**Technology and Elderly People:
Design Methodology for Interactive Communication in Later Life**

by

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A thesis submitted to the
Faculty of Graduate Studies and Research
In partial fulfillment of
The requirements for the degree of
Masters of Architecture

Carleton University

Ottawa Ontario

January 03, 2005

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Abstract

This research focuses on studying contemporary issues concerning the challenges that technology offers in later life in relation to the involvement of older citizens with communication technology. It presents certain criteria, which when followed, would encourage more elderly people to partake in web-activities and communications to counter detachment from advancement in communication technology.

It then proceeds to the applied research and user needs study towards developing a communication device to test the preliminary ideas related to use and interactions. The test results and user-feedback help to further establish a set of design methodology which can be used by the industrial designers and media designers to develop a communication device ideally suited to meet the requirements of elderly users.

Acknowledgements

I would like to acknowledge the support, guidance and encouragement of my advisor Professor Lois Frankel. Lois has given me a great deal of freedom to explore new ideas and gave insightful guidance about which one to pursue. I take this opportunity to specially thank her.

This has been a multi-disciplinary study and I have benefited and learned greatly from many experts in various fields. Professor Stephen Fai helped me discover many interests and considered my request to study in the School of Architecture. He also introduced me to literature in architecture. Professor Ben Gianni introduced me to the study of data modeling and excavating links between the real world architecture and the virtual world, and gave me valuable and much appreciated advice regarding my thesis. Professor Thomas Garvey who I respect as a teacher and friend allowed me to apply my knowledge in industrial design and architecture towards experimental studies.

I wish to thank my friend Naquib Hossain who during my study always provided his support and guidance for issues ranging from computer modeling to expressing and reflecting my ideas. Discussions with him have helped me shape many of my ideas in this thesis.

Allie's endless encouragement, support and patience helped me reach my goals. Without him and his love in my life I would not succeed. I owe him a great deal in my pursuit of this master's degree.

Last but not least, I am forever indebted to my parents, my father, who is my inspiration, his achievements, broad knowledge and admirable character made me follow his steps. My mother who is my role model, the love and passion she gave me made me a better person. My parents belief in my capabilities and their encouragements and support made this journey possible.

I dedicate this thesis to my husband, Allie, and my parents. I am always grateful for sharing my life with them.

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1 Introduction

Ever-changing communication technologies are rapidly leading us to a new concept of a communication society. People of all ages, those with different abilities, needs, educational and cultural backgrounds, especially the aging population, have to cope with these changes in order to avoid isolation and loneliness.

Gerontological studies identify elderly people as a group that is not successful in adapting and coping with new advancements in information and communication technologies. This condition will be aggravated further due to physical and cognitive limitations (Green et al. 1992).

It is the premise of this study that the older population is at an accelerated risk of being steadily isolated from the stream of communication technology that binds together most members of society, and that this isolation could result in a rift and disconnection from the mainstream.

Modern technology, however, offers a variety of techniques that can prevent the most negative consequences of this detachment. It is possible to design

modifications to suit elderly people and to make communication technology easier and more accessible. With this in mind it is essential to compare different types of communication mediums and their potential in helping the aging population to communicate more effortlessly.

Designers should recognize the demand for new forms of communication for elderly people. They should participate in re-shaping communication mediums so that they are more reliable in producing a sense of belonging and shaping a community that supports emotional connection for elderly people. The ultimate goal of this research paper is to enable older adults to establish a sense of personal integrity and dignity, maintain a self-concept of competence and value, exercise cognitive skills, and have the ability to interact at social levels.

1.1 Opportunities: Virtual Communication and Elderly People

It is not uncommon for the aging population to have an overwhelming feeling of isolation in a world that is focused on new communication technology, a

technology that in many instances does not address or support the physical requirements and emotional needs of elderly people.

As society advances towards more evolved forms of virtual communications, many older citizens lose their sense of belonging and find difficulty in relating to or feeling a part of a greater community.

As technological advances become more complex and specialized, the inability to adapt creates countless frustrations and challenges particularly for older adults who have difficulty performing tasks requiring even a casual awareness of these elements. The failure of designers to develop elderly-friendly designs along with a lack of information regarding interface design for this group, may affect the already limited participation of the aging population in the field of virtual communication.

Part of a possible remedy or solution to these problems would involve designing a virtual-based interface application as a new medium for elderly people, which would involve considering physical and cognitive limitations along with social and emotional concerns. A different approach for the design of communication media must be developed. They must provide opportunities for

elderly people to realize a meaningful, touching, and emotional experience and feel the message conveyed.

This thesis will explore the challenge of creating meaningful experiences through different mediums for communication. It intends to develop a design methodology for communications media designers in order to meet the needs of elderly people.

1.2 Thesis structure

Chapters two, three and four develop a theoretical basis for this endeavor. Issues related to communication in later life will be explored, including sociogenic and physiological problems faced by the aging population. Technological advancements and their challenges to elderly people will be discussed. Furthermore, the potential to augment existing communication devices will be shown together with the virtual tools and applications related to them.

The theoretical research also considers the available technologies that can be

adapted to the needs and abilities of elderly people to build a communication medium in order to satisfy their emotional and physical needs, helping to reduce the gap between the older and younger generations.

Chapter five analyzes the user needs for a communication medium, which is designed to test the gathered information and develop the study further through applied research. It focuses on the development of a communication device and its testing with a target group and the results that will emerge. These findings will identify opportunities to improve and extend the design methodology.

This thesis begins with a discussion about contemporary issues regarding communication in later life. It examines the different factors that are responsible in causing difficulties to interact with other people.

2 A Study of Contemporary Issues Regarding Challenges in Later Life

2.1 Background

Advancements in information and communication technologies in the past decade have changed and affected society in a dramatic way. They have changed the methods of interaction and communication among citizens and forced them to continuously readapt themselves to these elements.

If the technologies do not facilitate the aged population and their needs, they will cause them to feel rejected, push them to become passive and inactive members of the society, resulting in the creation of a social gap between the younger and older generations (Gotesky 1965).

2.1.1 The Role of Communication In later Life

In old age communication can be the key to social survival. It can be the means by which the older adult can establish personal integrity, maintain a self-concept of competence, and exercise cognitive skills, all in the context of environment which may or may not be supportive, but always presents a challenge (Dunkle et al. 1984, 64).

Communication helps maintain a basic structure throughout the course of life. It is the fundamental means of exchange and self-maintenance, and it enables the individual to adapt to an ever-changing environment.

New technologies, especially information appliances and tools, change the ways elderly people communicate. While attempting to make life easier and opening new opportunities for an aging society, they also create a variety of new challenges.

Communication has effective and cognitive dimensions. Specifically, the functions of communication are to convey information and emotion, to socialize and instruct, and to provide the basic elements of mental organization. It ultimately links the individual to his or her environment.

Elderly people have to maintain the ability to communicate and use available

tools as a complimentary device to compensate for the physical and cognitive deterioration which may prevent them from communicating effectively as other people do in society.

2.2 Sociogenic Issues

Sociology has always seen personal relations as the mortar of society. It is through such relations that people are taught norms that make for smooth social interaction, are assisted in times of trouble, and become contributing members to broader social life (Peplau and Perlman 1982, 2).

2.2.1 Social Assumptions about Elderly People

As each generation enters the "Third Age" they have to contend with social attitudes towards them that are the legacy from the past. (Bengston 1973, 31-42)

British writer, Alex Comfort, writes as follows:

Let us look at the stereotype of the ideal aged person as past folklore presents it. He or she is white haired, inactive, making no demands on anyone, least of all the family, docile in putting up with the loneliness, able to live on a pittance and slightly deficient in intellect. Folklore says that old people are weak in the head. He or she is unemployable, because old age is second childhood and everyone knows that the old make a mess of simple work. Most of them prefer their own company and the company of other aged unfortunates (Comfort 1990, 116).

This image of older people is not just a British Stereotype, the French writer Simone de Beauvoir in her book, *La Vieillesse* presents her view of aging in this quote: "old age is a shameful secret, a forbidden subject" (de Beauvoir 1992, 36).

While those were written 30 years ago, it is important to state that in France as in Britain in recent years there has been some progress in overcoming the banishment of 'the old' from society. "The University of the Third Age" was first inaugurated in France, and has now spread into many countries. In Britain, organizations such as "Age Concern" have made a significant impact on the isolation of older people (Gibson 2000).

The stereotype of older people as displayed in fiction and other literature,

suggests that disengagement from social life is a constant and universal theme of old age. It is natural therefore that the assumptions about old age, and their influence on the self-perception of older people, continue to persist and still have detrimental affects on old people.

2.2.2 Living Arrangements

One of the most important social changes today can be seen in the structure of the contemporary family, which is shifting from the traditional patriarchal to the modern urban household and is more fragile. Economic needs and increased opportunities often tempt the younger generation to move far from their homes to find suitable jobs. The geographical distances create new conditions in family dynamics, and particularly affect elderly people. They are more in need of communication with the outside world in order to remain active members of society and to feel a sense of belonging to their community.

An elderly person who lives in a rich atmosphere of human relationships becomes ill less often than one who is alone. The affection of friends and/or

relatives removes the negative perceptions of old age (Cantor 1989, 99-113).

2.2.3 Social Care System

One of the crucial factors affecting the aged population today in society is the system for their social care. The vast majority of older people live in their own households, either alone or with spouses or partners. A large part of the success of a social care system relies on the family of elderly people, who provide the emotional support needed for their well-being through the frequency of personal contact, and provide the opportunity to feel close to loved ones. The independence of the older generation and the role of the younger generation in caring for them are both crucial factors.

While the family continues to play the central role in the welfare of its older members, the environment in which families function is changing rapidly due to a variety of factors such as, greater geographic dispersion and the entrance of larger numbers of women in the workforce. It is unlikely that the family can continue to carry the full responsibility for social care without relying on

services provided by formal systems such as health care (Harvey 1995).

The emerging role of the health care system is significant, as it provides assistance to elderly people, develops social, educational, and recreational resources. It also ensures that elderly people of the future will have meaningful opportunities to communicate and interact with the outside world so that the wisdom of one generation is passed to the next. Young people, therefore, have the opportunity to see older people as strong, functioning members of the aging society (Cantor 1991, 337-346).

2.2.4 Retirement and Disengagement from Social Life

When people retire their new life begins. It is a time for people to reassess themselves. They lose their contacts and their friends at work. Their position and status in society will be changed (Harris 1985, 75).

"Disengagement Theory" holds that the process of giving up rights and responsibilities at a certain age is universal, and is to the advantage of both society and the individual (Cumming and Henry, 1961). This theory has received a great deal of criticism in more recent years. Most specialists working in the

study of aging advise that, for the sake of physical and mental health, people should continue to be active and participate in daily functions of society as long as they can throughout the aging process (Laslett 1996). According to this argument, it is not to the advantage of elderly people to stop social activities due to retirement.

2.2.5 Economic States

A gap in support services or an inability to access necessary supports can have a major impact on the lives of elderly people living in poverty.

A Statistics Canada study has shown that the poverty rate among the aged population dropped significantly between 1980 and 1995 (Statistics Canada 1996). Unattached elderly persons - those not living with spouses or other family members - however, remained quite vulnerable to poverty. In 1995 almost half of them (45.1%) lived below the poverty line, compared to a 6.9% poverty rate for those who lived in families (Canadian Council on Social Development 2004). Over the last two decades, seniors have experienced a

decline in poverty, due in large part to receiving government income transfers, such as Old Age Security (OAS), Guaranteed Income Supplement (GIS), Spouse's Allowance (SPA), and Canada Pension Plan (CPP). (Lee 2000, 30) However, when a senior's only source of income is government transfer payments, he/she is in fact living at a level of poverty, as defined by Statistics Canada's Low Income Cut-off (LICO). The LICO is adjusted for community size and measures the amount of money needed to live and participate as a Canadian citizen. For instance, an unattached senior with no other source of income in the Waterloo region is eligible to receive a combined OAS/GIS benefit of \$938.38 per month, far below the monthly LICO for a single person of \$1,244 (Statistics Canada 1996, 13-551).

The number of persons 65 years of age and older in Canada is expected to double by 2021 (HELPS 2000). The projected increase in the senior population means a potentially greater demand on income support programs and health services. As David Foot notes in *Boom, Bust & Echo*, there will be relatively fewer people in the work force to support the increased need for services (Foot and Stoffman 1996). Therefore, in the coming years we will expect more poverty among elderly people.

2.3 Technological Advancement and Its Challenges for Elderly People

. . . The moment man first picked up a stone or a branch to use as a tool, he altered irrevocably the balance between him and his environment. New objects appeared that were not recognizable as a mutation of something that had existed before, and as each one emerged it altered the environment not for a season but forever. While the number of these tools remained small, their effect took a long time to spread and to cause change. But as they increased, so did their effects: the more the tools, the faster the rate of change (Burke 1995, 2).

The 20th century has seen extraordinary advancements in the world of technology. Modern society has seen discoveries and inventions in medicine, science, transportation, engineering, and communication of unparalleled magnitude and proportions. The impact of these technologies on modern society has been undoubtedly beneficial. But, some might argue the contrary (Davis 2000). In this matter it is elderly people who are more at risk of falling behind this fast advancement of technology, along with potentially inactive members of society.

2.3.1 Limits of Knowledge

Reasons often cited for non-use of assistive devices and other technology by seniors include: lack of knowledge about the new technological developments, fear of technology, poor financial status, difficulty accessing needed items, and inability to accept their physical decline. They also experience device-based barriers such as size, weight, and limitations in maneuverability that are not designed for their disabilities. The study shows the trends toward an increasingly educated population (Aminzadeh and Edwards 1997). It would seem reasonable to expect technophobia to be less prevalent in future. But given the current pace of technological advancement and the consideration of historical precedents, it is also sensible to assume that the technological advances will out pace elderly people ability to adapt to them. While seniors of the future are likely to be better equipped to become accustomed to devices and other mechanisms and systems which may compensate for their disabilities, it is also likely that these technologies will suffer obsolescence at the hand of later advances, causing them to have to readapt all over again.

2.3.2 Communication and Interaction

In recent years, we have witnessed the revolutionary advances of information technology and telecommunications. Technological progress is now rapidly leading us to a new concept of an 'Information Society'. Citizens with different abilities, requirements, educational and cultural backgrounds and preferences, will need to perform, in the context of their everyday activities, multi-modal interactions with multi-media applications and telematic services. This unstoppable technology offers new opportunities for all citizens in society, including elderly people. However, it may also introduce new barriers, human isolation and alienation, if the diverse requirements of all potential users are not taken seriously into consideration (Smither 1995, 158).

Information technologies are transforming the ways in which people relate to their world and to each other. Telecommuting is no longer an experiment, but an everyday part of the week. The Department of Commerce reports on the "Digital Divide" have shown a consistent gap between senior citizens and the communication technology society (Appendix A1). Although there is a digital divide between those who have access to information technologies and those who do not, segments of every population group have joined the information revolution (Stephanidis 1997).

Social professional and creative activities are expected to further develop and

follow a multi-disciplinary and user-centered approach, aiming to ensure that the emerging technological developments within the "Information Society" will empower all citizens, including elderly people, in their everyday life activities. These developments affect the way seniors, as well as others, acquire and use information and the way in which they interact with other people. In a survey of seniors and seniors' organizations conducted by the Centre for Information Technology Innovation (CITI), respondents were asked about the principal function of multimedia technologies for seniors. Sixty five percent viewed these as having access to up-to-date, accurate and essential information. Fifty two percent viewed these as a way of increasing social interactions (Geoffroy 1994).

