

Usability Analysis on online Social Networks for the elderly

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Abstract

Online social networks are becoming familiar to an increasing number of people. Services provided by online social network websites, such as file sharing, chatting fora, and discussion about interests, have largely improved the quality of people's life. However, the group which gains major benefits from this newly flourishing technology is the young, while online social networks typically exclude the elderly. One reason for this is that unlike the young, the elderly find it difficult to adapt to new innovations. As the average lifespan of people extends and the average number of children people have diminishes, the share of the elderly of total population is steadily on the rise. Senior people, especially those after retirement, are facing inevitable mental and physical deterioration together with loneliness. However, one solution here may be to enroll them as members of social networks. In spite of the wide use of high technology, the Internet remains alien to many seniors. Therefore, it is significant to analyze the usability of social networks from senior people's point-of-view in order to enable them to use social networking tools to improve their quality of life.

In this paper, I first review the concept of social networks, and its significance to senior citizens, after which I propose and analyze usability factors associated with social networks for the elderly. This paper continues with several successful solutions to the usability problems faced by seniors. This is followed by a case study on the usability of three online social networks (OSNs) specially designed for seniors.

KEYWORDS: social networks, the elderly, usability

1 Introduction

Among different age groups, the elderly are the last to be engaged with the Internet. However, the percentage of older Internet users has been increasing in recent years. According to statistics released in 2009 by the China Network Information Center (CNNIC), the percentage of Internet users aged over 60 in mainland China steadily rose from 0.3% in 1998 to 1.5% in 2008[24]. By contrast, this percentage for people between 50 and 60 rose from 1.0% to 4.0%. Figure. 1 shows the proportion of senior Internet users from 1998 to 2008 in mainland China. Elsewhere, the European Union is also trying to reduce the gap in the use of the Internet between the elderly and the average of population. Figure 2 is a survey of Internet use by age and the average in European countries in 2007, in which we can find a considerable proportion of

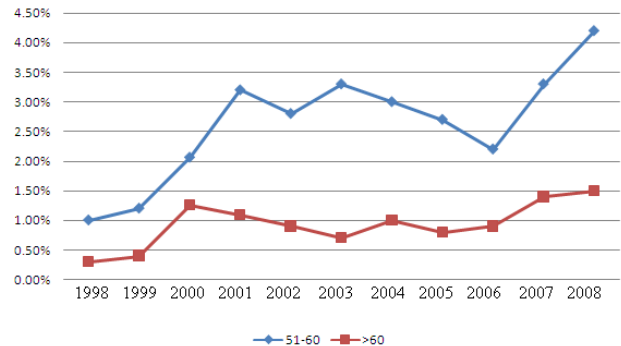


Figure 1: Proportion of the older Internet users 1998-2008[1]



Figure 2: Internet use in EU countries in 2007[10]

older Internet users.

With the advent and development of online social networks, an increasing number of old people are beginning to explore these new technologies. The current situation in which young people dominate most parts of online social networks is undergoing major changes as more aging people who have mastered — or are in the process of learning — basic computer skills join the social networking force. The trend towards online sharing technology is providing people with more convenient ways to find old friends, acquaint with new ones, communicate with each other and share information, such as via blog entries, videos, pictures, favorite web pages. Figure. 3 from the Nielsen report[11] reveals that from December 2007 to December 2008, Facebook added more than 13.6 million users aged between 50 and 64, which is about twice the number of added users under 18 years old.

However, young people, the pioneers of social networks,

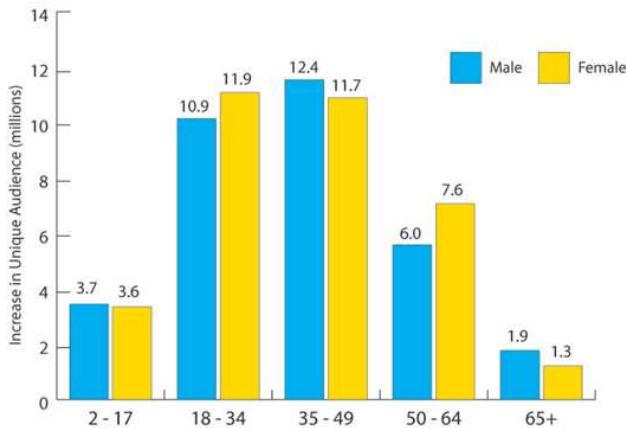


Figure 3: Facebook's growth in global audience numbers[11]

are still the mainstream. Services available and appropriate for older people are inadequate. In addition, in contrast to most young web users, the elderly face challenges when enjoying such services because their physical and mental states have changed. In fact, the designs of most social network websites are poorly suitable for the elderly. This fact often keeps the elderly away from existing services, no matter how popular and functional these services can be. Therefore, user-centric design is crucial for a social network service directed for the elderly audience.

