Ergonomic accessibility standards

D. W. Fourney, J. A. Carter[a]

[a] *Department of Computer Science, University of Saskatchewan, Saskatoon, SK S7N 5C9, Canada*

Abstract

This paper critically discusses several new international computer accessibility standards. Although recognition of the need for guidance on accessible computing has existed since the early 1990's, development of such guidance is a recent trend that has accelerated greatly in the past five years. The development of these standards suggests how far the computer industry has come with regards to accessibility. Each standard discussed in this paper provides a specific type of guidance to assist developers to design their products to meet the needs of the widest number of users. Ergonomists can benefit from an awareness of the existence of these documents and a consideration of how their use benefits both developers and consumers.

Keywords: Accessibility, international standards, universal design

1. Introduction

International Standards play an important role in global commerce. They form an agreement that ensures at least a standard level of expectation is met. The International Organisation for Standardisation (ISO) is probably the most well-known and highest profile standards making organisation in the world. ISO has already published ISO Technical Specification (TS) 16071 and is currently in the process of publishing ISO/IEC Technical Report (TR) 19766. It is also currently developing ISO 9241-20, ISO 9241-171, and ISO/IEC 24756 which will provide a major achievement in the evolution of accessible computing systems. Accessibility is also moving into the mainstream with ISO/IEC TR 11580 adopting a model for all user interface objects, actions, and attributes that supports universal access.

2. ISO TS 16071

One of the earliest lists of suggestions towards developing accessible software is the *Nordic Guidelines for Computer Accessibility* [1]. These guidelines, originally published in 1993, applied the approach of "Design for All" to describe a set of accessibility features of a personal computer system which facilitate access and use by people with the widest possible range of capabilities. There are 52 requirements, both hardware and software oriented. These accessibility guidelines were originally intended to be used in calls-for-proposal for personal computer systems [1].

The Human Factors and Ergonomics Society's HFES/ANSI 200 committee recognised the importance of developing accessibility standards and started work in this area in the mid 1990's. While their original draft was based on the Nordic Guidelines, they have gone far beyond the original set of software development

guidelines. In 1998 the HFES/ANSI 200 committee submitted their work to date to ISO committee TC159/SC4/WG5 *Software Ergonomics and Human Computer Dialogue* as the basis for international work on software accessibility standardisation. This led to the development and publication of ISO TS 16071 Guidance on accessibility for human computer interfaces [2].

One key innovation in ISO TS 16071 is its definition of accessibility. ISO TS 16071 defines accessibility as "usability of a product, service, environment or facility by people with the widest range of capabilities" [2]. For software (or any other technology) to be accessible, it must support multiple paths to achieve the same task. For the inclusion of the widest range of abilities, at least one path must be usable by each individual within the set of intended users.

Many authors believe that there should be no distinction between the concepts of usability and accessibility (e.g., "Accessibility is good usability." [3]), and that the term "usability" should encompass the meaning of both terms. The ISO definition of the term "accessibility" recognises that usability problems impact all users equally, regardless of ability and that a person with a disability is not disadvantaged to a greater extent by usability issues than a person without a disability [4].

In the ISO 9241 series, usability is defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [5]. An accessible path can be evaluated in terms of effectiveness, efficiency, and satisfaction to determine its usability. This does not suggest that equivalent levels of effectiveness, efficiency, and satisfaction need to exist across all potential paths; rather it suggests that for a specific path to be accessible, it must also be usable for the intended users.

The ISO TS 16071 definition of accessibility recognises that accessibility cannot be seen as a "special case" of usability. It is dangerous to think that "if usability is about producing products and systems that are easy to use and perform the function for which they were designed, then accessible design is about producing products and systems that are usable by all persons regardless of (dis)ability" because such a product could be "usable" without being "accessible." Designers who view accessible design as "outside of" usable design may produce inaccessible products.

