Universal Access: A Concept to Be Adapted to Technological Development and Societal Change

Laura Burzagli and Pier Luigi Emiliani

National Research Council of Italy, Institute of Applied Physics, Florence, Italy
{l.burzagli,p.l.emiliani}@ifac.cnr.it

Abstract. Society is undergoing a transition toward an information society, due to the very fast development of ICT technology. This transition is creating a new complex social environment that requires new ways of looking at universal accessibility and methodologies to guarantee it. After an analysis of the present situation and possible developments, the main conclusion of the paper is that not only the information society (equipment and services) must be designed for all, but also that it must be designed by all. This means that users must be integrated not only in the phase of requirement analysis, but as actors in designing and implementing solutions.

Keywords: Universal design, Design for All, Ambient intelligence.

1 Introduction

Universal access implies the accessibility and usability of information and communication technologies by anyone, at any place and at any time, regardless of social class, ethnicity, background or lack of physical, sensory, cognitive abilities. Universal access aims to enable equitable access and active participation of potentially all people in existing and emerging ICT mediated human activities, by developing universally accessible and usable equipment and services. These equipment and services must be capable of accommodating individual user requirements in different contexts of use, independent of location, target machine and run time environment [1] [2].

This paper aims to show how the application of this general principle is changing in accordance with the development of technology and its impact on users.

Therefore, a short outline of the main technological developments is offered, with some general comments about their impact on society.

Then, the complexity of the new emerging situation is outlined, which requires changes in the way the problem of accessibility has been tackled so far.

Finally, it is maintained that the situation requires non only that the information society must be designed for all, but that it must also be designed by all, meaning that users must be introduced not only in the phase of requirement analysis but also in the design and implementation of possible accessible solutions.

C. Stephanidis and M. Antona (Eds.): UAHCI/HCII 2013, Part III, LNCS 8011, pp. 22–29, 2013.

2 Ongoing Developments

Society is undergoing a transition toward an information society. This is caused by many different factors, two of which are considered here for their direct impact on universal access: (i) the very fast development of information and telecommunication technology itself and (ii) the new approaches to its use for producing equipment and applications, which have impact on the way people carry out activities related to access to information and interpersonal communication. A correct analysis of the changing living environment cannot be limited to the description of new protocols of access to information and communication and new applications, but must also include the impact of technology in people's daily life. On different levels, this impact concerns every citizen, regardless age, economic condition, or geographic location.

2.1 Technological Developments

From a basic technology perspective, the available computational power is ever increasing while the size, power consumption and cost of the corresponding components are decreasing, with a corresponding impact on many equipment of general use, as, for example, cell phones, which incorporate additional intelligence and offer new advanced functionalities. Nanotechnology is also developing very fast, with foreseen impact e.g. in the sector of sensors, which will become not only wearable but also implantable and able to navigate through the human body. Finally, computing power is being made available in the network.

From an interaction perspective, wherever a person is, she is supposed to be able to use whatever display is convenient, for example on a wall using a projector that project keyboards, displays and control panels on it, to access any information, carry out computing activities, view movies, listen to music, communicate etc. Alternatively, it is possible to project an image, which floats in space in front of a person and is seen only by the person using glasses or goggle-based systems. It is also possible to project the image directly onto the retina. A gesture recognition system can be used to operate the controls that float along the display. Voice technology is developing hands-free operation and voice control. The cost to build speech output into products has reduced to the point where speech can be provided on almost anything. External electrodes in the form of a band or cap are available as commercial products for elementary control of equipment directly by the brain.

From the network perspective, the World Wide Web, originally used as a document repository, is rapidly transforming (Web 2.0) into a fully-fledged virtual collaborative environment, facilitating media services, interaction and communication. The future network is seen as a space where services are made available and can also be implemented and/or modified by end users. Moreover, Internet it is developing toward an Internet of Things, where everyday objects, rooms, and machines are connected to one another and to the wider digital world.

However, the integrated use of the above technology is creating a more general evolution and the society is in transition toward an information society, caused by its reorganisation as an interconnected intelligent environment (Ambient Intelligence – AMI [3]).

