoyance they had to put up due to the interruption. For this reason, they preferred having a "do not disturb" option that would block further chat requests or at least have the option of accepting or ignoring such requests extremely easily and swiftly. However, they wanted to be notified of any changes to their flight information immediately. *Respondents like to be able to tell what type and how important a given interruption is before they attend to it.*

Although respondents worried about missing important flight related announcements, they were satisfied with the current design of alerts and presentation of updates.

Respondents felt that the "My info" screen presenting personalized flight related information was a tremendously useful service and a great improvement over the experience of having to find the relevant piece of information from long and slow lists on low resolution TV screens mounted high in the airports. Respondents were also happy with the amount of information presented to them and do not aspire for any further detail. The only additional piece of information that they felt might be useful was their current location in relation to where they ought to be at any given point of time. They also felt that voice messages were not necessary to indicate updates, as this was too important for them to overlook. *However, specific changes to the indication of changes or updates have been described elsewhere in this chapter.*

Respondents expressed no significant inclination to use the layover companion to talk or chat with airport or airline officials.

The layover companion offers the facility of users making contact with airline officials for any queries they may have or for use during time-critical situations. However, respondents did not see much value in it as it is easier and more effective to contact the official at the counter. Besides, due to the placement of the questions button alongside the flight-related information, some respondents thought that this was a facility to ask the "whys" and "whats" of the information immediately preceding it. This in itself was of no significance to them as what was relevant was not the reasons behind the changes but how the changes affected them and what they would have to do next. Also, they were unsure if officials would really answer their questions and some of them thought they might receive either automated responses or contact numbers or just a FAQ screen on clicking the "Questions" button.

In time-critical situations, users did not fancy using this device to communicate to officials. In the scenario of running toward a gate at the last minute, users expect that if the device is on, the airline officials should be able to track him/her down and probably even assist him/her by sending an airport buggy to that location without any extra effort on his/her part. *The "questions" facility can be dropped.*

In agreement with the implications derived from observation, respondents confirmed that they would look for specific amenities that are close by to where they ought to be unless they have lot of time left of the layover.

Most respondents said they'd like to choose the amenities first and then decide if they wanted to see the ones that were close by or a list of all of those facilities available.

Also, most of them said they'd choose "what's near" unless they were extremely bored and had a lot of time on hand. In fact, one respondent said, if he had a lot of time, he would not even use this device but explore on his own and use this facility only to get back to where he ought to be should he get lost. Respondents also said whether they chose "show all" or "what's near" depended on the amenity in consideration. Irrespective of how long they had left, they would look for phone booths and restrooms that were close by but if they had the time, then they would probably use the "show all" option to view their choices of restaurants.

Respondents welcome information updates delivered to them. They do not mind chat requests coming to them if they have the option of turning it off. They do not want commercial messages or offers to be delivered to them unsolicited.

Respondents expressed a lukewarm interest in deals and offers and other commercial messages. They did not mind seeing it in the shopping section or in the context of detailed information about any store in particular etc.

USABILITY INSIGHTS

Specific interface problems with Creation of profile - Screen1 (Figure 27)

Most respondents overlooked the "Chat name" field in the step 1 screen in the creation of chat profile process.

Respondents were not certain they could choose a chat name for themselves, as this field went unnoticed and when prompted, the space provided for typing the name was not identified with its purpose and respondents wondered if there was a means to actually specify a custom name. This field was the only one that was different in format in this

screen. All the other fields had drop down menus with prominent rectangular fields of input. However, the chat name field was more like a form entry on a paper-pencil form with

just a dotted line space for the name to be typed followed by a small "auto" button to generate an automatic chat name. The absence of a binding box to the text entry field and its presence on the top of the screen might have led respondents to neglect it as a title. Most respondents also said they found it deviating from the more usual format of having a text box in which they typed. With this expectation, some respondents also thought the auto button was in fact a text box and typing a new name would replace the label "auto" with their chosen one. *The space for typing should be enclosed in a box with "click here to type) and the "auto" button could be preceded by the text "or" so that users know that they can either type a name of their choice or go in for an automatic name.*

Most respondents figured out the purpose of the "auto" button either immediately or reasonably quickly.

Some respondents misjudged the purpose of the auto button. This might have been partly because of the fact that the chat name field itself was not clearly understood and hence this button associated with this field was not understood either.

Most respondents had some degree of confusion on figuring out how to move on from the first creation of profile screen.

Respondents did not immediately associate the forward arrow with "next" or the cross with "close". The "next" button in the form of a forward arrow was variously perceived as the horizontal scroll or screen pan button, the "more" button etc. It was also confused with the GPS button that also has a directional arrow as its symbol. The cross

symbol for "close" is pretty common but probably the absence of an enclosing box around the cross made it seem less like a button. Also, the placement of this button at the bottom of the screen was not conventional for the "close" functionality. From the feed back of the think-aloud-tests, it seems like users perceive screens of the layover companion like pages on a browser. So, they are comfortable with navigation using a forward and back feature. They seem to perceive it less as navigation through a scheme of windows where one window is closed to see the other open window or the main "desktop-type" interface. *For clarity, it is therefore recommended that important navigational buttons be labeled instead of being presented as symbols. Also, the layover companion device can function like a browser in terms of navigation within each functionality. So, there will be a screen that presents the four main features of the device on the screen in addition to the hard buttons on the body. Within each main feature, there will be some parts of the screen that will be anchored and unchanging throughout the time when the user uses that function. For instance, the next, prev. and close buttons will still figure at the bottom of the screen but will be labeled and the close button will be a cross within a box. Tapping on this button will return the user to the main screen that presents the four functionalities. Tabs will be used within each functionality module to have easy access to its features or various stages. For instance, in the chat module, "chat", "profile", "search for chat partner" could be the main tab accessible at the top of the screen at all times. The next and previous buttons will function like the navigation buttons in a browser within each functionality module.*

The "Omit" option in the drop down menus listing was perceived as useful in some situations.

Respondents did not even notice the presence of the drop-down menu listing called "omit" in questions where they had an answer ready in their minds and were only looking to match it in the menu. But, they found this option useful in evading questions that caused unease or where they were not sure of choosing any other specific answer. Some respondents felt that this was a redundant menu listing in questions that needed a yes/no answer. However, one respondent felt that this was a useful option since it gave him the option of not choosing any polarity and allowing him to be flexible to handle how he/she felt about that specific issue at a later time.

Specific interface problems with Profile screen2 (Figure 28)

Most respondents preferred drop-down menus to preset information that they could choose to show or hide.

In this screen, information from the user's ticketing was extracted and preset in the fields followed by a show/hide toggle button. The show/hide toggle button confused most respondents – While some could not figure out the purpose of this button, others were confused if clicking the button when it was labeled "show" would reveal the information or clicking on "hide" to reveal the "Show" label would reveal the information. Some respondents expected that when they clicked on the "show" button, it would open up another screen with details.

Some respondents did not even understand that their information was already preset on the screen and they were looking for a way to type the information if they were comfortable in sharing it. However, none of the respondents (on prompt or on their own)

had any objection to the information already being there. They felt that it was a welcome thing that their information need not be typed when it can be pulled out form the airline records but they liked to have full control on who accesses that information. *Respondents were more confident using the drop-down menus in the previous screen. The same format can be maintained here too for ease of use and consistency. The same preset information could appear as a drop-down menu listing along with the "omit" option.*

Specific interface problems with Profile screen3 (Figure 29)

Listed topics for chat were considered generally sufficient in number.

Most users considered the number and the range of topics listed satisfactory, as any more topics would have been overwhelming on a small screen. Respondents liked the idea of having a few broad topics in the list as it allowed flexibility and scope for discovering things during the actual chat itself. In fact almost all respondents said they would use the chosen topic only as a starter and if the person was interesting and the chat session extended for some time, they would feel free to digress into topics of mutual interest.

Respondents felt some topics were named too vaguely or frivolously.

For instance, some respondents felt that "special topics" seemed vague, broad and in some ways similar to "anything under the sun". Some respondents thought it might result in another screen where they could either choose or specify specific special topics but some of them also expressed concern of further lengthening the pre-chat process. There was a mixed response to the topic called "anything under the sun". Some respondents felt that this type of topic suggested something fun and was apt for a chat experience for boredom relief. However, some others felt that this topic name was too

frivolous and that in making this choice, they may stand a lesser chance of being chosen by others as a chat partner because they may be considered as people who were cranks and potential trouble with no serious intention to have a harmless chat to kill time.

"Interests" or "Hobbies" are considered a powerful way to match profiles for potentially interesting chat interactions.

Some respondents felt that "occupation" or "hobbies" would be a better way to match profiles and interests than "special topics". These are missing currently in this screen as well as in the creation of chat profile in general. *The existing screen with " occupation" instead of "special topics" could be included for informational chat as part of the creation of profile. An optional screen of specifying interests can be included in only the fun chat interaction as it is likely that users looking for specific information are not concerned about the other interests of their information sources.*

Users find it annoying to have to check each entry if they find on first glance that they want to select everything on the list.

Option of "Select all" required in screens with check boxes. As a consequence a "clear" or "reset" button is also required. *Add "select all" and "reset".*

Specific interface problems with the "Browse for chat partner" (Alphabetical) screen (Figure 31)

Initial confusion in associating chat name with profile details.

Although there were no showstoppers, a few respondents initially mistook the information about the number of people available for chat as a numerical id of a person whose profile details were seen in the inset box. Some others thought of this number as a number assigned to them or a room number but associated the chat name and profile

details correctly. All respondents however, understood the actual meaning of this number when the read the text preceding it -" People available for chat". *The chat names can be clearly linked to the inset box by using visual elements like an arrow or a dotted line to make the association obvious. This will also prevent the visual grouping of the inset box with the line informing the user of the number of people available for chatting.*

Entries in the profile inset box that spread over to more than one line were perceived as separate entries on first glance.