An evaluation of the content of ISO TS 16071 soon after its publication suggested a number of key areas that needed further attention [6]. In particular, this study noted that large numbers of the 71 guidelines were narrowly focused on a relatively small number (of the many potential) abilities and skills of users. In anticipation of an expected promotion for 16071 from TS to International Standard (IS), several areas needing new guidance were noted [6].

As the result of a large-scale renumbering of all ISO ergonomics standards to create a larger ISO 9241 series, the envisioned ISO IS 16071 emerged as ISO 9241-171.

3. ISO 9241-171

The ISO 9241 series is a set of standards concerned with the ergonomics of computers. Part 171 is especially concerned with the accessibility of software. Whereas ISO TS 16071 focused on providing accessibility to people with special needs, ISO 9241-171 takes a wider "design for all" approach [7].

International standards are typically based on empirical research, accepted best practice, or both. Often, standards developed by one country are offered as a source for an International Standard. As the above history of ISO TS 16071 attests, this is true of ISO 9241-171.

The development of ISO 9241-171 began with the publication of ISO TS 16071. Drawing on the evaluation of ISO TS 16071 [6] as well as several other contributions by others, ISO 9241-171 contains a variety of new content not found in its ancestors.

ISO 9241-171 is nearly double the size of ISO TS 16071. Among its 130+ guidelines is greatly expanded guidance in existing areas (e.g., more guidance to support users who are hard of hearing) and entirely new areas of guidance not already covered by ISO TS 16071 (e.g., new guidance to support users with poor tactile sensation when using tactile interfaces). In addition, ISO 9241-171 also contains guidance on complying with its guidelines.

The ISO/IEC development process involves multiple nations participating in both the development and review of a document through a five-stage process (Working Draft, Committee Draft, Final Committee Draft, Final Draft International Standard, and International Standard). Currently this standard is undergoing further refinement. Within the ISO five-stage process, this document should be published as an International Standard in 2007.

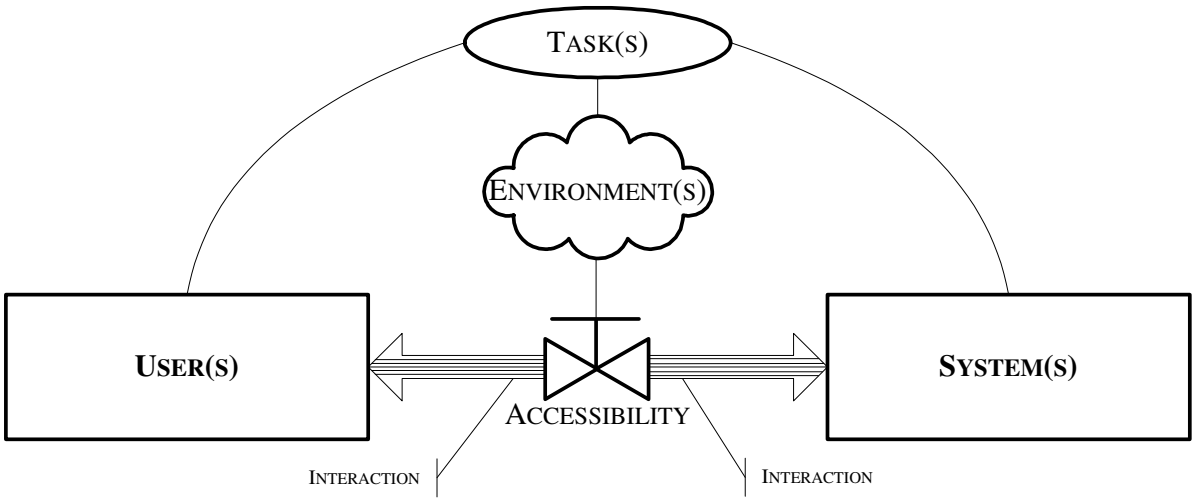

Fig. 1: The Universal Access Reference Model (adapted from [6])

4. ISO 9241-20

With the explicit focus of ISO 9241-171 on software accessibility, the need was recognised for a computer hardware accessibility standard. However, in advance to developing a specific hardware standard, the decision was made to develop a high level systems and services standard that would apply to both hardware and software, without duplicating any of the content that is contained in ISO 9241-171 or that would be contained in a hardware accessibility standard. Thus, ISO 9241-20 was born [8].

