

Appropriate User Interface for the Elderly

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ABSTRACT

Today human being is facing various types of information throughout computers, electric and telecommunication devices. As information society today, it seems impossible to maintain our lives without accessing information including work, education, and health information and communication. In particular, the proportion of the elderly group for accessing health information are significant larger than other age group. The older adult group aged 65 over requires more medical attention and watchfulness since the human nature of aging accompanies with vision loss, memory impairments, and decreasing literacy levels. According to New Zealand Statistics in 2000, it is predicted that the population of the elderly will take a quarter of the whole population by 2051. This means more number of the elderly will be exposed to deal with computers and electric devices for accessing information. However, current user interfaces of computer based application, web pages and electric devices have issues with accessibility and usability for the elderly. Since everyone and every group of people in society have the right to access to information equally, consideration of designing user interface which satisfies all user group must be taken into account. In this research, the factors cause the aging will be analysed and considered for user interface design. Also, the research will address current issues with user interface particularly the elderly and will provide guidelines for developers and interface evaluators.

Author Keywords

User Interface, Elderly, Voice Interface, Touch Screen Interface, Conversation Interface, Multimedia interface, Sound Characteristic Frequency, Colour Distribution.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Aging is an inevitable fact of human nature which cannot be reversed. However, through the development of medical practice and the advancement of our health care system, human beings are increasingly able to prolong their existence over time. As a result, the elderly group makes up a significant proportion of the overall worldwide population. The following statistics (New Zealand Statistics, 2000) reveals the extent to which the percentage of the elderly group is growing. For instance, the latest indication represents that the number of persons aged 65+ will reach up to about 1.2 million, which is approximately 25% New Zealand's whole population, by 2051(Figure 1)[8]. This means that the elderly group should no longer be considered separately as a minority group. In addition, the elderly, in particular, who are sixty years or older are having more opportunities to access health information through computers. However, it is not guaranteed that the elderly will successfully access and gain the information that they are seeking. Therefore, adequate and universal interfaces satisfying all types of users including both the elderly and children are necessary in allowing them to interact with such systems as web-browsers, all types of software applications and electronic devices.

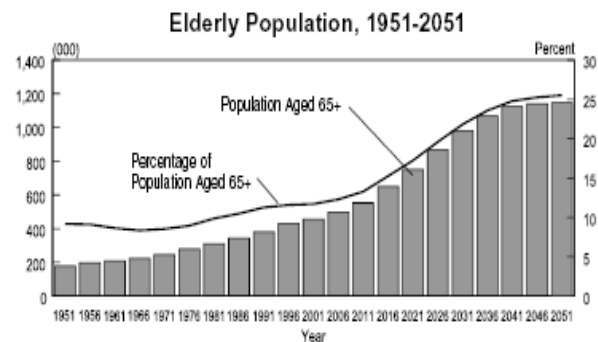


Figure 1. Elderly Population of New Zealand from 1951 to 2051

AGING FACTORS

As the aging processes, the older group are more exposed to chances of having a disability. As the result of survey conducted by the Administration on aging in US, approximately 45% of adults in the age group 56 to 69 have a disability and it increases up to 74% for over 80 years old group. The disability includes hearing impairments, heart disease, diabetes and hyper tension. Therefore, the elderly group can have benefits by accessing the information related health using the internet/computer. Unlike younger age group, the elderly group shows a decline in cognition, vision, motor skills and literacy level. Those elements affected by aging influence to usability and accessibility on both computer and web based applications which are the gateway of accessing online health information. For example, not elderly friendly font size, graphics, colour schemes, navigation and search functions might become barriers for the elderly to benefit by health related resources [4].

Vision loss

Vision loss as normal aging is caused by a decline in elasticity in the lens. As results, the ability to focus on close objects is significantly reduced and it makes the elderly hard to see objects clearly. Also, reduction of light sensitivity and depth perception disable many older adults from judging an object located with the distance. In addition, user interface elements such as font style, font type and size, background and foreground colours, and background images and patterns cause eye strain and fatigue to the older adults group [4].

Declined cognition

As the elderly has cognitive issues, the elements are identified such as working memory, attention and problem solving which influence to usability and accessibility. Working memory is used for holding and manipulating information temporarily while the users perform the tasks. Since working memory declines due to aging, it become so difficult when the older adults group is engaged to complete following tasks; complicated navigation and poorly designed search function [4].