However, elderly people community is noticeably absent from most policy discussions about information technology (Geoffroy 1994). This technological revolution either has the potential to further isolate and leave them behind their urban peers or ameliorate problems related to growing old and enhance their circumstances.

2.3.3 Adaptation

With the help of communication technology and media elderly people are more aware of changes in their society and environment. It is however, usually hard for them to adapt to these changes and more often than not, they feel helpless, especially towards technological changes which are related to their everyday life (Smither 1995).

A survey done by Statistics Canada in 1991 shows that as people age the use of technological tools decreases (Appendix A2). The reason is that people in later life find it hard to learn and adapt their habits and needs to new tools and technologies. They would rather use other alternative products which do the same job or close to it (Statistics Canada 1991).

In order to encourage elderly people to take advantage of the convenience that new technology offers, familiar technologies such as the telephone, TV, and computers have been enhanced and integrated, with their capability being augmented by addition of new function and interactivity (Appendix A3 shows the trends and developments in information technology of relevance to seniors).

Growth in interactive services, multimedia, television and computer services offer important opportunities for information and communication. Designers have tried to integrate new technology and services into familiar products, which allows the users to adapt and learn without having to change their habits, therefore immediately taking advantage of the convenience that these technologies offer.

There are some programs and efforts that point the way to more active involvement in making universal communication technology a reality for the people. So far, however, seniors have been ignored by most of the programs aimed at closing that divide or training people to adapt to the new technological changes (Smither 1995).

Adaptation has to happen by both tailoring the tools and the needs of the elderly, and facilitating their acceptance of these changes.

2.4 Physiological Problems

Human beings decline in physical robustness towards the later part of their life. Sight and hearing become less efficient through natural deterioration during the aging process, muscles weaken and joints become stiffer. Most of the internal organs begin to perform their functions less efficiently, and there is a general slowing of most bodily responses. This condition can result in being house-bound (Gibson 2000).

2.4.1 The Aging Population

The elderly populations of many countries are increasing rapidly. These demographic changes are a direct result of the success of socio-economic development, literacy and education, which has led to a decline in mortality rates at all ages and a reduction in birthrates. The aged population will continue to suffer with the problems of dependency, disability and increased risk of disease, and the burden of care is compounded by the dramatic rise in their numbers. According to the World Health Organization (WHO), the elderly

population will double to more than one billion by 2020. By 2050, one-third of the world's population will be 65 or older (Global Population at a Glance 2004)

There will, therefore, be a need in the near future for society to help alleviate their condition of detachment from communication and allow them to have opportunity to take advantage of the comfort that new technological inventions offer. As it will be inevitable for them to be exposed to new tools and products which are common among the younger generations, the effort must be made to update and maintain their skills in a progressively changing context.

2.4.2 Physical and Mental health

There are many physical and mental changes associating with aging such as:

- Hearing impairment that affects 48% of men and 37% of women over 65 years of age.
- Visual changes cause poor reading speed, difficulty seeing in dim light and difficulty locating objects visually.

- Reflexes are slowed by the aging process.
- The probability of increase in chronic illness, such as hypertension cataracts, diabetes, and arthritis.

Despite these physical difficulties, 75% of 65-74 year old community-dwelling elderly report that their health is good. Some elderly people run marathons in their eighties and beyond, while others are so debilitated by illness that just getting up in the morning is a major effort. In these cases, age is less of a chronological marker than a combination of factors that determine the overall functioning of people in their mid-sixties and beyond (Statistics Canada 2000).

Genetics play an important part in the aging process. Aging is associated with the development of chronic diseases such as high blood pressure that contribute to wear and tear on the body. High cholesterol, heart disease, cancer, diabetes, and other problems can be caused by genetic factors. Some experts feel that the body's immune system is also affected by aging. It gradually loses its ability to recognize outside threats and hence, puts the person at a greater risk of disease.

Despite the fact that an older person may look well physically, they may still be

at risk for mental illnesses such as Alzheimer's disease, depression, and anxiety. According to the American Psychiatric Association (APA), 15 to 25 percent of the elderly population in the U.S. suffers from significant symptoms of mental illness. In spite of the fact that over one million elderly people have some sort of abnormal memory loss (senility or dementia), they are often too embarrassed or too ill to seek help.

Social and financial changes are commonly overlooked as part of the aging process, but they can contribute to both physical and mental illness in elderly people. For instance, many elderly live on fixed budgets. If their income is modest, then, every fluctuation in the economy has an impact on their lives, which can affect their nutrition and their ability to afford medication (American Psychiatric Association 2003).

Many older people also suffer severe stress from radical changes in life-style. Frequently this happens to aging widows who outlive their spouses. Retirement itself can be a source of stress for elderly people, whether financially secure or not. Some who have worked all their lives have no idea how to slow-down or may find it hard to adjust to full-time life with their spouses. These massive

changes, when added to factors such as, heart condition, for example, can increase stress on already inefficient organ systems.

2.4.3 Psychological Issues

Emotional and psychological issues have a major impact on overall health and the aging process. Research studies have shown that as a natural result of aging most people tend to become more introverted in later life (Evans 1992). Although many people would attribute this effect to social factors, Evans offers evidence that it is partly due to physiological changes in the nervous system. Therefore, in later life, older people have a desire to have less social interactions and sometimes this form of solitude results in loneliness.

Depression can be caused by several personal losses experienced in rapid sequence, which is often the case among elderly people. Certain medical conditions seem to be associated with depression, which include: Alzheimer's disease, cancer, congestive heart failure, diabetes, Parkinson's disease, rheumatoid arthritis and sexual dysfunction.

According to the American Association of Geriatric Psychiatry, depression affects 15 percent of adults older than 65 in North America. It is not just a condition that occurs when people get older, but is rather a treatable medical illness. There are over 40 million Americans over the age of 65, and more than 6 million of them are affected by depression (Hamilton 1994, 5)

Virtual methods of interaction and communication can act as valuable option for those who prefer not to engage others in a shared space or through physical presence, but feel the need to maintain a personal link with others.

2.5 Summary of Key Issues Related to Challenges of Later Life

The key issues related to challenges of communication in later life that may have design implications for this study are:

- Decline in physical capabilities due to old age
- Lack of communication with the outside world
- Lack of family support

- Cost effectiveness and affordability
- Isolation from society due to technological advancements

These issues will be considered in developing design methodology for an elderly-friendly communication medium. Furthermore, the task should extend to constructing a framework which allows elderly people to maintain a continued level of adaptability, and help evolve their skills at a measured pace against that of technological advancements.

The next chapter explores different approaches by designers to facilitate the use of communication technology for the aged population. The study will show available technologies which could help elderly people compensate for their physical and emotional losses.

3 **A Study of Related Communication Mediums and Their Application**

Community ties are already geographically dispersed, separately-knit, connected heavily by telecommunications (phone and fax), and specialized in content. There is so little community life in most neighborhoods in western cities (Wellman and Gulia 1997, 4).

People have particular surroundings and personal environments composed of, family, friends, school, work and neighborhoods that shape individual identities. The small-scale communications and interactions that people have on a day-to-day basis in the places they live and with the people around them, can be condensed to what is referred to in "media-speak" as "situated culture", an experience that is primarily identified as an oral one, passed on and formed largely by intimate word-of-mouth communication (Wellman and Gulia 1997).

Since the mid 19th century, people have come to live not only in a situated culture, but in a culture whose experience is mediated through the press, film and cinema, television and radio, the internet, consistently supplying larger scale means of public communication (Grinter and Eldridge, 2003).

Media develop in forms that not only make communication between parties easier, but also help users be more involved in community and social activities. This can occasionally lead to the development of personal relationships and emotional attachments with a particular medium.

Media have influenced the development of different communication tools and appliances, and the continued rapid pace of that development has made it hard to adapt to some of these tools. Some users may have difficulty operating them, especially those with disabilities or cognitive troubles, and can thus be left behind.

A number of recent studies have focused on people's use of communication media. The studies have shown how Instant Messaging (IM), email and text messaging have provided a whole new way of keeping in touch with friends and family. The way mobile phones are used has also been the focus of much research. A general finding being that friends and family used them frequently to maintain a high degree of awareness about each other (Grinter and Elbridge 2001, 219-238). The case for elderly people however, is different. Studies suggest that there is a much greater use of communication tools among the

young and working people, while older people, who have typically built up a large number of social contacts throughout their life, may not maintain them very well (Schiano et al. 2002)

The need for more effective communication tools for the aged population has been identified, but has as of yet received very little attention. Designers have tried to make many tools and their applications user friendly for the disabled but few have been met with success (Schiano et al. 2002, 594).

In the following sections, the study addresses a few of the communication media and their applications which have facilitated the rise of virtual communication for the aged population in relation to their habits and preferences of usage. It explores the attempts made by designers to develop better interactions for elderly people with the outside world and investigates new ways of communication to involve them in the same technology that is in use in the greater community. It also looks at opportunities to take advantage of these technologies to create experiences in the same manner that active members of society interact and communicate with each other.

3.1 Television

Research conducted over the last 20 years offers a number of theories about the relationship between older people and TV. Physical limitations related to advancing age help to explain why TV viewing increases after age 50 (Center for Media Literacy 2002).

Older people may turn to TV when sensory loss and problems with seeing or hearing begin. Since TV provides both verbal and visual information simultaneously, elderly people find television easier to interact with.

The classification of old people as active television viewers is well supported by research data. Questioned about the use of their leisure time, all the studies from 1960 on have found that the activity of watching television appears more often than any other activity listed, and the social circumstances of the aged are the most commonly cited reasons for its popularity. Television is easily accessible, offers a variety of choices, is entertaining, and is comparatively free of cost (Davis 1980).

Several researchers have suggested that television replaces lost social contacts

for older viewers, helping them maintain an ongoing sense of participation in society and combat feelings of alienation and loneliness. A 1974 study by M. Graney developed a theory of activity "substitution" or "compensation," which sees heavier media use as a means of compensating for financial, social and physical losses people experience as they age (Garney 1974, 88-96). This matter is always debatable, as many researchers suggest the exact opposite, where increased television viewing by older people acts as a sign of disengagement from the world and further causes isolation among the elderly population (Korzenny and Neuendorf 1980, 70-81).

Although the primary gratifications the aging audience seeks from TV include a greater sense of involvement in the world, being entertained, acquiring information and passing time, it is the nature of the medium that a person may feel detached from society and real people. Watching TV is a passive activity based on an explicit distance between the content and its viewer; a disconnected relationship that requires no social interaction, where any resulting exchanges can be responses to the content rather than to other users.

3.1.1 Interactive TV

The accessibility to television as a passive time-filling activity may reinforce other factors which already tend to isolate elderly people from involvement in the broader life of a community. These comments apply primarily to the one-way broadcast entertainment use of the television medium. Designers have tried to understand these problems and introduce alternative ways of using the medium to promote integration rather than enforce isolation, and involvement rather than passivity through the design of Interactive television.

One of the best known examples of Interactive television by and for elderly people was the Berks Community Television (BCTV) project in Reading, Pennsylvania. BCTV was begun in 1975 as an experiment in two-way cable communications. The purpose was to determine the feasibility of using interactive cable television as a means of delivering social service information to elderly people. (Dunkle et al 1984, 102-129)

This system has been described as follows:

Old people successfully ran their own closed- circuit cable TV station using two-way communications capability to take classes and hold discussions. Evaluation research has indicated that the cable program did not substitute for social interaction and the viewers' knowledge of public services improved and they found themselves more active in their society (Kubey 1982, 16).

This system worked in mutual presence (two parties have to be present at the same time), two people in remote locations, using a single cable channel and split screen image. In practice, any two locations within the cable system could send a live video signal and interact with each other, the speaker and the listener being able to see and hear each other simultaneously over a geographic distance (Kubey 1982). Interaction in this case was defined as being a distinctly human process involving communication on a one-to-one basis rather than a technical process involving the generation of feedback between a person and a machine.

The programming resulted from the combination of user direction and interactive technology and covered a broad spectrum including:

- Social service programs

- Socializing programs which stress informal interaction between senior citizens in various locations
- Generation Gap was an intergenerational program that linked senior citizens with students for informal discussions on any topic the students proposed (Carey 1978, 35)

After the experiment ended in the mid 80s the effect of this interactive project on the lives of the senior citizens of the area was analyzed in a survey done with the participants. The strongest effect articulated by respondents to the research survey was that the programming caused the elderly users to feel better about themselves and other seniors, and to feel better about being more active as members of society. Other results included increased awareness of available social services. Eighty percent of respondents who participated in this program from their own homes considered the interactive system to be the most significant improvement in services for senior citizens.

In 1998 Microsoft linked up with the cable television division of Toronto-based Rogers Communications Inc. and brought interactive TV (i.e. Web TV) services to Canadian residential users as Rogers Interactive TV (fig.3-1, 3-2, 3-3).

Fig.3-1 Rogers interactive TV interface

Although after 5 years of activity, the program was cancelled in 2003. It is important to look at the features and services that it offered and the disadvantages and short comings which caused it to be cancelled.

In the service offered by Rogers Interactive TV, the target group was people without a computer and internet service.

Fig.3-2 Rogers interactive TV wireless keyboard for typing and remote control for navigations

The service offered Internet access, an e-mail account, shopping and banking online, a personal webpage, online chat, posting and reading messages in discussion groups, all without having to own a computer at home (Steinborn 2003).

What we've learned from MSN TV is that with a high penetration of PCs in the home today, many North American television viewers don't want to use their TV for tasks like surfing and emailing; they can do that more effectively on their PC instead. That said, MSN TV continues to have a large fan base among people who typically don't have a PC in their home but want an easy and inexpensive way to keep in touch via email and browse the web (Steinborn 2003).

While having the service on TV would encourage elderly people to try the technology and have more desire and access to it, this would still present them with technical and physical challenges and difficulty. ITV offered an alternative to PC-accessed internet browsing, but maintained the same interface and device components of a computer, requiring the use of a keyboard as an input and navigational device. The different steps required for an intended command to be executed often caused the user frustration and discouraged him/her from using the service.

The venture was successful in attracting customers by selling the idea of combining various services into a single package, but designers were misguided in assuming that integrating multiple functions would help users overcome the task of understanding and absorbing the individual components. Market shifts further contributed to the end of the service.

3.2 Telephone

The telephone is one of the central and crucial tools of everyday life. People call their friends, family, doctors, information directories and so on. It compresses the distances between people and makes almost everyone reachable. At home the telephone gives easy access to the outside world and for many people it is their main link to others. This is particularly so for disabled and elderly people.

Telephone services can be an addition to elderly care, especially when no other resources are available. Through help lines and personal assistance that is available all night through one number, an elderly person can make contact whenever she/he needs or wants to, and immediately connect with another party.

To enable elderly people to have convenient interaction with the telephone device, designers added some extra features to the basic device that are adjustable to the elderly person's abilities. Many old people, for instance, find it difficult to read a telephone number and dial rapidly on a conventional number pad. With a dial-out buffer memory a person can carefully dial a

number at their own speed, read it on a screen to check if it is correct and when ready press 'dial'.

The telephone can be a hindrance to communication if it is difficult to use. People with joint problems, arthritis, and troubles with their hands may have difficulty holding the receiver. Some designs make the numbers hard to read, and impossible to hold the phone without accidentally pressing the dial-pad.

Other problems may include finding and remembering the correct person or number because of cognitive issues, difficulty conducting and following conversations, and managing time while on the phone.

3.2.1 Cell Phone

The cell phone is an increasingly multifunctional and lively pocket companion; an interactive object with all the qualities of a useful cyber pet (Plant 2003, 55).

