Accessible User Interfaces: Priorities for Research

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Introduction

During a normal day most people interact with a wide range of switches, keypads, instruments and machines. At the end of the twentieth century a major shift took place in the way computers are used to drive these machines - which saves time, provides information, entertains, and permits communication.

With the introduction of more sophisticated machines, such as digital interactive television, mobile telephony and the Internet, even more complex controls, buttons and interfaces are being employed.

When considering the needs of elderly people and persons with disabilities, it is necessary to be aware that having little or no vision, poor manual dexterity or weak grip can make using the machines and tools in everyday activities very difficult. Lack of foresight and thought into the way people interact with machines can mean that access is denied to a significant section of the population.

It is not just with new devices where there are problems for people who have a disability. The increasingly sophisticated controls for cookers, microwave ovens, washing machines and central heating systems have created extra problems for disabled users.

In some instances it has been feasible to provide an *adapted* user interface such as a special keyboard for a user with a physical disability. However this type of approach has not proved viable for most public terminals, so *adaptable* user interfaces have been developed. For example the user's card might contain information which is used by the terminal to automatically change the font size or foreground and background colours on the display; this type of approach is limited to changes which can be achieved using software alone. A more sophisticated approach is to have an *adaptive* user inter interface which automatically adjusts the terminal based on the user's behaviour; this type of approach has been demonstrated under laboratory conditions but has proved difficult to implement in practice on public terminals.

The Consumers

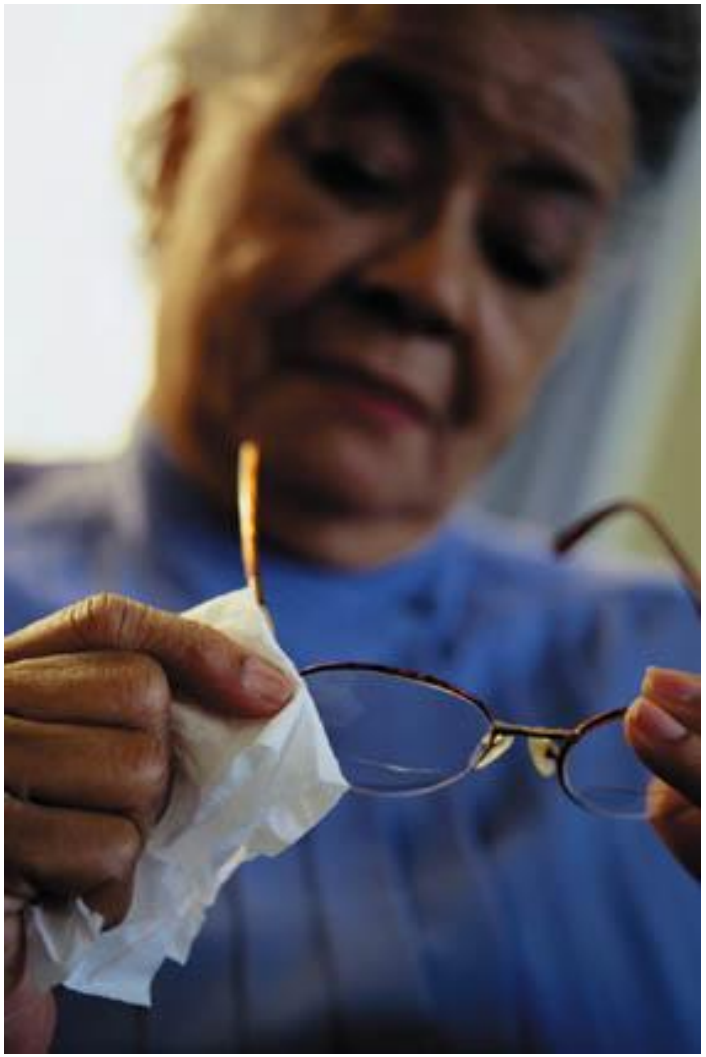
The number of people with disabilities is gradually increasing since more people are living to an older age and many disabilities are correlated with age.

