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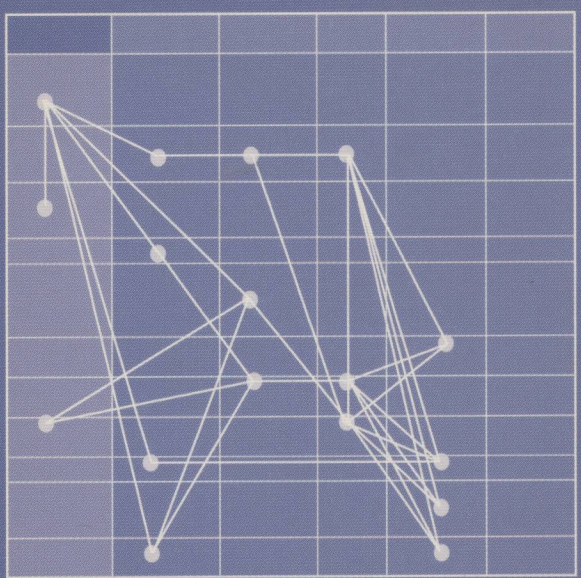
Universal Access in Health Telematics

A Design Consortium Code of Practice



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Universal Access in Health Telematics

A Design Code of Practice

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Volume Editor

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Preface

The Information Society is bringing about radical changes in the way people work and interact with each other and with information. In contrast to previous information processing paradigms, where the vast majority of computer-mediated tasks were business-oriented and executed by office workers using the personal computer in its various forms (i.e., initially alphanumeric terminals and later on graphical user interfaces), the Information Society signifies a growth not only in the range and scope of the tasks, but also in the way in which they are carried out and experienced. To address the resulting dimensions of diversity, the notion of universal access is critically important. Universal access implies the accessibility and usability of Information Society technologies by anyone, anywhere, anytime. Universal access aims to enable equitable access and active participation of potentially all citizens in existing and emerging computer-mediated human activities by developing universally accessible and usable products and services, which are capable of accommodating individual user requirements in different contexts of use and independently of location, target machine, or run-time environment. In the context of the emerging Information Society, universal access becomes predominantly an issue of design, pointing to the compelling need for devising systematic and cost-effective approaches to designing systems that accommodate the requirements of the widest possible range of end-users.

Recent developments have emphasized the need to consolidate progress by means of establishing a common vocabulary and a code of design practice, which addresses the specific challenges posed by universal access. IS4ALL is the acronym of the European Commission-funded Thematic Network (Working Group) "Information Society for All" (IST-1999-14101). IS4ALL is the first project that addresses in a systematic manner the task of consolidating and codifying available knowledge on universal access in the context of health telematics. The primary reason motivating the work of IS4ALL is the fact that universal access is a relatively new concept, frequently confused with more traditional approaches to accessibility. Secondly, it becomes increasingly obvious that prevailing conceptions (e.g., human-centered design), although useful, do not suffice to explicitly address universal access goals in the context of the Information Society. Thirdly, universal access is increasingly becoming a global quality attribute and a prominent factor of product/service differentiation in the public and private sectors. In this perspective, accessibility needs to be investigated beyond the traditional fields of inquiry (e.g., assistive technologies, landscapes, interior/exterior design, etc.) in the context of selected mainstream Information Society technologies and important application domains with significant impact on society as a whole, such as health, education and training, and public administration. There is, therefore, a genuine and compelling need to consolidate existing experiences into a body of knowledge, which can guide designers concerned with universal access through the various steps involved and provide concrete examples of good practice.

The domain of health telematics was selected in IS4ALL because it is a critical service sector, catering for the population at large, and at the same time involving a variety of diverse target user groups (e.g., doctors, nurses, administrators, patients).

These characteristics render it a complex domain, with an inherent diversity, and an ideal "testbed" for exemplifying the principles of universal access and assessing both the challenges and the opportunities in the context of the emerging Information Society. Such an objective entailed several challenges. Specifically, despite the increased research, academic and industrial interest in universal access in the recent past, the field requires further elaboration of the detailed knowledge necessary to practically apply universal access in the development of modern applications and services. The first and foremost evidence factor is the variety of conceptions about universal access. For instance, many researchers, typically in the field of assistive technologies, consider that universal access effectively entails a renewed interest in people with disabilities. From this perspective, it is claimed that an explicit focus on the needs and requirements of people with disabilities — who traditionally have been overlooked or underserved — will meet the objective of universal access. Others in mainstream sectors maintain that universal access is merely a matter of complying with existing principles and proven practices of user-centered design. On the other hand, others realize the need to improve prevalent user-centered design to encompass new methods of understanding user requirements and evaluating novel features of interactive software.