From a conceptual perspective, there is a change from a model based on products (computers, terminals) and activities (tasks) to be carried out through them to a model in which functionalities are made available to people, irrespective of their real technical implementation, by intelligent objects available in the environment. From the perspective of users, including users with activity limitations, there is a fundamental change from an approach based on adaptations of products to be accessible in order to give the possibility of carrying out necessary activities, to a situation where emphasis is placed on the goals of people that the environment should be able to infer and support with functionalities adapted to the capability of any single user.

Following the originators of the AmI vision [4], Ambient Intelligence is defined according to its properties. Technology is supposed to be: (i) Embedded in the physical and social environment of people; (ii) Context Aware - employing machine perception, a model of activities of people and their social and physical context can be obtained; (iii) Personalized - addressing each user as an individual person; (iv) Adaptive to context and activities of the person; (v) Anticipatory - predicting user's needs and taking action to support them.

It is clear that some concepts and methodologies used so far in the field of accessibility (for example, personalisation and adaptivity) are supposed to become integrated in the very fabric of the emerging technological environment.

2.2 Changes in the Use of Technology

Even if society is far from a complete implementation of the Ambient Intelligence paradigm, ICT is becoming more and more pervasive and is changing the life of people, at work, at home and during leisure time. For example, many home appliances and cars have often processors on board and people are increasingly supported by or have to cope with the intelligent components that offer them functionalities.

This starts to have some visible consequences. For example, people are becoming less interested in accurate knowledge of devices (hardware) and the way they are controlled (software), but more interested in the functions provided by them. The main question is not: how is an equipment implemented, but how can I use its functionalities. For example, with a mobile phone, people starts to be more interested in how to send an SMS than in the hardware and software characteristics of the specific equipment.

This in turn has an impact on how people interact and use the technology. Different relationships between users and technology are emerging. For example, it is becoming common that people, before starting the engine of their car, get information about the state of the system and its previous patterns of usage on the screen of the onboard computer. A cooperation is established in order to take care of the car maintenance and data about the usage are made available, as the amount of gasoline used for a particular trip. During the travel, the car can offer advices on how to drive in order to reduce consumption or to adapt to the road characteristics.

Another interesting aspect is related to access to information. In the past, this was possible only in specific places, such as at home or at work. Now, people start to give for granted that they can browse the World Wide Web in any place and at any time,

even if with different devices or terminals. This has an important impact on how information is collected, organised and presented (for example, in a way that is adapted to the size of the available display).

3 Complexity of the Emerging Situation

If one would like to characterise the new emerging situation with a single words, this could be: complexity.

Starting from the most important perspective, i.e. the user, so far information technology and telecommunications (apart from plain telephony and television) was a business for specialists. Even if some of them had difficulties in using available equipment and applications due to the lack of necessary abilities, they were part of the literate part of the society and ready to learn alternative ways of using the technology. Now, users are all citizens and difficulties can be expected not only due to lack of physical, sensory, cognitive abilities, but also from the fact of being part of a specific social class, ethnicity, educational background. The number of ICT users is increasing and, correspondingly, also the number of people who may need support for accessibility.

Another element of complexity is connected to the differences of age. Young people, the so-called digital natives, consider the interaction with digital devices as natural and are eager to get and test new equipment and interactions. At the moment, the market is essentially addressing this user group. Adults have often followed the technology evolution. They have been educated to take into account the design and the characteristics of the technology, i.e. what it could do rather than the available functions. Many of them are not interested in most of the available functionalities. Finally, elderly people often realize that some new technology can give them important services in term of safety, health and leisure (such as mobile device), but address their interest to a limited set of functions and for each of them to a limited and well defined number of usage steps.

From a technological perspective, so far reference could be made to a Personal Computer with a keyboard, a monitor, a microphone and loudspeaker as a standard configuration. Now different devices are available: Personal Computers in the offices or at home, but also laptops, tablets, and smart phones. Then, environmental control systems are also becoming available. All these equipment have different characteristics (e.g. dimensions of screen) and software configurations (e.g. the operating system).