Entries and headings to entries can be distinguished by making the headings appear in bold. Also, care can be taken to design content to fit the screen width by using common abbreviations and symbols instead of lengthy words and phrases.

Most respondents were unsure of how to return to the "Search for chat partner" menu once they were on the "browse for chat partner" screen.

Respondents did not notice the instruction/tip on how to access the "Search for chat partner" menu again on the "Search for chat partner" main screen. Some respondents tried to use the "previous" button and also tried the chat tab on top of the screen. None of the respondents identified the smiley symbol on the top right as the place to click for the menu. Some respondents said they would have eventually figured it out but it was not obvious or clear on first glance. *In the chat module, "chat", "profile", "search for chat partner" could be the main tab accessible at the top of the screen at all times. The next and previous buttons will function like the navigation buttons in a browser within each functionality module. This would eliminate the need for a menu button in the form of the smiley symbol.*

Changing functionality of next and previous buttons confuses respondents.

In the screen that allows users to browse profiles, the next and previous buttons change functionality and help in navigating through the user profile lists. Respondents get confused, as there is no indication of this change. *A permanent navigational area on the screen will remove these confusions. This area will have labeled buttons. The buttons to navigate across lists will be separate from these buttons both in function and appearance.*

Specific interface problems with the "Browse for chat partner by vicinity" screen (Figure 33)

Respondents preferred to have a wider range of relative distances by which to choose their potential chat partners.

Most of the relative distances specified in the prototype were all in the close sphere of visibility and most respondents were not too comfortable with choosing people at such a close range. *Wider distance ranges could be offered so long as they were all within the same terminal.*

The show/hide toggle button confused most respondents.

Some respondents could not figure out the purpose of this button. Others were confused about whether clicking the button when it was labeled "show" would reveal the information or clicking on "hide" to reveal the "Show" label would reveal the information. Some respondents expected that when they clicked on the "show" button, it would open up another screen with details. Only a couple of respondents remembered this functionality from the profile creation screens. *Check boxes can be used instead of these buttons. Users could check all those parameters by which they want the resulting list to be displayed and then tap on one display button.*

The graphic representation of the relative distances of the user and the potential chat partners was considered a useful tool.

The circles of varying radii preceding each of the specified relative distances were remembered across the screens. Some respondents took a few seconds to figure out that these circles represented the relative distances and provide a quick view of people's location in a list but all of them considered it a useful device. Respondents felt it was difficult to remember the sizes but it was nevertheless easy to tell who was closer or farther based on the relative sizes.

Specific interface problems with the text chat interface (Figure 35)

Indication of chat partner's status was not perceived clearly in the simulation.

Respondents saw value in knowing the status of their chat partner's activity but were uncertain if there was a means of finding out that in the simulated interface. An animated chat balloon was designed to indicate that the chat partner was typing but due to a bug in the simulation, the animation occurred continuously. This might have been one of the main reasons for respondents to perceive it variously as a symbol of being online or connected, voice chat or volume control or as a send button. On being informed of the problem in the prototype and the actual purpose of this animating element, respondents said it was easy and acceptable and in keeping with the increasingly popular norm of indicating user status in messaging software available today.

A few respondents missed the soft button for the "send" feature in the chat interface.

In the current design alternatives, the send button is proposed as part of the keypad to save screen space. The prototype simulation was designed for a desktop computer screen with an image of the device and the proposed interface within it. The

respondents used the mouse to interact with the interface and so for the test, the way they interacted with the hard interface or the physical device was the same as the way they interacted with the software on the simulated screen of the device. In reality, if they were to view this on a prototype implemented on a real handheld device, they would probably be using both their hands to hold the device and use the keypad and therefore it might be more inconvenient to then keep pulling out the pen stylus and tap on the "send" button on the screen. *For this reason, the send button will be a part of the keypad only.*

Respondents were confused about terminating the current chat session or retracing to the browse for chat partner screens.

Only one respondent remembered having seen a tip/ instruction on one of the "browse for chat partner" screens that the smiley symbol presented the user with options of finding other chat partners and terminating the current session. Most other respondents thought they would have to fidget with the interface to find out how they would achieve the goals of terminating a chat or finding someone new as they did not see the familiar back button. Some respondents said they would try using the help facility or use the hard button for chat again to reset the process. One respondent said he might try the smiley symbol but is skeptical about trying it because it is positioned where the close button is usually positioned and if his intention was just to retrace temporarily. *The interface lacks a close button that indicates clear termination. Retracing to "Browse for chat partner" or "suggest my chat partner" should not be an issue with the scheme of tabs suggested earlier.*

Specific interface problems with the shortcuts and emoticons enriched text chat interface (Figure 36)

Respondents did not find the language shortcuts useful.

Most respondents did not understand what the "arbitrary" words on the screen meant until after a demo was shown. Some people mistook it for the outline/log of the chat conversation even after viewing the demo. Those who did figure out what they were meant for thought that this feature just occupied precious active screen area and did not add much value as they just offered words that saved typing a few characters while they would anyway have to type the rest of the sentence. Also, they felt that these aids were useful only if they were readily available on the screen for use. In the proposed design, a drop-down menu holds 5-7 words/phrases of which only one is visible and the user has no way of knowing what else is available unless he/she takes the added effort of actually tapping the menu. Emoticons received a more favorable response although there was concern on its size and number available for use. *In the existing interface, only the emoticons can be retained and be presented in a drop down menu instead of being laid out on the screen occupying more space. This would also help in retaining them in a good size where the expression can be clearly seen. The words and phrases shortcuts can be dropped.*

Specific interface problems with system of alerts (Figure 37)

Respondents were unable to tell what type and how important a given alert-type interruption was before they attended to it during a chat session.

Some respondents mistook the "alert" feature for an indication of connectivity or a signal problem. To these people, "Alert" sounded like a very strong word and was misleading.

None of the respondents identified the graphic indicators for the type of alert (flight related alert, chat alert, commercial info alert) and could not tell that there was indeed a means to identify the type of alert. They said they did not understand the symbology and they probably needed an easily accessible legend to understand them.

They liked the chime that accompanies the alert and also saw value in the alert flashing until they attended to it although they admitted that the flashing could be a source of irritation. They also wanted to have the option of turning off the chime sound.

Respondents generally preferred the alert to appear at the corner as is proposed in the current design but fear missing the flight related alerts. Hence, for this type alone, despite the annoying obtrusiveness, they prefer a pop-up that appears right up front in the center on the screen without needing them to open it. *The alerts need not be called "alerts" on screen. The same symbols on the hard buttons on the device can be used to identify the flight information and chat alerts. These symbols can be made bigger to fit the entire area occupied by the label previously and this symbol itself can flash.*

From the feedback, it is clear that users prefer a much stronger indication of the different type of alerts. Besides the graphic distinction, these alerts can have a time and sound factor associated with it. The flight alerts could flash with a recurring beep sound for 10-12 seconds after which it automatically opens up in the center of the screen as a pop-up over the ongoing chat session. Chat alerts on the other hand could arrive with a distinct chime different from the beep mentioned earlier and flash for 10-12 seconds and

then remain on screen for another 2-3 seconds without flashing before eventually getting turned off automatically by sending an automated message to the sender of the chat request that the user is currently busy. Any other commercial messages, if any, should appear and flash for about 3-4 seconds with no sound associated with it and then remain on screen for another 3-4 seconds before just disappearing. This time factor will also reduce the probability of overlapping alerts.

Specific interface problems with "My Info" screen (Figure 38)

Respondents did not notice changed or updated information.

Respondents did not notice that the bulleted piece of information was flashing for a few seconds to indicate a changed status. Although the circular bullet was noticed, some respondents thought it was just to highlight that piece of information or mark it as important but they did not associate this distinction with the possibility of a changed status. A few others applied their earlier learning from the browse for chat partner by vicinity screen and thought that the circle indicated how far they were located at that moment form where they should be especially since in the simulation the bullet preceded the gate information. Most of the other respondents figured out that the flashing and bullet indicated a changed status with a lot of deliberation and effort. All respondents felt that it was necessary to make the changed status more obvious especially because this information was critical and also because this device was not a familiar personal device. Respondents suggested that the old and the new information bits could be displayed. However this eats into precious screen space. *The "My info" screen could begin with a section called "changes to your info". This can be followed by the regular information as it appeared initially but with the changes incorporated. However, this would mean that*

the users would have to either scroll or flip through pages to see all the information. Instead, the circular bullets that are confused with vicinity can be dropped and instead changed information can be accompanied by the word "changed" in bold and caps within parentheses. The information itself need not be in bold so that the word "changed" gains focus and hence draws attention to that particular piece of information. Users also thought that the flashing of that specific piece of information was a powerful way to highlight the change. However, for it to be more effective, this piece of information can flash for a few seconds periodically instead of just on entry.

Respondents were confused about what to expect from "General Info" but more or less figured out what to expect from "Airport info", "My info" and "Questions" in the Information module of the layover companion.

Most respondents did not know what to expect from "General info" and their guesses ranged from city info and weather to general information related to the flight such as safety tips, in-flight menu, entertainment and exercises etc. There was also a slight confusion among some respondents in distinguishing between "Airport info" and "My info" as they thought airport info would also present their flight information. "*General Info" can be renamed as "News" or "Outside the airport". "My info" can be renamed as "My flight info" to make it distinct and clear.*

Positioning of the "Questions", "Airport info" and " General info" buttons seem to convey that they pertain to the information on the current screen and not as buttons to screens with distinctly different information.

Some respondents were confused about the relevance of these buttons because in some cases it did not make sense to link the information on the screen with these buttons

and yet the positioning seemed to strongly suggest that. *Tabs can replace the buttons. These tabs will be available perpetually in the information mode of the layover companion.*

Specific interface problems with "Airport Info" screen (Figure 39)

Respondents liked to have a point of reference to qualify the label of the "what's near" facility.