2 Social networks

2.1 What are social networks

A social network is a topology architecture that brings individuals who share common interests or characteristics together to form a social community. Social communities in traditional social networks require physical presence of their members for communication. Typical examples of such communities are academic organizations, career associations, economic fora and so on. Nowadays, with the rapid development of Internet Communication Technology (ICT), social communities have moved onto the Internet to form a new type of social networks: online social networks. Famous examples of online social networks include Facebook, MySpace and LinkedIn, which are already popular in Europe and the US. Worldwide acceptance of OSNs are also becoming the trend as is shown by Xiaonei.com[9] in China and Cyworld.com[2] in Korea.

Online social networks provide more extensive kinds of services than traditional social networks. The most obvious advantage of online communities is the lack of requirement for attendance. Any member with a computer linked to the Internet can participate in all activities or forums at any place. Another breakthrough is the change of communication status. In traditional social networks, two statuses are '0' and '1', which means contact and no contact respec-

tively. By contrast, online social networks introduce a status between '0' and '1'. People are able to obtain new information from their friends even without contacting them. This feature is shown in Facebook, which provides a news feed service. In addition to that, online social networks provide members with a more convenient platform to exchange files such as audio files, video files.

2.2 Social networks and the elderly

"Social networking isn't just growing rapidly, it's evolving — both in terms of a broader audience and compelling new functionality," says Alex Burmaster, author of the study and Communications Director across EMEA for Nielsen Online. The change of social roles after retirement is forcing the elderly to adjust to the shift from a social world to a world of solitude. In contrast to meeting colleagues or social friends every day, most retired people are actually staying at home with far less opportunities for social activities. In addition to that, children of most of the elderly are working or living in different cities or even countries, which makes daily communication with their family members more difficult and less frequent.

It is the feeling of loneliness, rather than solitude that has a significant impact on the elderly[13], especially for those who have lost companions. A population study of loneliness among the elderly in Stockholm[15] shows 35% out of 1725 people aged over 75 experienced loneliness. Loneliness is one cause of disorders for the elderly such as depression and insomnia. According to a survey among a sample of 131 aged people in China, sleep quality decreases sharply with the increase of feeling lonely[23]; A survey[23] among 1000 aged people in Tangshan in China reveals that people with mild depression accounted for 17.2% while those with medium and severe depression accounted for 5%. And this is mainly due to a lack of entertainment, care from family and communication with others.

One solution to alleviate loneliness is to encourage the elderly to participate in social networks. [21] concludes that social support could be widely beneficial for the elderly with depression. Social networks include companions, children, other relatives, neighbors, colleagues and other friends. In this paper, I roughly classify people in social networks into two types: relatives and friends.

However, some physically disabled elderly people are not likely to gain access to traditional networks, which require physical presence. Their health condition deprives them of much fun in social networks, from which young people gain great benefits. According to survey carried in [20], making phone calls is the main method to connect with relatives and friends in Mexico. Even phone calls are not made frequently, except used to update information or on important dates such as birthdays. The finding also shows a strong preference of the elderly to communicate with their relatives and involve in social activities. Compared with traditional social networks, a sophisticated online social network will provide more services to people to participate in social activities.

3 Online social network usability factors for the elderly

However, only a small number of senior people are active in ordinary online social networks. This is partly due to differences between the elderly and the main group of online social network users — the young and middle-aged people. I am going to analyze the differences in this section. In addition to that, examples for online social networks designed for the elderly are not many and they are far less popular than mainstream online social networks such as Facebook.

Significant for senior people as online social networks are, their usability is a bottleneck for best serving for the elderly[18]. When senior people grow older, they face both physical and mental changes. These changes should be taken into account by OSN designers.

3.1 Physical aspect

First and foremost, the elderly are undertaking inevitable and irreversible physical changes such as eyesight deterioration, hearing loss, and decrease in movement precision[22]. Eyesight deterioration makes them more difficult to recognize small letters on keyboards. Hearing loss is a great and annoying enemy to enjoy a conversation through the Internet and lack of movement precision is a barrier for using a mouse to click buttons on the screen[17]. A well-designed user interface should considerably provide convenience for its older users.