Low motor skills

The performance of controlling standard devices such as mouse and keyboard for the elderly was measured and this is much slower than younger group. Also, the movement and positioning mouse cursor of the elderly group tends to less co-ordinated and less fluent in particular, when interacting with small size interface like icons or buttons.

Low literacy level

The literature shows that there is significant decrease on literacy level with the users' age regardless their education level. As people are aging, it becomes harder to remember and learn new information as well as to understand context. The guideline was established for senior-friendly interface; clear presentation, using voice interface with easy language and familiar and positive writing style are suggested.

USER CENTRED DESIGN FOR ELDERLY

It has been clearly proven that audio, video and animated interfaces are preferred by all types of user groups, including the elderly throughout the research over decades. Regardless of the elder's educational level and computer skills, all of the elderly felt positive about multimedia supported presentation and interfaces. In addition, by appearance of new type of interface technology like touch screen, accessibility and usability for the elderly are expected to improve. Also, new design guidelines of user interface for touch screen are researched as the technology spread widely. Based on the results produced through a number of experiments and research conducted, designing the user interface for the elderly should consider the followings [2].

Multimedia VS text-based interface

It has been reported that visualising information with multimedia interface improves the memorisation of information. For example, 10% of information gained through vision can be memorised, 20% through hearing and about 50% can be retained through both hearing and vision. Throughout hearing, vision and action, up to 80% of information can be memorised. The user interface combined with audio and video sources will provide communicative and easy environment for the users in particular, the elderly group. The literature reported that the older people are, the more the amount of time is required for reading because of vision and memory loss. The research was conducted to figure out which type of interface was preferable from all kinds of users including the elderly. The result shows that the interface based multimedia was preferred by both men and women user groups. Also, for the elderly, they prefer multimedia interface and the fewer amounts of reading material and regardless of their education level [2].

Audio interactive interface through communication rather than one-way

Studies have shown that conversational interface improve accessibility and usability for the elderly users. *Relational Agents* which applied animated conversational interface was developed in order to improve interaction with users (Figure 2).



Figure 2. A Screenshot of Relational Agent Interface [1]

This also considered social-emotional relationships with users especially the older adults group. Through the study, conversational interface was proven as an effective approach for behaviour change intervention and communication for health resources. In general, conversational interface is known as universal interface which does not require learning steps and takes only few text-based interfaces. Also, face-to-face conversational interface is more accessible than other types of interface and allows people with low education level to access easily. Synchronised synthetic speech was used for simulated conversation with large font size of menu for maximising easy readability for the elderly in *Relational Agent*. Test was conducted to check the users' responses and the satisfaction rate marked 5.7 out of 7 (where 7 is the highest mark).

	Min (1)	Max(7)	Mean
Satisfaction	Not at all	Very	5.4
Liking	Not at all	Very Much	6.3
Trust	Not at all	Very Much	6.4
Relationship	Stranger	Close friend	6.8
Friendly	Not at all	Very	6.7
Informative	Not at all	Very	6.5
Repetitive	Not at all	Very	4.8
Interesting	Boring	Interesting	6.4

Table 1. Satisfaction rate for the application applied conversational interface [1]

Therefore, conversational interface is any effective channel particularly, the application related health and behaviour changes programmes even though very few problems were detected during talking to the system [1].

However, overloading information into speech and conversational interface will make users difficult to absorb long synthetic speech messages. Especially for the elderly, they will not remember all instructions if the speech or audio interface is too long. Also, once the users failed to retain information or choice of options during engaging the

task, the confusion and anxiety will be increased. When speech interface is used for menu selections, a large number of selections will make users (especially the older age group) hard to control and use the system. Therefore, study suggested using a smaller number of selections will make the whole operation easier with well-organised grouping. In case of having a number of selections, it is recommended placing the most commonly used options at the end of the list. The guidelines which may reduce current problems with speech and conversational interface especially the elderly users have been established; 1) reduce functionalities which require a conceptual background as many as possible 2) for memory impairment users, emphasize the presentation of selections 3) minimise choices and provide the default choice at the end 4) avoid using technical term [5].