According to the Oxford English Dictionary, one of the earliest uses of the word 'mobile' was in association with the Latin phrase 'mobile vulgus', the excitable crowd (Plant 2003). Today's mobile lives up to these origins: the cell phone

(short for cellular phone in North America) introduces a new sense of speed and connectivity to social life, establishing new kinds of relationships between individuals and with the urban crowd. In this respect, the cell phone can facilitate the emergence of a new private world, a virtual community which can be pulled together in a matter of moments (Laufer 1999).

Elderly people and those with disabilities are using cell phone services because of the additional comfort and security these products offer compared to traditional telephones. An elderly person can sit down on a park bench and chat with friends. An alarm button for getting help is available if needed. Based on Global Positioning System (GPS) the user can easily be tracked in case of an emergency situation (COST 2000).

According to the research firm Yankee Group about 80 percent of American people between nineteen and sixty-five years old own mobile phones in addition more than forty-five percent of those who are between ten to eighteen years old do, but only 39 percent of people 65 and older use them (Matt 2004, 2). Among the elderly users, the most frequent calls were made to spouse (70%), children (63%) and friends of the same gender (49%) (Do Co Mo

Report 2002, 6).

There are some different approaches to mobile phone use among people, some value mobiles as a means of expression and social communication, others are more likely to use them as interactive toys on which they also tend to make more perfunctory calls (Plant 2003).

Text messaging has become particularly popular with individuals and in cultures which tend to be reserved with other people: in Bangkok and Tokyo, people value text messaging as a means to communicate without having to verbally speak about their feelings and thoughts (Plant 2003).

Some of the design issues affecting the disabled and the elderly users make the cell phone and its services useless in some cases. The dimensions of a cell phone device require that all buttons as well as the display must be small. Therefore, elderly people with disabilities may have problems navigating the keypad and if a person has reduced strength or problems with mobility, it can be difficult for them to find and press the individual keys if they are too small or located too closely together (Include 2003).

The other problem elderly users have is their reduced cognitive ability which may make it impossible for them to operate a cell phone as the operational procedures may prove to be a challenge to remember. Moreover, since the display size limits the ability of elderly person to read the contents, they are largely dependent on the audible features and feedback. It is therefore, only possible to make use of the most basic facilities of the phone.

Several studies have argued that cell phones leave people unable to appreciate the challenges, pleasures and opportunities 'dead time' can present. They expressed the concern that such connectivity might even undermine people's self-reliance, making them unable to operate alone, and leaving them dependent on the cell phone as a source of assistance and advice. (Plant 2003)

The cell phone as a new technology can help elderly people overcome some obstacles with communications but the device itself has proven to be less useful for elderly people than its services and applications.

3.3 Computers and the Internet

Many seniors have an antique notion of computers, counting their use of punch cards in the 1960s and 1970s as computer experience. They are afraid they will break any new technology they attempt to learn. Access, skill, and intimidation are the barriers - and the greatest of these is intimidation (eMarketer 2003).

In a February 2004 survey, 22% of Americans age 65 or older reported having access to the Internet. This represents a 47% increase between 2000 and 2004 and shows that elderly people are willing to participate in this new communication activity. There are, however, always barriers which prevent them from becoming members of this virtual society (Pew Internet & American Life Project 2004).

The survey conducted by Dr. Roger W. Morrell determined a number of specifics of Internet use and nonuse in over 300 middle-aged (40 - 59), "young-old" (60 - 74), and "old-old" adults (75 and above). Respondents indicated that they were primarily interested in learning to do the same three things: 1. use E-mail, 2. access health information 3. access travel information. They also found that computer ownership and access had stronger relationships to Internet use than

other demographic factors. Lack of knowledge about the Internet was also shown to be a major reason for not using it (Morrell et al. 2000).

Eight out of ten off-line seniors do not think they will ever go online. They often live lives far removed from the internet, know few people who use email or surf the Web, and cannot imagine why they would spend money and time learning how to use a computer (Pew Internet & American Life Project 2004).

The reasons for the lack of computer and internet use by the aged population have been researched by *Pew Internet & American Life Project* and they are as follows,

- Lack of experience with computers: Many of elderly people were probably not in the workforce when computers became standard issue at offices, schools, factories, and other work sites.
- The lack of peer or family reinforcement having significant effects on a senior's interest or ability to go online. In February 2001, 84% of 'wired' seniors reported that they first got Internet access for reasons unrelated to work or school and about half of those said family members encouraged them to do so. Younger Internet users are often eager to

share the benefits of email and the Web with their parents, grandparents, or other older relatives.

- Learning process: it takes more time for seniors to learn new skills and it is very hard for them to maintain or remember the things they have learned. The problem is compounded as the internet grows and increases in complexity, where the amount of offered and accessible information on different sites becomes overwhelming.
- Seniors are more likely than any other age group to be living with some kind of disability. This prevents them from using the tools and devices that are not adapted to their condition. Twenty-eight percent of seniors reported in December 2002 that a disability, handicap, or chronic disease keeps them from participating fully in work, school, housework, or other activities (Pew Internet & American Life Project 2004).

The research conducted by the Markle Foundation demonstrates that the internet can have a powerful impact upon the communication patterns of retired older adults. They feel more involved and connected to the outside world (Markle Foundation 2004). As a communication tool, the Internet has grown, and is viewed as an important and essential source of information by

the vast majority of people who use online technology, It has been estimated that about 55.2 million North Americans have used the Internet in some manner to obtain health information, among them 45% of adults over the age of 60. (Pew Internet & American Life Project: Online life report 2002).

Because older adults are heavy users of health services, it is possible that they could benefit the most from online health information. Thus, the Internet could be instrumental in helping older adults manage, and possibly prevent, disease, as well as maintain adequate levels of health literacy, which has been shown to decline substantially with age.

3.3.1 Email

The primary Internet communication tool is electronic-mail (e-mail). While e-mail is the least expensive type of Internet communication tool to implement, it is also the most powerful because it is simple to operate, fast, and reliable. For these reasons it is the most widely installed and used internet technology and the surest way to communicate with the broadest possible users. By 1995

the number of e-mails sent is thought to have exceeded the amount of ground mail. In 2001 nearly 12 billion email messages were sent every day and 440 million electronic mailboxes were in use, growing at a rate of 32% per year. (Jupiter Communications 2004)

E-mail combines the near immediacy of the telephone for reaching people with the word processing power of the computer. Although e-mail can include complex data types such as graphics, audio files and video, it is most often used to send plain text-based messages.

E-mail is also an extremely low cost form of communication. Unlike the telephone or standard postal mail, there are no volumes or long-distance charges for sending e-mail. This means there are no charges other than the basic subscription to an e-mail account to send one e-mail message across the city or 10,000 messages to the other side of the world.

It is also an asynchronous media. Responses to email may come within minutes or not for months. The advantage of this media is that people in different time zones, on different schedules, and in different locations can exchange and share data. Almost 88 percent of all Internet users in the U.S. use email. (Pew

Internet & American Life Project: Online life report 2002).

Email is equally popular among users age 65+ and their younger counterparts. Fully 94% of 'wired' seniors have sent or received email, as they find it a convenient way of communication. When they were asked to explain why they use more email for communication rather than Instant Messaging the answer was because they have more time to write and send the message. They would rather learn one way to send messages, and getting to their inbox and writing the message is the easiest and most common practice. Elderly people most frequently send mail to "children" (62%), followed by "friends of the same gender" (38%) (Pew Internet & American Life Project Surveys 2003).

3.4 Information Appliances

An information appliance is a computer-enhanced consumer device dedicated to a restricted cluster of tasks.

The concept of information appliances is borrowed from the traditional notion of an appliance: it is a device that performs only a few tasks, but does them well, efficiently, and with little conscious effort from the user (Norman 2001, 12)

Information appliances apply this notion of a dedicated device to computing technology, with the goal of creating small, easy-to-use, low-cost devices to only perform specific tasks. Instead of using a PC that does everything from email to 3D game playing, users can have a choice of owning inexpensive information appliances that perform a dedicated set of tasks suited to their needs.

3.4.1 Internet Appliances

An Internet Appliance is a tool that allows someone with no knowledge of Internet technology or computers to access the Internet.

In January of 1997, the research company Jupiter Communications predicted that sixteen percent of Internet access would be from non-PC technologies by the year 2000. That prediction set many different manufacturers on a quest to develop and produce internet appliances that could fill the potential demand.

To reach an audience that had not adopted the PC because of its complexity, the internet appliance pioneer 'Netpliance' developed a simple and "easy-to-

learn” interface for their main user target-elderly people, unveiling their product, the ‘i-opener’ in 1999 (fig. 3-3).

Fig.3-3 i-opener

I-opener was not introduced as a personal computer, but as a device that allowed users to accomplish three primary tasks with much greater ease than a PC. It addressed the assumption that there were three specific areas of need for the target users covered the following tasks;

1. Sending and receiving email.
2. Categorical Content (news, weather, sports, etc.)
3. Web Accessibility

While the concept is compelling due to their design specifications, and the consideration of the users’ needs as the main concept for the development of the device application, so far none of these various Internet appliances have been particularly well accepted by the public. Once heralded as potential PC

killers, internet appliances today are dropping in popularity. The study shows that early attempts at Netpliances failed because of poor product designs, high hardware costs and flawed business strategies by the vendors (Mainelli 2001). "The main purpose of most Internet appliances today remains unclear", says Milosz Skrzypczak, an analyst with the Yankee Group. He continues as follows,

Are they supposed to be Web browsers, e-mail stations, or something else? If an appliance is supposed to do many of the things that a PC can do but it doesn't do them as well, where is the appeal? (Mainelli 2001)

Two compact devices have also been introduced in the market. One is a small sized equivalent to the i-opener called the 'Mailbug' (Fig.3-4).

Fig. 3-4 Landel MailBug

Though smaller, the device is neither portable nor practical. Again the keyboard interface is carried over, but this time combined with a minute, hard to read monotone screen. Aside from the bland design, the mailbug requires a land phone line and external power source, effectively defeating the need for its limited dimensions.

Fig. 3-5 Interaction with the Mailbug

Fig. 3-6 Color BlackBerry
7230 Wireless Handheld

The blackberry (Fig.3-6), on the other hand, is fully portable and wireless, has a compact keyboard coupled to a decent sized easily readable color screen, and contains a variety of other functions, making it a truly portable internet appliance.

The main disadvantages to both devices, when viewed from the elderly users' point of view, are the keyboard interface, which furthermore is prohibitively small in the Blackberry, and the visual interface, compact on the Blackberry, and utterly illegible on the Mailbug. The Blackberry does however offer more potential as a mobile unit with efficient connectivity, and can provide design inspiration for communication device for the aged population.

Designers must continue to innovate and to design application-specific Internet appliances with an eye on appealing form factors that encourage frequent usage, said report author Navin Sabharwal. He noted that early adoption will occur in households that already have PCs, not in non-PC homes, which many in the 'Net Device' industry had not expected (Pastore 2001).

This argument has proven to be right because in long run, the non PC users were found not to be interested in internet appliances. Though conceptually designed for elderly users who are not familiar with computers and the internet, it appealed more to those with previous knowledge and confidence in using PCs.

3.4.2 Virtual Reality Creature

Domesticated pets have existed in human society for over twelve thousand years, and archaeological evidence points to the conclusion that these animals held social positions within the culture. Today North America is home to millions of pets, and pet ownership is a cultural experience that extends beyond the limits of a nation; the practice of raising animals for "non-utilitarian" purposes has been documented by anthropologists in a wide variety of societies throughout the world. The companionship and affection a pet can offer is particularly special to those in their later years, who often rely on their loyalty and presence to give a rhythm and structure to life, and possibly help fight the isolation and loneliness of old age.

In recent times some companies have attempted to replicate that relationship through electronic gadgets and applications. It is in the interest of this research to understand what it means to simulate the experience of pet ownership. Can raising a virtual pet act as a substitute for the owning and caring for real thing? Products such as Tamagotchi and the other imitators on the market offer an unconvincing simulation of the actual experience (Stern 1999).

Tamagotchi is a virtual reality creature that was created in Japan in 1996

Fig. 3-7 Tamagotchi

(Fig.3-7). The product literature explains how they hatch from tiny eggs after traveling millions of light-years through cyberspace to learn what life is like on earth, and eventually return to their home planet. A Tamagotchi's stay on earth is determined

by how well it is cared for by its owner. With proper care and feeding, it quickly grows into a friendly virtual pet, each individual Tamagotchi developing in a variety of manners and personalities.

Recognizing a shortage of meaningful interactive experiences with these products, a small virtual-pet industry has developed and offers desktop mounted alternative pets. One of the products is "Virtual Petz" (Fig.3-8).

Fig. 3-8 Virtual Petz

These characters are directly interactive with rich personalities, emotions, and the ability to express themselves through performance action and behavior, but lack the wider appeal of the Tamagotchi (as measured by market impact)

(Frank, Stern and Resner 1999).

While the Tamagotchi is hardly "pet like" in appearance (encased in a small oval plastic case), there is still a physical space that the "pet" can be said to occupy. The portability of the unit allows for another important feature: continuity. Unlike desktop counterparts, the Tamagotchi can never be paused or turned off for long periods of time. It is frequently necessary to "play a game" with the simulated pet in order to "keep up its spirits", and maintain its "health" (by keeping its "weight" low). This game provides the context for humans to treat the device as a real animal.

Fig. 3-9 Virtual Babyz

In order to increase the potential for more explicit interaction, designers produced the human cartoon baby characters "Virtual Babyz" (Fig.3-9).

Within the simplified cartoon-like visual style, "Virtual Babyz" can display a wide

range of emotional facial expressions such as happiness, giggling, laughing, crying, anger, curiosity, fatigue, and so on. They can crawl around their virtual house and pick up objects, throw them, use them, eat them and carry them to different places. Through voice recognition "Virtual Babyz" can understand simple words spoken by the user in the form of praise, discipline, and the names of objects. "Virtual Babyz" will "learn" to speak back these words in the form of "baby talk", allowing them to sound like they truly say what they want and feel. (All behaviors are pre-authored, with the user's interaction unlocking them over time, to create the illusion that the "Virtual Babyz" are learning.)

The success of the "Virtual Babyz" and "Virtual Petz", with over 2 million copies sold worldwide as of 1998, as well as the success of other virtual character products such as the Tamagotchi, is an indication that there is a

broad interest in these products. Moreover, there may be a pragmatic value to these virtual creatures. Current research into the therapeutic benefits of pet ownership among elderly people, the disabled, and emotionally disturbed children may intersect with the suggestion by psychotherapists that "it is probable that the ultimate potential of 'Virtual Reality' for therapy lies in the simulation of the social, as opposed to the physical, environment " (Glantz, et al. 1996, 465-473).

On the other hand some social theorists have not been so optimistic in considering the overall impact of virtual reality. Michael Cranford, a "Social Ethicist" at University of Southern California (USC) suggests that,

The degree to which simulated experience lacks the constraints of the real world determines our ability to apply substantive ethics. In the case of virtual-pet ownership, the "virtualness" is unsatisfactory in as much as it fails to result in real-world social consequences (Cranford 1996).

This raises serious concerns. As Myron Krueger writes in his forward to Micheal Heim's, *The Metaphysics of Virtual Reality*; "Will real action lose its immediacy when it is but a recapitulation of simulated activity?"(Heim 1993

3.4.3 Interactive Toy Characters as User Interfaces

The general assumption by interface designers has been that technology is simply a tool, similar to a hammer or a washing machine that helps the users either accomplish their existing tasks more quickly and easily, or allow them to do new things that would have been difficult or impossible using traditional techniques.

As interactivity has expanded both in scope and complexity, integrating computational intelligence with auditory and visual media, a promising new strategy for interface design has emerged in recent years that compliments the tool model. The new strategy is to treat human-computer interaction not as if it were a functional interaction between a worker and a tool, but rather as if it were social interaction between two people (Bickhard and Terveen 1995).

