Opportunities and Risks of the Information and Communication Technologies for Users with Special Needs

Julio Abascal[1] and Antón Civit[2]

[1]Informatika Fakultatea. Euskal Herriko Unibertsitatea

Manuel Lardizabal 1, E-20018 Donostia. Spain

julio@si.ehu.es

[2]E. T. S. de Ingeniería Informática. Universidad de Sevilla

Reina Mercedes s/n, 41012 Sevilla. Spain

civit@atc.us.es

Abstract– **The fast developing of information and communication technologies has aroused the hope of a new society in which all people would have the same opportunities to access -through diverse eservices- to knowledge, work, leisure, etc. Information society has also offered a promising opportunity for social inclusion of people with disabilities. The combination of technological advances (such as wireless personal area networks, wearable computing, etc.) with social advances (such as new inclusive legislation and social awareness) would make the social inclusion of people with special needs possible. Nevertheless, this will not automatically happen. It is necessary to apply inclusive design methods and to identify and avoid technological, ethical and social risks. This paper analyses the opportunities that information technology can offer to disabled people and the main risks that must be avoided. As a conclusion some guidelines to avoid these risks are outlined.**

Index terms—**Digital divide of users with special needs, Accessibility to ICT.**

I. INTRODUCTION

The current trend towards a knowledge based society where Information and Communication Technologies (ICT) play an important role in the relationships among individuals, companies and public services presents an opportunity for the social integration of people with disabilities and elderly people that should not be lost. The so-called eServices have an important potential for increasing personal autonomy and therefore they allow independent living in situations where traditionally this has not been possible [1].

This opportunity is not free of potential risks. If disabled and elderly users are not considered when ICT services and products are designed, they could be completely useless for these user groups. Therefore the capability gap between these users and the "standard user" would increase. This risk has led to another form of "digital divide" where the possibility of accessing ICT services, based on knowledge, abilities, economic situation, etc., divides the society into two separated groups.

This paper analyses a set of technologies that, if properly used, can help in the full integration of disabled and elderly people. In practice, many of the technologies mentioned in the paper will interact to provide integrated communication environments. As we progress towards systems supporting the "ambient intelligence" concept [2], the ICT based systems will be more transparent to the user and the distinction between the technologies will became less meaningful.

In any case, as already mentioned, it is important that the needs of disabled and older users are considered from the first steps of the design stage. This is the basis of the "Design for All" concept where services and products are designed so that they can be used by a wide variety of users. Unfortunately, the design for all products and services do not fully cover the wide spectrum of special needs. For those users that can not use these products as they are, some adaptations must be provided. Moreover, for those users who are not able to access standard products and services through adaptation, specialised services should be provided.

In many cases, accessibility to standard devices is performed through *technical aids*[1]. Therefore, it is essential that all services and devices use a widely accepted communication standard, in order to allow the mediation done by Assistive Technology devices. The links between assistive technology and design for all are discussed in [4].

[1] Technical aids are devices specially tuned to particular users needs, based on Assistive or Rehabilitation Technolo gy [3]

II. HOW CAN TECHNOLOGY HELP SOCIAL INCLUSION?

Many new technologies are currently being developed. Some of them can have a very positive influence over the social integration of people with disabilities and elderly people. All of them have a direct or indirect relationships with computer or/and telecommunications technology. In the next sections, some of these technologies are reviewed.

A. Web Access

Although other Information and Communication Technologies are still in much wider use, the World Wide Web is probably the fastest growing technology in the last years. Of course the Web is a means of entertainment and a source for a wide range of information but, in the long run, its use for education (*e-Learning*), access to public services (*e-Government*) and for professional activities (*Tele-working*) are some of the most interesting services for all the users and specifically for the disabled and elderly people.

The importance of Web access for all has been recognised in most countries and there is a strong trend to make accessibility compulsory at least for public web sites[2]. It is clear that this type of initiative represents an important step in the integration of disabled and elderly people in the so-called Knowledge Based Society. But it should also be clear that granting access to the Web should only be a part of a more general approach to accessibility where other aspects of electronic and physical accessibility are also taken into account.