Respondents wanted to qualify what's near with either a distance range or with a reference to their own location. *The label can be changed to "What's near me".*

The "show all"/ "what's near" feature was understood clearly by most respondents on the screen where they chose categories of airport amenities but not when they browsed specific amenities after navigating through a couple of screens or interaction levels.

On a page with details about a particular restaurant, some respondents were confused about whether "show all" would lead them back to the restaurant list they were at previously (all restaurants close by) or if it would show all of the other franchise or branches of the same restaurant in the airport or if it would display all amenities near by or only all restaurants everywhere. *The "show all" and "what's near me" feature can be retained only at the categories level and dropped from the subsequent levels. The users can instead navigate using the back feature available consistently throughout the experience.*

The GPS soft button at the end of the information about a specific amenity like a restaurant is perceived as a "next" or "more info" button.

All respondents did not connect this symbol with an identical symbol on the hard button on the device and instead thought of it as the "next" button that would display

information about the next amenity on list or display more information about the same. They said they would click the hard button to get directions. *A button labeled "Directions" or "GPS" may be clearer than the graphic symbol.*

CONCLUSIONS

The three main focus areas of this study as identified in chapter 1 were -

- Will choosing a chat partner according to one's own interest or motive (making him/her the "relevant other" and not just anyone) add value to the chat experience especially in the context of the fact that this chat is between strangers in a layover?
- Is there a preference on the nature of information exchange – informative or entertaining - given the circumstances of the layover?
- What are some important and useful design tenets for designing a chat type interaction on handheld small platforms?

This study evinced useful conclusions in all these three areas.

IMPORTANCE OF FINDING THE RIGHT "RELEVANT OTHER"

Most respondents prefer finding their own chat partners to chatting with a system suggested partner and they prefer chatting with a system suggested partner to chatting with a random partner. This suggests that finding the right chat partner is important to users. But, while this is important, the option of easy and quick trials and switching partners is preferred to spending a long time in finding the right one on the first try. This is because people in layover situations are primarily bored and usefulness of the experience or how meaningful it is, is supplementary. This study showed that a device designed for boredom relief should allow people to have a good time with the least input or effort from them. Another extremely interesting finding from this study was that users

expect the various features on the Layover Companion to be entertaining but they also perceive the process of discovering the product itself entertaining and a powerful means of boredom relief. This to some degree discounts the importance of the "relevant other".

PREFERENCE OF INFORMATION TYPE

As mentioned earlier, the primary value that users see in a device like the Airport Layover Companion is as a means to boredom relief. All other motives such as learning something or gathering information from others etc. is secondary. As a result pure entertainment content and interactivity such as games is preferred over chat type interactivity. The inconvenient methods of text input further accentuated this preference for games over chat. Further, chat as an informational resource was not preferred.

However, users enthusiastically welcomed information updates regarding their flights and the airports. They were not keen on gaining information directly from officials and they did not want commercial messages or offers to be delivered to them unsolicited.

DESIGN TENETS

Detailed findings relevant to designing on the small platform in general and the Airport Companion specifically, have been discussed in chapters 5 and 8. The most important learning from this study is that in designing for the small platform, there are no set design tenets. Instead, there is a shift in emphasis from standards and heuristics to contextual judgments based on tasks involved and the users using it.

However, some design guidelines gleaned from this study are as follows -

- Do not create scaled down versions of existing desktop or other services when designing for the small platform.
- Simplicity is key and only what is most important is included in the design, stripping out all frills and trappings.
- Graphics and animation are not as important as text information available and accessible immediately.
- Clearly set the expectations of users of the function and capabilities of the device or software.
- Reduce the explicit human-machine interaction and shift to a more implicit model where the user's involvement is precise and occurs only when absolutely necessary. This also implies that notification mechanisms will have to be stronger.
- Avoid a toggle between the various possible input interfaces on any given interaction or set of activities.
- Content for the small screen has to be clear, concise and task focused. In this context, personalized content gains emphasis.
- Design pages to fit the window screen.
- Place a permanent navigational area with labeled buttons or any key information/search facility on the top of the page.
- Do not change the scope of the functionality of navigational elements depending on the context in an effort to save screen real estate.
- Clear nomenclature and descriptions for links are important to ensure predictability and avoid frustration in downloading irrelevant information.

- Symbols and icons must be used judiciously as they may actually hamper the user experience because of being open to interpretation although they might occupy lesser screen space.
- Do not use narrow text boxes.
- A text block should at least have four lines to ensure good readability.
- Allot enough space for the items on the menu lists and text links and not have them broken down into a couple of lines.

APPENDICES

APPENDIX 1

Scenario Development – Personal Scenarios

(From original ideation notes)

AN IDEAL WIRELESS DEVICE FOR MALINI

It took me quite a bit of effort to ideate on the gaps that a wireless device could fill in my life or enhance it in anyway...

I miss my family

Wondering how a new wireless device will serve my purpose here in connecting me in new and meaningful ways with my family overseas. I can immediately see two limitations - cost and innovation (for now, I am unable to think beyond what can so well be accomplished using existing technology in the comfort of my room.

I most certainly miss mom when I am walking from one class to another or when I am shopping and need her opinion. But given the time differences between India and the USA, how can a wireless device help me establish a spontaneous interaction that is at once more than what a mobile phone can offer me and also one that is effective in cost and service?

I am unfamiliar with the roads

Driving directions and "navigator" like instructions are already available with car GPS systems... When in UK, I saw that they have on TV what is called tele-text and though it is quite a pain to navigate through using the remote, it had a host of useful local information. To me what made the most sense was traffic status and weather reports on

all major motorways... Something to that effect may be useful on a wireless device while driving.

Shopping binges

I love shopping and like to find great deals. I wish I had a device that would not only hold my shopping list for me but also somehow "learn" where the best sales/deals are offered within a huge mall/factory outlet and also alert me on that. Maybe, I should even be able to beam a coupon from my device to avail the offer! (I just read an article that describes a technology that makes this possible - http://biz.yahoo.com/iw/001025/be.html) Maybe the device can even pick up the signal from a range before I reach the mall and so I am all ready as to where to go and look even before I reach the location.

Scribble pad

I like writing poems. Many times on the move, ideas flash in my mind and I fear that I will lose it before I get a chance to jot it down somewhere. I wish I had a device that would serve as a notepad that I could scribble my poems or doodles into and then work on it on my desktop by hot synching it. If in some way, it can double up as a simple point and shoot camera, that would be great too because many times sources of inspiration are fleeting images.

Meeting people

At the current station in my life now, I am going to have to meet a lot of people in my personal and professional life. I use the Internet to get in touch with interesting men and am wondering if there can be a novel extension of a wireless match making service

that goes beyond just classifieds but exchanges real time info in an anonymous manner...I am just freewheeling here!

On the professional front, I am sure I will find myself attending job fairs and conferences/seminars sooner than later. I am dreaming of a device in which I can enter my profile and requirements and on entering a particular area of the fair/conference/trade show, the information, I have decided to make public is wirelessly shared and people can get in touch and make contacts in easier ways.

I love traveling

Whenever I get a chance, I try to visit new places. With this activity goes a host of others that I can think a handheld wireless device might help - entertain me in a boring journey, be my tourist guide, be my travel agent and go one step further and advise itineraries for me etc.

I love playing games

I am thinking of a wireless device that will let me interact with users I don't even know. This interaction may be collaborative games with them when I am on the move in a chauffeur driven car or maybe just an AMTRAK train!

I like being organized

I enjoy the PDA's PIM facilities and just wish the "to-do-list" worked in conjunction with the date book!

APPENDIX 2

Scenario Development - Scenarios for Potential User Groups

(From original ideation notes)

Scenario 1: Wireless Travel Companion

I am imagining a wireless travel accessory that serves to entertain the traveler in long waiting hours or journey times. I am imagining a small universe of bored people - in an airport between connections or in the AMTRAK traveling on a longish journey... (since it is kind of local, I would imagine wireless connections should be a lot more inexpensive). This device could either be an inexpensive disposable "toy" or it could be an extension of the new generation of hybrid cellular phone + PDA. Most people carry mobiles and assuming this hybrid device catches on, this can be an application that runs on it or it could even run on the cellular phones itself (?). I am thinking of this device as a means to connect complete strangers in entertaining and relaxing ways as they wait or travel. Assumed names or even anonymous users turn on their devices and get an overview of the population density in this wireless virtual world (others in the airport/train who have turned their devices on). Depending on their status (connect to me/I am busy/ I am connected and new entry is closed), the user can connect to others and either chat or play a game or even exchange information. People feel uncomfortable starting a conversation with complete strangers sitting by their sides. But judging from the popularity of chat rooms, it might not be a bad guess that the fact that the are interacting with the man two seats down the aisle or 3 coaches away may actually be an

added element of success. Whether it is a game or relevant information, I think it will be far more interesting and meaningful if the collaboration actually resulted in a collective whole that is useful and interesting to everyone than the little pieces of information that each of them holds on their device. This piece of information can be randomly assigned to sets of people as they log on by a central controlling system. For example, in a flight or a train, people could learn more about their destination from tidbits that they have on their devices to form an entire picture or alternately, after a brief exchange of information, tourists could interact with locals to get more information from them about the city. These interactions can even lead to disclosure of names and seating and people could actually meet up over a cup of coffee and become friends.

I also think that in flights and in trains, this kind of thing can actually be an added facility for passengers provided by the airline/railway service. Alternately, if people will have to buy it, then it can be viewed as a device that they even buy it in the airport or railway station and it could be made available in various models - Chat and book, game and chat, game and book, information and chat etc. models. Even less expensive ones could have just one function associated with it.

If it is in the form of an application on a PDA+ phone, then it could also have a system that detects the information locally available at the destination wirelessly and furnish information to the tourists on what to do and see in the city and in each monument/landmark. So, suddenly, the device becomes something that makes other people and even buildings and inanimate objects spring to life and "talk" to you in your presence and request.