Approximate proportion of the population who experience difficulties in using information and communication technology systems (NB Do not aggregate these figures since multiple impairments are common)

0.4%	Wheelchair users	1%	Dyslexic
5%	Cannot walk without an aid	3%	Intellectually impaired
2.8%	Reduced strength	0.1%	Deaf
1.4%	Reduced co-ordination	6%	Hard of hearing
0.25%	Speech impaired	0.4%	Blind
0.6%	Language impaired	1.5%	Low vision

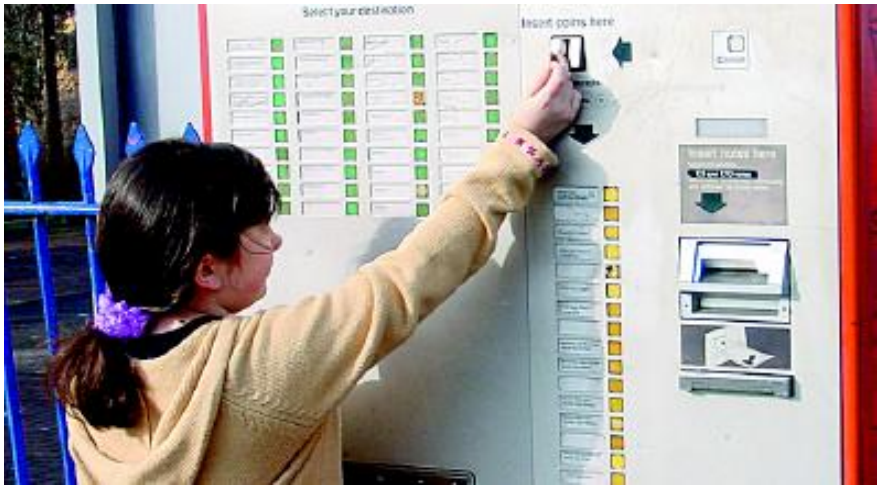
Just to group people by the impairment can be misleading since each impairment can take many different forms. To give an example, about 1.5% of the population in the UK have vision such that they could be registered as 'blind' or 'partially sighted'. However the impact depends on a number of factors including medical condition (eg macular degeneration), environment (eg illumination), and contrast.

In the past having a modest hand tremor was not a problem for operating controls, but the introduction of small touch screens on smart phones has meant that more people potentially have problems using everyday devices.



Inclusive Design of User Interfaces

Most user interfaces are designed for someone conceived as a ‘standard person’. The most common human characteristic is variety, so most designs do not completely fit the needs of an individual. Therefore the user has to adapt him or herself to the interface. Those not able to do this adaption may find that they are excluded from using a product or service.



Although techniques exist for avoiding unnecessary limitations, they are frequently not employed by designers of mainstream applications. The reasons for this include the complexity of applying existing methodologies and the time involved. However inclusive design means that mainstream products can be used by people with disabilities as far as is reasonably possible. When the inclusive design approach does not meet all the needs, assistive technology can provide enhancements or alternative methods of interacting with systems. However such assistive devices have to be designed such that they fully integrate with the mainstream systems.

It is important to determine what developments are required so that resources can be allocated in an optimal manner. These reasons are not just financial but also the finite quantity of appropriately skilled staff.

Key Developments Required

Category		Short term	Medium term	Long term
User centred design	Holistic approach	Methodologies that consider not only the interface but the entire interaction dialogue	Methodologies to include the human diversity in user interface design	
	Human factors	Research on who could be excluded from using novel user interfaces	Basic research on assistive technology abandonment/adoption	Accessibility implications of biometric systems
	Complexity and effort of user interaction	Reduce the complexity of user interaction whilst retaining functionality	Avoiding cognitive barriers in the design of the interface	Decrease the cognitive load associated with multimodal UIs
	User participation	Involvement of end users throughout the design and development process	Training programs for disability representatives to effectively participate in R&D processes	Using testing based in realistic settings
	Privacy, safety and trust	Trusted products that users can inspect and update system information	Improve legal certainty and consumer acceptance	
	Advanced design methodologies and tools	Methodologies and tools for HCI accessibility evaluation, including monitoring and benchmarking	Tools to facilitate the creation of digital accessible materials to non-accessibility experts	Tools for decision making in the user-centred design process
	User modelling and adaptive UIs	Methodologies that efficiently collect data about users	Enhanced user interaction profiles	Practical adaptive user interfaces
Advanced methodologies	Innovative user interfaces	Innovative interaction devices for accessibility	Accessible interaction with robots. Novel human-machine interfaces for	Accessible telecomms technologies for people with