Treating the computer as a partner rather than a tool is thought to be beneficial to the user because such a collaboration, built on models of interaction between humans, distributes the burden of remembering, ordering, and executing all the elements of a given task between the computer and the user, rather than requiring the user to always be in control of all aspects of the

effort (Maes 1997).

Social interfaces can make interaction with technology simpler and more intuitive because they are built on implicit social understandings that users already possess, and hence require little extra effort or accommodation. In conversation for example, dialogue takes the form of simple turn-taking between users and computers to capitalize on the already-established expectation about interpersonal speech. It gives the interface a familiar feel for the user and can allow the interaction to go more smoothly as a result (Bickhard and Terveen 1995).

To test their hypothesis about humanized interaction and to investigate verbal

Fig.3-10 Aibo

and emotional communication between human and computers, researchers and designers have built interactive characters. Aibo is the first commercially available interactive pet (fig.3-10). Besides entertaining the user with its behavior it can also read web-pages and e-mails, with the additional "Aibo Life" program it also

develops its own character and behaviors. The user can initiate the interaction

by giving a voice command or touching the pet, to which Aibo will react with a set behavior. (Bickhard and Terveen 1995)

Tama, an orange cat and Kuma, a blue bear, (fig.3-11), are other examples of interactive characters, and were designed specifically as companions for elderly people. The Japanese health ministry commissioned

Fig. 3-11 Tama and Kuma

these toy characters to monitor elderly

people who need medical attention (Matsushita 2001).

These electronic stuffed furry animals rely on their digital brains and sensors to respond to their owners' moods, strike up a conversation with a bit of local news, or provide another party with feedback from the patient who plays with one of these interactive pets.

Each teddy bear sized electronic pet will record how often its owner talks to, touches, or squeezes it and transmit the information to welfare agencies. When petted, Tama and Kuma wiggle their arms and legs. When asked, they may

relay the local weather and social events. And when scolded, they can even express remorse. (Matsushita 2001)

A discussion on the underlying assumptions and consequences of these robotic applications is required at a broader social level. In the case of Kuma and Tama one can question the ethics and significance of marketing a synthetic creature to elderly people as replacements for real social contact, and as a valuable or legitimate alternative to other technologies and activities that promote and help build relationships with real people.

Many studies have been performed to attempt the integration of emotions into machines. Products range from computer games, to toys, software agents and robots. A more the recent attempt is the prototype of Muu2 (Fig. 3-12).

Fig.3-12 Muu 2

Muu2 focuses on the ability of emotional expression, which the designers believe would influence the enjoyment of the interaction. The area of interest in this project was the conveyance of one's presence by connecting

two sets of Muu2s over a network. "User A interacts with his set of Muu2s,

which are mapped to the actions of user B's set of Muu2s. By observing his set of Muu2s, user B can feel the presence of user A". (Bartneck et al. 2002)

3.5 Summary of Key Issues Related to Communication Devices

A set of complimentary themes can be isolated from the examples studied in this chapter, all contributing to enabling elderly people to access the shifting nature of information technology, and further using this access to help stay in touch with contemporary society and special individuals.

Each venture, idea, or device is only as successful as its ability to condense accessibility, usability, and interactivity into a unified format. Shortcomings or oversights in each category affect the properties and usefulness of other categories. For example, where a device may have a wide range of applications and availability, it becomes useless to someone who is confounded by its interface. And while the public face of a device is important, a badly designed application can put undue strain on a user.

When communication is made efficient and usable in ways that are tailored to elderly people, it enables them to maintain a sense of personal dignity and social relevance. The ability to maintain an intimate and personal connection with others is crucial in smoothing the social issues that appear in old age, and communication technology can help facilitate the various transitions while maintaining a robust social framework.

The ideal for interpersonal exchange through digital media must therefore incorporate wide availability and a friendly interface with adeptness for reciprocal contact. The following matrix (table 3-1) supported with examples, summarizes the important design issues relating to the development of communication devices for the aged population.

Table 3-1 Matrix of Contemporary Communication Devices for Elderly People

Examples	Technology	Accessibility	Usability	Interactivity	Opportunities
Web TV, merging television with interactive communication media	Familiar interface to have interaction with.	Consistency and clarity is very limited due to navigational process.	Keyboard and remote control as an input for navigation. it is based on PC interaction model. The out put is the screen of the television	Use of the familiar device as the physical interface for communication and interaction.
Rogers Interactive TV: browse the web, send and receive e-mail, shop and bank online, create personal websites, chat online, post and read messages in discussion groups.
Wireless personal communication.	Can be used as a security device. Size offers mobility and ease of carrying, but the features are not adaptable to elderly people physical and cognitive limitations.	limited usability due to the compact size of the devices. Tasks other than making a phone calls can be difficult and awkward. Limited consistency throughout the interface.	Voice receiver enables the user to have voice interaction with the other users. Ability to send and receive short text and graphic messages through the key pad and LCD display.	mobility and sense of security due to frequent use.
Cell phone: Wireless Personal Communication Device
Information appliances, Internet Appliances offering internet access	Less functionality compare to computers makes the interface more understandable. Provides content according to the user pattern of usage.	Needs computer knowledge and background.	Keyboard and monitor as input and output devices. Interface mimics PC interaction, requires previous knowledge and experience to use.	Less functionality but more simplicity. Specific device for specific tasks.
i-opener (Netpliance): Internet Appliance
Virtual Companion, Digital Stimulated Pet	The Interface develops and responds to the users patterns of usage.	User communicates with the "creature" by playing games with the character and allowing it to "grow". user must remain in constant contact with the device.	Small display and inadequate key pad as the interface for interacting with the device.	Encouraging the user to have frequent contact through the development of the device interface. personalization
Tamagotchi: Virtual Reality Creature
Desktop mounted program	with voice recognition, developing character and behavior through interaction with the user.	Requires computer access. Character development and involvement can be very limited.	Can make interaction with the computer fun and mimic human interaction. Communication is through voice commands, to which the characters react and respond to.	Developing social interfaces for communication with the device
Babyz: short-term narrative experiences, as well as long-term emotional relationships and narratives
Interactive Toy Character: Robotic Pet.	Physical character is easily adaptable to the target users with no previous knowledge. It reacts to the users interests and preferences.	Developing a relationship with an unreal character may cause a detachment from the real world.	speech and touch, and develops through the interaction with the user. Feedback from the interaction is then sent to social services to help monitor the user's needs.	Safety and security through connectivity. Developing tactile input and output. Device acts as an agent between the user and the other party.
Kuma: designed as companion for the elderly people.
Interactive Toy Character: Social Interface.	Developing social contacts between two users through individual devices. Easy to interact with.	For all its emotive characteristics, it is still a synthetic device. Involvement may prove to be intense yet ultimately unfulfilling.	Interaction through social interface. The facial reactions and expressions of one indicate the distant presence of another. Creates a more personal response through facial expressions.	Approximates personal interaction and presence through emotive facial expression, bridges distances and simulates closeness.
Muu2: social bonding and emotional relationship.					

4 Building a Communication Medium for Elderly People

Designers are struggling to conceive and build the ideal communication tools for elderly people. Studies and research on information media have determined that the problems in introducing meaningful and understandable interfaces for communications for elderly people are not caused solely by software designers and developers. Product designers have had a major role in making products user-friendly and acceptable for older adults.

Designing a communication tool involves expertise not only in the field of industrial design and engineering, but must also include an understanding of anthropology, sociology, psychology, computer science and user interface design, among others. It is one of the most challenging tasks of today because it is an inter-disciplinary endeavor, with few established guidelines or tried and tested conventions governing the design of communication devices for the aged population.

The consistent and rapid advances in the elements that forge these products can be driven by a self-feeding loop of technological pursuit rather than based on an assessment of human needs and aspirations. The relationship between

‘what’, ‘how’ and ‘why’ is thus in constant flux.

Most of the new communication devices that have been studied in this thesis were designed to display the latest available technologies. Consumer products and technology can improve the quality of people’s lives if designed to meet their requirements. This chapter focuses on existing principles of product design and its application for elderly people by considering the findings in previous chapters. It has to be stressed that communication devices can only simulate the experience of real personal interaction, and that the intention of this thesis is not to establish a replacement. The goal is to explore virtual and real communication experiences in order to benefit from both in developing design methodology for communication devices for elderly people.

4.1 Human Factors Considerations

Physical and cognitive limitations are the most important factors in any design implementation for elderly people. Chronic conditions in elderly people should be considered in the product design needs of elderly people. Studies in chapter

two indicate that a majority of older population suffer some level of limited psychomotor function such as arthritis. Traditional input devices such as computer mice and keyboards will, therefore, not be effective tools in a symbiotic communication system. This explains why some of the communication devices that have been discussed in chapter three could not succeed in serving the aged. Rogers Interactive TV and internet appliances, i.e. i-opener, were designed with the keyboard as the input device.

Another condition that elderly people face is hearing impairment. It affects the usability of products that rely on audio transmission as the prominent communication mediums such as telephones and cell phones.

Some individuals can also be affected by some degree of visual impairment. Current Liquid Crystal Display (LCD) and Visual Display Terminal (VDT) are used in a number of popular devices (cell phone displays and computer monitors, etc.), and can therefore be unusable. These technologies also emanate a contrast ratio too low for some seniors to read or view (Charness 2001).

Despite a few successful programs and discussions on design for elderly people, the studies speak more about what can and should be done rather than what is

being currently done (Spiegle and Molton 2001). While researchers admit to improvements in ergonomically designed products for the aging population, they also acknowledge the problems described previously regarding PC-based communication technologies such as e-mail and text messaging. Designers should consider concepts which can improve the quality of life for elderly people through a variety of physical, emotional and psychological interventions. (See Appendix B1 for more in-depth review of modalities for human computer interactions.)

4.1.1 User Friendly Heuristics

According to the studies in the previous chapters, one of the concerns in designing a communication device for elderly people is the usability of the product. Product features should be designed to fit the constraints of elderly people's limitations in order to enable them to manage the desired task without any help. It is important for elderly people to feel comfortable using any technological device.

There are some general principles in the design of these products which should be adhered to. These issues are most often not found independently and their overlap cannot be addressed in isolation. When considered and responded to in combination, the resulting ideas will lead to faster and easier comprehension and better interaction, which would translate into faster and easier communication.

Some of the design guidelines that are derived from this research are:

- In menu style interactions the most frequently used menu items are placed first on displayed lists, where possible selection can be with a single key. The objective is to try and minimize the memory load on users. (Barber and Noyes 1993, 134)
- Where information is displayed for users to read, it is recommended to use short words which are positively phrased. There is evidence that it is harder to understand material phrased in a passive or negative form (Barber and Noyes 1993, 160).
- Consistency is a key design objective of user interface design, as consistency makes it easier for users to build up their own internal models

of how a system will operate. It makes a system easier to comprehend and once something has been learned, subsequent similar situations will already be familiar. Controls and display layouts must be consistent to facilitate commands and operations. Thus it is important to try and ensure that menu items or keys which have the same labels perform the same functions at different points in a dialogue and that the same actions always have the same consequences. (Include 2003).

- Products should be designed to be obvious or apparent in operation. It requires a combination of good labeling, structured tasks and where necessary, cues for operation to be explicitly given. Thus if a user must press a key at a particular point in an action it can be useful for the system to explicitly remind the user that this action is needed (Include 2003).
- Error correction routines may also be of value in this context, guiding the user to appropriate actions when mistakes have been made. Another aspect of this is to try and ensure that interfaces are self descriptive, containing all the information that a user needs in order to learn and use them. Interfaces which do not provide these features will cause users to rely on

external sources of information e.g. instruction manuals (Rauterberg, Menozzi and Wesson 2003, 430).

- All actions should provide feedback to the user as soon as possible after an action. At the simple level, users should be made aware of when a control or action has been activated or engaged. In some systems this may be immediately apparent by the nature of the control task itself like telephone ringing, in other cases more explicit feedback will need to be designed into the interface. Where the required time to execute is stated, the user needs to be given immediate feedback on the progress of the task (Rauterberg, Menozzi and Wesson 2003, 140).
- Interfaces should be perceived by users as being readily controllable, enabling the user to immediately understand where they are in an action, and the range of actions that is available to them. If users can easily build a mental model or personal representation of a system they are using, it will facilitate their acceptance of it and make them comfortable in its operation (Rauterberg, Menozzi and Wesson 2003, 339).
- Emphasis, where it is possible, should be placed on reducing the potential for errors to be made. Error correction is important in most application

areas, and it can be anticipated that many elderly and disabled people will make many mistakes when learning to use a new system. It is therefore important that the user can easily recover from errors made, and also know that the consequences of any mistakes will not be serious. It is also considered important that error messages do not implicitly or explicitly blame the user for mistakes made, but rather should be positive and guide the user towards recovering from errors (Include 2003).

- In order to improve the chances of an elderly or disabled person being able to detect output messages it can be useful to relay the same message through the different senses. On a fire alarm, for example, the letters in the word fire would illuminate on a panel while a "buzzer" would sound. Where possible devices should give visual, auditory and tactile feedback in order to improve on redundancy and the chance of operating with a variety of disabilities (Include 2003).
- Elderly and disabled people may also have difficulty responding quickly to these systems and it is important for this reason not to force such users to respond quickly. It should be possible to slow down or turn off timed responses, or to switch off any automatic key repeat, and adjust its delay

characteristics. It is recommended that systems requiring responses in less than 5 seconds or the release of a key in less than 1.5 seconds should have such adjustments as an option. Users should be given flexible amounts of time to complete tasks, with the user being prompted when delays are excessive (Include 2003).

- Attention should be paid to the amount of information presented on a display unit as it is common for designers to saturate screens with too much information. It can be effective to ensure that each display only contains one key idea, and in all cases the use of blank space can help to focus attention. Another good principle is to ensure that displays are kept consistent, with the same types of information always being displayed in the same areas of display screens (Rauterberg, Menozzi and Wesson 2003, 874).
- An attempt should be made to minimize what the elderly person has to remember in order to use a system, and as recognition is easier and efficient recollection the interface should give the user clues as to what actions are permissible at any given point in the interaction (Rauterberg, Menozzi and Wesson 2003, 1008).

4.1.2 Meaningful Interaction

In human-human communication, multi-modal interaction is the norm, as speech, gesture and gaze merge in seamless streams of two-way interactions. Equally rich modes of interaction have, to a limited extent, proven themselves in human-computer interaction (Barfield and Furness 1995, 463).

Communication between humans relies on the five senses: touch, taste, smell, sight and sound. Of these, sight and sound are the ones to be specifically factored in the development of the communication device, thus creating an interface that allows for a more natural interaction which would resemble the social exchanges of everyday life.

A well designed computer interface offers the user an efficient and effortless flow of information to and from the device with which he [the user] interacts with (Barfield and Furness 1995, 168).

Regardless of the mechanism behind human social responses to machines, researchers have proposed social interfaces (interactive toy characters) as a way of using these responses to help make human-computer interaction natural, enjoyable, and efficient. Research in this field has resulted in designing products such as Tama, Kuma, Muu2 (Fig.3-11 and Fig.3-12) and other interactive toy characters.

4.1.3 Presence and Awareness

To discuss presence in the context of virtual environment, it is first necessary to discuss the concept of presence in the non-virtual or real world. "Presence" generally refers to the sense of being present in time or space at a particular location (Webster's II Dictionary 1984). Thus, presence is a cognitive state which occurs when the brain makes sense of the information it gathers from its surroundings. Barfield, in his book *Presence and Performance within Virtual Environments* proposed that the concept of presence, that is, the sense of "being there", or of a person or thing "being here", serves as the underlying conceptual framework for virtual environments (Barfield et al. 1995).