At the same time, previous research indicates that universal access in the context of Information Society applications and services comprises much more than incremental advances in each one of the dimensions implied by the above concepts. Indeed, it requires a better understanding of the users, which is a long-standing premise of user-centered design. However, users are no longer distinctly identifiable or easily studied. It also requires a better understanding of technology and use practices in a rapidly changing environment, but neither of these turns out to be an easy domain of study. The above considerations have motivated recent calls for revisiting existing theory, providing creative interpretation of design guidelines and establishing new engineering grounds, with the aim of extending the level and scope of current theory beyond keystrokes and task specifications to gain insight into novel computer-mediated human activities. This requires a retrospective on our experiences in the context of our expectations for the future of society and technology and a deep insight into the changes brought about by the radical pace of technological innovation, the modern and ubiquitous networking infrastructure and the proliferation of novel interactive devices. In addition, universal access cannot dismiss the changing execution contexts of tasks and the increasingly social nature of interaction.

IS4ALL has investigated the above in the context of health telematics, and has established bridges across various research communities, including usability engineering, human-computer interaction (HCI), assistive technologies, software engineering, software quality, industrial engineering, and the social sciences, in an effort to bring to the surface knowledge and best practices that can contribute to a better and more elaborate understanding of universal access. The application domain of health telematics was selected as a critical service sector in the emerging Information Society.

To achieve the intended objective, IS4ALL engaged in a data collection activity that aimed to unfold new requirements in health telematics and new or improved design processes and methods, which could be used to cater for the emerging requirements. The inquiry into health telematics was inspired by the scenario-based perspective into systems development and resulted in a rich set of representative

scenarios depicting alternative patterns of use of electronic patient records. To this effect, the project involved a wide range of health telematics representatives working on health telematics research and development, everyday professional health telematics practices, regional health telematics networks, and end-users.

As for the methods, the project devised a common definition of what constitutes a 'method' and a 'process' of design. To this effect, a common template was compiled according to which all methods should be consistently described in terms of key features, such as the problem being addressed, the instruments and devices used, the process for using the device(s), inherent method assumptions, and method outcomes. This effort brought together, in a common format, knowledge (frequently tacit), that was previously hidden in practices of different design and engineering communities.

These methods, once consolidated, were validated and refined in the context of designated health telematics scenarios to assess relevance, practicality, and added value. The intention was to convey an insight into how each of the methods could be used in a practical design setting, as well as how each could be tailored to different organizational practices. The resulting experience and critical appraisal of the methods indicated the need to improve the method base with a view to establishing new design techniques to address unmet challenges.

This volume reports the most representative efforts of the IS4ALL consortium towards establishing a validated code of universal access practice. Although the book does not claim exhaustive analysis of relevant methods, it is worth noting that the methods presented share not only a common heritage, but also a common set of characteristics, aside from being oriented to interactive software design. First, they all are scenario driven, with the scenarios serving as an "engine" for directing and focusing the methods' activities. Second, the methods focus on documenting the rationale behind the design decisions made. In this way, the rationale serves as a knowledge base for existing and future decisions. Third, they all involve stakeholders so that multiple views of universal access quality are elicited, prioritized, and embodied in the systems being considered. Fourth, the methods can be tailored to the requirements and internal codes of practice of an enterprise or research group to ensure maximum benefit. Finally, the methods are compatible in the sense that a consultant, a quality assurance group, or a research team can select a specific portfolio of methods to guide their development process.

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Chapter 1
Universal Access

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Abstract. This Chapter provides an introductory account of Universal Access, identifies premises and highlights some of the reasons for attention being focused on Universal Access. The Chapter also provides a context for the work described in subsequent Chapters of the handbook.