3.2 Limited Internet use among the elderly

Another major factor is the Internet use of the elderly. While young people can adapt to new technologies fairly fast, it takes a considerably long time for senior people to learn. Slow adaptation to new technologies may cause them to give up new technologies, no matter how many advantages they would bring. According to CNNIC, the major reason for unwillingness to use the Internet is lack of skills to use. It is easy to see this phenomenon in Figure. 4, which is an analysis of reasons why people would not use the Internet from 2001 to 2008 in Hongkong. The percentage of people who stay away from the Internet for lack of the ability to use it is on the rise through these years. Figure. 5 also shows that in 2007 more than 65% of European people aged over 55 had never used ICT. This percentage rose to more than 85% among people over 65. Even for those people who had access to ICT before, most of them only had low skills.

One principle to design elderly-oriented online social networks is considering whether the elderly have the skills to use them. Even though the percentage of senior population who participate in the Internet is on the rise, the ratio is still very low. This indicates the majority of the elderly are not or at least not frequently using network tools. The elderly grew up without the Internet, the use of which boomed during their middle age or after retirement. Consequently, they have less interest in getting access to the Internet. This indicates that when designing online social networks, the designer should bear in mind that endowing the elderly with the ability to use the Internet is the first step to guarantee the use of the

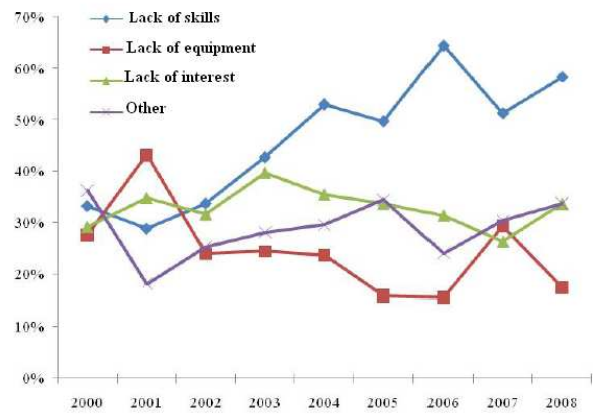


Figure 4: Reasons people would not use the Internet[1]



Figure 5: Distributions of Internet use among different groups[10]

Internet. Even for those elderly people who have the basic knowledge of how to use the Internet, it is comparatively difficult to adapt to new technologies.

3.3 Cultural aspect

A further issue which should be emphasized is the cultural consideration for the senior generation. As there are generation gaps between the younger and the older generation in many areas such as sense of value, cultural background, and personal experiences, it is always important for a social network designer to look from senior people's point of view and base the design on the elderly people's needs.

Research[21] has shown that a major difference between the elderly and the young is that senior people often tend to rely on their past experience and information. Additionally, motivations and interests are different between the two groups of people. For example, in China, young people are usually trying to access to new and challenging things, while most senior people would pursue a life with stability. Another interesting discovery is that the elderly learn new things by interacting with people rather than from textbooks and exams. This is because most senior people spent the majority of their past in social working environment rather than

in education. Research also has shown that classmates, colleagues, and friends are the major social networks for most young people, whereas the elderly interact more with their children, grandchildren and relatives. This phenomenon is obvious in many developing countries such as Mexico[20] and China[16].

In addition to various differences between the young and the elderly, there are also variations among the elderly from country to country[14]. Unlike the successful social network website Facebook, which gains a world-wide welcome, most online social networks for the elderly are nation-wide. The cultural belief is deeply rooted in the elderly, and therefore it is more difficult for them to accept different cultures. Consequently, there are no world scale online social networks specially designed for the elderly. As is discussed above, when designing an online social network for the elderly, it is important to consider their needs and cultural backgrounds.

4 Measures to improve usability

4.1 User-friendly Interface

Due to the physical and mental changes mentioned above, the elderly are slower than other age groups to adapt to new technology. If the user interface of an online social network is well-designed, the elderly will be more willing to participate in digital social communication.

According to the features of the elderly, user interface (UI) design should at least include the following principles. First, the elderly benefit most from a simplified and obvious UI, or in other words, less is more. Another important principle that should be taken into account is that linear progression of a task maximizes the efficiency. Parallel to this, simple as UI design should be, it would be better if less possibilities are offered[19]. The more options there are, the more difficult it is for an old people to make a decision.

