Designing Internet-based Systems and Services for All: Problems and Solutions

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Abstract:

Most current electronic services do not address the breadth of design issues necessary to comply with 'design-for-all' concepts, despite the fact that various design-for-all tools are available. One important reason for this gulf seems to be that most of the aforementioned work has not been provided to designers and Information Technology (IT) industry in a form that can enable them to easily include it in their design processes. This paper argues that design-for-all practical tools and methods need to be presented to designers, in an easily understandable and applicable manner, which will be generic enough to cover a wide range of requirements. The paper illustrates some of the obstacles preventing designers of Internet based systems and services from designing for all and suggests the need for a design aid environment that would bring the results from this work within the reach of designers.

1 Introduction

In the area of Internet-based services, various tools have been developed aiming at aiding designers in designing applications that can be universally accessed or designed for all. For example, at the level of requirements capture, methodologies and techniques aim to assist designers to trace user needs and characteristics in order to achieve a problem formulation that can lead to universally accessible services. At the level of design and modelling, recent advances in areas, such as adaptive user interfaces and software agents, provide solutions to conceptual and engineering issues related to design-for-all. At the level of policy, various recommendations, guidelines and standards for accessible design are available and try to address the problem of designing for all in a generic manner. Finally, at the level of development, a few tools are available, which implement part of existing recommendations.

However the extent and impact of this work in Internet-based services has not yet been widely seen. Typically, most designs still tend to address "average" persons' needs. As identified in the main report of CEN/ISSS project on Design for All and Assistive Technology (available at: http://www.ict.etsi.fr/activities/Design_for_All/INDEX.htm), *'few people represent the average person, with the consequence that if a product is designed for the average person, it might be uncomfortable or impossible for most people to use it'*. 'Design for all' has been described as the concept of addressing the needs of all potential users (Stephanidis et al, 1999). The need for designed for all products, is fuelled by the rapidly increasing demand for universal access covering a broad range of user requirements, reflecting the changing nature of human activities, the variety of contexts of use, the increasing availability and diversification of information and the proliferation of technological platforms.

One significant reason to explain the gulf between the existence of various design-for-all tools and the fact that most electronic services do not address the breadth of design issues necessary to comply with 'design-for-all' concepts, seems to be that most of relevant work has not been provided to designers in a form that can enable them to easily include it into their design processes. From the perspective of the IT professional, the process of designing for an inclusive information society requires awareness and to-the-point guidance concerning these design-for-all tools.

The paper argues that design-for-all practical tools and methods need to be presented to designers, in an easily understandable and applicable manner, which will be generic enough to cover a wide range of requirements. The paper illustrates some of the obstacles that prevent designers of Internet based systems and services from designing for all, in terms of guidance, applicability and take-up of existing work. Furthermore the need for a design aid environment that would bring the relevant results from this work within the reach of designers is suggested and a first view regarding its basic concepts is discussed.

The work presented in this paper is partially funded by the European Commission in terms of project IST-2000-26211 IRIS (Incorporating the Requirements of People with Special Needs or Impairments to Internet-based Systems and Services). The authors would like to acknowledge the contributions of their colleagues from EUROPEAN DYNAMICS S.A., University of Aegean, GMD-Forschungszentrum Informationstechnik GmbH, University of Basque Country and ISdAC (Information Society disAbilities Challenge).

2 'Design-for-All' aids

A considerable portion of previous and existing work on design for all includes aids related to approaches for requirements capture of a wide range of characteristics of users relative to requirements for access to computer-based systems; the design and development of system models related to the adaptation to user abilities, characteristics, preferences and tasks; and a number of standards, guidelines and recommendations that include the aforementioned requirements and models in computer-based systems and services and aim to guide designers to incorporate those into their designs. This section demonstrates the need for further extensions / adaptations of this existing work so that it captures the breadth of design-for-all requirements, by describing some examples of these aids in the aforementioned areas.