ISO 9241-20 recognises that accessibility is achieved and improved by serving "the widest variations within a context of use" which can be based on user characteristics, equipment characteristics, environmental characteristics, and task characteristics, and their variability. It presents a framework for accessibility that considers the characteristics and needs of users, tasks, equipment, and the environment and presents guidance relating to each of these four types of characteristics. This framework for accessibility of information communications equipment and services founded on the model used to evaluate ISO TS 16071 [6] as well as state of the art knowledge of ergonomics. This framework provides a relation between context(s) of use and accessibility.

Figure 1 above shows that user(s) and equipment interact with each other to achieve task(s). To design equipment and services it is important to understand user characteristics, equipment characteristics, and task characteristics. It is also necessary to understand interactions among these characteristics. For example, if a task is too complicated, a user cannot successfully achieve the task. Faced with the same task a foreigner has even more difficulty because text displays are shown in an unfamiliar language. The complicated operation and language expression both affect the accessibility of the task. It is also necessary to understand environmental characteristics to accomplish task(s). For example, it is difficult to monitor a screen if it is in front of glare from bright lights. In this way environment(s) affects accessibility.

It may not be possible to design a product that can be used effectively by all users in all contexts of use. User's limitations can be permanent or temporary. Accessibility is most readily provided by equipment and services that are designed for these conditions. However, in some cases, intermediaries such as assistive technologies (ATs) may achieve accessibility. These technologies change interactions to use different user capabilities to operate the equipment or service.

Developers of information communication equipment and services should not rely on user supplied ATs to achieve accessibility. In addition, although learning and increased experience with equipment or service may increase accessibility, it is important to ensure accessibility for first time users.

ISO 9241-20 contains 21 user-related, 18 equipment- and service-related, 2 task-related, and 3 environment-related guidelines. It will be published as an International Standard in 2007.

5. ISO/IEC 24756

Accessibility features, available in most operating

systems, are useless if not accessible [9]. They are generally not available until the user has successfully passed the login screen. However, without access to these features, many users may not be able to login. So-called "closed systems", such as kiosks, present even further problems, in that they do not allow user installation of AT software or hardware that could allow users accessible assistance in their login and setting of native accessibility features. To create a fully accessible login, the operating system might need to support an excessively multi-modal login interface for all users that would be a distraction to most users.

These difficulties suggest a need for an accessible way to configure/activate accessibility features by a user upon arriving at a wide variety of computing devices. The solution to this problem should focus on matching abilities rather than having to make allowances for disabilities. Rather than simply turning on/off specific technology features, which may or may not be present in a given system, there is a need to communicate the abilities of users to systems so that the system can self-adapt in the best possible way to meet the user's needs. The Common Accessibility Profile (CAP) described by ISO/IEC 24756, *Algorithmic framework for determining accessibility for individual users of interactive systems*, provides a standardised profile that meets these needs [10].

ISO/IEC 24756 is a standard that identifies "inaccessibilities". It is based on the definition of accessibility used in ISO 9241-171 and the model illustrated in Figure 1. The CAP, as described by ISO/IEC 24756, compares the needs and abilities of systems with the abilities of users to communicate using various modalities and takes into account the environment(s) in which the user and system interact. It allows the consideration of multiple levels of system components, including: application software, operating systems, computer hardware, peripheral devices, and ATs. This standard can be used to analyse existing human-computer interactions and to help evaluate the usefulness of proposed ATs. CAPs can be specified at various levels including:

1. the overall combination of (interacting components) users, systems, ATs, channels, and environments
2. individual interacting components (which can participate in various combinations at various times)
3. individual inputs, outputs, and processes (component features) of interacting components
4. individual details of the component features (that involve specific modalities and media)

This four level structure can identify sensory, physical, and linguistic accessibility issues. Due to the structure of the CAP, it is possible to add more detailed levels as they are needed. For example, the CAP could be extended to identify further cognitive accessibility issues not yet covered by ISO/IEC 24756 [9].