Appropriate sound characteristic for the elderly

As mentioned above, multimedia interface has proven an effective channel for the elderly. Multimedia interface normally includes audio, video and graphical user interfaces. Not only web pages and applications but also audio and visual equipments are spread into our daily life such as DVD software and VCR. Due to the aging factors, the elderly has a decline in speaking and hearing functions. As a consequence, the following problems are arisen; 1) hearing impairment within high frequency ranges 2) difficult to distinguish between voices and background sounds or noises 3) hard to catch up the rapid spoken words 4) difficulties with smaller/louder sounds. Studies have shown that the modification of sound frequency characteristic had effects to the performance of the elderly group for hearing. On the other hand, it did not affect to younger group. The result of experiment shows that when the frequency was lower than 120Hz, it became unsuitable for the elderly group to hear. On the other hand, it is shown that modifying the speed of speech did not affect to accessibility to the elderly group. Therefore, it has been proven that the sound frequency characteristic is one of the important elements to consider when designing multimedia interface (audio/video) for the elderly [3].

Design guidelines with touch screen interface

Due to the limitations caused by human aging, the elderly faces difficulties to control and interact with devices at home. Since the elderly are not able to handle universal input devices such as keyboard and mouse as effective as the other user groups, touch screen and voice commands that are highly usable user interface which is not requiring previous experience become alternatives to improve user interaction and accessibility. Study has discovered some issues regarding handling a touch screen interface; 1) the area of button are required to extend - the size of button interface within touch screen is often small and it causes mistakes from users 2) Avoiding complex control

techniques - due to the limitation of the elderly's upper limbs, the elderly finds hard to perform sliding and rotating touch screen controls 3) the terminology used for menu should be represented with easy and relevant words. Through the usability testing of prototypes created base on touch screen interface particularly the elderly and disabled, the following guidelines are suggested; 1) it must be consistent between interaction by touch screen and system feedback and quick enough so that users feel controlling and interacting with the system constantly 2) the elderly group requires helps with written text in order to avoid confusion caused by clumsiness 3) it is recommended using metaphor for designing interface for example the book metaphor (the notebook and closing the book) (Figure 3) [6,7].

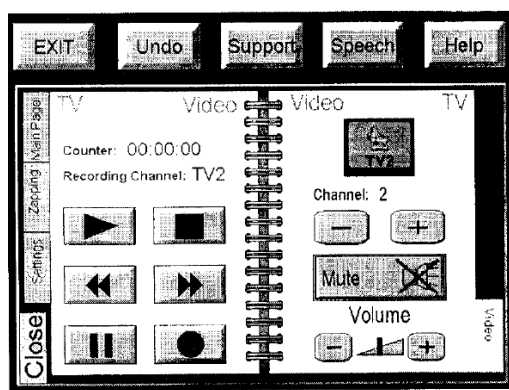


Figure 3. A screenshot of controlling device interface applied Book Metaphor [7]

Use of interface metaphor

Cognitive capabilities should be optimised by developers/evaluators due to the decreases of cognitive capabilities of the users with their age. Studies were conducted that ease of use, learning and increasing familiarity are possible to be achieved by using interface metaphor. Interface metaphor provides cognitive shortcuts to users through helping them to create on pre-existed models in memory when the users learn and face to new systems. Interface metaphor can be designed by maintaining physical form and interface design of the source domain. The new functions and attributes of the target domain should be in boundaries of the physical form of the source domain. Studies have shown that interface metaphor methodology makes the elderly having techno phobia less intimidated since it looks familiar as the source domain. Also, using interface metaphor minimises cognitive effort at the initial stage of using the system because users are able to retrieve functions and attributes through the metaphoric interface. Therefore, it does not require users to learn a new interface since it is already familiar with users [9].

Comfortable font, font size and colour distribution

National Library of Medicine (NLM) and National Institute on Aging (NIA) in Unite States have published the guidelines for user friendly interface for the elderly. This is based on scientific research the areas such as cognition, aging and human factors. The guidelines suggested that large font size and adjustable font size are to be used. Also, they recommended using sans serif font style for instance, Arial, Helvetica for the most appropriate font for the elderly. For the background, patterned images should be eliminated and maximise using highly contrasting background and foreground. A use of black colour font on the white background will be a good example for this (Table 2) [4].