2.1 Approaches for user requirements in Design for All

In many traditional software applications the potential users are either known in advance (for example for the case of a specific in-house application), or the metaphors to be employed into the functional design are well known (for example in the case of logistics applications). However, with the advent of the Internet, services have to address user requirements, characteristics, cultures at a worldwide level. In this sense, these services need to address the requirements of neither individual, nor small groups of users but rather large, diverse and multicultural user communities (Stephanidis et al, 1999). In addition, the already established metaphors of the office desktop may not be appropriate for the case of multi-user, distributed environments and interactions. Specifically in the area of assistive technology, user requirements capture usually had as a starting point the classification of users according to their disabilities, mainly aiming at developing individual solutions for each type of disability.

These types of approaches currently are being overcome by approaches that take into account user abilities and hence are much closer to "design for all" concepts. These approaches view the use of technology under "special circumstances" rather than viewing users "with special needs", which also allows for the target population to be much wider. For instance, people using a browser while driving a car may have similar access needs that blind people. In this way not only the potential market is increased, but also disabled people's needs are considered in an inclusive manner. This inclusive approach is also in accordance with the needs of people with disabilities, who are not interested in very specific products that cover their needs, which are also hard to afford (besides the psychological factors related to very specialised solutions), but they are interested to ensure that mainstream applications are widely accessible and incorporate their requirements. It is known that people with disabilities may need special equipment to access technology, but once they can, they should not have further accessibility problems. Thus the designer is committed to the objective to avoid added barriers.

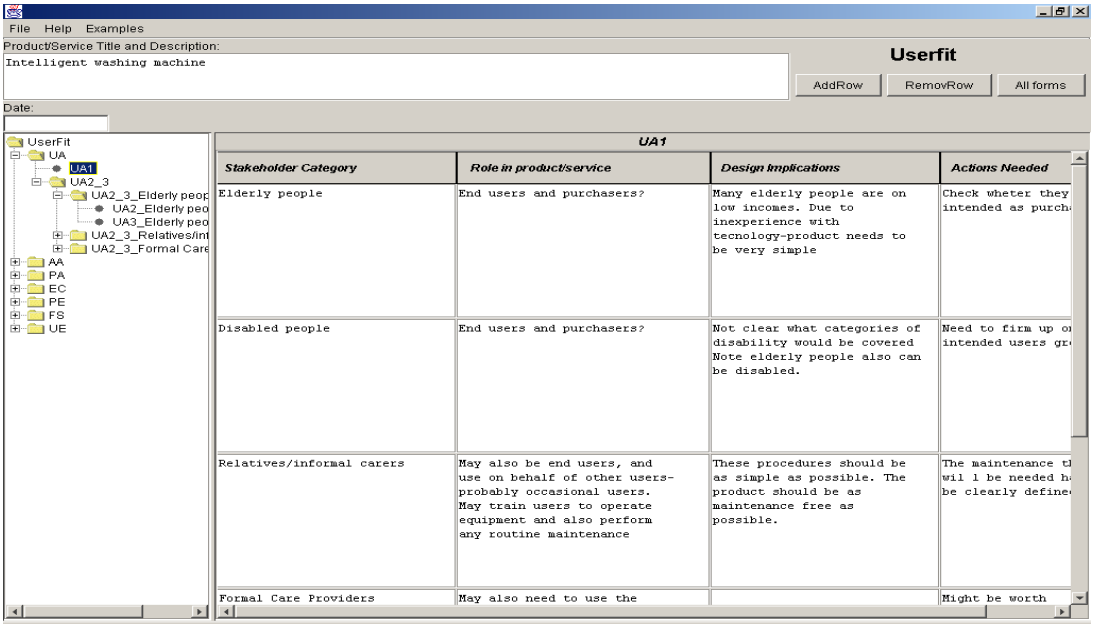

Figure 1: A snapshot of the user interface of a tool that can assist designers towards the use of the Userfit methodology.