Finally, the variety of available equipment and functionalities made available by them has also an important impact from the interaction perspective. Interaction with ICT applications is no more limited to the manipulation of objects in windows on a screen with a pointer and the input of text. New forms of interaction are emerging, as voice interaction, gesture recognition, and tactile interaction. Even if from a perspective this can be considered positive for universal access, because different modalities of interaction can be accommodated, however it is also introducing additional complexity in the ICT environment.

In addition to new technological opportunities and, sometimes, novel inclusion problems, the ongoing transition toward an information society is creating interesting conceptual changes. From a situation in which the emphasis was in the access to information and point-to-point interpersonal communication, now it is necessary to guarantee people the possibility of taking part in a knowledge process, in which information is produced in cooperative activities and communication is inside groups of cooperating participants [5]. This in turn increases the number and therefore the different characteristics of people in the different user communities. While accessibility has been traditionally a concern of people with activity limitations, now all the citizens must be considered among people who can potentially need support for accessibility. Therefore, forms of presentation of information and necessary interactions need to evolve toward an, in principle, unlimited number of configurations, with continuous adaptations to match the characteristics of user changing, for example, for modifications in the context of use.

Finally, applications are no more limited to specific usage contexts (as work, home, leisure) in specific places, but most of them are supposed to migrate across different usage contexts and/or spaces (work, home, public spaces). This may create problems not only from the perspective of availability of necessary resources (e.g. network connection and bandwidth) everywhere and suitable interactions in different contexts of use, but have an impact on more general levels, as privacy, security and trust.

Obviously, the above short description is far for complete, but it is sufficient to give an idea of the new opportunities offered by the developments in ICT and of the complexity of the situation that could emerge. Many experts, for example the members of the ISTAG panel, think that the technology under development has the potentiality to hide this complexity from the user, as clearly expressed in the specifications of the AmI environment above reported. One of the purpose of activity in universal accessibility is to help in guaranteeing that this will really happen.

4 From Design for All to Design for and by All

As previously stated, universal access implies customisation of equipment, their interfaces and services and applications to the abilities of potential users. Even if the principle of universal design is unique, different approaches can be adopted to apply it.

Traditionally, this customisation has been obtained with the use of assistive technology, i.e. technology to be connected to a system designed for the “average” user addressing the requirements of specific groups of users (for example, a Braille display or a voice synthesizer for people who are not able to see the screen or a mouse emulator for people who do not have enough motor control to use a mouse). More recently, the concept of design for all has been developed. The idea in the paper is that design for all must be generalised to take into account the emerging situation [6].

4.1 Design for All

When the number and rate of development of new systems and applications started to increase, adaptation of products on an ad hoc basis became less viable and new approaches to guarantee universal accessibility were looked for.

One of them is the so called Universal design (or Design for All in Europe), whose generally accepted definition is "The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (http://www.trace.wisc.edu). Recently a detailed discussion of this approach was carried out in the framework of the European project "Design for all @ eInclusion", whose results are reported in [7].

A valid implementation methodology for Design for All is based on the concept of automatic adaptation (adaptability at run time according to the user profile and real time adaptivity to the current activities of the user). A demonstration of the viability of this technical approach, whose results are reported in [8], were developed in the framework of several EU funded projects, even if some results appears now limited by the level of available technology.

4.2 Generalisation of the Design for All Approach

The need of a generalization of the design for all approach and its implementation methodologies is essentially caused by two concurring circumstances: (1) the technological development; (2) the way technology is used.

Design for all is based on customisation. Since the initial phases of development, the artefacts are designed in order to produce automatically different features and interactions according to the user profile (adaptability) and the utilisation (adaptivity). Even if this process has already given important and useful results, the need of generalisation is due to the fact that the concept of artefact itself (e.g. a telecommunication application) tends to become blurred. Features and functionalities of applications tend to vary in order to meet the varying activities of people and the ways to carry out them. Moreover, the modifications tend to be decided by the users themselves and often are implemented by them as part of a user community. Therefore, with the proliferation of modified applications and ways of using them, it become very complex to satisfy all request at design time or to be able to introduce a sufficiently flexible adaptivity. The abilities of people are no more the only design data to take into account, but it is necessary to consider that the way of using the system and application may vary because in time people change their behaviour patterns.