Criteria for web accessibility should be as global as possible as the nature of the Web is also global. In this aspect the European alternative of directly adopting the W3C/WAI WCAG[3] seems a very convenient approach. The US approach has the clear advantage of having the force of real legislation[4] even if it is not fully based on the WAI guidelines, the global *de facto* standard.

Nevertheless, the provision of Web accessibility to access education, professional and public services should not be used as an argument against providing physical accessibility.

B. Computer Access

Although strongly related to the Web accessibility problem, the computer access problem is clearly different. Web accessibility usually refers to the existence of services and contents that can be accessed independently of the user's capabilities. However, a terminal in the client side is evidently necessary to access these contents. Even if a very wide range of devices can be used to access the web, personal computers are still the most widely used type of terminal. That means that the computer interface has to be suited to the capabilities of the user. In most cases interface design methodologies that take into account the needs of disabled and elderly users are enough, but adaptations and specific designs are still required to allow access by severely disabled users.

It is important to mention that, although current legislation in the US has brought accessibility features into the main operating systems, these seem to be provided as an "add-on" than as a fully integrated capability.

C. Access to voice communication

Even if data communication has experimented a huge increase in the last decade, voice based communication is still the most widely used mean for person to person contacts. The reason is that voice communication is the most natural way to contact other people and to ask for help in case of need or emergency. This fact is important, as some e-Access policies tend to forget voice communication and concentrate more on fancy data services.

On the other hand, many people tend to think that voice communication has no access problems except for deaf and hard of hearing users. The actual situation is much more complicated as, for example, blind and visually impaired users can have problems locating and using public access terminals and even handling personal communication devices such as mobile terminals. Also users with mobility or dexterity problems have difficulties in using voice terminals in general. Although some elder users (especially under 80) in developed countries have become used to mobile telephony most of them have more problems and feel less comfortable with mobile terminals than with traditional fixed equipment.

An important part of the problem is that users with special needs were not adequately taken into account when the equipment was designed. Nevertheless, it is clear that terminals based on "design for all" criteria

---

[2] "e-Europe 2002. An information Society for all. Action Plan" http://europa.eu.int/information_society/eeurope/action_plan/pdf/actionplan_en.pdf

[3] Web Content Accessibility Guidelines 1.0. W3C Recommendation 5-May-1999. http://www.w3.org/TR/WAI-WEBCONTENT/

[4] Section 504 of the Rehabilitation Act: http://www.section508.gov

will probably not satisfy the requirements of several user groups. As an example, a terminal that is fully controllable by voice might fulfill the requirements of many users with mobility restrictions but will probably not work in the case of those users whose voice is affected by their disability. For these users it is necessary to be able to interface the terminal equipment with user adapted Assistive Technology devices. The emergence of open wireless communication standards (e.g. Bluetooth) could, in principle simplify these types of interfaces.

In some cases, adaptations are not a possible alternative. In the case of deaf users the only method for using voice communication is through voice to text relay services. In the future, this type of translation will probably be automatic but, currently interpreter based relay centres are still the only possible alternative.

Regarding voice communication an important and often neglected issue is the right of users with disabilities in obtaining access to these services at an equivalent cost to that paid by fully able users. There are cases (relay services is the most evident) in which the cost of the service provided to a disabled user is much higher than the cost of the standard service. In some other cases the communication takes longer due to the disability of the user. As telecommunications in general -and voice communication in particular- is a very strongly competitive market, it is difficult that these differences are considered without specific legislation. In the European Union, the Open Network Provision (ONP)[5] takes this fact into account and establishes a framework to compensate for the additional costs. Currently only access to the fixed telephony network is considered for this type of compensation. This is clearly not sufficient in a situation where the number of mobile terminals is greater than the number of fixed terminals and the use of both networks is similar.

D. Text Communication

Some years ago phone based text communication was only known to the deaf community. With the advent of 2G digital mobile phones and specifically of the SMS text message system, currently phone based text communication is a fully mainstream, very widely used technology.

[5] Directive 95/62/EC of the European Parliament and of the Council of 13 December 1995 on the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment. OJ L 101, 1.4.1998, pp.24.