Given the above problematique, an approach towards user requirements can be to use a methodology that helps to analyse, in a uniform manner, the special abilities, characteristics and constraints required by each user, in a given environment to design for a specific (set of) task(s). Userfit is a methodology oriented to requirements capture and specification for Assistive Technology design that can be described as user centred, system oriented and promoting iterative design (Poulson et al, 1996). The objective of Userfit is to help in the collection and processing of the information related to the user, by means a set of summary tools.

Furthermore, in order to accommodate the requirement for the collection and organisation of a wide range of knowledge about users, there is a need for tools that can aid the analyst/designer to better organise this knowledge and lessen the effort for timing tasks. For instance, for the case of Userfit the filling of the required summaries for a complex application is quite tedious. Therefore a tool that can significantly ease analysts' tasks is being developed (Figure 1).

2.2 Designing for adaptive system behaviour

As illustrated above, the design-for-all concept calls for the incorporation of a wide range of user requirements into service designs. However these requirements may result into conflicting or not simultaneously interoperable technical solutions. For example, the use of small fonts is not appropriate for users with sight impairments. Thus, in order to design for all, it is important that the system can provide alternative modalities, which are often related to human sensory cues.

Furthermore, even if a system supports multiple states and can cover a wide range of requirements, a given system state may not be at all accessible by users with requirements that totally conflict with the given system state, with the consequence that these users cannot change the given system state at all. For example, a default 'small fonts' setting cannot be altered by users with vision impairments, even if the system is configurable regarding its font size, because it is not at all accessible by them at the given default state. Therefore, besides supporting multimodalities, it has been realised that an approach towards achieving design for all is that of designing for system adaptivity, i.e. the system inherent property to trace and automatically adapt to user requirements.

A widely discussed paradigm for adaptive user interfaces is that of interface agents. Interface agents 'watch over the shoulder' user actions and can collaborate with them to ease the performance of a task or even undertake tasks on their behalf. Interface agents have been designed for a number of application domains. For the case of ACTS project GAIA (Generic Architecture for Information Availability) (Hands et al 2001), an interface agent was designed to provide various types of assistance to users of Internet electronic brokerage services in two contexts: the user interface context, to assist users to comprehend and manipulate the user interface: and the domain of application context, to provide users with information and advice according to their preferences (Koutsabasis et al 1999).

Despite the fact that interface agents are a promising paradigm for adaptive system design, there is still work to be done in a number of areas. For example, work on interface agents has not fully taken advantage of recent advances on user modelling research (Koutsabasis et al 2001) or mixed initiative interaction theories (Cohen et al 1998), which are highly relevant to their design and can enhance it towards behaviours and actions that are more predictable and accurate from the user point of view. Furthermore, there is a need for tools and libraries that can be used directly by designers in order to design such adaptive systems, thus contributing to design for all. For example, despite the fact that there is active research on interface agents in the last few years, there are still no specific development environments (a review of software agent developer environments, see Agentbuilder Web site, Agent construction tools: http://www.agentbuilder.com/AgentTools/index.html). Interface agent development environments should aim to ease the integration of interface agents into existing environments, ensuring a degree of adaptation to user characteristics as well as compliance with existing application requirements, such as those related to tasks to be performed and media to be employed for effective user-system interaction.

2.3 Applying accessibility guidelines to user interface design

In order to provide designers with guidance regarding the application of design for all principles, a number of recommendations, specifications and standards have emerged (Nicolle C. and Abascal J., 2001). These types of tools aim to assist designers to reduce the large number of design options into those that follow accessibility and usability principles. These initiatives broadly fall under the following classes of work: a) general standards for usability; b) technical accessibility guidelines; and c) domain specific specifications for user profiles.An example of a general standard for usability is ISO 9241 'Ergonomic Requirements for office work with visual display terminals (VDTs)'. This standard describes ergonomic requirements on several issues such as: task, visual display, keyboard, environment, colours and dialogue and it may be a basis for Web accessibility certification. The fact that it is general in scope, results that it may require further interpretations in order to be used further.. An example of an elaboration of ISO 9241 for the evaluation of user interfaces is that of Gappa et al (1997) who have developed a guideline oriented expert-based evaluation method that prepares the requirements of the standard to be tested in about 450 test items. However, the task of placing general guidelines into a particular context is not easy and may result into nearly exhaustive enumerations of properties and characteristics. Furthermore, such tasks, related to the interpretation of general recommendations, may discourage designers to consider the use of such recommendations into their design processes.