In addition to providing a basis for identifying personal accessibility needs to a system, CAPs can be used to select ATs to improve the accessibility of a system for a user.

CAPs are highly adaptable and easy to use. A user's CAP can be loaded onto a variety of different portable media (e.g., a USB stick, smart card, etc.) that is easily carried and used by a wide range of supporting devices. Users with disabilities can use these portable CAPs to discretely load their individual needs into a system to request that the system self-adapt in the best possible way to meet the user's needs. This self-adaptation can occur prior to user login and may even be acceptable to otherwise closed systems.

CAPs for systems, ATs, and their components are based on existing technical specifications. CAPs for users and environments are developed using tools. All CAPs can be saved to a local database. Evaluating the interaction of these CAPs can determine the potential for the system and its components to meet the unique needs of the user (or groups of users with different needs). Where needs are not satisfied, the CAP database could be searched to identify additional software or hardware ATs that could be added to improve accessibility. This evaluative aspect of the CAP also has potential for use when evaluating the satisfaction of legal and/or contractual requirements.

Currently this standard is undergoing further refinement by defining machine processable formats for specifying and processing CAPs and by further describing how to use CAPs to evaluate and improve accessibility. Within the ISO five-stage process, this document should be published as an International Standard in 2008.

6. ISO/IEC TR 19766 and ISO/IEC TR 11580

When icon standardisation first started in the early 1990's, the focus was on the graphical symbols used as the visual interface to icon functionality. Thus the ISO/IEC 11581 series of icon standards currently specifies only icon graphics, permitted variations of these graphics, and a general statement of the primary

function of the icon [11]. While these standards use headings to identify each icon verbally, there is no requirement in the standards that these names used in headings also be used as textual labels or alternative text names for the icons.

The next generation of icon standards, which involved multimedia control icons (ISO/IEC 18035) and Web browser icons (ISO/IEC 18036) [12,13], continued with the same format as ISO/IEC 11581. ISO/IEC 18035 went further in specifying functionality, by linking its icons with the controls specified in ISO 14915-2 [14]. However, they still did not consider the needs of making these icons accessible.

Work began on ISO/IEC TR 19766 in 2004, with the purpose of identifying accessibility-related recommendations for icons [15]. ISO/IEC TR 19766 introduced a model for greater specification of icon related properties. This model contains: identity properties, information properties, presentation properties, and operations.

Identity properties are used by a system to recognise and distinguish between objects. They also can support alternate media renderings of an object, including renderings by assistive technologies. Information attributes are intended to assist the user in finding out about the object. Information attributes are defined as text attributes so that they can be formatted and presented to the user through the widest possible variety of media / modalities. Presentation properties specify how an object can be rendered in various modalities. Operations specify the functionalities required of an object, regardless of the modality or media in which it is represented.

ISO/IEC 19766 is being published by ISO as a Technical Report in 2006. It is already being used in a third generation of icon standards that include accessibility provisions. This new generation has started with ISO/IEC 24755 [16] and will be continued within the restructuring of all existing icon standards that is to begin in the fall of 2006.

The accessibility model from ISO/IEC 19766 is also being generalised as the basis for ISO/IEC 11580 which specifies meta-data categories for analysing and standardising user interface objects, attributes, and actions [17].

7. Conclusion

The international standard developments, discussed above, show that the computer industry has progressed significantly in the last few years with regards to recognising the fundamental importance of accessibility. Where accessibility was once ignored or thought of as a special case, now it is rapidly becoming an issue routinely designed into any computer development project.

The upcoming publication of these standards and technical reports is exciting. They will each provide guidance to assist developers to design their products to meet the needs of the widest number of users. Further they will increase awareness among developers who do not currently design with consideration of accessibility.