Although originally the SMS system does not fully cover the needs that text telephones covered it has the tremendous advantage that it lets a deaf user communicate just in the same way as everybody else in the mobile phone network without any need for relay services and interpretation. Currently many deaf users are making a wide use of the SMS messaging system to communicate with their friends, relatives, etc.

Most users would find useful the possibility of being able to use SMS to contact emergency service or to make appointment for doctors, etc. These types of services are currently not available in most countries.

An important, and already mentioned fact, is that text messaging does not provide the immediate feedback that traditional text telephones could provide as it does not support two way interactive communications completely. Another fact is that through SMS, a deaf user can only get in contact with users in the mobile network. These reasons justify the need for keeping voice to text relay services even if their use decreases due to the use of standard text messaging.

In [5] the use of mobile text and voice communications is further analyzed.

E. Video telephony

Video telephony has been one of the greatest misspredictions of the telecom industry in the last decades. In 1980 most people would have thought that in the year 2000 almost all person to person remote communications would be done using video telephones. The reality is very different and the use of video telephony has not increased very much in the last years.

Video telephony is important specifically to sign language users. In this case, video telephony can be used to communicate with other sign language users or, through an interpreter to a standard speech user. As sign language interpreters are scarce, remote interpretation, where video telephony is used to contact an interpreter when a sign language user needs to keep a conversation with a speech user, is a very attractive possibility. Requirements for sign language video telephony are higher than those used for ordinary video telephony and are considered in detail in [6].

Another situation in which video telephony can be very useful is in the relationships among elderly people with relatives and even with carers or doctors. Good quality video telephony brings a feeling of presence that voice telephony is not able to offer. Requirements for this use

are not as strict as for sign language communications. Several experiments have studied this use and demonstrated its potential utility [7].

F. *Broadcasting*

Together with voice telephony, broadcasting (radio, TV) is still the most widely used ICT. Access to mainstream broadcasting is considered as a right by most users, including people with disabilities. In the case of public broadcasting this right is even clearer as it is supported by all taxpayers' money without considering the abilities or age of the taxpayer.

The main techniques to have "television for all" are based on subtitling and audio description of the contents. In most developed countries the number of subtitled -or audio described- broadcast hours has ground steadily in the last years but they are still a small percentage of the total broadcast time. These techniques require human interpretation and are, thus, relatively expensive. Private broadcasting will probably not consider providing access for all if it is not required to do so by specific legislation.

An interesting related issue is webcasting, in which the Internet is used as a means to transmit audio and video real time info. Apart from the generic interest, webcasting could have interesting legal consequences. As an example, currently in the European Union institutional web sites should be accessible according to WAI WCAG1.0 guidelines. New versions of the guidelines should be adopted when they are available. As newer versions of the guidelines will probably include accessibility requirements for webcasted content, this would mean that public webcasts should be accessible. Considering the percentage of public broadcasting in the European Union and the increasing percentage of simultaneous webcasting this could have important consequences.

G. *Alarm and Health support systems*

The development of social alarm services is an important growth area in the last years. As the age of the population increases and more and more elderly people live alone, it is essential to provide the support to make safe independent living a reality. Although ICTs by themselves cannot solve this problem their potential to be an important part of the solutions is clear.

Currently, indoor active alarm systems in which the users can press a button if they require assistance are, by far, the most widespread system. In fact and although the capabilities of different implementations vary widely, this technology is fully deployed in developed countries.

Indoor alarm systems are important tools that help in keeping disabled and elderly user s in their homes. The fact that these type of systems are not operative outdoors is a very important limitation.

Currently, with the deployment of 2.5 and 3G mobile networks, the technical means to build outdoor alarm systems are clearly in place. Localisation is still a possible limitation but, in many cases the data that can be obtained directly from the network[6] is sufficient. In those cases where network location does not provide enough accuracy, satellite positioning can be used to complement this data. These systems will probably become widespread in the next decade.

