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Department of Computer Science

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The Common Accessibility Profile

Jim Carter, David Fourney
Department of Computer Science
University of Saskatchewan

ABSTRACT
Potential users of Assistive Technologies (AT) have little assistance in AT selection and support. This paper develops the concept of a Common Accessibility Profile (CAP) which can be used as the basis for selecting and supporting computer-related ATs. The CAP is based on a user-AT-system model focusing on improving accessibility to the interactions between users and systems. The CAP provides a basis for identifying and dealing with accessibility issues in a standardized manner across multiple platforms. CAPs can readily be developed for existing systems and ATs and can be custom developed for specific users and environments. The CAP can be applied to the selection and management of ATs.

Keywords
accessibility, assistive technology, common accessibility profile, universal access, usability

1. INTRODUCTION
Potential users of Assistive Technologies (AT) need an accessible tool to help select the AT(s) most suitable for their individual needs to create their own accessible computing experience. Existing tools that provide information relating to ATs for computers do not meet the requirements of many of their potential users. These tools rarely focus only on accessible computing, preferring to provide information on AT in general.

1.1 Consumers and their Advisors
A survey of the role of computer-based AT in Canadian post-secondary environments found that university and college service providers admit not being very knowledgeable about computer-related ATs used by students with disabilities [7]. A survey of elementary and secondary teachers found that many were unaware of the availability of ATs that could provide students with disabilities improved access to information technologies [5]. These findings raise the question of how these professionals can possibly help their clients/students.

Colleges and universities typically have a limited set of ATs for their students with disabilities on campus (e.g., screen-readers, adapted mice). This limitation in the amount and kinds of AT is at least partially due limitations in the knowledge of service providers [7].

There exists a lack of training in the use of AT for both post-secondary student consumers with disabilities and on-campus IT support personnel [7]. If the consumer does not know how to use existing ATs or even what is available, it is not likely that anyone else will either.

Among post-secondary students with disabilities, the survey found that although 95% of the 800 respondents use a computer and 87% of these computer users use the Internet, only a quarter of the respondents currently use an AT with their computer. However half of the respondents reported a need for an AT. The main reasons for lacking an AT were: cost and lack of information [7].

Thus, there are at least two user groups concerned with access to AT: consumers and their advisors (i.e., service providers and teachers). However, both suffer from different types of lack of information.

To get this information, people need to access a computer but do not know what devices/software are available to create an accessible computing experience. In addition, the consumer who experiences a barrier in their computing environment, may not, because of this barrier, be able to fully access the electronic information available so as to relieve this barrier on their own. Many consumers must rely on advisors for assistance.

To best assist their client, advisors try to develop a full understanding of their client's needs. Even though advisors do not feel that they have a broad enough AT-related knowledge base to assist their clients, they can "easily" access on-line information. However, on-line information is highly decentralized and not well organized, thus advisors may not be able to find information relating to the available ATs that best meet the one client's specific computing needs.

Therefore, from a consumer's perspective: not only do you not know what is out there, but the people who you rely on to know what is out there may not know what is out there or be able to find what is out there.

1.2 AT Selection Resources
Currently, there are many on-line (e.g., [1, 16]) and print (e.g., [3]) resources of information about available ATs. This material is frequently organized by either disability or ability (e.g., [3, 17]). Among searchable electronic sources of AT information, some are focused on one theme (e.g., a focus on Microsoft Windows-compatible AT [16]) while others, although not focused on the computing environment, may provide better access to the available information such as a search engine or a product type catalogue (e.g., [1, 4]).

Microsoft's "Overview of Assistive Technology" [16] has a limited breadth oriented to Windows-only computing and provides no information about the technologies available for other platforms. In addition, it provides limited depth offering only a general list of types of available products; discussing, for example, screen readers in general without giving further specific information that may help the consumer.

Although *www.assistivetech.net* [4] provides an innovative approach in a wizard-like interface and offers information on many available ATs, not much attention is given to computing explicitly. Assistivetech.net offers a wide breadth of information and is not focused to computing. This resource's limited depth touches many areas without details, for example not much information is given on low-tech (and possibly less expensive) solutions. However, the site does provide better access into their database of information than many others by providing multiple search mechanisms.

The Alliance for Technology Access (ATA) provides a comprehensive set of information about available computing ATs [3]. Using a question and answer format with possible answers presented in tables organized by ability, the reader can be pointed to a set of tools via cross-reference and thus traverse a "path of information" [3].

The ATA resource is highly specialized and is focused specifically to computing. There is information on both low-tech (e.g., anti-glare filters) and high-tech (e.g., touch screens) solutions. It has a good breadth of information. Its wide depth gives more detailed information on each solution.