A large number of technical guidelines are available to support the design of usable and accessible Web sites. However, as Vanderdonckt (1999) remarks *'most of these guidelines come from multiple guideline sources with various trust levels so that their application does not guarantee any improvement of either the accessibility or the usability of Web sites'*. Furthermore the extent to which each set of guidelines addresses technical issues, as well as the degrees of freedom according to which each set of guidelines can be used to aid the design process significantly vary. Stephanidis and Akoumianakis (1999) demonstrate that

different engineering perspectives in the implementation of guidelines can lead to different interpretations and can influence the quality of the final products.

Work in specific application domains has also led to the production of specifications related to adaptations of services to user characteristics according to user profiles. Within the context of learning technology environments, there is much effort on the one hand, at defining metadata for educational content, and on the other, at specifying learner user profiles. For example in the distance learning sector, specification such as IMS Enterprise (available at: http://www.imsproject.org/enterprise/index.html) and IEEE LTSC LOM (Learning Object Metadata, available at: http://ltsc.ieee.org/doc/wg12/LOM_WD4.htm), aim to develop frameworks for interoperable, personalized services in this area. However there is still work to be done, for example towards joint efforts for defining metadata schemata and user profiles due to the complementarity of these two types of specifications (Konstantopoulos et al, 2001).

The establishment of the aforementioned types of recommendations requires tools, which can automatically aid designers to apply such guidelines at design time. For a few of these recommendations, such tools are already available. For example, Bobby (available at: http://www.cast.org/bobby) is a Web-based tool that analyses Web pages for their accessibility to people with disabilities following the W3C.WAI Web content accessibility guidelines (available at: http://www.w3.org/TR/WCAG20) and extensions to this tools already exist to cover the needs of very large Web sites, i.e. more that 10.000 pages (Cooper et al, 1999).

However these tools address very specific needs and have not been yet well situated into the design process for Internet-based design. From the perspective of the IT professional, the process of designing and developing for an inclusive information society requires awareness and to-the-point guidance with respect to design-for-all tools. In order to provide effective guidance to designers, a general-to-specific aiding approach is required that will organise and elaborate the bewildering variety of strands of existing work into into a format that can deliver practical results.

3 Towards a design aid environment to assist designers to design for all

IST-2000-26211 project IRIS aims to contribute towards addressing the above requirements. The main objectives of the IRIS project are to:

- Encapsulate into a design aid environment, work on design-for-all tools and methods; user modelling theories and methods including users with special needs; guidelines, recommendations and results from work about hypermedia, enrolment and accessibility; and
- Use this environment to redesign and enhance existing services in the areas of teleworking / on-line learning and electronic commerce, guided by rigorous user testing and evaluation.

The IRIS project will identify the suitability of a range of existing tools and methods for design for all, such as those related to guidelines, standards and recommendations for usability and accessibility, user modelling and profiles, delivering a range of media and content formats. It will identify and incorporate diverse strands of work, from multiple sources: i.e. open fora, such as W3C; industry, such as the Sun Accessibility Initiative, and standardisation organisations, ISO and CEN-ISSS, as well as other research projects. The project will also work on elaborating models of user requirements relevant to media, by involving large and international groups of users with varying abilities, with the aim of translating these models into technical characteristics of communication channels so that services may be configured to these characteristics.

By building upon this body of existing work, as well as the research with users, IRIS will work towards extensions of existing design tools and methods, so that these are in accordance with 'Design for All' concepts, as well as the technical development of new tools that can easily be incorporated into the design process and can assist designers. This work will contribute towards the first objective of the IRIS project, the design of a designer aid environment that can assist designers to design for all. The specification, design and development of the information infrastructure (e.g. such as user models – profiles and content descriptions) and of user centred techniques for adaptation of media and content has started employing the technologies of directory services and software agents respectively, as part of the design aid environment.