To design a communication device for the aged population, the designer must understand a virtual connection should occur between elderly person and the other party in the course of communication. He/she should feel the presence of the other party through his/her interface.

This could be seen in the design of Muu2 (Fig. 3-12). When the user interacts with the toy, he/she is aware of the other party through the reactions and responses from the toy. Similarly, a virtual communication device should offer

elderly people an awareness of the others' existence within his/her action environment. Hence, their interaction gains a dimension of reality and becomes more intimate and immersive.

4.1.4 Audio Interface Design

Audio alarms and signals of various types were used before there were computers. The development of user interfaces has historically been focused more on visual modes than on aural ones (Barfield and Furness 1995, 291). The development of an audio user interface will help elderly people to employ their natural communication habits to interact with a device. Sound and voice can influence the user's emotions, and may cause them to experience a sense of connection, physically and emotionally, towards the product. The audio user-interface in communication devices can act as an agent between the user and another party. By transforming data into voice communication to convey the message, it could make it easier for an elderly user to interact with the device.

In terms of audio interface design principles, several relevant aspects of how

such language should be scripted can be found in the research to date, most of it focusing primarily on adult users of telephone interfaces. Long speech segments will limit users' sequential memory, causing them to forget part of what they heard. This problem is worse in older adults whose memory capacity is quite reduced relative to younger adults. In terms of style of speech, research on adults using phone interfaces has found that open queries (for example, "what would you like to do now?") prompt user responses less often than do explicit directive such as "to place a call, press 1 now." These two findings concerning the value of directive speech have also been reported for elderly people using assistive devices. (Barber and Noyes 1993, 178)

4.2 Technology Considerations

Different types of technological considerations were studied in order to find compatibilities with the task of design, appropriate function, and user adaptability. Concentrating on specific selections rather than broader subject areas will help distill a correct proportion of technological components and ideas towards the shape and character of the device.

4.2.1 Synchronous and Asynchronous Communication Technology

Synchronous tools enable real-time communication and collaboration in a "same time-different place" mode. They allow people to connect and interact at a single point in time from great distances. A drawback of synchronous tools however, is that by definition, they require simultaneous participation different time zones and conflicting schedules can offer challenges (Barfield and Furness 1995). (See Appendix B2)

Asynchronous tools enable communication and collaboration over a period of time through a "different time-different place" mode. These tools allow people to connect together at each person's own convenience and own schedule. Asynchronous tools are useful for sustaining dialogue and collaboration over a period of time and providing people with resources and information that are instantly accessible, day or night. The primary drawback of asynchronous technologies is that they require some discipline to use when used for ongoing communities of practice (e.g., people typically must take the initiative to "login" to participate) (Barfield and Furness 1995). (See Appendix B3)

According to the research studies in chapter three, elderly people would rather

have asynchronous communication as it would allow them to communicate whenever needed and desired. The fact that both parties do not have to be present at the same time is a great matter of convenience for them.

It must also be pointed out that general assumptions consider asynchronous technology as something elderly people cannot benefit from if they are not internet users or unfamiliar with applications such as e-mail, bulletin boards or sending text messages via cell phones. Asynchronous communication can be a convenient technology for elderly people; there are currently no devices on the market which could offer them the advantage and the service.

The design focus of this thesis will instead try to accommodate those with no previous knowledge of such applications.

4.2.2 Invisible Technology

Expressing or concealing the technology that composes a product has long been a debated issue in industrial design and architecture. The American architect Louis Sullivan brought the expression "form follows function", claiming that

function, when intelligently considered automatically and naturally produces the ideal form. This meant that no material or function should be hidden or neglected, but clearly presented in the final design. While this was a principle foundation to modern aesthetics, most contemporary buildings hide all of their construction under stylistically embellished surfaces (Hjelm 2000).

According to Hjelm, reasons for hiding function are based on aesthetic assumptions, where designers purposely regard the technical elements as after-thoughts, contrary to the applied styles and visual sensibilities.

Eric Bergman begins his book *Information Appliances and Beyond* with an interview in which design expert Donald Norman details his vision of "making technology invisible." In the course of the interview he explains this idea, which he believes has to be applied to information appliances in order to make them work.

It is the kind of invisibility which is of a different sort. It's when the device fits the need so perfectly that the user forgets it is a complex technical device. Technology is invisible in the sense of not occupying any psychological space (Bergman 2000, 12).

Designers should make technology available for elderly people but keep the

product simple. It is crucial to design a product that is easy to use and adapt to the needs of elderly people. So the users do not view it as a hi-tech complicated device. It will be simply a tool to satisfy their needs.

“Hiding” the technology in this case then is not an act of stylistic concealment but a way to ease the process of understanding and promote familiarity. The technology is thus implied through the function rather than showcased as a design element.

4.2.3 Functionality versus Simplicity

A long-standing truth in the industry is that the more functionality included in products, the more complex it becomes. In designing information appliances, it is critical to reduce functionality to the most essential needed functions (Bergman 2000, 42).

Products should be simple to operate for elderly people. A trade off that needs to be explored is that between providing more functions with the corresponding possibility of a complex control structure, and more simple systems with reduced functionality. The indications are that the latter strategy

is likely to be more effective with elderly people, and systems should be developed which only provide simple functionality (Bergman 2000).

For elderly people to benefit from the advantages of using technology there should be a reasonable amount of tasks that they can readily understand and handle. It is best to reduce the functionality of the product and service and keep the design simple and understandable for elderly people.

4.2.4 Adaptive and Adaptable User Interface

Making interfaces suit the needs, desires, and preferences of users is one of the fundamental problems in human-computer interaction research. Many proposed solutions to this problem fall into two broad categories: 'adaptive interfaces', which change their characteristics automatically based on inferences about user requirements, and 'adaptable interfaces', which provide users with the tools to make such changes themselves (Fischer 1993). Both these approaches were first described in the early 1980's and are still evolving today. In the first decade of their existence, most literature on adaptive and adaptable

interfaces focused on describing systems that applied these approaches. More recent studies however, have considered the benefits and drawbacks of each approach and the possibilities for integrating them.

The ultimate objective of both adaptive and adaptable interfaces is to create an interface with greater flexibility through adaptation, but, there are substantial differences between the goals of the two approaches. These differences can be seen as part of a broader argument in the Human Computer Interaction (HCI) community, between the advisors of direct manipulation techniques, which endeavor to help users interact with interfaces directly, and the supporters of intelligent interfaces, which employ techniques such as software agents to mediate between the user and the interface (Fischer 1993, 49-68).

According to Shneiderman, direct manipulation interfaces provide users with a sense of responsibility for and control of the objects represented by the interface (Shneiderman and Maes 1997, 42-61). In response to this, Maes argued that the high complexity of the modern computing environment and increasing numbers of amateur users unaccustomed to dealing with this complexity

require a transferring of responsibility from users' limitations to the electronic capabilities of intelligence in the interface. Adaptive interfaces fulfill this need by modifying themselves in response to user preferences and habits, serving as what Maes calls "extra eyes, ears, hands and brains". Thus, while the goal of the adaptable approach can be summed up as empowering users by making them capable of performing adaptations, the adaptive strategy aims to bring adaptation to the system to allow users to focus on their tasks rather than the interface.

Design environments need to be both adaptive, in order to respond to user-specific situations with tailored advice and critiques, and adaptable, to allow users to apply tacit knowledge and to change environments in response to changes in the underlying domain (Fischer 1993, 56).

In conclusion, the studies have found that most of the comparisons and evaluations of adaptive and adaptable interfaces have found them to be complementary. Therefore the optimal solution will likely lie in integrating adaptive and adaptable techniques to provide a variety of adaptation opportunities and appeal to different user personality types.

Many of the problems facing elderly people in using interfaces can be solved by developing ones with an underlying approach of tailored adjustability.

Given the nature of age-induced impairments, designers need to develop an interface which has the capacity to adapt to the needs and pattern of usage and provide information to the user according to their lifestyle, interests and preferred information.

4.3 Computer Metaphors

The dominant interaction metaphor for the computer interface changed in the 1980's. Modern graphical interfaces, like those developed at Xerox PARK and used for the Apple Macintosh, have transformed the "text based" interaction from one in which users "talked"(by writing commands) to their computers to one in which they "acted out" their commands in a "desk-top" display. This so called desk-top metaphor provides the users with an illusion of an environment in which they enact wishes by manipulating symbols on a computer screen. (Barfield and Furness 1995, 15)

Metaphors are especially useful when they relate well to a user's experience. A good example is the desktop metaphor used by many personal computers. The

strength of this idea is that it uses familiar objects to indicate relationships by analogy (e.g., a trashcan for discarding files or folders).

It is generally agreed by interface designers that icon-based interfaces are more effective than purely textual ones, and that has led to the wealth of graphical user interfaces currently used. In a rehabilitation context, the use of symbols in complex selection tasks in communication aids is common (Zagler, Busby and Wagner 1994, 148).

But it is important to point out that the manipulation of the graphical metaphor is not always enough to present a complete interface. Especially in the case of the elderly users, who usually suffer from vision impairment have to be offered other alternatives. The interface should stimulate other senses as well, such as those of touch and hearing. The use of buttons with raised surfaces that indicate functions and engage the tactile senses, along with sound elements now commonly known as 'earcons' that refer to actions and commands through auditory indications will raise the quality of interface metaphors and the elderly people's physical and cognitive abilities.

4.3.1 Setting the Context through Meaningful Information

Elderly people must be able to make sense of the information provided by the interface. It should be suited to their requirements in order to be meaningful and beneficial.

The dictionary defines 'context' as "the parts of a discourse that surround a word or passage and can throw light on its meaning" or "the interrelated conditions in which something exists or occurs" (Merriam Webster Online).

Successful communication applications do not present data. If, for example, presenters have not bothered to provide context and build meaning, audiences have little patience for doing it themselves. As designers, we constantly must ask ourselves what service we provide (Shedroff 1999).

The proper organization of data can transform a raw quantity of general facts and figures into a set of qualitative information and knowledge.

Context tells us to get close as possible to the ideal situation of being physically present. Staying in context enables us to gather ongoing experience rather than summary experience, and concrete data rather than abstract data (Beyer and Holtzblatt 1998, 47).

The communication device learns from the habits and preferences of the user to tailor the information for maximum usefulness and expediency. It studies the users and preferences to extract specific criteria from the indeterminacy of mass information, establishing a contextual framework of asynchronous communication for the elderly user to interact in. While this may seem analogous to the way "cookies" operate in internet browsers, the device's system is not designed to target advertisements or commercial information to the user, but rather to facilitate the access to health information and personal interests.

4.3.2 Companionship Metaphors

As cell phones and other communication devices become part of the everyday life, a certain personal attachment can develop with the user and the habitual use of the object and the service it offers, providing a sense of companionship, dependability, and safety when carried around.

As previous chapters have shown, there have been attempts to produce

communication devices with the specific intention of providing companionship such as Kuma and Tama. With this strategy, elderly people not only benefit from communicating with the outside world, but also experience the closeness and existence of a companion which could increase the frequency of contact with the device.

4.4 Summary of Key Issues

The functional framework set in this chapter will now help determine the physical and aesthetic design features a device for elderly people the design process will incorporate the ideal balance of considered technological potentials and their adaptability to the target group.

User friendliness does not solely apply to the digital interface, but also to the device's tangible qualities, requiring a high amount of clarity and legibility, demanding a minimal amount of interpretation and simplicity as explored in this chapter, and encourage the sense of connection needed by users.

To study the user needs in applied research, there is a need to develop a design

concept of the literature research. The framework for the design developments of the communication device for elderly people should fit to these three criteria in order to address usability of the product;

1- The device should be easy to understand and navigable according to the users' limitations;

- Consistency of the interface brings clarity and ease of use.
- Access to the needed information and features should be prioritized.
- Minimizing the information and services offered by the interface.
- Contextualization: setting the information and services according to the needs of elderly users.
- Multi-model interface stimulates other senses rather than visual therefore the interaction with the device is easier, meaningful and adaptable to user experience.

2- Users' attention should be effectively focused with the help of visual, auditory and tactile input and output features;

- Reducing potential for errors by providing immediate augmented

modality feed back.

- The time frame for the action and interaction should be made according to the user abilities to respond.
- Offering presence and awareness through visual and tactile stimulations.
- Development of social interfaces and social interaction with the device.

3- Technology used in the communication device and its services should fulfill the needs of older adults;

- Combination of synchronous and asynchronous communication technology should be offered.
- Increasing the simplicity by reducing the functionality of the product.
- Tangible and non tangible interfaces should address adaptivity and adaptability.

This set of frame work is the theoretical foundation for the development of applied research in the next chapter.

5 User Needs Research

To identify the user needs in this part, the development of design concept for a communications device for the elderly takes into account the various issues related to asynchronous communication and considers interactivity that is possible through the device. The scope of this research targets a specific set of criteria and addresses their functionality and adaptability to the target group. E-mail has been identified as a revolutionary technology that has arranged the way society communicates. And while its use and reliance is wide-spread, the number of elderly who use it is still limited. The platform or product through which to present these concepts to the target user will be called the "Smart Companion".

This applied research is not intended as the definitive answer to the challenges of digital exchange. The design will focus on an interface for asynchronous method of communication to be used for elderly people with no PC experience in order to identify the user needs towards interacting with the communication device and further develops the design methodology.

5.1 Challenges

The challenges the Smart Companion attempts to address are:

- How to bring the elderly in the family, who often cannot benefit from the technology to keep the same level of contact with others, into a closer sphere of contact. The elderly and their families live far from each other, and younger generations in the family keep in touch from distances via e-mail and text messages.
- Building an alternative for family members who try to be in touch with the elderly via devices that they already feel comfortable with (such as the telephone), but which may not always be viable due to limited accessibility, or a lack of time or inability to speak.
- Creating physical and interactive virtual interfaces that are easily accessible, navigable, and continuously adaptable. The elderly may have minimal computer experience, making user interface metaphors and models that are borrowed from desktop environments inappropriate. Pop-up menus, scrollbars, drag and drop actions and desktops may be quite unfamiliar. They may feel uncomfortable dealing with anything

that is considered to be too “high-tech” and tend to be unwilling to learn complex interaction models.

5.1.1 User Specific Issues

Old age involves challenges for people in later life, as pointed out in earlier sections of this document. Apart from health related issues, they have to learn to cope with changes in their lifestyle and adapt themselves to products that help make their lives more convenient.

The most important ones that have been identified are physical and cognitive limitations, along with the issue of adaptability in later life. As people get older, changing their habits and starting to use new devices may be hard and discouraging for them.

5.1.2 User Needs Assumptions

Defining user requirements in a new field is a difficult task. Customers who have owned a particular type of product have many opinions about what they need when buying another. In new product category, however, it can be difficult for the consumers to know what exactly they want (Bergman 2000, 60).

The users' needs have been identified through the research in chapters two and three, then developed and addressed in this and the following chapter; the ability to maintain contact and communicate easily with friends and loved ones. Access to an easy to use and adaptable communications device will be a facilitating factor, allowing the elderly to be part of the ever changing landscape of communications technology. In this chapter testing the design concept on the target group will further the development of the user needs research.

5.1.3 Design Considerations

i. User centered approach

Effective user involvement in the design process is an important step in improving usability, functionality, and adaptability. In mainstream product development much useful information is obtained by studying how the consumer uses existing products and the difficulties that are faced in those activities. It is also important that the designers understand as fully as

possible the context in which a product will be used, as a lack of this is often a major weakness of existing design methods. For example, design methodologies for large information systems often concentrate on understanding the manipulation and flow of information, so that database applications which model the structures found in the real world can be constructed. But little emphasis is placed on understanding the activities making up a particular person's habits or needs, and many software developers see design work and task allocation as outside their area of responsibility.