Although it is available electronically, the ATA guide was originally published as a book. The electronic version is not very "browseable" as it is simply HTML-ized book pages. As the content was not reorganized when the on-line version of the book was made, it does not take advantage of the web's ability to browse content.

There are some problems with the ATA guide. First, since the information is not organized by disability, the ATA guide is not well presented for those persons who would prefer to search it based on "disability" rather than "capability". Second, this resource does not work as well for someone, such as an advisor, who is looking to purchase a tool and is interested in the various issues one solution solves compared to another because it is not clear if some solutions overlap. Finally, the "path of information" provided is so rigid that it can only be traveled in one direction. This further prevents readers from discovering other issues a particular solution might relieve.

1.3 The Need for a Standard Approach to AT

There is an increasing movement towards standardized information that can be used across multiple platforms (e.g., [2]). This paper develops the concept of a Common Accessibility Profile (CAP) that can be used as the basis for selecting ATs. If such a profile can be agreed upon, it also could be used to help manage the use of ATs by users and their systems.

2. ATs AND THE UARM

The "Universal Access Reference Model" (UARM), as illustrated in Figure 1, concentrates on the interactions between a user and a system [6].

Handicaps are anything that may interfere with the accessibility of interactions between users and systems. A handicap may have one or many sources among the system, user, interaction, and/or environment. This model is "blame-free," since overcoming any handicap is more important than attributing blame to the source of the handicap.

The figure uses a pipe metaphor to illustrate the flow of interactions between the user and the system and a valve metaphor to illustrate various levels of handicaps. A fully open valve represents the absence of a handicap. A fully closed valve represents being fully handicapped. Any other setting of

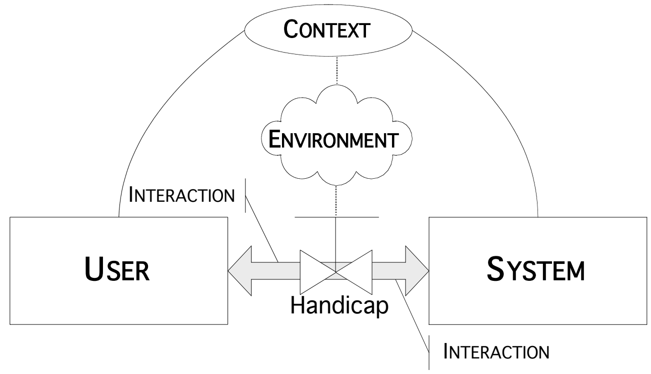

Figure 1. Universal Access Reference Model (UARM)

the valve represents being partially handicapped.

Essentially, an AT is a means of opening the valve. ATs reduce handicaps. While a consumer of an AT may not have a disability, there is some component of the interaction that is "handicapping" them. For example, one could attend a lecture where the speaker uses a language unknown to the listener. Since most people know at least one language, the listener may eventually come to know the language the presentation is given in, but is currently handicapped by not knowing the language at the present time. The listener's task of following the details of the presentation would not be possible without the use of a translator to bridge the interaction between the listener and the speaker. In this sense, the translator would be an AT.

In the computing world, AT can be realized through: alternative input devices (e.g., trackball, left-handed mouse, sip/puff systems), alternative output devices (e.g., voice, Braille display), accessible software (e.g., screen magnification software), and "Universal Design" (i.e., barrier-free design). Since the interaction is what is being handicapped, an accessible computing experience is realized by a reduction of this handicap.

The UARM was originally developed to identify areas requiring further accessibility guidance in international standards [6], but it is useful in outlining a user model applicable to an accessible computing experience. It can be evolved to explicitly show the role of AT within the user/system interaction.

2.1 Channels

Interaction is a two-way process involving a number of one-way messages. Users interact with a system to use the system; systems interact with a user to respond to user requests.

Accessibility is dependent on the message recipient's ability to receive, interpret, and create interactions. Accessibility may be increased using multiple messages transmitted via different media over different channels, in the hope that one or more messages will be received and interpreted. If the context of the recipient is known, the choice of channels can be limited to those that the recipient can access successfully [6].

The single valve, in Figure 1, is a simplification of what is really happening. Each channel is uniquely influenced and thus can have its own handicap. As Figure 2 shows, it is more correct to depict each channel as having its own valve.

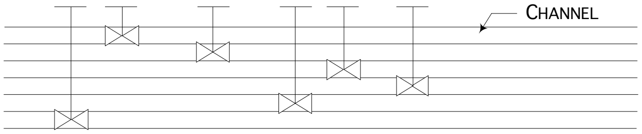

Figure 2. Media Channels and Handicaps

If, as Figure 2 suggests, each channel has its own handicap, then it is not unreasonable to suggest that each media type/channel may require its own AT to reduce or remove its handicap.