Many innovations are available to improve UI design for the elderly. Jive[6], a proof-of-concept for a range of user-friendly devices for the elderly who have little knowledge on how to use a computer and the Internet, is one of them. Three main components of a set of Jive device are friend passes, a tangible screen called 'Betty' and a router. A friend pass is a physical connection to the friend's online social world. The friend pass is linked to an RFID (Radio-frequency Identification) tag. When a user purchases a friend pass, the connection between the friend pass and the RFID tag is initialized, which helps to update online social information of the friend. The second component, Betty, is a tangible and elderly-friendly UI which mainly displays three types of service for a friend: showing updates of a friend, sending messages, and exploring the friend. It works together with a specified friend pass. The third component is a simplified wireless router which embeds all setup details of the Jive device. This integrates complicated device setup procedure to three steps: plugging the router to a telephone, plugging in the power and turning on the switch. It uses an ADSL modem with automated connection setup. Figure. 6 [6] shows the three components of Jive.

Grandparents begin their online social communication by placing a friend pass on Betty at three different places: the



Figure 6: Three coponents of Jive[6].Left: a friend pass. Middle: a router. Right: Betty screen

left, the middle or the right, which supports sending a message, showing general updates of the friends and showing specific details of the friend respectively. The elderly can send a message by an ordinary keyboard. The updates of a friend on Betty screen come from social network websites of the friend such as Facebook[4] and Flickr[5]. In this way, an elderly person is able to get in touch with his or her children, grandchildren and other friends with an easy-to-operate device, which does not even require using a computer. Figure. 7 illustrates how an old people connects with his daughter via Picasa, Facebook and Amazon, his grandson by Facebook, Youtube and mobile phone, and his granddaughter through Facebook and mobile phone.

4.2 E-education among the elderly

Based on senior people's learning process, it is essential that detailed educational instructions are included in online social network services targeted at the elderly with different level of network experience[12]. For those who have experience with Internet technologies, it is necessary to give step-by-step knowledge to new features of services. Meanwhile, for those who have little access to the Internet, basic education on the Internet is crucial to encourage participation in social activities.

However, education methods for the elderly are different from those for young people. It was found out in a study[21] that the elderly learned mainly from their past experiences rather than from tests or instructional teaching. This indicates and recommends studying senior people's past experience to design effective education methods. Additionally, due to eyesight deterioration of the elderly, text-based instructions are far less useful than video-based ones. Another discovery is that the elderly learn more by communicating with others than by studying alone. Thus in order to help more elderly to join social network services, the designer should also develop elderly-oriented education methods and materials. Research also indicates that using easy-to-understand language instead of computer jargon enables the elderly to understand new technologies better.

One case study by [21] looked at the subject of online picture sharing by studying the needs of the elderly. It was discovered that the senior people had interest in online sharing. The study carried out an experiment by organizing the elderly to study online picture sharing together rather than studying individually. The elderly students were expected to share their photos with each other online and discuss their difficulties in time. This experiment encouraged both inter-