However, the publication of these documents is not enough. Ergonomists need to be aware of the existence of these documents and how their use benefits both developers and consumers. Only by spreading the word can professionals in ergonomics ensure greater access for all.

References

[1] Thorén C. (Ed.) Nordic guidelines for computer accessibility (2nd edn). Nordic Cooperation on Disability, 1998. http://trace.wisc.edu/docs/nordic_guidelines/nordic_guidelines.htm

[2] International Organisation for Standardisation. ISO/TS 16071:2003 Ergonomics of human system interaction – Guidance on accessibility for human computer interfaces. International Organisation for Standardisation, Geneva, 2003.

[3] Moulton G. Huyler L. Hertz J. and Levenson M. Accessible technology in today's business: Case studies for success. Microsoft Press, Redmond, 2002.

[4] Thatcher J. Waddell C. Henry S. Swierenga S. Urban M. Burks M. Regan B. and Bohman P. Constructing accessible web sites. Glasshaus, Birmingham, U.K., 2002.

[5] International Organisation for Standardisation. ISO 9241-11:1998 Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on usability. International Organisation for Standardisation, Geneva, 1998.

[6] Carter J. and Fourney D. Using a Universal Access Reference Model to identify further guidance that belongs in ISO 16071. Universal Access in the Information Society. 3 (2004) 17–29.

[7] International Organisation for Standardisation. ISO DIS 9241-171:2006 Ergonomics of human-system interaction – Guidance on software accessibility. International Organisation for Standardisation, Geneva, 2006.

[8] International Organisation for Standardisation. ISO DIS 9241-20:2005 Ergonomics of human-system interaction

– Part 20: Accessibility guidelines for information communication equipment and services. International Organisation for Standardisation, Geneva, 2005.

[9] International Organisation for Standardisation and International Electrotechnical Commission. ISO/IEC CD 24756 Information technology – Algorithmic framework for determining accessibility for individual users of interactive systems (ISO/IEC JTC 1 / SC35 Document N903). International Organisation for Standardisation, Geneva, 2005.

[10] International Organisation for Standardisation and International Electrotechnical Commission. SC35N0913 Information Technology – User interfaces – Accessible user interface for accessibility setting on information devices Part 1: Introduction. International Organisation for Standardisation, Geneva, 2005.

[11] International Organisation for Standardisation and International Electrotechnical Commission. ISO/IEC 11581 Information technology – User systems interface – Icon Symbols & Functions, Parts 1-3 and 5-6. International Organisation for Standardisation, Geneva, 1999-2004.

[12] International Organisation for Standardisation and International Electrotechnical Commission. ISO/IEC 18035:2003 Information technology — Icon symbols and functions for controlling multimedia software applications. International Organisation for Standardisation, Geneva, 2003.

[13] International Organisation for Standardisation and International Electrotechnical Commission. ISO/IEC 18036:2003 Information Technology - Icon symbols and functions for World Wide Web browser toolbars. International Organisation for Standardisation, Geneva, 2003.

[14] International Organisation for Standardisation. ISO 14915-2:2003 Software ergonomics for multimedia user interfaces — Part 2: Multimedia Control and Navigation and Control. International Organisation for Standardisation, Geneva, 1998.

[15] International Organisation for Standardisation and International Electrotechnical Commission. ISO/IEC 19766:2006 Information Technology — Guidelines for the design of icons and symbols to be accessible to all users. International Organisation for Standardisation, Geneva, 2006.

[16] International Organisation for Standardisation and International Electrotechnical Commission. ISO/IEC DIS 24755:2006 Information Technology — Screen icons and symbols for personal mobile communication devices. International Organisation for Standardisation, Geneva, 2006.

[17] International Organisation for Standardisation and International Electrotechnical Commission. ISO/IEC DTR 11580:2006 Information Technology — Framework for describing user interface objects, actions, and attributes. International Organisation for Standardisation, Geneva, 2006.