The situation is becoming more complex and potentially interesting, if the social aspect of present developments are considered. Up to now, the focus was put on the accessibility as such, i.e. on the possibility of accessing information or point-to-point interpersonal communication through a suitable interface. Now, the very concept of accessibility is changing, because the goal of people's activities with a processing or communication device is also changing. Becoming members of a knowledge society, people are not only interested in receiving information and communicating, but also in giving a personal contribution to the common knowledge. The problem is no

more to grant a person access to an equipment to look for information or to communicate, but to empower a community who deals with different problems and tries to achieve a solution cooperatively. Therefore, a modification of universal accessibility from static concept to a dynamic process is necessary. Accessibility means being able to carry out the tasks, developing in time, necessary to be part of the knowledge society.

Therefore, in addition to guarantee adaptability and adaptivity of equipment and applications to the user characteristics, it is necessary to make available a direct link with the intelligence embedded in them, through which the single user can consciously modify the features of the application or its interface. This is in accord with the emerging paradigm whereby users themselves become actors in producing, even cooperatively, information and applications. The crowdsourcing concept, defined by Wikipedia as "the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, rather than from traditional employees or suppliers", becomes important. People are no more considered active only in accessing information and communicating, but also in the production of information and in the implementation of solutions of interest for the society.

Therefore, end users must be introduced in the design for all procedure so that products can be designed in order to cope with available knowledge about user requirements and behaviour through automatic adaptability and adaptivity, but also open to modification by users themselves (design for and by all).

Moreover, if a social dimension is considered as included in the universal accessibility concept, some of the problems of people in accessing information and communication can be solved with the help of other people instead of by technological adaptations. A social network can represent a different option to solve some user's problems in being part of the knowledge society, not due to a perfect design of the artefacts in it, but to the cooperation with other users. In this scenario, a community is made aware of the problems of one of the members and a solution may arise from the support by other members [9].

5 Conclusions

Universal accessibility is a very important concept and it must be pursued in order to implement an information society that does not run the risk of discriminating a (large) part of the population. Methodologies for the implementation of ICT products (equipment and applications) must change to cope with the change of behaviour of users.

The main idea presented in the paper is that universal access is not a static concept, but a dynamic process that must adapt to changes in technology and the way people use it.

This implies the need of involving users not only during the phase of requirement elicitation, but also in the design and development of possible solutions of accessibility problems.

References

1. Emiliani, P.L., Stephanidis, C.: Universal access to ambient intelligence environments: opportunities and challenges for people with disabilities. IBM Systems Journal 44(3), 605–619 (2005)
2. Stephanidis, C. (ed.): The Universal Access Handbook. CRC Press - Taylor and Francis Group (2009)
3. Information Society Technology Advisory Group (ISTAG): Ambient Intelligence: from vision to reality. Information Society Technologies Programme of the European Union Commission (IST) (2003), ftp://ftp.cordis.europa.eu/pub/ist/docs/istag-ist2003_consolidated_report.pdf
4. Aarts, E., Marzano, S.: The New Everyday views on Ambient Intelligence. OIO Publishers, Rotterdam (2003)
5. Project WeKnowIt: D9.4.2 - Final white paper on Collective Intelligence (2011), http://www.weknowit.eu/sites/default/files/D9.4.2.pdf
6. Emiliani, P.L.: Perspectives in Accessibility: From Assistive Technology to Universal Access and Design for All. In: Stephanidis, C. (ed.) The Universal Access Handbook, pp. 2.1–2.18. CRC Press - Taylor and Francis Group (2009)
7. Emiliani, P.L, Burzagli, L., Billi, M., Gabbanini, F., Palchetti, E.: D2.1 - Report on the impact of technological developments on eAccessibility. DfA@eInclusion Project (2008), http://www.dfaei.org/deliverables/D2.1.pdf
8. Stephanidis, C. (ed.): User Interfaces for All. Laurence Erlbaum Associates, Mahwah (2001)
9. Karampelas, P.: Techniques and Tools for Designing an Online Social Network Platform. Lecture Notes in Social Networks, vol. 3. Springer (2013)