It is difficult to create a good product if the designers have little idea of how users will operate the device in practice and the way that use of a system fits into wider task activities.

ii. Adaptability and adaptivity

Chapter four provided information about adaptive and adaptable interfaces and the possibility of their integration. The device should learn from user's preferences and adapt itself to them in the usage process, therefore helping the elderly to experience a sort of natural interaction. The

interface software and hardware should adapt itself to the changes that the elderly may go through in the process of aging.

iii. Account for the target domain

The user interface of the communication device for the elderly must suit the application domain for the device. A domain is characterized by the environment, the application or tasks, and how the device is likely to be used. This device is to be dedicated to a set of very specific and related tasks in a defined setting, such sending and receiving text-based emails and images. Both hardware and software are optimized for this domain (Bergman 2000).

iv. Dedicated device and user interface

Communication products use input and output methods optimized for particular uses. A Mailbug has a keyboard for text input, while a Blackberry uses its smaller equivalent, the keypad. Additionally, the functions available on the devices are specific to their purposes. ITVs may have a

dedicated electronic program guide, and a blackberry may have an address book and calendar.

The focus of the design should consider product requirements and a user interface that is integrated with the applications and input/output among other characteristics. This high level integration works to the advantage of the user because all components are designed to work well together and with one goal, to get the specific task done.

The user interface may vary from one product to another. This variation can be true even for the same software application deployed on different hardware platforms. For example, consider an email application that must run on a TV set and a Blackberry. In the case of the ITV, the application will appear on a color TV screen (at roughly 640 x 444 resolution for an NTSC signal), and the user interacts with the product using a remote control. For the Blackberry, the application will appear on an integrated 240 x 160 color LCD screen. The user interacts with the product using an integrated "thumb keyboard". Clearly the display size and color differences, as well as input mechanisms, will have significant impact on

the user interface in the two products. Each interface and device must therefore employ different approaches to the same application.

v. Allocate functions appropriately

Communication devices offer the opportunity to depart from standard input/output (I/O) of a desktop PC, such as keyboard and mouse, and discover other opportunities for I/O that may be closer to the target user's experiences in real life.

Good design can allocate functions to best meet the needs of the device and its users. These design decisions have considerable impact on the user interface and two of the key factors in determining the allocation of functions are usage frequency and importance of use. Tasks that users perform frequently should be assigned to very visible and easily accessible locations in the user interface; this approach applies to both hardware and software. Importance of critical features must also be made highly available to the users. Importance and frequency of use are somewhat related, but they should be considered separately. There may be functions

that are not performed frequently but are quite crucial to the successful use of the product.

vi. Simplify

In the case of designing for the elderly, simplifying the user interface is a prime objective. Easy and understandable interactions between the user and device should be considered according to the users' physical and cognitive limitations. Arthritis, hearing impairment, visual impairment and speech impediment are the main disabilities which will affect the ability to communicate with others in effective ways. In both the physical and virtual world the design of the communication device and its application should consider these disabilities as priorities and implement the suitable input and output devices for the user to interact with.

One of the approaches to simplifying and adjusting the interface for elderly users is to develop and adapt the characteristics of communication products and applications that are familiar to them into the new design. A concentrated functionality will result in more simplicity, as was discussed in chapter four.

vii. Design for responsiveness

Users expect immediate and reliable responses to their inputs. Heightened responsiveness is a positive quality of any system, and is a goal in the PC domain as well. For the consumer, however, responsiveness takes on characteristics that are unconventional from a PC perspective. The two most important criteria in this design are "interruptibility" and "continued feed back". In the communication device, almost all operations should be immediately interruptible. Users build an experience of behavior through years of using other consumer devices, such as TVs and telephones which can be interrupted any time. Additionally, it is important for the user to feel in control. The communication device should respond continuously so users are confident that their inputs are being processed.

5.1.4 Preliminary Steps and Objectives of the Design

The functional and formal requirements of the device are derived from information gathered from the literature research. The questions here try to address the fundamental characteristics of the Smart Companion, and establish a set of assumptions to develop and follow towards the establishment of specific design methodology for an interactive communication device.

The design assumptions are as follows:

- What should the product be?

The product is a communication device that provides a sense of reliability through instant asynchronous communication between user and his/her loved ones. It can be carried around and have easy input and output abilities.

- What should its function be?

The design development will focus on the ability to send and receive messages and pictures. Web access and online services such as providing health information and other desired tasks for the elderly can

be implemented as the user feels more comfortable with the device.

- What input/output behaviors should be included?

Input and output devices should resemble the user's previous experiences in interacting with similar devices. When composing a letter or message for example, the user has the experience of writing rather than typing, or when executing a command the user can verbally relay his/her wishes in a way that resembles everyday social interactions. Speech, touch, and vision will be considered as the main interaction forms, and the input/output devices and methods will be designed accordingly.) Appendix B1 shows the technology and features consideration to design a communication device.

- Aesthetics considerations: How does the device look and feel?

The device should fit the living environment of the elderly, and possibly avoid a gratuitously high-tech look. It has to be modeled in a manner that allows for easy adaptability through the similarity with devices and objects that the elderly user would already be familiar with. This would allow a more comfortable connection with the device.

The device would therefore have:

- Immediate accessibility (Always on when approached)
- Attractive appearance
- Easy navigatability
- High quality display screen
- Voice enabling
- Expandability (Software and hardware)
- Portability (Compactness, lightness)
- Familiarity and adaptability

The physical layout and visual interface of the device is designed through a user-centered approach, and focuses on their specific needs and abilities. It is intended to encourage the elderly to have more contact with their friends and families by using the same media that are popular and more in use in contemporary society.

5.2 Proposal One

The study has resulted in the design of a communication device which has been named the "Smart Companion". This first iteration of the communication device attempted to bring together information based on the literature search, and tried to cover the needs of the elderly for communication, along with their

interests in other activities. The design was intended to be used as a preliminary prototype to test initial assumptions. The design addressed these two areas of focus;

1. Sending and receiving e-mail.
2. Categorical content (news, health information, chat room, games).

In this design the user has the option of interacting with the device alone or along with a TV display. The Smart Companion can be carried around the house and also outside through its integrated wireless service.

The user can receive e-mail messages through the device, which would inform the user who the message is from and then read it to the user and the message receipt would be forwarded to the sender. The user has

Fig.5-1 Proposal One, Smart Companion

the option to answer the message, save it for later time, or delete it immediately.(Fig.5-1)

This first version of the Smart Companion is designed to encourage the elderly to go online and communicate in the virtual world with other elderly people and their own families, through the ability to interact in online cafés and participate in online games. Statistics on the use of health information can be also kept to respond to physical concerns.(Fig.5-2)

Fig.5-2 Device Action Path Organization- Proposal One

The main input and output device of this design is an audio interface which gives it a more natural interactive character; it asks questions to which the

user can agree or disagree, and tailors command options to the sequence of answers. Different colored light emitting diodes (LED) will also indicate a variety of options and commands.

The device can plug into a television and access a wider area of interaction. (Fig.5-3 and 5-4) It duplicates the performance of a remote control, which users will find familiar to navigate with. The device can build a database of

users' habits and tailor command sequences to suit them. (Fig.5-5 the TV interface). (Fig.5-6 shows the available services on TV display)

Fig. 5-3 Smart Companion -Proposal 01 Interaction

Fig. 5-4 Proposal 01 - User Actions Chart

Fig. 5-5 Proposal One, Extension of the Smart Companion .TV display

Fig. 5-6 Smart Companion TV Information Organization - Proposal 01

5.2.1 Testing Proposal One

The first tests were performed to observe the reactions of users to the initial prototype of the device and their level of comfort with its formal features. The test was conducted in Sandy Hill Community Centre in Ottawa on five potential qualified users. The goals of the testing were to identify the impact of the device and its services on the users and the usability of the product.

Focus groups were asked to watch a short clip about the services that the device offers and to write down their understanding of the product. Through the different steps of the testing the questions were focused on different aspects of user needs and desires. This helped in developing an inviting layout for a tangible device and its tactile features, allowing for a better level of usability. The digital interface was then developed in relation to the degree of comfort the users felt with the layout and the preferred services.

Aside from being an integrated communications solution, the proposed Smart Companion also has the ability to connect to a television. This was seen to be a rather superfluous feature, as the users were far more interested in personal one-on one interactions rather than the communal sort offered by the online

cafés through television connectivity. Based on feedbacks, the main focus therefore shifted to developing the internet-appliance capabilities of the device further, specifically e-mail applications that would help the users maintain contact with family and friends.

Please refer to Appendix C1 and C2 to view testing materials and comprehensive results.

5.3 Proposal Two

The questions and considerations from section 5.1.4 were followed-up and updated to more specifically address the requirements of this new version.

It was determined through the tests performed for proposal one that the users were more interested in a self-contained device that facilitated their e-mail connections with family members and friends, and would rather not trade those features for broader connectivity to groups and strangers. The interface concept will concentrate on the Smart Companion's e-mail compatibilities, and the ease with which the users would be able to adapt to it. Its fundamental

function would be to send and receive text-messages and images through e-mail. The device also has the ability to archive the correspondence and images into a personal album that can be accessed at any time.(Appendix C7 shows the design development)

This second iteration of the Smart Companion presents a friendlier face to the user, with a more fundamental layout of buttons set to facilitate sequences of commands; both the buttons and screens are large for easier legibility; commands are given through vocal inputs and touch screen options, while data can be input directly on -screen with a stylus.(Fig.5-7) These options, being based on daily activities such as writing and speaking, will help the users immerse themselves faster into the device. To create a further sense of familiarity, the device resembles a table picture frame, which reinforces its visual character and blends well with the furniture and decorations.

Fig. 5-7 Smart Companion - Proposal 02

The second iteration integrates all the functions without the need of external outputs. The large buttons are lit and easily readable, and the docking station acts as a battery charger.

5.3.1 Device Usability

Interface Features

Fig. 5-8 and Fig 5-9 shows the interface of the product. (See appendix C8 for product technical features.)

Fig. 5-8 Device unfolded for writing a message. When opened, the device gives the user the option to read old messages or write a new one from scratch.

Fig. 5-9 Screenshot of writing interface. The user inputs the message directly into the body of the message with a stylus, and choose one of the options on the left screen.

Buttons

The buttons are large in size so as to be easily understandable and accessible. They give visual feedback through their LEDs, and work synchronously with the audio interface which can describe the status of a command or the function of each button.

E-mail:

To activate the e-mail application the user has to push the button and the application starts running. Also when the user receives a message the button color changes from dark red to light red and flashes.

Album:

To activate the Album application press the album button and the blue light will illuminate to indicate that the album feature is active.

Audio Interface:

Activates and stops voice commands and interactions. Also adjusts output volume.

ON/OFF: The button lights up when the device is on. The audio feature also announces when the device starts or ceases operation.

Pen release:
Releases the stylus when pressed.

E-mail count: when the device receives a message, the total number would be displayed on the device.

Battery life light:
When the battery is full the blue color covers the whole rectangle and as the battery is being used the white area become more visible and when it is

Aside from tactile and voice commands, the device also accepts personal handwriting when using the stylus on the touch screen display. (See Appendix C6 for a comprehensive inventory of interactive content.)

5.3.2 Device Information Organization

Fig.5-10 Device Information Organization

5.3.3 Website Data Organization

The Smart Companion requires the equal partnership of the device users and their acquaintances in order to function smoothly and effectively. When first purchased and delivered, a person with internet access, possibly a family member who bought the device for an elderly relative, registers the device user's information into the Smart Companion's website. People who will be in

Fig. 5-11 Smart Companion Website Organization - Proposal 02. Pt. 01

When first purchased, both the device user and the sender must be registered on the Smart Companion website. Once registered, the website creates a personalized homepage. The sender can then circumvent the initial steps, log directly into the members' area, and send emails to the device user.

-contact with the elderly user will also register in order to be able to correspond to each other. Limiting the ability to exchange emails exclusively through the website creates an intimate circle of acquaintanceship, and furthermore prevents potential commercial sites and strangers from sending spam mails and advertisements. (View Figs. 5-11 and 5-12)

Fig. 5-12 Smart Companion Home page Organization - Proposal 02. Pt. 02

After registration, e-mail sender logs in and accesses the home page in order to communicate with the user of the device.

5.3.4 Use Case Scenarios

Linda is 72 years old and has never used a computer before. She lives in Ottawa and wants to communicate more frequently with her children - Bob in Toronto, Susan in New York- and their families. Linda would like to be able to send e-mails to them and her grandchildren, and in return receive e-mails and pictures back from them. She has seen the Smart Companion advertisements, and several of her friends have bought it. She called Bob for advice, and he tells her that the reviews he has read say the Smart Companion is convenient and easy to use.

Linda decided to purchase the Smart Companion and calls the 800 sales numbers, where a representative informs her about the device and service options. She provides a credit card and shipping information and is then told that the device will be on her door step within the next couple of days. She is also told about the website where Bob can register the device and names of the user and contacts, and fill in the address book entries for her.

The Smart Companion arrives two days later as indicated. Linda opens the box and scans the graphic instruction sheet. She takes the device out of the box

and finds it very light. It lifts up as one unit. She removes the cover wrapped around the Smart Companion and its base. Linda plugs the power cord in to its outlet. She presses the power-on button and the device comes to life in a few seconds.

The Smart Companion provides a short introduction and navigation tour through the sound and graphical interfaces that explains the basics of using it. Linda is then asked to say her first and last names or write them down on the screen. The Smart Companion recognizes and records her information, and informs her that her name has been registered (since the device has been personalized when it was sold) and "lindasmith@smartcompanion.ca" is automatically entered to her address book. (Fig.5-13 shows the sender use case scenario, Fig.5-14 shows the user use case scenario after the message has been received and for better comprehension Fig.5-15 shows Linda's action chart.)

Step 01. Screen shot of Sarah, Logging in to the Smart Companion web site

Step 02. Screen-shot of Sarah's home page.

Step 03. Screen shot of Sarah composing a message to Linda

Step 04. Screen shot of generated message by the web site

Fig. 5-13 Web Site Use Case Scenario

Linda now sees the Smart Companion user interface that was explained to her in the introduction. (Figure 5-10 shows the Use Case Scenario for Linda, when she first interacts with the received message from Sarah.)

Step one: The device receives an e-mail, and the red button flashes to notify the user. The device will also make an audio announcement to that effect.

Step Two: Once unfolded, the email is immediately shown on the screen, and the user is given a number of options to help them read it. The sender is informed of the email being read through a digital receipt.

Fig. 5-14

Smart Companion - Proposal 02
Opening Sequence - The user receives a notice of an incoming e-mail and unfolds the device to read it

Fig.5-15 Action Chart of Linda Use Case Scenario

5.4 Testing Proposal Two

The tests were performed to study the ease of use and level of comfort the target group would have in handling the Smart Companion. The test was performed on four of the potential target group.

Fig.5-16 A message has been received
Image of the user when
she was told to explain
each button on the interface

Their interaction with the mock-up of the device and its content was closely observed. (Figs.5-16, 5-17, 5-18) They were asked to try and send a message to one of the members of their family using the device and then were asked to record their ideas and opinions about the usability of the product.

The feedback was then used as recommendations for updates and the fine-tuning of the device. A questionnaire referring to the ideas behind the functions of the interface was also submitted, describing its interactive features, ease of use, and elevated adaptability. The response from the questionnaire helped establish a set of command-sequences that follow logical steps and ease the level of intervention required by the user.