1. Origins and Applications

The term Design for All refers to the conscious effort to consider and take account of the widest possible range of end-user requirements throughout the development lifecycle of a product or service. In many ways, universal design is not entirely new. Architects have been practicing it for several years now and have developed a common understanding, which is summarised in the following definition:

> *"Instead of responding only to the minimum demands of laws, which require a few special features for disabled people, it is possible to design most manufactured items and building elements to be usable by a broader range of human beings, including children, elderly people, people with disabilities, and people of different sizes." Encyclopaedia of Architecture, Design, Engineering and Construction, 1989, p. 754*

In recent years, there have been several applications of universal design in interior and workplace design (Mueller, 1998), housing (Mace, 1998), landscapes (Mace et al., 1991), etc. This is not to say, by any means, that the built environment we live in has been designed for all, but merely points to the fact that universal design is not specific to the Information and Communications Technologies (ICT) sector of the industry. However, the distinction that should be made is that, whereas the existing knowledge may be considered sufficient to address accessibility of physical spaces in a built environment, this is not yet the case with ICT, where universal design presents numerous challenges.

This Chapter is concerned with the challenges of Design for All in the context of Human-Computer Interaction (HCI), and with the design of interactive products and services in the domain of Health Telematics. HCI and Design for All have only

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recently established reciprocal openings, leading to the formulation of new concepts and research agendas. Examples include the notions of Universal Access (Stephanidis et al., 1998; Stephanidis et al., 1999) and Universal Usability (Shneiderman and Hochheiser, 2001; Shneiderman, 2000), which now constitute core thematic areas in academic communities[1].

2. Universal Access

Universal Access in HCI, which is the strand motivating the present work, implies a conscious and systematic effort to advance proactive approaches (in terms of designated design processes, development tools, etc.) towards interactive products and environments that are accessible and usable by the broadest possible end-user population, anytime and from anywhere, without the need for additional adaptations or specialised (re-)design (Stephanidis et al., 1998; Stephanidis et al., 1999). It should be noted that the notion of Universal Access, as defined above, extends the previous conceptions of universal design by adding at least two dimensions of consideration. Specifically, Universal Access postulates explicit consideration, in the course of design, of the context of use and the platform and/or access terminal, in addition to users. In other words, if U, C and T represent a designated set of target user groups, envisioned contexts of use and technology platforms respectively, then Universal Access entails the consideration of a design space that is the Cartesian product UxCxT, as opposed to any particular subset. It follows, therefore, that the rationale behind Universal Access research in the context of HCI is typically grounded on revisiting some of the assumptions that have prevailed in HCI research and development efforts in the past two decades. In Chapter 1 of Stephanidis (2001c) these assumptions are summarised as follows:

- *The "average" typical user - in the context of the emerging distributed and communication-intensive information society, users are no longer the computer-literate, skilled and able-bodied workers driven by performance-oriented motives. Nor do users constitute a homogeneous mass of information seeking actors with standard abilities, similar interests and common preferences with regards to information access and use. In short, in the emerging Information Society and for the vast majority of modern applications (i.e., World Wide Web Services), conventional strategies will not necessarily help because the set of users of an application or service is*

[1] The term "community" is used in the present context to reflect the fact that research programmes on universal access and universal usability are scaling-up to obtain international recognition, having own and separate research agendas, technical and scientific forums (i.e., International Scientific Forum "Towards an Information Society for All" – ISF-IS4ALL, http://www.ui4all.gr/isf_is4all/ ; ERCIM WG UI4ALL, http://www.ui4all.gr/), international conferences, such as Universal Access in human Computer interaction (UAHCI) http://www.hcii2003.gr/thematic-areas/uahci.html and ACM Conference on Universal Usability (CUU) http://www.acm.org/sigchi/cuu/ and archival journals (i.e., International journal on Universal Access in the Information Society (UAIS) http://www.springeronline.com/journal/10209/about

unknowable, other than by statistical generalities, and the users have only indirect influence on developers or providers (Olsen, 1999). Instead, it becomes compelling that designers' conception of users should accommodate all potential citizens, including the young and the elderly, residential users, as well as those with situational or permanent disability.