Passing conversations are often mixed and garbled but extremely interesting. Train station and airport scenarios offer a good setting for some interesting concept based on passing conversations. However, privacy concerns will be an issue.

Scenario 2: Wireless friends for bed ridden hospital in-patients

I am thinking of extremely simple to use wireless devices to connect sick people in the hospital (either bed ridden or in quarantine) - I am sure they must suffer loneliness and I assume they would welcome any kind of distraction from their pain. So I am thinking of a simple device with maybe just voice input or just a couple of buttons / or a turner that needs just the thumb to "scroll"... Every patient can choose a unique icon for himself/herself and this becomes the identity - visual and audio information can then be exchanged to facilitate a sharing of experiences, hopes and consolations besides hopefully some fun and jokes too.

Scenario 3: Wireless "connections agent"

I am visualizing a device to be used in huge trade shows and conferences where one of the primary objectives is to make and extend contacts. I am imagining a device that the organizers provide to visitors for use for the duration of their participation in the event. Participants presenting their work will provide their most relevant information to be "aired" and so would the visitors on registering for the conference. So in a sense, even as they come in, people have an idea of who they should meet and further ideation can be carried out to examine if any real time data can be exchanged in new but meaningful ways given the context.

The We Sync (www.wesync.com) software is similar to Avantgo but instead of presenting web content, it links people with PDAs into a community and they can access one another's PIMs and share common calendars etc.

Scenario 4: Shopping aid

I guess I am looking at the lay users - productive function quadrant in my positioning diagram. My idea stems in a "smart shopping cart". Inspite of online shopping becoming popular and groceries etc. being ordered through Priceline and Webvan (now not in business), smelling, touching, feeling and buying has not yet lost appeal and we find that the Targets, Krogers, Meijers and Sams Club are flourishing yet.

So instead of suggesting an m-commerce application that substitutes/replaces trips to these places, I am suggesting a smart cart that has a device attached to it that serves as a shopping aid in more than one way. I am imagining that these carts either come fitted with these devices or that shoppers can fit their smart phones or PDAs in a multi-device cradle.

A typical scenario would be - A shopper gets a cart and swipes his/her "preferred card" (given by these chains to regular customers) and the cart now recognizes the customer. Based on previous shopping visits and a profile, it throws up a comprehensive shopping list in small parts in a location specific fashion - that is if the shopper is at the frozen vegetables section, it would display a list of vegetables that the shopper usually buys. Alternately, the shopper can come with a shopping list on his smart device and beam it to the cart.

I am imagining a shopping experience that almost completely makes a checkout counter dispensable - So, I am thinking that the device should also be able to read the bar

codes and scan the items places and removed from the cart and prepare the bill. The customer profile can have the credit card information and so once the shopper is done, it will just display a screen to confirm the amount and for signature. All that needs to be done then is to pack the bought items into bags.

Added functionality could be the option of the device suggesting new items to the experimental shopper and discounts/coupons/sales and deals to the coupon shopper.

Scenario 6: Virtual home and family

In families like mine where the members of the family are dispersed all over the world, I am imagining a scenario where a virtual household continues to run. I am pulling in concepts from messaging and avatars and imagining a device each for each family member and changes made in any one of them would result in changes to all of them. I am even thinking of the device as one's home with family members represented by active or passive icons depending upon whether they are connected at that time. Each person has his room accessible to others with permissions based on relationships (for example, dad could have access to all rooms on default but children above 18 years of age can change that permission on mutual consent and allow access on request - a la knocking the door). The house could also have a common space like the living room where amongst other things members of the family can chat, plan, draw and leave notes for one another. For instance, mom could from across the world remind her daughter of the pending medical check up she had been mentioning for quite a while. On a more fun note, one could also leave notes like B-day wishes and maybe the other family members can program the device to set off an alert/alarm at a given time with a b-day song maybe even in personalized voices.

Other ideas

Business/commerce or banking application/device, mobile communities

APPENDIX 3

Choice of Scenario for Detailed Conceptualization

PARAMETERS FOR NARROWING DOWN TO TRAVEL COMPANION SCENARIO

- Transportation – Car, train, bus, flight, 2-wheeler
- Time of interaction – during journey, in between journey (connections, rest/breaks)
- Duration of travel – lasts longer than 1hour (long), lasts from 5-30 minutes (medium), lasts 2 – 5 minutes (short)
- Purpose of travel – serious non-routine purpose, business/official (all these are considered serious), regular (daily routine), no specific purpose or vacation/entertainment (fun)
- Familiarity of route/location

METHOD

Starting from the mode of transportation, other identified parameters were successively considered additionally and choices of acceptance or rejection were made at each stage based on logic, potential demand and user requirements considerations. The following were short-listed for final consideration –

During frequent, familiar, long, fun, car drives

During infrequent, familiar, long, fun, car drives

During infrequent, unfamiliar, long, fun, car drives

During frequent, familiar, medium duration, fun, car drives

During frequent, unfamiliar, medium duration, fun, car drives

During frequent, familiar, medium duration, routine, car drives

During frequent, long, fun, flights to familiar destinations

During frequent, long, fun, flights to unfamiliar destinations

During infrequent, long, fun, flights to familiar destinations

During infrequent, long, fun, flights to unfamiliar destinations

During frequent, long connections between flights on fun trips to familiar destinations

During frequent, long connections between flights on fun trips to unfamiliar destinations

During infrequent, long connections between flights on fun trips to familiar destinations

During infrequent, long connections between flights on fun trips to unfamiliar destinations

The main difference between people traveling in a car versus a plane is their involvement in the act of actually "driving" it. Though the car setting offers many interesting possibilities, the fact that the hands and the sense are kind of engaged in an activity limits it to mainly auditory with or without visual interfaces. Also, this would be a high-risk application as distraction can result in fatal accidents. So the list reduces to the flight scenarios. These scenarios are considered individually for content and interaction possibility with likely issues as relevant –

During frequent, long, fun, flights to familiar destinations

Users are likely to use this device to kill boredom than seek information. May become information provider to infrequent/unfamiliar travelers. May want to connect to airline to find out their frequent flyer account status at most if they are seeking information.

During frequent, long, fun, flights to unfamiliar destinations

Excitement, novelty and meeting locals and getting information makes them an ideal target for this type of service. These guys will probably be interested in boredom relief as well as seek information about their new destination.

During infrequent, long, fun, flights to familiar destinations

Boredom factor would probably be more important to this group than seeking information.

During infrequent, long, fun, flights to unfamiliar destinations

High information seeking requirement and lesser degree of killing boredom

Connections/Stopovers

This will be interesting because stopovers can be in exotic places and one might be connecting to anyone from any culture – so the interaction will have to have either multi-lingual or pictorial syntax. Flight information, boarding call etc. will also be relevant pieces of information that they will be interested in.

During frequent, long connections between flights on fun trips to familiar destinations /

During frequent, long connections between flights on fun trips to unfamiliar destinations

In both these cases, the familiarity or unfamiliarity with the final destination may not matter because they are potentially contacting anyone in the airport terminal/gate. Frequency of travel may make them share their experience and give info on the stop over airport. But people going to unfamiliar destinations might want to connect to people who are heading to the same place.

During infrequent, long connections between flights on fun trips to familiar destinations/ During infrequent, long connections between flights on fun trips to unfamiliar destinations

Nearly the same as the previous pair of scenarios but in this case their might be additional need for airport guidance where consulting this device will replace kiosks serving as location guides and information counters because of the in frequent stopover experiences at any given airport.

LIMITATIONS

The potential issue here if there will be any "class" distinction which will influence the interaction if this system potentially allows every passenger to connect to every other passenger who has turned this feature/device on at his/her seat. Also, I am wondering if there will be a requirement difference with the business class being able to afford this new service but not wanting it and the economy class passengers desiring the service but not willing to pay more for it.

FINAL CONSIDERATIONS

Both in flight and between flight scenarios offer a host of possibilities within 2 main user requirement realms – killing boredom and seeking information. It seems possible that one

device/system can be used in both these types of scenarios. But for the purposes of this study, I think the between flights, stopover scenarios offer more scope and have a greater need. Passengers tend to use their time in diverse activities such as resting, eating, reading, watching a movie, listening to music, sleeping or even chatting up during flights than during stopovers.

APPENDIX 4

Chronology of Handheld Computers

(Extract from URL: http://www.islandnet.com/~kpolsson/handheld/)

1972

(month unknown)

- Hewlett-Packard introduces the HP-35, the first scientific handheld calculator.

1973

(month unknown)

- Texas Instruments enters the pocket calculator field with the introduction of the Texas Instruments SR-50 Slide Rule Calculator.

1980

July

(month unknown)

- Panasonic and Quasar unveil handheld computers, made by Matsushita. The unit uses a 1 MHz 6502 CPU, and weighs 14 ounces (397 grams).

1982

January

- Sharp introduces the Sharp PC-1500 Hand Held Personal Computer. It comes with 16 KB ROM, and 3.5 KB RAM.
- Radio Shack introduces the TRS-80 Pocket Computer, Model PC-2. It uses a 1.3 MHz 8-bit microprocessor, and has a 26-character display, with upper and lower

case characters. It comes with 16 KB ROM, and 2.6 KB RAM, expandable to 16 KB. An optional 4-color printer attaches to the side.

August

- Hewlett-Packard introduces the HP75C portable computer. It features a rechargeable battery pack, 16K RAM, 65 key keyboard, 1 line by 32 character LCD display, magnetic card reader, 48K ROM including BASIC interpreter, text editor, and scheduler. Size is 11.1 x 6 x 1.1 inches; weight is 26 ounces.

1983

January

- At the Winter CES, Commodore Business Machines demonstrates the HHC-4 (Hand-Held Computer). It features 24-character LCD screen with 4 KB RAM expandable to 16 KB. This was one of Commodore's pre-PET business products. Price is US$199.