Sample Guidelines for Designing Readable text		
Sans serif	Use font typeface that is not condensed (for example, Arial, Helvetica) to display information content	
Large font size	Use 12-14 point font size to improve legibility of information content	
Sample Guidelines for Presenting Information		
Style	Present information in a clear and familiar way to reduce the number of inferences that must be made	
Simplicity	Write the text in simple language	
Sample Guidelines for Increasing Ease of Navigation		
Hep and Contact Information	Provide help information as well as options to go previous status or menu	

Table 2. Guidelines for making elderly-friendly interface [4]

CONCLUSION

In this research, user interface issues caused by human nature of aging have been addressed especially the elderly group. There are some elements that should be taken into account during the user interface design process. Throughout the process, usability and accessibility to the system for the elderly can be improved. Multimedia interface including speech and voice were preferred from the elderly rather than text-based interface. In particular, conversational interface produced high accessibility emotional relationships from user group even though more fluent and nature dialog plans are required with rich conversation scripts. The range of sound frequency which improves hearing ability of the older adults group was also discovered and defined throughout a number experiment. The guidelines for designing interface with touch screen technology were established. For providing familiar environment, metaphoric interface was recommended and it will increase users' accessibility and usability even though cognitive capabilities of the elderly are limited. Comfortable font, font size and colour distribution also influences to the performance of the elderly when they are interacting with the system.

FURTHER WORK

For the area of conversational interface, more complex dialogs are required in order for users to express themselves freely without limitation. For the future research, studies of the international standard of sound frequency according to each/all age group are necessary for improving accessibility of all devices and application using audio/video interface. It is necessary for usability guidelines to identify the most suitable reading grade levels for the all user group and discover and minimise any literacy barriers encountered to the elderly group.

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REFERENCES

1. Bickmore T. & Lisa Caruso, C., *Acceptance and usability of relational agent interface by urban older adults*. CHI 2005, April 2-7, Portland, Oregon, USA, ACM Press (2005)
<http://portal.acm.org.ezproxy.auckland.ac.nz/citation.cfm?id=1056808.1056879&coll=ACM&dl=ACM&CFID=64884761&CFTOKEN=38996737>
2. Ogozalek V., *A Comparison of the use of text and multimedia interface to provide information to the elderly*, CHI 1994, Boston, Massachusetts, USA, ACM Press (1994)
<http://portal.acm.org.ezproxy.auckland.ac.nz/citation.cfm?id=191666.191700&coll=ACM&dl=ACM&CFID=64884761&CFTOKEN=38996737>
3. Sugawara Y & Sato M. & Sugihara T. & Kasuga M. (2004). *Experimental approaches to user friendly audio visual contents for the elderly people*. TENCON 2004, IEEE Region 10 Conference (2004)
<http://ieeexplore.ieee.org.ezproxy.auckland.ac.nz/iel5/9709/30647/01414614.pdf?tp=&arnumber=1414614&isnumber=30647>
4. Becker S. *A Study of Web Usability for Older Adults Seeking Online Health Resources*. ACM Transactions on Computer-Human Interaction, ACM Press (2004), pp 387-406
<http://portal.acm.org/citation.cfm?id=1035578>
5. Zajicek M., *Interface Support for Elderly People with Impaired Sight or Memory*, CNR-IROE, Florence, Italy ERCIM (2000)
http://www.ui4all.gr/UI4ALL-2000/files/Short_papers/Zajicek.pdf
6. Holzinger A., *User-Centered Interface Design for Disabled and Elderly People: First Experiences with Designing a Patient Communication System*, Lecture Notes in Computer Science, pp 467-484, Springer-Verlag Berlin Heidelberg (2002).
<http://www.springerlink.com.ezproxy.auckland.ac.nz/content/40xqr9gy3u47a7c0/fulltext.pdf>
7. Valles M. Manso F, Arredondo M, Pozo F., *Multimodal Environmental Control System For Elderly and Disabled People*, Interface for Control, IEEE Engineering in Medicine and Biology Conference, Amsterdam, IEEE (1996).
<http://ieeexplore.ieee.org.ezproxy.auckland.ac.nz/iel4/5216/14214/00651843.pdf?tp=&arnumber=651843&isnumber=14214>
8. Statistics New Zealand. (2000). *Population aging in New Zealand*. Retrieved March 26, 2008, from <http://www.stats.govt.nz/products-and-services/Articles/pop-ageing-Feb00.htm>
9. Yousef M., *Assessment for Metaphor Efficacy in User Interfaces for the Elderly: A Tentative model for Enhancing Accessibility*, Workshop on Universal Accessibility of Ubiquitous Computing, Alcacer do Sal, Portugal, pp 120-124, ACM (2001)