and tools to overcome e-accessibility barriers			recreational activities	speech impairments
	UIs to grant access to advanced environments	Mobile technologies as access interfaces for public and private ubiquitous environments	Inclusive user interaction in ambient intelligent environments	
	Web accessibility	More understandable accessibility design guidelines. Web accessibility accreditation and certification methods	Rich interaction through distributed objects. Guidelines for ARIA compatible with AT and browsers	Augmented reality and the internet of things. Virtual reality technologies and guidelines for their accessibility
Interoperability and standardisation	Interoperability and standardisation	Interoperability among devices to enhance accessibility to ubiquitous computing environments	Standardised and harmonised remote HCIs	Dynamic composition of complex interfaces
Collaborative research and international knowledge sharing to overcome e-accessibility barriers	Collaborative research	Methodologies to analyse collaborative accessibility of user-centred design	Clearing house for inclusive HCI	
	Knowledge sharing	New mechanisms for international collaborations	Research on sharing accessibility internationally	
	Open technologies and innovative service delivery	Open APIs for the delivery of the interface to many more varied platforms	Ways to move from purchase to lease or renting accessibility and assistive technology	
Other issues	HCI designers: education and awareness research	Specific and clear accessible guidelines for application developers	Inclusive practices of professionals responsible to develop new products or services	Increasing and widening accessibility in professional education
	Policy related proposals	Why existing knowledge and standards on accessibility are not known or applied by HCI developers	Effective automated tools for publicly monitoring national government web site accessibility	Awareness of accessibility to general purpose applications as a civil right

Recommendations

Most of the activities carried out so far have been based on a *market* perspective, on the basis that the market is fragmented and that most of companies working in the field of assistive technology are too small to invest in development of new technologies. This market is unusual in that the products are often paid for by the service providers and not the users. Therefore it has been assumed that supporting companies in the development of new products would favour their European diffusion, and so reduce fragmentation and increase availability.

In the area of information and communication technologies, this approach has not worked and the situation has barely improved. There have been modest improvements, but these have been due to the mainstream developments and to general initiatives.

The idea, common to all European programmes, of putting together industry and academy to carry out research is sound, and is probably the most efficient way to achieve technology transfer. The problem in eInclusion has been that this cooperation has not delivered at the level of research, but at the level of development of specific products. In addition, it is not using resources in an effective way, because members of academia have expertise in developing new ideas and not in developing products. For the industrial partners the considerable cost of converting a prototype to a production item has proved prohibitive. Therefore mechanisms need to be developed to make the knowledge generally available if no product results from the project.

Moreover, this approach leads to incremental improvements in available products and therefore to limited advantages for the users. Incremental improvements are effective in some fields, such as consumer electronics, where products are bought as a status symbol and not for real advantages. This is not the case for disabled users who will only change to a new model if there are significant benefits for so doing.

The situation is even worse with deployment pilots. In this case, industrial organisations are happy to be paid to show their products, but very reluctant to invest in adapting them for the needs of pilots.

Therefore, European support should be devoted to research (ie to the development of the knowledge necessary for allowing industry to compete). The suggestions, in the earlier table, are not referring to specific equipment or technologies but to general investigations and tools. This would also allow for proper consideration of the technology transfer activity, which is not the transfer of products to users, but the transfer of technology to be used for the design of new products.

It is also necessary to reconsider how users should be part of this activity. If a technology is available and someone wants to adapt it to people with activity limitations, then it is possible to ask them to test it and suggest possible solutions to be implemented. But, when a technology is not yet available, it is only possible to work at the level of general functionalities and application scenarios. Methodologies and tools for extracting information at this level are necessary.

Another issue is the need for sharing knowledge; eAccessibility frequently requires software resources or written materials that should be shared by the developers in order to be used by a sufficiently broad community. To this end it is convenient to set up a network that ensures the availability and quality of the shared materials, helps to retrieve them and facilitates all the processes.

Legislation is very important, but it is necessary to consider the situation in Europe, where different national legislations exist.

Therefore it would be interesting to investigate what are the compatibilities of the different technological specifications with the national legislations.

There is also a need to establish a body to monitor the protection of the rights of the users against invasive technology. Most technology designed to support people with physical, sensory or cognitive restrictions or dependent people may have a considerable impact over their privacy, autonomy, sociability, and many other ethical issues. Current privacy laws are not sufficient to protect people with disabilities. It is vital to establish a permanent body that monitors and controls the impact of the R&D projects, starting with the initial plans (not only after the project is finished and the product is almost delivered).

Standardisation clearly has an important role to play both in terms of supporting legislation and developing international standards that cover the needs of everyone.

The Cardiac Project

The aim of the project is to create a platform that can bring together the various stakeholders in the area of accessible and assistive information and communication technology with a view to identifying research and development gaps, emerging trends, and generate a research agenda roadmap.

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For further information, please visit:

www.cardiac-eu.org