May

- At the Japan Microcomputer Show, Casio shows the Casio FP 200 handheld microcomputer. It features 8-line x 20 character display, 8 KB RAM, 32 KB ROM.

(month unknown)

- Texas Instruments introduces the Compact Computer 40 (CC-40). It uses the 8-bit TMS 70C20 processor, 6 KB RAM, 34 KB ROM with BASIC, and 31x1 LCD display. It runs on four AA batteries, lasting up to 200 hours.

1984

January

- Seiko Instruments U.S.A. Inc. displays the first wristwatch computer, with a 10-character, 4-line LCD.

1989

(month unknown)

- Atari Computer introduces the Portfolio, a 1-pound DOS-based PC. It uses a 4.92 MHz 80C88 processor, 240x64-resolution screen, and runs on three AA batteries. Price: US$400.

1991

(month unknown)

- Apple Computer petitions the FCC to allocate a 40 MHz wide band of frequencies for use with its personal digital assistants.

September

- Chips & Technologies introduces the F8680 PC/Chip microprocessor. It is designed for use in notebook and handheld computers. The CPU is compatible with the Intel 8086 and Intel 80186. The chip also includes a universal asynchronous receiver/transmitter, CGA-compatible display controller, and PCMCIA support, making it the most integrated chip ever produced to date.

(month unknown)

- Hewlett-Packard introduces the HP 95LX handheld computer. It runs MS-DOS 3.2, includes Lotus 1-2-3 v2.2 in 1 MB of ROM, displays MDA graphics, and weighs 11 ounces. 512 KB RAM is standard, with optional 128 KB and 512 KB RAM cards. Two AA batteries can power the system for six weeks.

- Psion introduces the Psion Series 3 palmtop computer. It features 8 row by 40 column LCD display, 4 MHz NEC V30 processor, 384 KB ROM with operating system and seven built-in applications, 128 KB RAM, slot for Flash EPROM memory cards. It runs for up to 120 hours on two AA batteries. Size is 6.5 x 3.3 x 1 inches; weight is 0.5 pounds.

1992

January

- Apple Computer chairman John Sculley coins the term Personal Digital Assistant, referring to handheld computers that typically operate via a stylus on a LCD display. Sculley announces that Apple Computer will enter the consumer-electronics market by the end of the year.

(month unknown)

- Apple Computer announces the Newton pen input device. Features include: multitasking NewtOS operating system, ARM 610 processor, one PCMCIA 2.0 card slot, 7 1/2 x 3 1/2 inch size, 3 x 6 inch screen, and weight of under one pound.

(month unknown)

- Eo announces the Personal Communicator 440 handheld pen-based microcomputer. It features 20 MHz Hobbit processor, 4 MB RAM, PenPoint operating system in ROM, 480x640 screen, optional internal 20 MB hard drive, optional external floppy disk, keyboard port, one PCMCIA Type II slot, and various built-in software programs. Weight is 2.2 pounds. Size is about 11 x 8 x 1 inches. Battery life is about 4 hours.

- Eo announces the Personal Communicator 880 handheld pen-based microcomputer. It features 30 MHz Hobbit processor, 4 MB RAM, PenPoint operating system in ROM, 480x640 backlit screen, optional internal 64 MB hard drive, VGA output port, SCSI II interface, optional external floppy disk, keyboard port, two PCMCIA Type II slots, and various built-in software programs. Weight is 4 pounds. Size is about 13 x 9 x 1 inches. battery life is about 4 hours.

1993

March

- Amstrad begins shipping the Amstrad Pen Pad PDA600 Personal Digital Assistant (PDA) in England. It is the first PDA to be shipped. The Pen Pad weighs under a pound, is 1 inch thick, and features a 240x320-resolution 3x4 inch screen. It uses a 20 MHz Zilog Z8S180 microprocessor, and can run for 40 hours on three AA batteries. It includes 128 KB RAM, with a PCMCIA expansion slot for memory expansion to 2 MB.

August

- Apple Computer launches the Newton MessagePad 100 personal digital assistant at Macworld Expo, in Boston's Symphony Hall. It features 640 KB RAM, 3 MB of ROM storing applications and the operating system (Newton Intelligence), a low-voltage 20 MHz 32-bit ARM 610 microprocessor, 240x336 resolution (85 dpi) 2.8 x 4-inch LCD screen, one PCMCIA Type II expansion socket, data transfer of 9600bps, and runs on four AAA batteries. 50,000 units sell in the first 10 weeks, but only 80,000 are sold during the product's life.

1994

March

- Apple Computer introduces the Newton MessagePad 110 handheld computer. It features 1 MB RAM, 20 MHz ARM610 processor, and runs on four AA batteries. Remote data transfer rate is 38.5 Kbps. Battery life is five times that of the Model 100.
- Apple Computer introduces an improved Newton MessagePad 100. It is physically identical to the previously released model, but contains improved software.

(month unknown)

- AT&T closes subsidiary Eo, ending life for the Hobbit processor, and the PenPoint operating system.

1995

September

- Intel announces the 80486SXSF and GXSF 486 microprocessors, designed for handheld computer products. The GX has a 16-bit bus, the SX a 32-bit bus. Both are 33 MHz, operating on 2.0-3.3 volts.

December

- Apple Computer ships the Newton 2.0 operating system.

December 31

- Shipments of smart handheld devices in the US for the year: 1.5 million. World shipments: 2.4 million. (1.1 million in US)

1996

June

- Apple Computer introduces the Apple Newton MessagePad 130, with transreflective LCD with an electroluminescent backlight, battery life about 8 hours (4 with backlight on), 1.2 MB heap space, 20 MHz ARM 610 RISC processor, 320x240 pixel display, one Type II PC Card slot, 2.5 MB internal RAM.
- U.S. Robotics debuts the Palm Pilot.

September

- Microsoft unveils Windows CE operating system for handheld PCs. Code-name of the project was Pegasus. "CE" stands for Consumer Electronics.

November

- Compaq Computer ships the Compaq PC Companion handheld computer. It features a Hitachi SH3 processor, 480x240 pixel backlit LCD, one Type 2 PC Card slot, 2-6 MB RAM, 4 MB ROM with Windows CE, IrDA port, keyboard. Size is 6.8 x 3.6 x 1 inches, weight is 0.89 pounds. The system runs on 2 AA batteries for up to 20 hours,
- Hitachi Home Electronics ships the Hitachi Handheld PC, running Windows CE.
- Casio Computer ships the Cassiopeia, a handheld computer running Windows CE.

December 31

- Worldwide shipments of PalmPilot handheld computers for the year: about 350,000.
- Shipments of handheld computers in the US for the year: 1.9 million. (1.5 million)

- Worldwide handheld computer sales: about 2.4 million. (2.6 million)

1997

December 31

- Shipments of handheld computers in the US for the year: 2.471 million.
- Worldwide shipments of handheld computers for the year: 5.5 million.
- Worldwide shipments of PalmPilot handheld computers for the year: about 350,000.

1998

(month unknown)

- To date, about 500,000 Windows CE devices have been shipped.
- Apple Computer ceases development of its Newton operating system and Newton OS-based products.
- 3Com begins shipping the Palm III handheld computer. The Palm III features 2 MB RAM, two AAA batteries allowing use for 6-8 weeks. Weight is about 6 ounces.
- Microsoft announces Windows CE Handheld PC Professional Edition hardware reference design, based on Windows CE 2.11.

December

- Palm announces the Palm VII handheld computer.

December 31

- Market share of US mobile computers for the year: 3Com Palm 40%.
- Worldwide shipments of handheld computers for the year: 3.988 million.
- Installed base (worldwide) of handheld computers: 8.2 million.

1999

(month unknown)

- Palm Computing introduces the Palm VII Connected Organizer handheld computer. It features 2 MB RAM, and modem. Size is 5.25 x 3.25 x 0.75 inches; weight is 6.7 ounces. Two AAA batteries power the unit for 2-3 weeks. Connectivity via Palm for email and Internet access costs US$9.99 for 50 KB transferred per month or US$24.99 for 150 KB.
- Sony Electronics introduces the Sony VAIO C1 PictureBook handheld computer. It features digital video camera, 266 MHz MMX Pentium, 4.3 GB hard drive, 64 MB RAM, Windows 98, Zoomed Video PC Card slot, USB port, V.90 modem, 8.9 inch TFT 1024x480 display, Microsoft Works, Adobe PhotoDeluxe Business Edition, Intuit Quicken, Microsoft Money 98. Weight is 2.4 pounds; size is 1.5 x 9.5 x 5.5 inches. Battery life is about 1.3 hours. Optional external 16x CD-ROM drive.
- Hewlett-Packard introduces the HP Jornada 680 handheld computer. It features 13 MHz Hitachi SH-3 processor, 16 MB RAM, 16 MB ROM, 6.5 inch 640x240 256-color LCD display, V.90 modem, Windows CE Handheld PC Professional v3.0. Size is 1.3 x 7.4 x 3.7 inches; 1.1 pounds. Lithium ion battery life is about 8 hours.
- Palm Computing releases the 3Com Palm IIIe handheld computer. It features 2 MB RAM, and reverse backlit LCD touchscreen. Size is 4.6 x 3.8 x 0.8 inches; weight is 5.8 ounces, and it uses two AAA batteries.

- Psion introduces the Psion Revo personal digital assistant. It features 8 MB RAM, 36 MHz ARM 710T RISC processor, 53-key keyboard, 1.5 x 4.5 inch monochrome 480x160 pixel touchscreen, 8 MB ROM, Symbian EPOC32 v5.0 operating system, 19.2 Kbps modem. The system operates for about 14 hours on nickel hydride batteries. Size is 0.8 x 6 x 3 inches; weight is 7.8 ounces.