An important limitation of most alarm systems is their passive nature. The system depends on the user capability of pushing the emergency button. Active alarm systems, where the system can automatically trigger an alarm when the user is not able to do so, have been an important research area for many years. Currently there are still many important technical challenges in developing active alarm systems but, clearly, the main topic to be solved is related user acceptance and, especially to ethical issues related to the capability of the system of triggering alarms without the user consent.

H. *Smart Homes*

The use of Information and telecommunication technologies to control or exchange information between different home devices (e.g. doors, heating and air conditioning, alarm systems, phones, entertainment systems etc) can be useful in keeping disabled and older users in their homes.

Traditionally the smart home infrastructure has been separated into control and telecommunication functions. Most research in the use of smart home technologies for disabled and older users concentrate exclusively on control functions. Although the results from many trials show the benefits of this technology market uptake is very small. The reasons for this include the existence of several standard networks (e.g. EHS, EIB) and the lack of trained staff in installation and maintenance companies.

---

[6] The accuracy depends of the type of network and the location but, in many cases, it is about 100m.

Currently, a clear market for home networking is clearly appearing. Most of it is related to applications such as internet access, multiple PCs or game console interconnection and other "infotainment" applications. Probably when the network infrastructure is available, device control applications will follow. This scenario is not free of dangers as, most probably, the needs of disabled and older users have not been considered in the design stages and accessibility and usability problems may easily appear.

A survey of smart home technology for all can be found in [8].

III. POTENTIAL RISKS

When accessibility to e-services is analyzed many risks can be identified. We have classified potential risks into three main categories: technological, social and ethical risks.

A. Technological risks

The use of an inadequate methodology or the ignorance of the user's actual needs can lead to an inaccessible design. For instance, in some cases devices can not be manipulated even by some people that usually do not require adapted equipment. This risk can be avoided if the designers use relevant guidelines towards a design for all approaches and if representative samples of the users take part in all the stages of the design process from the beginning.

On the other hand, e-services can be inaccessible if they cannot be used by people with special needs, even if they have adequately adapted equipment. To avoid this risk it is convenient to use standard procedures in the design process and to follow well known recommendations and guidelines. Sets of guidelines relevant to this field have been issued by diverse institutions. See for instance, the ones from COST219bis [7] and W3C/WAI[8]. On the other hand, the use of inclusive guidelines is widely discussed in [9]

B. Social risks

Some services enhance user access but can have a side effect in user socialization. In other words, these services can favor social isolation. This is the case of e-services that substitute other traditional services usually delivered by humans and therefore lead to a situation with lower human contact. For instance, the provision of e-services -such as remote Internet access to studies for disabled people, tele-care services, etc.- can lead to the cancellation of equivalent services delivered directly by humans, putting disabled users in the situation in which they can only access the electronic service.

In these cases, it is crucial that social authorities provide compensatory measurements to enhance user social participation. In addition, there is a need for laws against discrimination and institutions devoted to the surveillance of disabled user rights.

An analysis of some social implications of telematics can be found in [10]

C. Ethical risks

There are some risks that can be related to ethical issues [11]. For instance, when personal information is stored and/or transmitted without the authorization of the user, there is a dangerous lost of privacy that must be avoided by means of privacy protection laws and enhancing the user awareness of personal information use and cession.

In some cases, decisions concerning the user can be taken by machines or persons not authorized by the user, thus leading to a lost of autonomy. In this case, laws to protect the autonomy of disabled people are required too. However, it is also very important to enhance the user's awareness of decisions about them that can be taken by other people or by "intelligent" systems.

Most of the ethical risks must be faced from the legal protection of the user rights. Even then, the designers must be aware of the ethical implications of their products to avoid unnecessary invasions of user rights [12].

IV. FINAL REMARKS

Information technologies offer a challenging opportunity for social inclusion of people with special needs. Nevertheless, many factors can ruin this opportunity. Among them, economical restrictions, bad design and social and ethical risks have been detected. It is not credible that the natural evolution of the market will drive the industry to produce more accessible devices and services. These problems can only be overcome through international collaboration,

[7] http://www.stakes.fi/cost219/cosb235.htm
[8] http://www.w3.org/WAI/

standardization and legal protection. Table 1 offers a summary of basic guidelines to face the mentioned technical, social and ethical risks.