Fig. 5-17 Image of the user when she was told to interact with the interface. User reads the received message

The device's portability and album features were identified as its main physical and visual strengths, while its ability to efficiently and effortlessly connect the user to friends and family was regarded as chief amongst its functional attributes. Users at first

seemed to be puzzled by the different services available on the device, but soon learned the advantages of the complementary functions through the Smart Companion's easily navigable layout. Users also expressed interest in the device's potential to further expand it uses at a pace commensurate to the level of comfort and comprehension experienced by the user. (Appendix C3, C5 shows the testing materials and the result that merged. Appendix C4 shows the visual experience of the testing)

Fig. 5-18 Image of the user when the the product portability was tested

5.5 Summary

The previous literature research and the applied study now leads to the delineation of a set of design methodology that help develop a communication device for elderly users; they can identify and orient themselves through it, communicate and interact with others and participate in the growth and progress of virtual communication technology, experiencing a sense of belonging. Through the design of the Smart Companion the attempt was made to address the challenges and questions raised by the literature research. These challenges are inter-related and have overlapping characteristics.

As communication devices become part of everyday life, a certain personal attachment can develop between the user and the object through its habitual use, reliability, durability, ease of use, consistent adaptability, and relevant functions. The research aimed for the development of the design of a communication device which can become an indispensable tool in facilitating interpersonal connectivity for those who can not cope with input/output and the interface of the common virtual communication devices.

6 Design Methodology

Connectivity is at the heart of community. People have to be able to easily exchange words and thoughts in order to feel a sense of belonging, mutually addressing each others' presence in a network of communication that closely binds the individual with the broader group. Proximity is not a requirement anymore, as people from different continents and opposite hemispheres can interact with the ease and convenience of living next door.

This research topic began with identifying the issues and causes of loneliness in the elderly and their relation to contemporary methods of communication. As the study progressed it was determined that older people are less disposed or often unable to absorb the technical requirements needed to effectively use technologies such as the internet to keep in touch with the outside world, resulting in a condition of detachment and isolation from mainstream. The focus of the study therefore, shifted towards the contemporary issues regarding the interaction between older adults and communication devices in physical and emotional levels.

The factors concerning inaccessibility are various yet co-related. As technology

progresses at an accelerated rate it inevitably leaves a trail of obsolescence, and the evolving pace of digital communications demands a continuous level of updating and retraining from its users. Each leap causes previous advances to be surpassed, along with the skills that had been learned to qualify at the time. It is therefore inevitable that certain sections of society are at the mercy of this continuous process and cannot handle the course of change; those with issues of a cognitive sort, people with certain infirmities or physiological problems, and individuals who just cannot naturally acclimatize to new demands.

Elderly people are the main group in danger of being rendered irrelevant. Where the pace of progress outstrips their ability as a group to constantly readapt, the gap between the rest of society and their own abilities runs the danger of becoming immense and possibly insurmountable. This in turn continues the cycle of isolation that is created from their inability to connect with people outside their immediate social circle (which often includes only other older people), steadily concealing them in a world where communications are becoming faster and more specialized.

Part of the response to this age-related condition is an increased access to newer methods of communication, which facilitate conspicuous interaction through communication devices and allow the elderly to reach the people who may mean the most to them. But how is it possible to circumvent the learning curve and high demands of the new technologies? Communications are contingent upon the availability of the devices that allow them, and design may therefore be able to provide a viable solution. Devices that allow the elderly to easily access the internet through clear and effective interfaces, which, when well designed allow the user to progressively adapt to changing scenarios, and would also be continuously adaptable to the user's skills, would be an ideal way to embrace this neglected group in the domain of virtual wireless communication.

The literature search and applied research conducted in this thesis led to a design framework that can be followed in order to produce an internet device which is tailored and suited to the users' abilities and skills.

6.1 Generated Design Methodology

The latest technological advancements often leave the elderly behind. Users can feel comfortable and take advantage of new technologies when access to the advancements is tailored and designed to meet the requirements and cognitive abilities of that age-group.

In the design of a communication device its functions and tactile appearance must involve the end-users and consider their needs in the design process. The research undertaken in the previous chapters, along with direct feedback from the polling of target users, has led to a set of design methodologies that establish a creative framework for Industrial designers and media designers, on how to create a communication device for older population who have limitations in working and adapting to advanced technological devices, with a user centered approach to the design concept.

User Analysis

The designers should identify the detailed information about the target users of the proposed product and their requirements. User analysis leads designers through a process of identifying users and the challenges they may face due to technological advancement and its effects on their lives. The target end user population are elderly people. It is worth bearing in mind that many people in this category have cognitive and physical limitations and this factor along with the list which follows should be considered in development of a virtual communication device for elderly people;

- Physical and cognitive limitations
- Poor Financial Status
- Isolation from mainstream due to technological advancements
- Technophobia
- Inability to adapt to any changes
- Limits of knowledge
- Family reliability for social care
- Geographical isolation and lack of traditional family support

Similar Product Analysis

In order to understand the users needs and to identify them, the process of usability, adaptability and interactivity of similar communication products and those which are more in use by the elderly people should be classified according to the kind of use they will make of the available products. The kind of activity the user would have with these products and any background information on user attributes based on the information on their background research would identify the values and drawbacks of each product. At this stage of the analysis some decision also needs to be made regarding the bearing each particular attribute may have on the development of design concept of the product.

The opportunities that could be carried out for the development of a new communication medium is as follows;

- Familiar interface
- Providing the sense of safety and security
- Applying tactile and audible interactivity
- Mobility
- Personalization

Activity Analysis

In “activity analysis” the users need to be analyzed in more detail in relation to interacting with the similar devices that have been identified in “similar product analysis”. Their preferences and their interests should be analyzed. In addition, the relation with the product and the other party should be studied, and any implications that this may have for design concept and personal connections with those they love and cherish.

These include:

- Active TV viewers
- Internet communication by Asynchronous services most of all e-mail activity
- Internet and acquiring needed health information
- Contact with family and friends with telephone

Environmental Context

This tool considers in more detail what is known about the environment in which the product will operate, and any implications that this may have for design. This tool reminds designers to consider the wider implications of how the product will be supported, and also documents some of the likely implications of these decisions.

Even at this early stage, the designers should be encouraged to understand the service provision aspects of their product. The tool highlights issues for clarification and implications for design which are considered in other more detailed stages of the Methodology, namely the “user analysis” and “activity analysis” tools.

The communication device operates on physical and virtual environments and the designers should understand and identify the different technology that could be used in these two environments.

The technologies identified in this environmental context are as follows;

- Social interface technology
- Synchronous and asynchronous communication technology
- Non-visual sensory stimulation

Concept Developments

To gather implied information and to have direct contact with users and observe them in interacting with the concept design, the mockup should be made and shown to the users. Their reactions and comments should be recorded and then fed back to the development of the concept design.

In concept developments, the interface application of the product has to be developed along with its tactile features. The results that merge from the user needs testing, help to identify the needs of the users in both environment at the same time. In addition it helps to further the study and develop the concept at mutual and practical level.

In this study, in proposal one, the interface and the physical appearance of the Smart Companion were developed considering literature research of users needs and activities. When tested the result showed that the interface as well as the physical appearance of the product need to be changed. The users' comments along with furthered applied research resulted in the creation of proposal two with the same attributes but different interface for both environments.

Usability Evaluation

Evaluation is a creative exercise which involves an understanding of how specific users are likely to use a product and the way in which different activities may interact with each other. The overall aim of this tool, therefore, is to describe the common activities that will take place when the product is

used and from that design test procedures that will measure how well the product supports those activities.

The type of evaluation required an overall plan of how these activities will be carried out. It is anticipated that the evaluation plan would be developed in a workshop held with developers and other relevant parties, and that normally this would take place when there was a reasonably good understanding of what the product was going to be, the activities that would take place, and the attributes of any users.

The outcome of this exercise should initially be a plan showing what usability goals have been identified for the product and a summary of how these will be measured in practice.

Once evaluation activities have been conducted the results of these are also documented to produce a summary of the evaluation findings with a list of actions that are needed. As mentioned above, this process is commonly iterative with the findings of any evaluation being fed back into the design process with the aim of refining the product further.

Design Developments

The final step is for the designers to develop the prototype of the tested and evaluated design concept and test in a limited market trial.

6.2 Conclusion

In order to be useful from the users' experiences, designers have to understand that the perceptual abilities of the elderly, their experience and needs are different from the rest of the society, and must be directly addressed to fulfill any design criteria.

Technology must allow for a broader inclusion of users in order to be a more equalizing force in our society. The stated design methodology can begin to offer designers a reasoned antidote and an inclusive purpose by informing the formal concept of new devices with new ideas of interactivity. Once the barriers have been dropped to wider accessibility, elderly people will be more able to use the advances and requirements of new technologies.

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Appendix A1

**Percent of Canadian Households Using the Internet by Age
Rural, Urban, and Central City Areas 1998 (Statistics Canada 1999)**

	CANADA	Rural	Urban	Central City
Under 25 years	20.5	13.3	22.0	22.8
25-34 years	30.1	24.2	31.6	28.8
35-44 years	34.1	30.2	35.4	31.3
45-54 years	35.0	30.8	36.5	30.7
55+ years	14.6	12.4	15.4	13.8

Appendix A2

Use of Technology by The Elderly (Statistics Canada 1999)

Technology used (N)	45-54 (206) %	55-64 (204) %	65+ (198) %
Calculator	75	65	39
Cable TV	40	39	32
Computer	37	29	18
Video recorder	12	7	6
Automatic Teller Machine	19	14	10
Video Games	29	14	12

Appendix A3**Technology Trends and Developments (Harvey 1995).**

ENHANCEMENT SERVICES	INTERACTIVE MULTIMEDIA CAPABILITY	MOBILITY
Telephone phone	voice mail/Conference calls Call waiting/Transactions	Videotelephone/Cell Fax
Television	Pay Programs/ Electronic shopping	Videoconferencing/ Portable TV
Computers	Internet/E-mail/Telephony Bulletin board/Chat rooms Text Transfer Computers	Lap/palm top

Appendix B1

Modalities for Human Computer Interactions (Spiezle and Molton 2001)

	Modality	Technology	Function
1	Character entry and discrete event entry	Switches, keyboards and keypads Tablet and Stylus with handwriting recognition	Entry of discrete items of information such as characters and mouse clicks
2	Speech input	Discrete speech recognizer Continuous speech recognizer	Entry of words, phrases, sentences and commands
3	Pointing	Mouse Tablet and stylus Head tracker Eye tracker Body-part tracker	Pointing to objects on the screen Selecting blocks of text Drawing on the screen
4	Gestures	Video camera with image recognition Instrumented gloves and body suits Pressure sensors Strain gauges	Pointing with arm or head movements Facial expressions Lip reading Body Language Button clicking by hand or facial movements
5	Biometric inputs	Electrodes IR detectors Fingerprint detectors Micro Impulse Radar	User verification
6	Physiological inputs	Electrodes IR detectors Temperature sensors	Blood pressure Heart rate Galvanic skin resistance Mood detection Satisfaction Attention

			Confusion
7	Video displays	Standard Screen Head Mounted display Projected images Enlarged characters 3D images	Displaying standard text and graphics Displaying enlarged images for visually impaired users
8	Speech Output	Recorded messages Synthesized text to speech	Reinforcing text delivery Primary output for blind users
9	Sonification	Mono or stereo sound Synthesizer	Representing graphics to blind users Augmenting layout information for processing graphics
10	Tactile	Braille Displays Raised Image Pin display	Representing text and graphics to blind users Representing graphs and diagrams for individuals with learning disabilities
11	Haptics	2D Haptic mouse 3D Haptic display	Navigation aids for blind users Productivity tools for CADD operators
12	Olfactory	Odor synthesizer	Recalling memorized information by association with smells

Appendix B2

Synchronous Communications Values and Drawbacks (Barfield and Furness 1995)

Tool	Useful for	Drawbacks
Audio conferencing	Discussions and dialogue	Cost, especially when international participation is involved
Web conferencing	Sharing presentations and information	Cost, bandwidth; may also require audio conferencing to be useful
Video conferencing	In-depth discussions with higher-touch interactions	Cost, limited availability of video conferencing systems
Chat	Information sharing of low-complexity issues	Usually requires typing, "lower touch" experience
Instant messaging	Ad hoc quick communications	All users must use compatible system, usually best for 1:1 interactions
White boarding	Co-development of ideas	Cost, bandwidth; may also require audio conferencing to be useful
Application sharing	Co-development of documents	Cost, bandwidth; may also require audio conferencing to be useful

Appendix B3

Asynchronous Communication Values and Drawbacks (Barfield and Furness 1995)

Tool	Useful for	Drawbacks
Discussion boards	Dialogue that takes place over a period of time	May take longer to arrive at decisions or conclusions
Web logs (Blogs)	Sharing ideas and comments	May take longer to arrive at decisions or conclusions
Messaging (e-mail)	One-to-one or one-to-many communications	May be misused as a "collaboration tool" and become overwhelming
Streaming audio	Communicating or teaching	Static and typically does not provide option to answer questions or expand on ideas
Streaming video	Communicating or teaching	Static and typically does not provide option to answer questions or expand on ideas
Narrated slideshows	Communicating or teaching	Static and typically does not provide option to answer questions or expand on ideas
"Learning objects" (Web-based training)	Teaching and training	Typically does not provide option to answer questions or expand on ideas in detail
Document libraries	Managing resources	Version control can be an issue unless check-in / check-out functionality is enabled
Databases	Managing information and knowledge	Requires clear definition and skillful administration
Web books	Teaching and training	Not dynamic and may lose interest of users
Surveys and polls	Capturing information and trends	Requires clear definition and ongoing coordination
Shared Calendars	Coordinating activities	System compatibility
Web site links	Providing resources and references	May become outdated and "broken"

Appendix C1

Testing Proposal 1

Goals for Testing:

- Ease of use
- Acceptance
- The user interface should be inviting, friendly, and comforting
- The user should be enticed to come back often, (if he/she is at home the whole day at least once a day.)
- The user is not required to recognize all the available functions the first time, she/he can learn through discovery, but should be able to remember after a few times.

Test Plan

Introduction:

I am Nasim Sarir, a student at Carleton University. For my final project at school, I have designed a friendly communication device for the elderly. This device has been designed to develop personal and intimate friendship with the elderly and act as a communication medium in order to help them develop relationship with their community. This companion will help the elderly to overcome the feeling of loneliness and give them emotional support when it is needed.

As a requirement of my project I need to get my design evaluated. Your feedback would be of great help to me in realizing my mistakes, improving my design and finishing the project. Thank you in advance for your time, help and cooperation.

The information provided by you will be kept confidential.

Informed Consent

You are being asked to help me trial the some component of “Smart Companion”.

I am asking for your permission to use your feedback to help design the product.

The purpose of an informed consent is to ensure that you understand the nature of your involvement. The informed consent must provide sufficient information so that you can decide if you want to participate in the study.

Present Study: “Smart Companion” to enable the elderly to communicate with a community.

Purpose: The purpose of the testing is to determine if the device and its interface is elderly friendly and will encourage you to interact with it. In this test we are not testing you; we are testing the design concept. There are no right answers. Your action will help me develop the design to suit users like you.

Task Requirements: You will be asked to participate in a series of activities individually.

- I will ask you some questions
- I will ask you to look at some pictures
- I will show you the model and ask you how you feel about it.

Duration and Location: The session will last approximately 35 to 40 minutes. Testing will take place at Sandy-hill community centre in Ottawa.

Potential risk / discomfort: There are no potential physical or psychological risks in this interaction.

Anonymity/ confidentiality: All information will remain at the university. With your permission, photograph might be taken of you using the model, and your face will be blurred to maintain anonymity.