2000

(month unknown)

- Compaq Computer introduces the iPAQ Pocket PC handheld computer. It features 2.25 x 3 inch color screen, USB port, 206 MHz Intel StrongARM processor, 32 MB RAM, Windows CE 3.0. Expansion packs offer access to PC Cards, flash memory cards, email, music file playing, digital camera, modem, bar code scanner, etc.

APPENDIX 5

Figure 43: Affinity Diagram for "Information" functionality

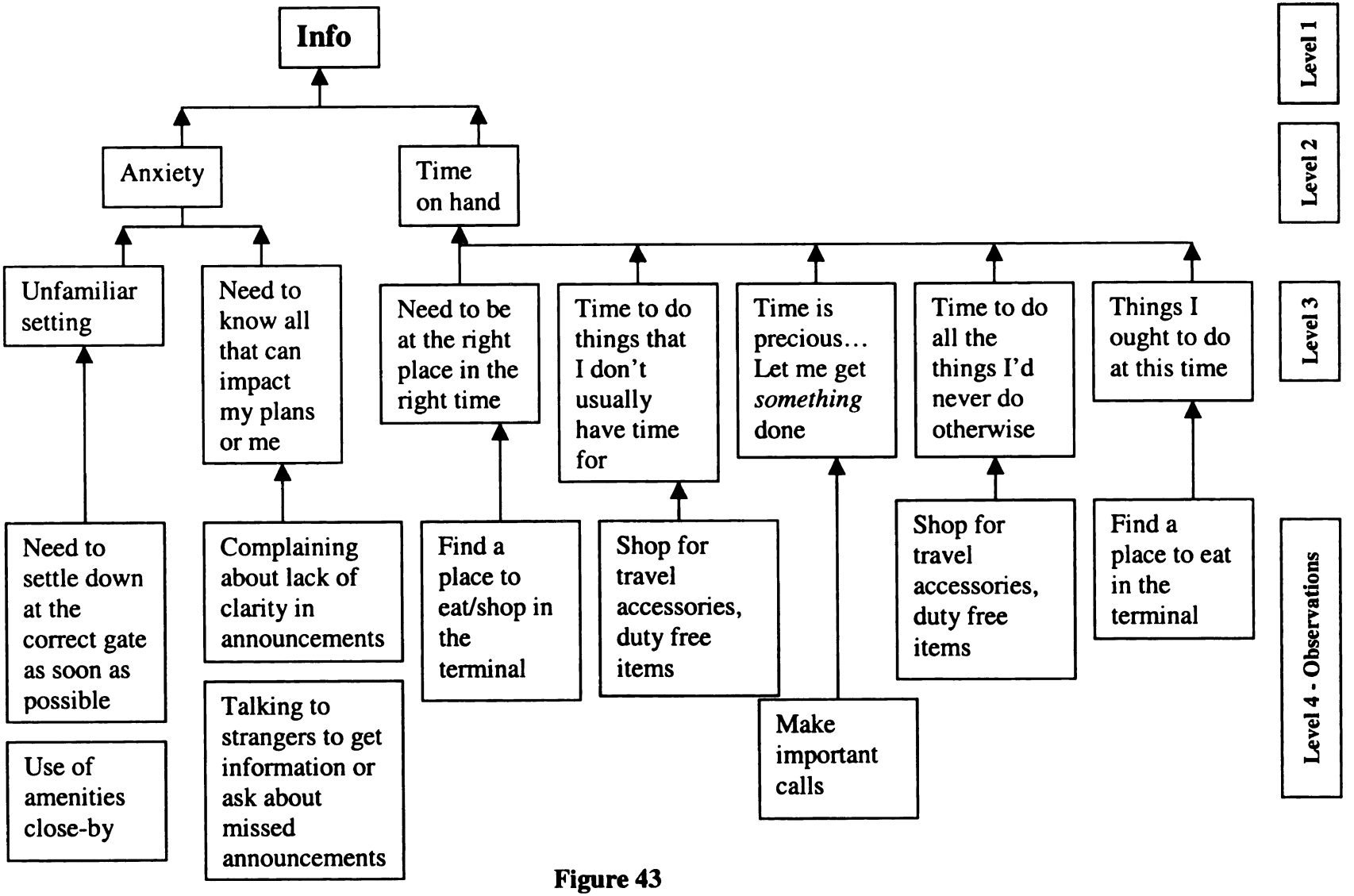
Info
Anxiety
Time on hand
Unfamiliar setting
Need to know all that can impact my plans or me
Need to be at the right place in the right time
Time to do things that I don't usually have time for
Time is precious... Let me get *something* done
Time to do all the things I'd never do otherwise
Things I ought to do at this time
Need to settle down at the correct gate as soon as possible
Use of amenities close-by
Complaining about lack of clarity in announcements
Talking to strangers to get information or ask about missed announcements
Find a place to eat/shop in the terminal
Shop for travel accessories, duty free items
Make important calls
Shop for travel accessories, duty free items
Find a place to eat in the terminal
Level 1
Level 2
Level 3
Level 4 - Observations

Figure 43

APPENDIX 6

Figure 44a: Affinity Diagram for "Chat" functionality

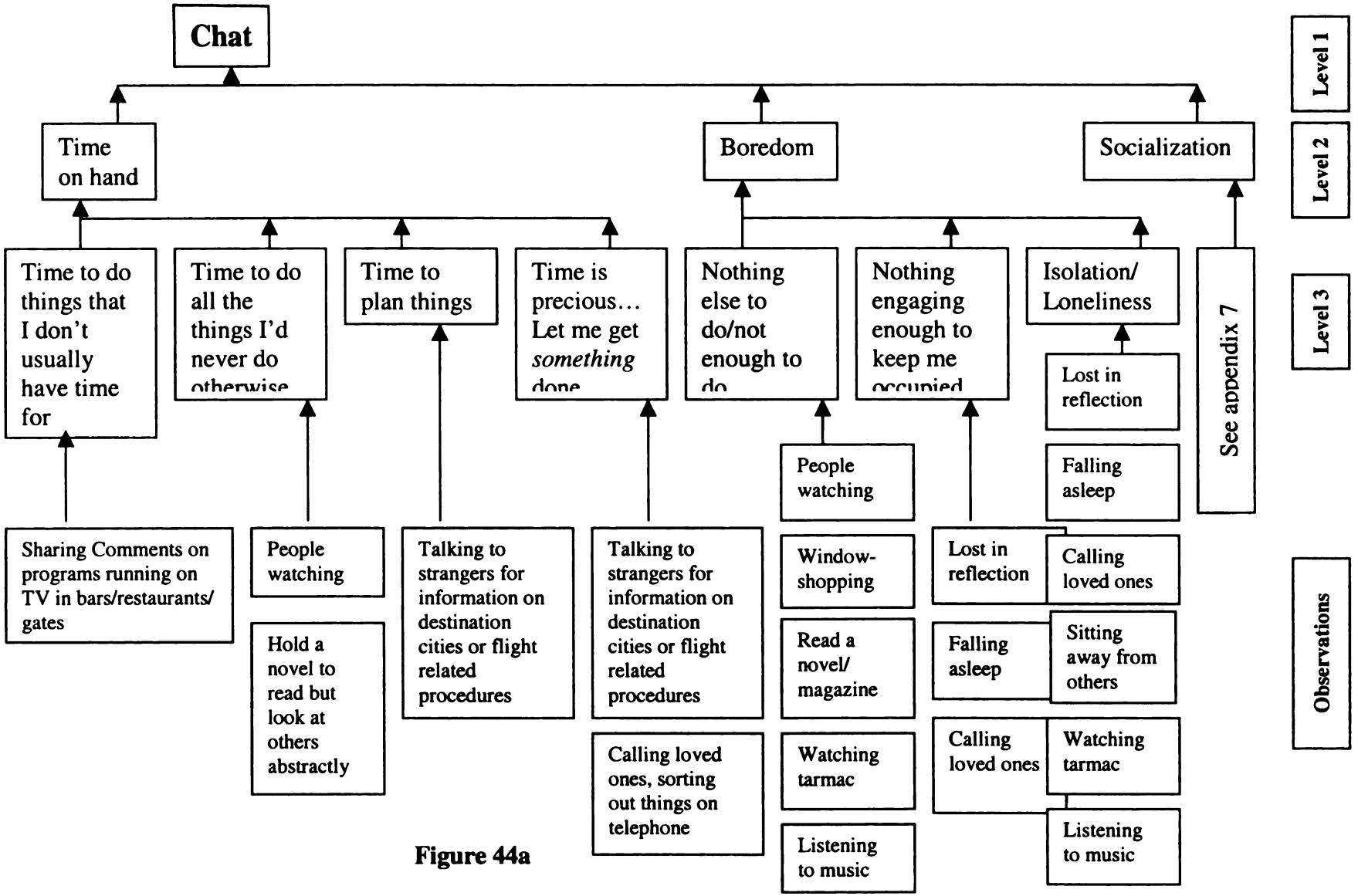
Chat
Time on hand
Boredom
Socialization
Time to do things that I don't usually have time for
Time to do all the things I'd never do otherwise
Time to plan things
Time is precious... Let me get *something* done
Nothing else to do/not enough to do
Nothing engaging enough to keep me occupied
Isolation/ Loneliness
See appendix 7
Lost in reflection
Falling asleep
People watching
Window-shopping
Read a novel/ magazine
Watching tarmac
Listening to music
Sharing Comments on programs running on TV in bars/restaurants/ gates
People watching
Hold a novel to read but look at others abstractly
Talking to strangers for information on destination cities or flight related procedures
Talking to strangers for information on destination cities or flight related procedures
Calling loved ones, sorting out things on telephone
Lost in reflection
Falling asleep
Calling loved ones
Calling loved ones
Sitting away from others
Watching tarmac
Listening to music
Level 1
Level 2
Level 3
Observations