ACKNOWLEDGEMENT

The authors are grateful to their colleagues in COST219bis European action, where many of these ideas were discussed. The research associated to this paper is partly supported by the Spanish Ministry of Science and Technology under projects *Domosilla* [Grant No. TIC2000-0087-P4] and *Heterorred* [Grant No. TIC2001-1868-C03].

REFERENCES

[1] P. Roe. "Bridging the Gap". Cost219bis CEE, 2001.

[2] K. Ducatel et all. "Scenarios for ambient intelligence in 2010". European Commission. Brussels, 2001. ISBN, 92 894 0735 2. ftp://ftp.cordis.lu/pub/ist/docs/istagscenarios2010.pdf

[3] Cook A. M. and Hussey S. M.: Assistive Technologies: Principles and Practice. Mosby, 1995

[4] J. Abascal González & A. Civit Balcells. "Bridging the Gap between Design for All and Assistive Devices. In C. Stephanidis (edt.) Universal Access in HCI. Towards an Information Society for All. Lawrence Erlbaum Associates, 2001.

[5] J. Abascal González & A. Civit Balcells. "Mobile Communication for People with Disabilities and Older People: New Opportunities for Autonomous Life. In P.L. Emiliany & C. Stephanidis (Eds.) "Information Society for All. 6th ERCIM Workshop on User Interfaces for All". Consiglio Nazonale delle Ricerche. Firenze, 2000. Pp. 255-268.

[6] J.-I. Lindström (ed). New ways of using video telephony. A COST219bis Guidebook. European Commission 1999.

[7] L. M. Pereira and J. I. Lindström (Eds.). "Video telephony for Disabled and Elderly People". COST 219. CEC-DGXIII [EUCO-TELE 219/CTD/94]. Lisbon, 1994.

[8] J. Abascal, A. Civit, K. Fellbaum & M. Hampicke. "Telecommunications and Smart Homes. Technology for the future. J. Engelen (Ed.) Proceedings of the COST219bis Semminar "Telecommunications: Access for all?" Leuven December3-4, 2001.

[9] Nicolle C. and Abascal J. (eds.) Inclusive Design Guidelines for HCI. Taylor & Francis, London, 2001.

[10] V. Taipale and L. M. Pereira "The Social Aspects of Telematics, Disabled and Elderly People and The Future Challenges" in P. R. W. Roe (Ed.) "Telecommunications for all" COST 219. CEC-DGXIII. Luxembourg, 1995.

[11] Thakkar U. Ethics in the Design of Human-Computer Interfaces for the Disabled. ACM SIGCAPH Newsletter, June 1990; No. 42 pp 1-7.

[12] J. G. Abascal. "Ethical and social issues of "teleservices" for disabled and elderly people. In J. Berleur and D. Whitehouse. (Eds). "An Ethical Global Information Society. Culture and democracy revisited" Chapman & Hall, 1997.

	Risks	Description	Actions needed
Technological risks	Design of inaccessible devices	Devices that cannot be manipulated by people that usually do not require adapted equipment	??Use of guidelines towards a design for all approach to design ??User participation in the design
	Design of inaccessible services	Services that cannot used by people with special needs, even if they have adequately adapted equipment	??Use a design for all approach to design ??User participation in the design
Social risks	Services that favor social isolation	If they substitute services usually delivered by humans and lead to a situation with lower human contact	??Establish compensatory measurements to enhance socialization
	Cancellation of equivalent services	If the access to the regular equivalent service is discontinued due to the existence of the new e-service	??Laws and authorities against discrimination ??surveillance of user rights
Ethical risks	Lost of privacy	When personal information is stored and/or transmitted without the authorization of the user	??Laws to protect privacy ??User awareness of personal information use and cession
	Lost of autonomy	When decisions about the user are taken by others than the user or the person(s) authorized by the user	??Laws to protect autonomy ??User awareness of decisions about them that can be automatically or manually taken by other people

Table 1. Guidelines to face the mentioned potential risks