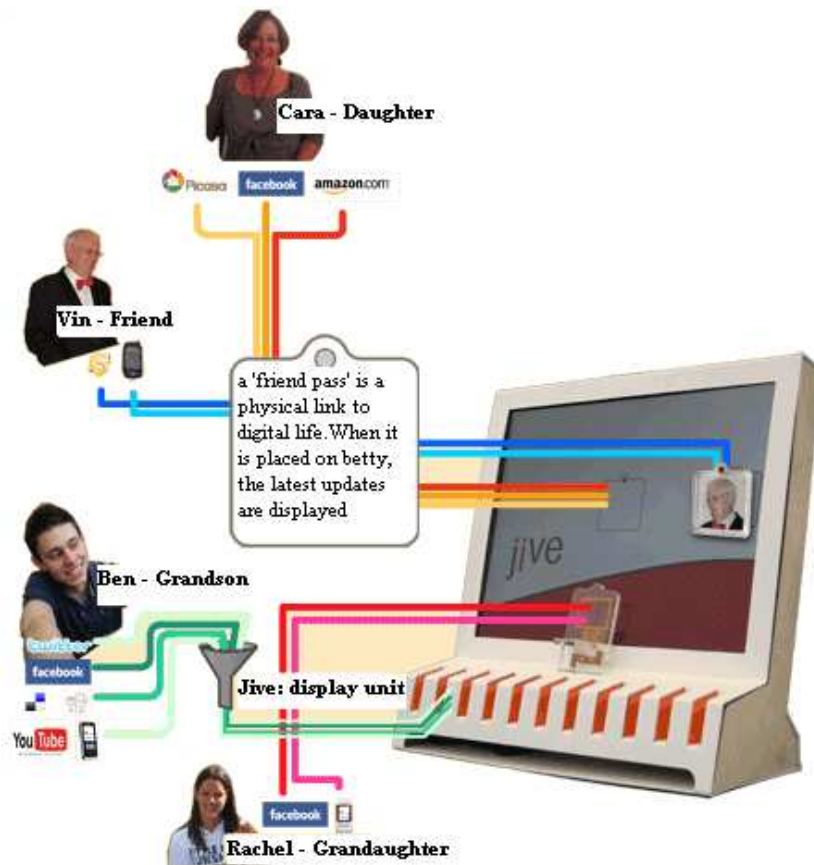


Figure 7: Schematic diagram on how Jive connects people[7]

action and discussion and generated promising results. The elderly learned more efficiently than studying alone. One spin-off of the experience of uploading and downloading files through this training is that the elderly would find it easier to use other various online file sharing services which are common in Web 2.0 services.



Figure 8: Header of main services in Oldkids[8]

5 Examples of elderly-oriented OSNs

In some countries, local companies have developed domestic OSNs. They have different emphasis as a result of different national situations. These situations include different levels of Internet skills of senior citizens and diversified cultural backgrounds. This section analyzes three examples: Oldkids, Eons and AboutMyage.

5.1 Oldkids

Oldkids[8] is the first online social network designed for the elderly in China. This website is developed by Zhang Zhian — a young Chinese who had discovered Chinese senior citizens' needs and potential to use the Internet. As the most successful social network website targeted at the elderly in China, Oldkids is a good example of how a young designer considerably takes the requirements of the elderly into account. Service of this website include a discussion forum, education, entertainment, making friends, and online

shopping. The mentioned services are almost the same with those provided in other popular websites. Figure. 8 shows the header of its services.

The main idea for this website is to help more Chinese seniors to gain access to the Internet and develop a new kind of lifestyle on the Internet. In 2008, people aged over 60 composed only 1.3% of the whole Internet users, and most of them did not use the Internet often because of lack of skills and knowledge. This idea is fully presented in the service 'Education'. The provided education services include the following areas:

- Education on how to use the website
- Education on how to enjoy life with computers and the Internet
- Education on other common knowledge, e.g. laws, health

5.1.1 Education services

The instructions on how to use Oldkids.cn begin with registration to the service. In order to make every elderly capable of using this website, Oldkids assumes that a new user has little experience with the Internet and has to learn everything from scratch. Compared with most website instructions displayed in text, instructions on Oldkids are integrated in a video with step-by-step explanations. The video explains every detailed step and basic Internet terminologies such as 'click a button', which are very familiar to the young, but may be totally new for some of the elderly. Usually a senior may be shy to ask some basic information on the computer and the Internet. It usually deprives them much fun from the Internet. However, with a patient online teacher with a sweet voice and many old 'classmates', more elderly can be invited to the online community.

In addition to a guide on how to use the website, the education service also provides other guide on how to use computers and the Internet. In order to make it more user-friendly to seniors, education services are provided in video form. Oldkids believes that the studying results will be enhanced when the elderly have a platform to exchange their feelings and display their results, which makes them feel self-approved. Therefore, in addition to the teaching materials provided by the staff of Oldkids, many materials are uploaded by its elderly users. Uploaded teaching materials range from recommended online materials to those produced by seniors themselves. Among those high-rated uploaded videos, one about how to make a good video of a naughty grandson has received high praise among the elderly. Instead of hiring a teacher for the elderly, this interaction online provides better learning results.

Other education such as fundamental laws, health tips are also providing the elderly with more information in an online community.

5.1.2 Cultures on Oldkids

Designing websites for the elderly and analyzing the culture of existing websites form an interactive loop in developing and improving the websites. Oldkids reflects some special cultures different from other Chinese online social networks such as Xiaonei.com. Here is a comparison of users of Oldkids and Xiaonei.