Figure 44a

APPENDIX 7

Figure 44b: Affinity Diagram for "Chat" functionality

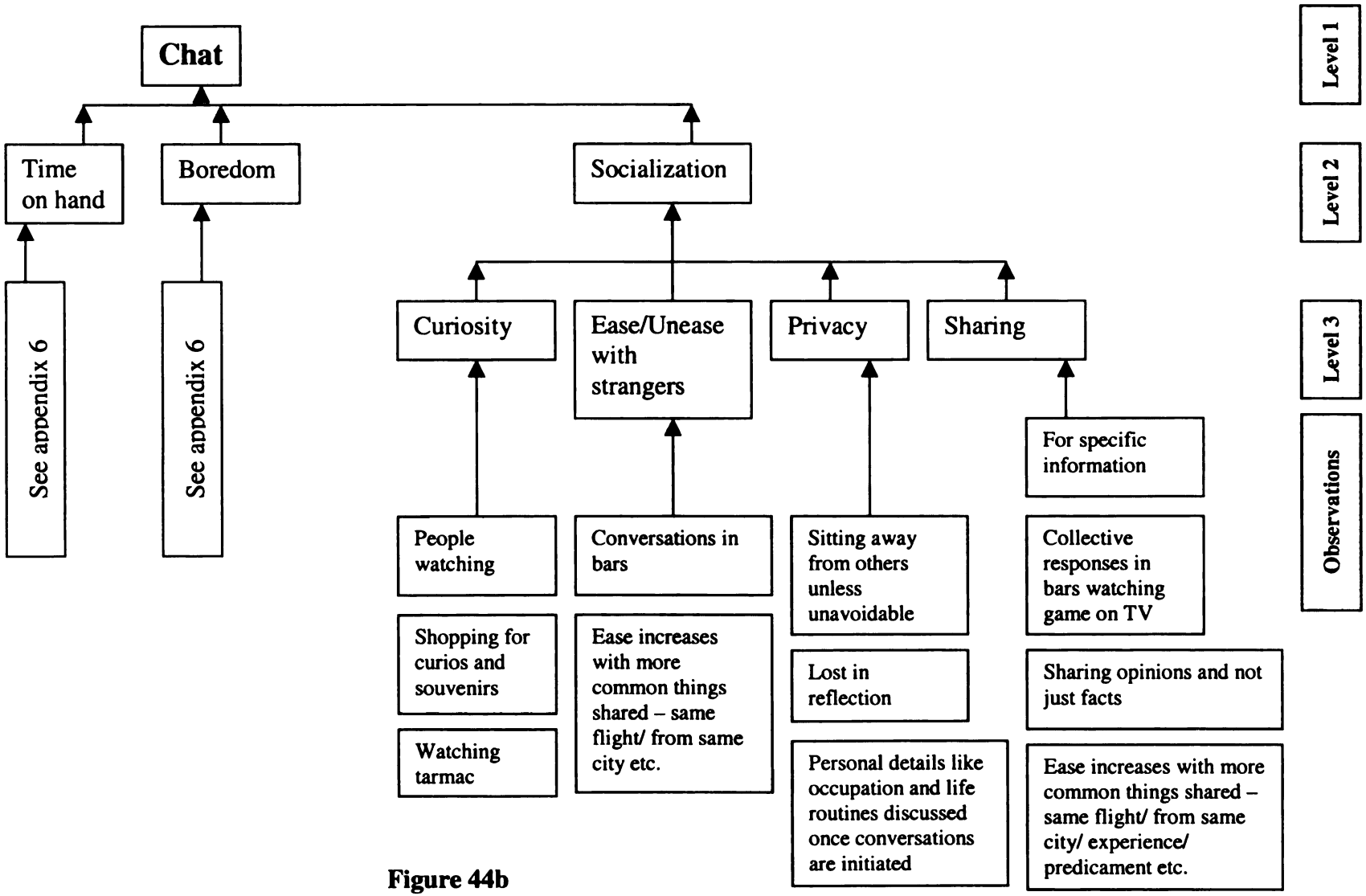
Chat
Time on hand
Boredom
Socialization
See appendix 6
See appendix 6
Curiosity
Ease/Unease with strangers
Privacy
Sharing
People watching
Shopping for curios and souvenirs
Watching tarmac
Conversations in bars
Ease increases with more common things shared – same flight/ from same city etc.
Sitting away from others unless unavoidable
Lost in reflection
Personal details like occupation and life routines discussed once conversations are initiated
For specific information
Collective responses in bars watching game on TV
Sharing opinions and not just facts
Ease increases with more common things shared – same flight/ from same city/ experience/ predicament etc.
Level 1
Level 2
Level 3
Observations

Figure 44b

APPENDIX 8

Figure 45: Affinity Diagram for functionality in Airport Layover Companion

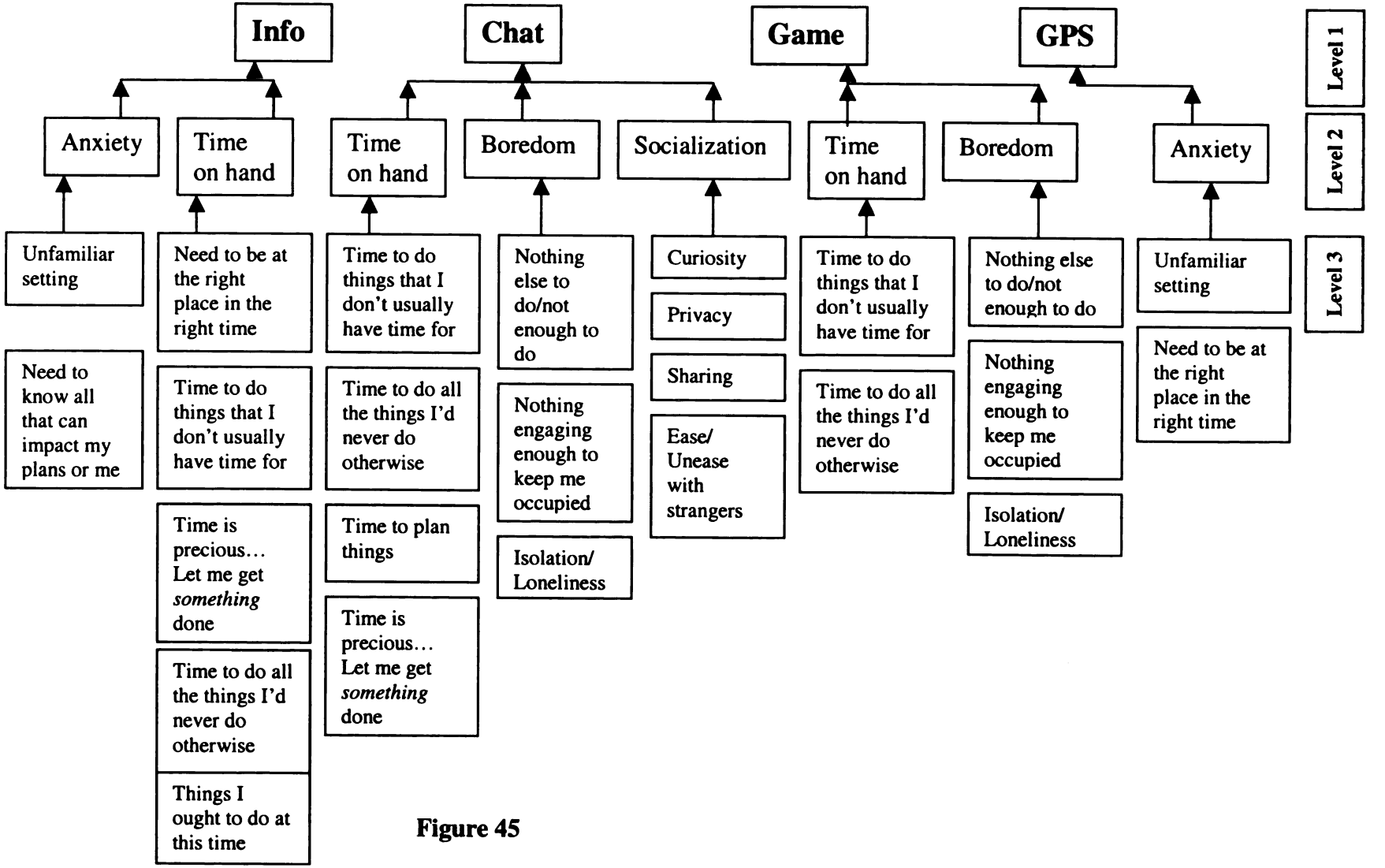
Info
Chat
Game
GPS
Level 1
Level 2
Level 3
Anxiety
Time on hand
Time on hand
Boredom
Socialization
Time on hand
Boredom
Anxiety
Unfamiliar setting
Need to know all that can impact my plans or me
Need to be at the right place in the right time
Time to do things that I don't usually have time for
Time is precious... Let me get *something* done
Time to do all the things I'd never do otherwise
Things I ought to do at this time
Time to do things that I don't usually have time for
Time to do all the things I'd never do otherwise
Time to plan things
Time is precious... Let me get *something* done
Nothing else to do/not enough to do
Nothing engaging enough to keep me occupied
Isolation/ Loneliness
Curiosity
Privacy
Sharing
Ease/ Unease with strangers
Time to do things that I don't usually have time for
Time to do all the things I'd never do otherwise
Nothing else to do/not enough to do
Nothing engaging enough to keep me occupied
Isolation/ Loneliness
Unfamiliar setting
Need to be at the right place in the right time

Figure 45

APPENDIX 9

Data Collection Instrument - General Questionnaire

Subject no: ☐

(Forms marked "I" will be filled out by International subjects and those marked "D" will be filled in by domestic subjects. All forms will be equally weighted and no discrimination whatsoever will be made. This distinction is made for analysis purposes only.)