Right to withdraw: You have the right to stop the session at any time.

Signature:

I understand the conditions of my participation. My signature indicates that I agree to participate.

Participant's name: _____

Participant's signature: _____

Witness: _____ Date _____

Pre-Study Interview:

Q1. A short animation will be presented to introduce a new product to you. This product (Smart Companion) is meant to be your companion and will enable you to communicate with your community, make new friends and be in touch with your family members.

Q1 Can you see yourself using this product?

Yes

NO

Please explain why?

Q2 If you could communicate using “Smart Companion” who would you like to contact?

Q3. This product will let you do more than your regular TV will. For this part of the study, I would ask you to choose words that describe what you would want to do. Imagine you are at home and you feel lonely and depressed what would you like to do? Take a moment to read the options and sort the action cards according to your preference.

(Presenting the cards)

1. watch TV
2. play games
3. look at some family pictures
4. send a message to a friend
5. talk to family members
6. listen to news
7. read mails
8. go to café and meet new people

Usability Testing:**Scenario #1**

Now you have this product that changes your TV. You are interested in knowing more about Arthritis in the wrist. What would you do?

Scenario #2

Imagine you wake up in the middle of the night and you don't feel good your "Smart Companion" senses that and the blue light turns on. (Show the flash movie) how does that make you feel?

Safe

Annoyed

Surprised

Frustrated

Protected

Satisfied

Any others please specify

Scenario #3:

You are at home and you receive a message. (*Show flash movie*)

What would you do?

- Listen to my message now.
- Listen to it when I choose to do so.
- Listen to it and answer back.
- Listen to it only if it is from source specified. Who?

Scenario #4:

You have not noticed that you received a message but you see the red light is on (to inform you the message has been received) if you want to hear your messages which one is more convenient for you

(Show flash movie)

On TV

On your device

If you want to reply the message what would you do?

Need one hint

Need 2 Hints

Explain the whole process

Conclusion:

Please explain how you feel about these experiences:

A. About the idea of using this new device as a communication medium?

Interested									Not interested
1	2	3	4	5	6	7	8	9	10

B. About the concept of being in touch with others whenever you want?

Interested									Not interested
1	2	3	4	5	6	7	8	9	10

C. About having a smart companion with you at home?

Interested

Not interested

1 2 3 4 5 6 7 8 9 10

D. About interacting with the device with voice commands instead of push buttons?

easy

hard

1 2 3 4 5 6 7 8 9 10

E. What do you like about it?

F. What do you dislike about it?

G. What would you like to be changed?

Appendix C2

Results of Testing Proposal 1

	A	B	C	D	E
Gender	F	M	F	F	M
Age	70	73	66	65	76
Living arrangement	lives alone in an apartment	with wife at home	with partner in an apartment	at home with husband	lives alone at home
How many children	none	2	5	3	1
Geographical despair		Ottawa, US	1Toronto,2 Montreal,1US,1Ottawa	US, 2Toronto	Ottawa
Main medium for communication	Telephone	Telephone	Telephone	Telephone	Telephone
Other tools for communication	Letter, Post Card	Letter	Telephone	email(asks husband to do it)	
Computer experience	none, has seen the brother use email to send and receives mails pictures	none, it is very complicated	none, her grand child plays game on the computer	knows how to play cards on computer, and the husband would help her to read e-mails	none
Pre Study Interview Q1	yes, it seems easy,	not sure, but it is easier than computer	not sure, but likes to be more in touch with children and grand children	yes, can read the kids emails, easy	no, not interested
Q2	my niece, and nephews	my son, and grand son	my grand children	my children	
Q3	5.4.3.7.6.1.2.8	5.4.1.6.3.2.7.8	5.3.4.7.6.8.2.1	5.4.3.7.2.8.6.1	1.6.3.2.4.7.5.8
Usability Testing Scenario1	able to do with 3 hints	able to do with 2 hints	able to do with 4 hints	able to do 1 hint	able to do with 2 hints
Scenario 2	protected , sometimes wakes up to go to the wash room and needs the light	Satisfied	does not know	Satisfied, likes to have the lights on when wakes up	Annoyed, can't go back to sleep.
Scenario 3	Listen to it and answer back	listen to it and answer back	Listen to it when it is from source specified, my kids	Listen to it when I choose to do so	Listen to it when I choose to do so
Scenario 4	both, with 3 hints	On my device, explain the whole process	on my device, explain the whole process	on my device, 3 hints	On TV. 2 hints
Conclusion A	3	6	5	2	9
B	2	4	4	4	5
C	2	5	5	2	9
D	4	4	3	4	8
E	can send and receive e-mails and pictures, wants to know more about health	can have contacts with his family	can see my grand children, pictures	It is easy to use	likes to play games
F	confused between TV and Device, talk to strangers	meet new people,	does not like TV application,	none	the light on the mobile device confusing
G	likes to find the device easily	Rings and informs when there is a message	see everything on mobile device	want to carry the pictures on the device	

Appendix C3

Testing Proposal 02

Goals for Testing:

- Ease of use
- Acceptance
- The user interface should be inviting, user-friendly, and comforting
- The user should be enticed to use it often

Test Plan

Introduction:

I am Nasim Sarir, a student at Carleton University. For my final project at school, I have designed a friendly communication device for the elderly. This device has been designed to develop personal and intimate friendship with the elderly and act as a communication medium in order to help them develop relationship with their community. This companion will help the elderly to overcome the feeling of loneliness and give them emotional support when it is needed.

As a requirement of my project I need to get my design evaluated. Your feedback would be of great help to me in realizing my mistakes, improving my design and finishing the project. Thank you in advance for your time, help and cooperation.

The information provided by you will be kept confidential.

Informed Consent

You are being asked to help me trial the some component of “Smart Companion”.

I am asking for your permission to use your feedback to help design the product.

The purpose of an informed consent is to ensure that you understand the nature of your involvement. The informed consent must provide sufficient information so that you can decide if you want to participate in the study.

Present Study: “Smart Companion” to enable the elderly to communicate with a community.

Purpose: The purpose of the testing is to determine if the device and its interface is elderly friendly and will encourage you to interact with it. In this test we are not testing you; we are testing the design concept. There are no right answers. Your action will help me develop the design to suit users like you.

Task Requirements: You will be asked to participate in a series of activities individually.

- I will ask you some questions
- I will ask you to look at some pictures
- I will show you the model and ask you how you feel about it.

Duration and Location: The session will last approximately 35 to 40 minutes. Testing will take place at Sandy-hill community centre in Ottawa.

Potential risk / discomfort: There are no potential physical or psychological risks in this interaction.

Anonymity/ confidentiality: All information will remain at the university. With your permission, photograph might be taken of you using the model, and your face will be blurred to maintain anonymity.

Right to withdraw: You have the right to stop the session at any time.

Signature:

I understand the conditions of my participation. My signature indicates that I agree to participate.

Participant's name: _____

Participant's signature: _____

Witness: _____ Date _____

Pre-Study Interview:

Q1. A short animation will be presented to introduce a new product to you. This product, Smart Companion, is meant to be your companion and will enable you to communicate with your family and friends via text messages and pictures. Especially the younger generation who are using new technology to be in touch with others.

Q1 Can you see yourself using this product?

Yes

NO

Please explain why?

Q2 If you could communicate using "Smart Companion" who would you like to be in touch with? Why?

Usability Testing:

Scenario #1

You have the 'Smart Companion' at home and you would like to send a message to your child.

1.1 Try sending the message with the 'speakers' on

Able to do

Able to do with one hint

Able to do with 2 hints

Unable to do

1.2 Try and send the message with the speakers off

Able to do

Able to do with on hint

Able to do with 2 hints

Unable to do

1.3 Which way you would rather to use the device? Why?

'speaker' on

'speaker' off

Scenario #2

Could you explain the buttons on the device to me?

2.1 What do you think each would able you to do?

- Speaker
- Mail
- Album

- Yes
- No
- On/Off

Comments:

2.2 Could you explain the icons and buttons you see on the screen?

- Read
- Write
- Letter
- Cards
- Saved messages
- Read to me
- Write for me
- magnifier

Comments:

Scenario #3:

You are at home and you receive a message. The picture on your device will be changed to the picture of the message sender how do you feel about it?

More connected to the sender

Annoyed

Surprised

Frustrated

more informed

Any others please specify

Scenario #4:

You have not noticed that you received a message (the picture of the sender and the name appears, also your 'smart companion' announce that to you.

4.1 If you want to check your messages how will you do it?

Need no hint

Need one hint

Need 2 Hints

Explain the whole process

4.2 Which one is more convenient for you?

Listening to it

Reading it

4.3 If you want to reply to the message what would you do?

Need no hint

Need one hint

Need 2 Hints

Explain the whole process

Conclusion:

Please explain how you feel about these experiences:

H. About the idea of using this new device as a communication medium?

Interested								Not interested	
1	2	3	4	5	6	7	8	9	10

I. About the concept of being in touch with family whenever you want?

Interested								Not interested	
1	2	3	4	5	6	7	8	9	10

J. About having a smart companion with you at home?

Interested								Not interested	
1	2	3	4	5	6	7	8	9	10

K. About interacting with the device with voice commands instead of push buttons?

easy								hard	
1	2	3	4	5	6	7	8	9	10

L. What do you like about it?

M. What do you dislike about it?

N. What would you like to be changed?

Appendix C4: Testing Developments

Views of Smart Companion mock-up being handled.

Fig.C4-1 Smart Companion
Portability

Fig.C4-2 Interaction with the device

Fig C4-3 Usability of the buttons

Fig. C4-4 Interaction of the user with the content

Fig. C4-5 User was asked to interact with "Write" Interface

Fig.C4-6 User was asked about the Content of the device and its interface

	A	B	C	D
Gender	F	M	F	F
Age	70	73	66	65
Living arrangement	lives alone in an apartment	with wife at home	with partner in an apartment	at home with husband
How many children	none	2	5	3
Geographical despair		Ottawa, US	1Toronto,2 Montreal,1US,1Ottawa	US, 2Toronto
Main medium for communication	Telephone	Telephone	Telephone	Telephone
Other tools for communication	Letter, Post Card	Letter	Telephone	email(asks husband to do it)
Computer experience	none, has seen the brother use email to send and receives mails pictures	none, it is very complicated	none, her grand child plays game on the computer	knows how to play cards on computer, and the husband would help her to read e-mails
Pre Study InterviewQ1	yes, would like to have asynchronous, text based communication	yes, can be in touch with younger generation the same way they communicate	yes, can read the kids emails, easy and have their pictures	yes, likes to have pictures to look at any time and get new pictures, also likes to have asynchronous communication
Q2	my family members, it would be easier and faster to have contact with them	my son, and grand son, they are always busy and behind the computer so they could send me message and I can answer back	my grand children, and children. Younger generation communicates in some other way and now I can be involved as well	my children and close friends, would like to use new services to be in touch with children and friends, be a part of the digital communication
Usability Testing Scenerio1.1	able to do with no hint	able to do with no hint	able to do with no hint	able to do with no hint
1.2	able to do with no hint	able to do with no hint	able to do with no hint	able to do with no hint
1.3	on	both ways	off	both
Scenario 2.1	understood the buttons and their jobs	the use of yes and no buttons had to be explained	understood the meaning of each button	the buttons were easy to understand
2.2	understood the content of each icon	clear about icons	Magnifier had to be explained	icons easy to understand
Scenario 3	likes to see the sender's picture	feels more informed and connected	feels surprised and more connected	feels someone is thinking about her, more connected
Scenario 4				
4.1	need one hint	need one hint	need no hint	need one hint
4.2	listening/both	reading	listening	reading/both
4.3	need no hint	need one hint	need no hint	need no hint
Conclusion A	7	8	10	7
B	5	5	7	5
C	6	8	9	6
D	5	5	6	7
E	can send and receive emails and pictures	can have contacts with his kids and grand children	can send cards for children's birthday	It is easy to use, likes the album feature. and mobility
F				
G	receive music, can set the volume of the speaker	Rings and informs when there is a message	not too many colors, some thing shows the device is on	could see the pictures in a bigger screen as well, like TV

Appendix C6

Content Inventory

This is a sample content inventory developed for a few items of the device and interface.

Description of fields in the content inventory

Item	- the visual presentation of the icons on the device
Content	- the actual content of the icons on the device
Function	- the presentation of the functionality of each item
Context	- each icon has a context which is a combination of text and graphic
Priority	- each item is marked by priority of its use according to the usability testing. '1' is least and '5' is maximum requirement.

Item	Content	Function	Context	Priority
DEVICE
To activate and access the Album application.	press the album button and the blue light lights up to indicate that the album feature is active push the button and the application starts running.	Tactile, button. Combination of color light and audio representation	3
To activate and access the e-mail application.	when the user receives a message the button color changes from dark red to light red and flashes.	Tactile, Combination of color, logo, light and audio representation	5
Activates and stops voice commands and interactions. Also adjusts output volume.	When the voice application communication is activated the button is LED.	Tactile, Combination of logo, color and audio representation	4
ON/OFF: The or ceases operation.	The button lights up when the device is on. audio feature announces	Tactile, Combination of color and audio representation	5

Push button

Releases the stylus when pressed
Tactile, Combination of logo color 3 representation

e-mail count screen.

when the device receives a message, the total number would be displayed on the device
color and text 3 representation

Battery life light screen

when the battery is full the blue color covers the whole rectangle and as the battery is being used the white area become more visible and when it is
Combination of color and audio 3 representation

Item	Content	Function	Context	Priority
INTERFACE
Text to speech Touch button	Once selected, the presented text turns into a sound file	Combination of text and graphic setting the context of text to speech	5
Speech to text Touch button	Once selected, It turns voice input by the user into a text file	Combination of text and graphic setting the context of speech to text	5
Providing contacts' lists Touch button	Once selected, it links the user to e-mail addresses	Combination of text and graphic setting the context of Address Book	3
Magnifying the text Touch button	It zooms in the presented text up to 3 times	Combination of text and graphic setting the context of magnifying	4
Minimizing the text Touch button	It zooms out the presented text up to 3 times	Combination of text and graphic setting the context of minimizing	3
Providing access to the Greeting cards section Touch button	Once selected, it links the user to send animated greeting cards	Combination of text and graphic setting the context of greeting	2

Appendix C7

Preliminary Design Developments

Fig. C8-1

Fig. C8-2
Preliminary design ideas.

Fig. C8-3 Interface Studies.

Fig. C8-4 Interface Studies.

Appendix C8

Device Specifications

Technical Specifications

Size. (LxWxD)	Closed - 9" x 7" x 1" Open - 18" x 7" x 0.5"
Memory.	Expandable 128MB flash memory 32MB integrated memory
Display.	Two 8" and one 6" high-gloss LCD screens with high contrast ratio for optimal viewing and touch-screen capabilities.
Battery.	Long-lasting rechargeable and removable Lithium-Ion battery.
Storage.	Minimum 2GB compact internal hard-drive. Extra storage available through USB ports and portable memory.
Input/Output	Integrated speaker and microphone for voice recognition, activation, and commands. Touch-screen capability for direct tactile input with a stylus or fingers. USB connectivity for data insertion and extraction.

System Specifications

Use of Oracle as the database, Cold Fusion as the middle ware and Flash-enabled browser as the client for the wireless interaction.

Use of audio with provision of adding advanced technological features in the future on availability of higher bandwidth.

Speech input technology for voice activated commands and inputs.

Text-to-speech capability to translate and read e-mail texts to the user.

Audio feedback on the activities of the device and reactions to inputted commands.

Tactile input recognition through touch-screen technology for command inputs and hand-writing recognition for composing e-mails.