- Oldkids is targeted at the elderly while Xiaonei's users are mainly university students
- Oldkids users pursue self-approval or social approval while Xiaonei users would enjoy social communication
- Profile pictures of Oldkids are pictures of their family members, whereas Xiaonei users use pictures about themselves
- Oldkids usually share pictures of family members or social activities while Xiaonei users share pictures of or related to their own
- Oldkids users tend to share old but classical songs, while young audiences from Xiaonei prefer new and diversified types



Figure 9: Header of main services in Eons[3]

- Oldkids users mainly use daily and regular language, whereas users from Xiaonei use more fancy and popular words

From the analysis above, we can easily discover the differences between developing a social website targeted at the elderly and other groups of network users.

5.1.3 Limitations of Oldkids

Even though Oldkids is a breakthrough in online social networks designed for the elderly in China, there are still some limitations. E-commerce for the elderly is not designed well. Not only is the purchasing website complicatedly displayed, but the online purchasing procedure is too complex for an elderly person. This often drives an elderly person away from experiencing online shopping and makes them less trust in online shopping.

5.2 Eons

Eons was established in 2006 in the US. Its target customer group is mainly American citizens aged over 50. As most OSNs, Eons also provides a platform for its users to join a virtual community. Figure. 9 shows the header of its main services.

The key innovation in Eons is the variety of games tailored for the elderly. These games are designed to train the brains of seniors and receive a wide welcome among the elderly. The brain training games also give information on which part of brain is trained. Scores from the games are a good form of stimuli for the elderly. As is commented by one of Eons users, "I try to keep my brain sharp with certain games. It is very easy to load games and play them and see your score. I really enjoy the site". Seniors can not only train their brains from these games, but also make more friends via games.

5.3 AboutMyage

Another example of OSN for the elderly is AboutMyage: a social network community for Australians over 50. This website divides its services into three types: user-related, friends-related and activities. The simple division of its services makes it easier to use. However, different from Oldkids, AboutMyage assumes that its users are able to use the Internet technologies well. Besides that, all instructions are in text form in relatively small fonts. Hence, the design does not take older users' requirements into account very well.

5.4 Domestic feature

The above mentioned websites are examples of senior-oriented OSNs in China, Australia and the US respectively. They are influential in their own countries. However, none of them is developed globally. For example, there are only 3

non-US members on Eons (information acquired by registering to the service in March 2009) even though it is in English which is the language used in the greatest number of countries in the world. Oldkids, which is established in Chinese, is more likely to be a domestic website. Even though an increasing number of countries in the world have developed their OSNs for the elderly, as the elderly are usually familiar their native languages, these websites are designed in domestic languages. Additionally, the elderly are more willing to communicate with people around themselves. So there is so far no obvious demand for cross-national and cross-cultural communication among seniors. Another reason is that friends in online social networks usually have a desire to meet each other also face-to-face, but international meetings are especially difficult or expensive to arrange. The above factors make online social networks for the elderly domestic.

6 Conclusion

Online social networks are increasingly needed by senior people. This is mainly due to physical and mental changes that they experience with age and shift in social role. Different from ordinary young people, some senior people may face difficulty to recognize small characters on keyboards. Other elderly may find it difficult to carry out online chatting, which is convenient and easy for young people. The mental changes such as a decrease in learning ability are depriving senior people of a great amount of entertainment. In other words, the more developed high technology is, the more likely senior people are lagged behind.

In order to design elderly-oriented social network services, the factors mentioned above should be taken into account. And indeed, many innovations are being developed to build a user-friendly network environment for the elderly. Jive is an interesting proof-of-concept for gaining access to social network services without a mouse, which is easier for the elderly who have problems using electronic devices controlled by precise movement. With the help of a friend pass (physical tag), Jive successfully links a senior to his friends and family members through other OSNs such as Youtube, Facebook and Myspace. Secondly, E-Learning is a necessary approach to equip seniors with the basic knowledge to use the Internet and other devices. And in this respect, learning in a social environment proves to be more effective than teaching the elderly separately.