1. How often do you travel long distance by air (with layovers and long flights)?

   More than twice a year

   About once a year

   Once in two years

   Never

2. Have you experienced an airport layover lasting 4 hours or more in the past 1 year?

   Yes

   No

3. Are you satisfied with the facilities available at the airport on how you can spend time during your layover?

   Very satisfied

Reasonably satisfied

Not satisfied

4. How comfortable are you in using a palmtop computer?

   Very comfortable

   Reasonably comfortable

   Uncomfortable

   Never used one

5. How comfortable are you in using a mobile phone?

   Very comfortable

   Reasonably comfortable

   Uncomfortable

   Never used one

6. How old are you? ----------

7. Your are a male/ female? ----------

APPENDIX 10

Data Collection Instrument - Discussion Guide for Scenario Based Usability Testing

Welcome! Thank you for participating in this study. I hope it will be an interesting experience and fun too. Your feedback is extremely important to us and will help us design a better product for people like you and me. So, please remember that you are not being tested and we look forward to having constructive feedback from you.

Once again, I'd like to remind you that this session is being video taped purely for analysis purposes. It just helps so that I can talk to you now rather than take notes. I will not be asking your name or identifying you in any way through this session or later. The videotapes will be erased after the thesis defense.

For the most part, from here on, we are not going to have you fill out boring questionnaires. Instead, we will do some role-playing - that is, I will set out a scenario or context that you might have recently or even frequently experienced and also show you some demo software. I will then either ask for your opinion or ask some questions that will help us understand how to make this product better.

1. Imagine that you are on a 6-hour layover at O'hare international airport, Chicago. The weather is not great and so you decide not to leave the airport. If you had one wish to be granted on finding the best way to spend the layover hours, what would you wish for? Why?

Let us now imagine that O'hare has this new facility of connecting people on long layovers wirelessly within a given terminal. We shall call this facility the wireless airport companion for convenience. If you had requested for this facility when you booked your tickets or at check-in, then towards the end of your first flight, the steward/stewardess distributes an airport companion packet to you. This packet contains a palmtop wireless device and a small handbook describing the device and its features. You learn that this device is designed for boredom relief and to gain important flight/airport related information and updates. For boredom relief, you can connect to other people in the terminal to either chat or play games. There is also a GPS facility that will help you find your way around the terminal.

When you first turn on the machine, you notice that it welcomes you by your name and then plays a tutorial on how to use the various features. You will use a stylus to select items on the screen, the jog dial or the stylus to select items on a menu list and a keypad to type in text. On the last leg of your journey, the airport companion device is collected back from you before you leave the aircraft. This then is the scenario and we will examine bits and pieces of what could happen within it in some more detail. Since we are still trying to design this product, what you will see are demo versions on a normal computer screen. With your feedback, the real product will be made eventually. Remember! There are no right or wrong answers. Ready?

CHUNK 1: Creation of layover chat profile

Screen 1 (Your chat profile has not yet been created. Would you like to create one now? Yes/No)

2. Now, imagine that you have clicked the chat button for the first time. You will see a screen like this. What would you choose? Why?

(If "No" chosen)

Screen 2 (You will not be able to use the chat feature unless you create your profile. Create Profile/ Don't Create Profile?)

3. Do you think the chat feature should be available to those who don't wish to create their profile?
4. would you want to chat anonymously? Why?

(If "Yes" chosen)

Screen 3 (Chat profile creation screen)

5. Without using the mouse or the keyboard, would you verbally tell me what you think you will do when faced with such a screen? Please tell me in detail, each step you will take in the process.
6. Would you like an auto-generated chat name to be assigned by the system? Why/Why not?
7. In creating your layover chat profile, what do you want others to know about you?
8. Which of the information bits on this screen would you be uncomfortable in revealing to others? Why/why not? (Probe for age/sex/city where you live and proximity of physical location in the terminal)
9. There are two preset entries in your chat profile - the city where you began your air travel and the city of your destination. As you can see, there is a "Hide" feature

available. Would you use this feature? Would you want this feature for any other information on your profile too? Why/Why not?

CHUNK 2: Search for others to chat with

Screen 1 (Chat menu)

When you are done with creating your profile or when you click the chat button again, you see this screen.

10. What would you do next? Why?

11. Would you modify your profile often? Why/ Why not?

12. How comfortable will you be with chatting with a system suggested chat partner?

13. How comfortable would you be with random chats?

14. Who would be an ideal layover chat partner for you? You don't have to be restricted by the choices available here to answer this question.

Screen 2 (Alphabetical listing of all online chat names)

Now imagine there are 200 people on long layover at the O'hare International Airport right now, carrying Airport Layover Devices like this one.

- 15 people on layover started from the same city you did
- 20 people on layover are on the same flight you are going to your final destination
- 30 people on layover are single and might be interested in finding a date
- 80 people on layover are male, 40 people are female, and 80 have not

specified their gender

- 20 people on layover are within 100 yards of your current location.

15. Now imagine that you have clicked "Browse for chat partner" and reached this screen. What would you do?

Now, let us look at an alternate screen to choose chat partners from.

Screen 3 (Categorical listing of online chat names)

16. How different do you think this screen is from the previous one? Does it let you do anything differently in choosing your chat partner?

17. Which one do you prefer (Screen 2 or 3)? Why?

18. What is overwhelming for you to browse?

19. Would you want to directly be able to read the profiles of all the people available or just the chat names and a couple of details in a list with the option for viewing full details?

20. Do you want to see everyone available or would you rather have some means of filtering out people?

21. What do you want to know about others when choosing a partner to chat with?

22. Do you want to be able to access everyone logged on or only those that are not already chatting?

23. Do you want to be accessible to others when you are already engaged in chatting with someone?

Back to **Screen 2**

24. Would you chat with an anonymous person who has refused to divulge any details about himself or herself? Why/why not?

25. Would you choose a person with a auto-generated chat name for a chat partner? Why/why not?

Back to **Screen 3**

26. Are the categories presented here representative of what you need to know about others to decide who you want to chat with? Are there too many/too less?

27. How important is it to you to find the "right" chat partner? How much time will you be willing to spend on finding your partner?

28. If you had 30 minutes to find a partner and chat with him or her, how much time will you spend in choosing your partner and how much time will you spend in actually talking to him or her?

CHUNK 3: The layover chat

Screen 1 (Chat interface - plain text)

29. What do you see on this screen? What do you think you can do with it? Please describe in detail every step.

30. Would you like to chat in groups? Why/ why not?

31. Would you feel limited to one topic if you have picked a chat partner because he/she were also interested in say talking about a particular city?

32. How important is the speed of communication and spontaneity in any given chat that you have?

Screen 2 (Chat interface with shortcuts and smileys)

Let's just briefly look at an alternate interface for you to use for your layover chat.

33. What does this screen offer you? What would you do? Describe in detail.

34. Would you care for such shortcuts and emot-icons? Do you think they make a chat conversation more interesting or richer in any way?

35. Do you think these shortcuts will aid in a faster exchange of ideas in a conversation or actually deter it?

36. Do you think you will feel uncomfortable choosing these shortcuts on the screen and typing via the keypad? Would you just prefer short key commands or none at all?

37. Would you care for a list of automated openers or closing lines?

Now, using either of the two chat interfaces that you just saw, imagine you are in the process of chatting with someone and it turns out that you are having a good time.

38. At this time, you get another chat request and a message shows up on the screen asking if you want to accept the chat. How would you react to this interruption?

39. Would you react differently if this request showed up in the form of an alert flag flashing on the corner of the screen with a low alert chime? This flag would stop the moment you hit the chat button to access the message. Clicking on the chat button again would return you to your original chat conversation.

40. Now imagine that instead of a chat request, the interruption was because there is an information update about your flight. How would you react to this?

41. Would you rather have it automatically show up on your screen or as an alert flag flashing on the corner of the screen with alert chime?

For a moment, let us imagine that you are NOT having such a great time chatting with the person you chose first.

42. Would you want to have a "block this person" feature?

43. In any conversation, when you feel like terminating the chat, would you like an option of the system putting an end to the chat on your request or would you find ways of ending the chat yourself?

Would you like a small break at this point or would you like to continue. We have a couple of screens to go before we finish.

We have taken a detailed look at the chat feature of the airport companion device. Now let us briefly take a look at the information facility that it offers.

CHUNK 4: Flight Information and Alerts

Screen 1 (Typical screen giving details such as flight status, gate number etc.)

Your Layover Assistant will keep you informed about the gate information and status of your departing flight. You can view the flight status screen, which checks for updates every minute, by clicking on the information button on the handheld device. When an update or important announcement is made about your flight, an alert chime will ring and an alert light will continue to blink until you click on it to view the announcement.

44. Would you like voice messages? Would you worry about missing an announcement?

45. How often would you check the status?

46. How much information do you want? Do you want to know when the plane you'll be on arrives at the airport? When baggage has been loaded? When the pilot arrives...?

47. Would you like to communicate to airport officials? When, about what?

48. How would you like to communicate with airport officials? Send them voice messages? Chat?

49. Would you like to communicate with airport officials in time -critical situations - for instance you are rushing to your gate on a tight connection and you want to let them know you are on your way. How would you like to communicate to them at such times? - automated messages preferred or choose from a list of messages or type message and send?

CHUNK 4: Airport amenities and maps

Screen 1 (View by category/ show me what's close)

Your Layover Assistant can tell you about stores, restaurants, email cafes, restroom and other airport services here at O'Hare. You can look for services by category, or you can see all airport services near your current location.

50. Which are you more likely to choose, category searches or show me what's close to me?

51. If there were announcements of special bargains ("blue light specials") would you want to know about them? (like grocery store coupons, but only for Airport Companion Users)

52. Do you think you would take more advantage of airport shops if you had a service like this?

53. Which of these information - flight/ gate information and airport amenities/offers information would you like to automatically be sent to you with alerts and what would you prefer to access when you want to access it and not be bothered by it otherwise?

Is there any other feedback that you'd like to give us today?

That brings us to the end of this session. Thank you very much for participating. Your feedback has been great. As mentioned earlier, it will be kept confidential and will be used for academic research purposes only.

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