- *The context of use - due to the unlimited business demand for information processing, the HCI community has progressively acquired a bias and habitual tendency towards outcomes (i.e., theories, methods and tools), which satisfy the business requirements and demonstrate performance improvements and productivity gains. However, since the early 1990s, analysts have been focusing on the increasing residential demand for information, which is now anticipated to be much higher than its business counterpart. Consequently, designers should progressively adapt their thinking to facilitate a shift from designing tools for productivity improvement to designing computer-mediated environments of use.*
- *Interaction devices & the "desktop" embodiment of the computer - the diffusion of the Internet as an information highway and the proliferation of advanced interaction technologies (e.g., mobile devices, network attachable equipment, etc), signify that many of the tasks to be performed by humans in the information age will no longer be bound to the visual desktop; New metaphors are likely to prevail as design catalysts of the emerging virtual spaces and the broader type and range of computer-mediated human activities. Arguably, these metaphors should encapsulate an inherently social and communication-oriented character in order to provide the guiding principles and underlying theories for designing more natural and intuitive computer embodiments. Consequently, the challenge lies within the scope of finding powerful themes and design patterns to shape the construction of novel communication spaces. At the same time it is more than likely that no single design perspective, analogy or metaphor will suffice as a panacea for all potential users or computer-mediated human activities.*

3. The Need for a Reference Framework

In the light of the above, it is argued that a prime Universal Access challenge is to provide a suitable methodological frame of reference to facilitate the objectives of understanding and designing for the global execution context of tasks. This involves the designer in a complex and iterative interplay between reflecting on prevailing practices (which may be sub-optimal) and envisioning anticipated or intended use (across a variety of contexts). The main departure from traditional design paradigms, especially those prevalent in HCI, amounts to the fact that whereas HCI designers are engaged in revising tentative designs within the realm of a specified design vocabulary (i.e., the visual embodiment of the desktop, interaction elements of some

mobile devices such as PDAs), Universal Access designers increasingly need to articulate proposals which cross over the boundaries of a particular design vocabulary. In other words, Universal Access designers should seek to develop proposals to reflect how a particular task is executed by different users, under various conditions of use and using a variety of platforms or access terminals, as appropriate for a specific scenario of use. In this context, Universal Access designers are primarily engaged in the construction of new virtualities (i.e., novel concepts and tools for carrying tasks and activities), which need not necessarily follow prevailing rules of thumb or a designated set of design principles. This becomes evident when one considers some of the well-known and frequently acclaimed examples of application of universal design in landscapes (Mace et al., 1991), interior, exterior and workplace design (Mueller, 1998; Mace, 1998), and appliances (Rahman and Sprigle, 1997).

The issue therefore arises of identifying a reference frame that could inform and guide designers to pursue Universal Access in the context of HCI design. Experience from architectural or other engineering design disciplines may be useful for this purpose, but needs to be validated. On the other hand, prevalent HCI frames of reference, such as human factors and cognitive theories, have had little impact on the field, other than formulations of general principles and design guidelines. However, there are several factors impeding the use of such guidelines in the context of Universal Access. The first relates to the scope of currently available guidelines. By scope here, we imply the type and range of accessibility issues that can be adequately addressed by available knowledge and the kind of solutions that can be generated. The vast majority of the existing accessibility guidelines have been formulated on the basis of formative experimentation with people with disabilities. Despite their sound human factors content, in the majority of cases guidelines offer disability-oriented recommendations. Furthermore, their context-independent formulation, which is inherited from the context-free research protocol of the human factors evaluation paradigm, necessitates substantial interpretation before they can provide practically useful insight. Lack of structured and organised methods to facilitate interpretation, impedes even further their use.

Secondly, experience indicates that the engineering perspective adopted determines the outcome of guidelines interpretation. There are two such engineering perspectives (Stephanidis and Emiliani, 1999) briefly reviewed in Chapter 3. The first is rooted in the reactive protocol, whereby adaptations are introduced a posteriori to provide an alternative access system, used by specific user categories. In the context of Universal Access, such an approach is clearly inadequate due to the inherent complexity, and any short-term benefits are quickly outweighed by software updates, versioning, the radical pace of technological change, but also the short life-cycles of today's software products. The alternative is to formulate guidelines, resulting into systems that are inherently and by design accessible. In contrast to the previous alternative, the latter is more in line with Universal Access, since it entails proactive engineering practices to alleviate rather than remedy accessibility problems (Stephanidis, 2001a). However, with only few exceptions, it is claimed that the prevalent state of knowledge cannot facilitate such proactive accounts. Further research is needed to re-address the accessibility challenge in a more generic manner (i.e., Universal Access), which accounts not only for diversity in human abilities, but also for diversity in the technological environment and the emerging contexts of use. To this effect, the