Given the fact that the young are the mainstream in online social networks, local companies in many countries have began to focus on the needs of the elderly and have developed their OSNs for the them, such as Oldkids in China, Eons in the US and AboutMyage in Australia. In addition to general services that appear in many OSNs, e.g. finding friends and sharing files, these elderly-oriented OSNs have other special services. One example is Oldkids, which aims to help more seniors to use the Internet and has already developed different kinds of education approaches for the elderly. Brain training games in Eons arouse much interest among the elderly with many seniors not only gaining much fun from these games, but also finding new friends through game results. However, most OSNs developed for the el-

derly are domestic ones and developed in native languages. None of them has global influence. This is partly due to finite social range of the elderly and partly due to different cultures from country to country. Alternatively, as the young and middle-aged citizens of today become the elderly of tomorrow, mainstream OSNs such as Facebook are probably both traditional and global OSNs for elderly of the future.

References

- [1] China Internet Network Information Center. <http://www.cnnic.net.cn/index/0E/00/11/index.htm>.
- [2] Cyworld.com. <http://www.cyworld.com/cymain/index.asp>.
- [3] Eons.com. <http://www.eons.com/>.
- [4] Facebook.com. <http://www.facebook.com>.
- [5] Flickr.com. <http://www.flickr.com>.
- [6] Jive: social networking for your gran. <http://jive.benarent.co.uk/>.
- [7] Jive: technical details. http://jive.benarent.co.uk/technical_details.html.
- [8] Oldkids.cn. <http://www.oldkids.cn/>.
- [9] Xiaonei.com. <http://www.xiaonei.com/>.
- [10] *Being part of it*. European Commission Directorate-General for the Information Society, 4th edition, 2008.
- [11] Global faces and networked places: A Nielsen report on social networking new global footprint. Technical report, March 2009.
- [12] Fu-ren Lin and Chun-hung Chen. Developing and Evaluating the Social Network Analysis System for Virtual Teams in Cyber Communities. In *the 37th Annual Hawaii International Conference on System Sciences*, page 8, January 2004.
- [13] K. Brunette, M. Eisenstadt, E. Pukinskis, and W. Ryan. Meeteetse: social well-being through place attachment. In *CHI '05: extended abstracts on Human factors in computing systems*, pages 2065–2069, New York, NY, USA, 2005. ACM.
- [14] V. Fuchsberger. Ambient assisted living: elderly people's needs and how to face them. In *SAME '08: Proceeding of the 1st ACM international workshop on Semantic ambient media experiences*, pages 21–24, New York, NY, USA, 2008. ACM.
- [15] K. Holmén, K. Ericsson, and B. Winblad. Loneliness among elderly people living in Stockholm: a population study. *Journal of Advanced Nursing*, 17:43–51, 2006.
- [16] G. Hong. Nursing psychology among the elderly. *Chinese Nursing Advanced Studies*, 3(10):902–903, 2006.

- [17] L. Sørensen and K.E. Skouby. Next generation social networks — elicitation of user requirements. In *IEEE 19th International Symposium on Personal, Indoor and Mobile Radio Communications*, pages 1–5, September 2008.
- [18] J. Nielsen. The usability engineering life cycle. *Computer*, 25(3):12–22, 1992.
- [19] E. Romoudi and T. Fokidou. Designing GUI for the user configuration of pervasive awareness applications. In *DIMEA '08: Proceedings of the 3rd international conference on Digital Interactive Media in Entertainment and Arts*, pages 492–495, New York, NY, USA, 2008. ACM.
- [20] P. C. Santana, M. D. Rodríguez, V. M. González, L. A. Castro, and A. G. Andrade. Supporting emotional ties among mexican elders and their families living abroad. In *CHI '05: extended abstracts on Human factors in computing systems*, pages 2099–2103, New York, NY, USA, 2005. ACM.
- [21] S. Sayago, P. Santos, M. Gonzalez, M. Arenas, and L. López. Meeting educational needs of the elderly in ICT: two exploratory case studies. *Crossroads*, 14(2):1, 2007.
- [22] T. Y. Wei Zhou and S. Yokoi. Using web usability to support senior's Internet learning. In *4th Symposium on Intelligent Media Integration for Social Information Infrastructure*, volume 151, pages 121–122, December 2006.
- [23] T. X. Xin Fengmei and C. ChangXiang. Depression symptom and related factors analysis for retired aged people. *Chinese Nursing Advanced Studies*, 2004.
- [24] W. Zhou, T. Yasuda, and S. Yokoi. Internet for senior citizens in China: survey and proposal. In R. Mizoguchi, P. Dillenbourg, and Z. Zhu, editors, *ICCE*, volume 151 of *Frontiers in Artificial Intelligence and Applications*, pages 371–378. IOS Press, 2006.