The IRIS design aid environment will be used to further develop existing Internet services, currently deployed in a commercial context, in the selected areas of electronic commerce and teleworking/on-line learning. The use of the IRIS designer aid environment and the application of principles for inclusive design to the redesign of those services can significantly enhance their impact and target market. The evaluation of the redesigned Internet services will be achieved in a user centred manner, with the participation of large international groups of users with special needs, which will enable IRIS to make the best use of their varying requirements and insight.

A diagrammatic illustration of the IRIS approach for aiding designers to design for all is shown in Figure 2.

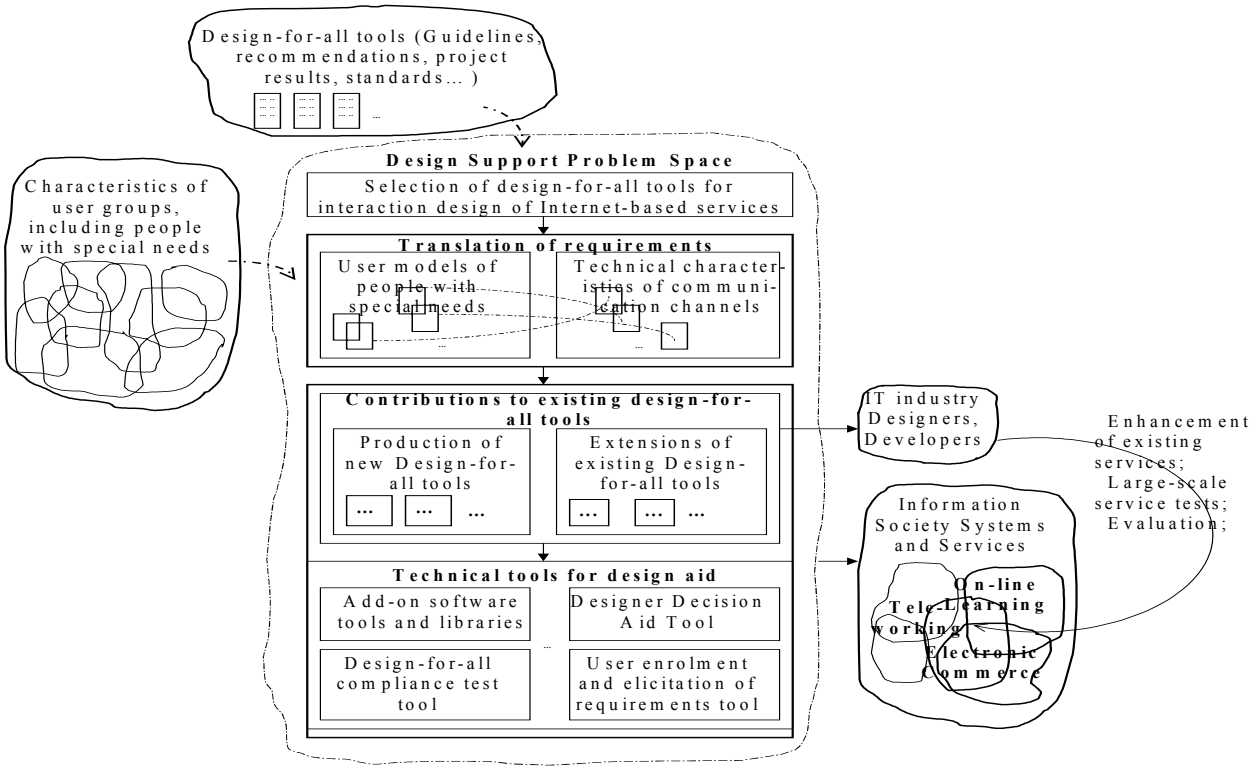

Figure 2: A conceptual view of the IRIS design aid environment context and impact.

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