currently available accessibility guidelines offer a biased insight to HCI design, by prescribing desirable features to promote the case of accessibility by people with disabilities. However, Universal Access solutions, in the form of anyone, anywhere and at any time access systems, entail a thorough understanding of diversity, and generic approaches to address variety in: the target user community, including the disabled and elderly, as well as the technological environment (i.e., platforms, access terminals) and the contexts of use (i.e., desktop, mobile, nomadic). To this end, there is a compelling need to provide process-oriented guidance on Universal Access and develop methods that offer insights to, and take account of, the global execution contexts of tasks.

4. Methodological Frame of Reference

A possible approach to cope with the design complexity intrinsic in Universal Access draws upon action research and advocates the use of scenarios as minimal resources for design insight and evaluation (Carroll, 1995). In scenario-based design, which motivates the technical approach of IS4ALL, three phases predominate in the iterative process, and these relate to prevailing use, anticipated use and design rationale. Recent studies (Carroll, 2001) indicate that scenario-based design is becoming an increasingly accepted practice, due to several reasons; first of all, scenarios are cognitively sound and reusable; second, they offer a blending of empirical and analytical design perspectives; in this context, scenarios provide an integration of prevailing use patterns (resulting from the analysis of tasks as carried out today) and design envisionment (Carroll, 1995).

A particular track of scenario-based design builds on argumentation techniques to provide a basis for structuring the scenario analysis process. Argumentation as an approach to design is not new. In the context of software design, it amounts to the development of methodologies and notations that aim to improve the reasoning of designers. Rittel (1972) originated this approach in the Issue-Based Information System (IBIS) framework for argumentation. IBIS was a method developed by Rittel as a language and a graphical representation of the debate and negotiation, which is central to the process of tackling a particular class of problems called "wicked problems". IBIS made use of issues as a means for structuring argumentation. Options in IBIS reflect alternative design solutions to particular issues. Finally, arguments are used to formulate the pros and cons of the proposed solutions for a given issue. In recent years, the argumentation perspective was advanced further in the area of HCI, which lead to the development of additional frameworks and semi-formal notations (for a review see Carroll and Moran, 1996) for structuring arguments, communicating alternatives, documenting design reasoning and re-calling attention to HCI design problems.

IS4ALL pursues the above lines of research in the context of Health Telematics (Stephanidis and Akoumianakis, 2002). Specifically, the project adopts a technical approach based on a scenario-based perspective on systems development (Carroll, 1995; Carroll, 2001), and in particular on requirements engineering through scenarios (Jarke et al., 1998). Scenarios, in the context of IS4ALL, are perceived as narrative descriptions of computer-mediated human activities in a Health Telematics

environment. The social setting of a Health Telematics environment may be bound to a clinic within the hospital, a ward within a clinic, or even to an end-user's business or residential environment. The scope of such scenarios is intended to be narrow and focused on specific issues.

Scenario analysis entails a process of extracting and developing scenarios for two primary purposes: first, to obtain a detailed insight into the Universal Access requirements relevant to Health Telematics, and second, to demonstrate the validity and applicability of the envisioned code of practice. These scenarios are being formulated around an agreed common theme, namely Electronic Patient Records. Scenario formulation is an iterative process. Initially, narrative descriptions of tasks, as carried out by actual users, are developed, and subsequently peer reviewed by health professionals or end-user communities. This peer review acts as validity check to ensure that the scenarios depict realistic and valid accounts of computer-mediated human activities in Health Telematics. In the course of this iterative phase, any system mock-ups, prototypes or other artefact that reveal aspects of the scenario's real execution context are taken into account. Once an initial formulation is compiled and agreed upon (by target users of the system being considered), scenarios are articulated in such a way as to unfold various perspectives relevant to Universal Access. Scenario articulation is primarily an argumentative process.