A channel is a function of media, style, content, and usability. The remainder of this subsection will discuss each of these four components.

2.1.1 Media

A medium is a form of presenting information to a user. Three basic media types – audio, still image, and moving image – may be classified on the basis of whether or not they are "realistic" (i.e., whether the medium would be perceived by a user as faithfully representing the natural world) [14]. They can be further classified on the basis of whether or not they are language-based.

ISO 14915-3 contains general guidelines on selecting media to ensure "compatibility with users understanding", appropriateness to "the characteristics of the user population", support of "user preferences", and consideration of "the context of use". However, it does not have any specific accessibility-oriented guidelines relating to: the general selection of media, the presentation of specific information types, or the use of specific media [6].

2.1.2 Style

Media render interactions that are based on particular dialogue styles. The ISO 9241 series contains guidance on a variety of dialogue techniques (menus [9], command languages [10], direct manipulations [11], and form fill-ins [12]) that form the basis for different styles of interaction. Natural language is an additional style that is becoming increasingly important. ISO 14915-2 Multimedia navigation and control [13] provides further information on controls and links that may be implemented via different styles.

2.1.3 Content

The actual content of an application can be composed of several different media-neutral types of information including: causal, conceptual, continuous action, descriptive, discrete action, event, physical, procedural, relationship, spatial, state, and value [14].

2.1.4 Usability

ISO 9241-11 defines usability 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." [8]. This composite of effectiveness, efficiency, and satisfaction describes how well a system does a task, how easily that task can be done, and how users feel about the process overall. In this context, the notions of effectiveness and efficiency are highly coupled.

Effectiveness relates the objectives of using the system to the precision and completeness that the objectives can be reached. It does not describe how the objectives were reached; only the degree they were reached [2]. Efficiency relates the degree of effectiveness realized to the amount of resources spent. Satisfaction is the user's subjective response when using a system [2].

Handicaps directly influence a system's usability. The presence of a handicap and the degree it interferes with the channel will impact system effectiveness to the point that one's objective cannot be achieved.

2.2 Context

All interactions are interpreted in terms of the context of the receiver. Context is information already known by the user and/or system that can be used to create interactions and to interpret and/or fill-in gaps in the interactions that they receive [15]. The context(s) of a user and a system provide the skills and assumptions brought into the interaction between them (e.g., symbols/language and/or application knowledge). Where these assumptions agree, shared context is created. Where the assumptions of one party either conflicts with the assumptions of another or are not known to the other, a "gap" in the shared context is created. Where contextual gaps occur, further interactions making use of shared context or tools (such as ATs) are used to explicitly close the gap or clarify the original interaction.

As shown in Figure 1, context is used by a user and/or a system to interpret an interaction. If context necessary to interpret an interaction is not shared between a user and a system, then the interaction is handicapped. Context cannot help where the interaction is fully handicapped and no communication takes place, but it can help where interactions are partially handicapped.

Contexts may also hinder interactions if they are not suitable to the interaction. Where context is inappropriately assumed (e.g., idioms that are not shared and thus misinterpreted), it may lead to misassumptions. Where context is required but missing, its absence will handicap the interactions. The specific environment in which an interaction occurs can focus attention on specific contexts [6].

2.3 The System in Detail

Traditional, human-computer interaction models of software systems are often divided into three parts: a front-end interface, the processing logic, and a back-end database. Figure 3 shows how the UARM grows this basic structure by including a new part containing interaction components, which provide the basic elements of an accessible interface [6].

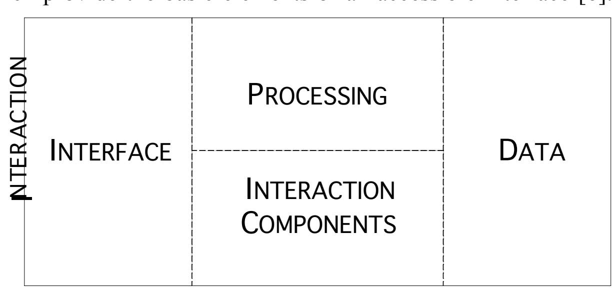

Figure 3. A Model of an Accessible System

Data may be stored for a variety of different purposes: application content, system context (i.e., the system's own context), environment context, and a representation of a user's context. These last two, while somewhat "optional," have a direct impact on improving the interactions between the user and the system. The user's context in particular is the target of AT.

The application content is the system's knowledge of the application domain and includes the data being used and the task being performed. It includes both the application logic the system uses and the data being used by the application for the user. A system's context knowledge includes information about available interaction styles and media types, and current system state. System context is used by the interaction components to define available interaction styles for the interface.

A system may maintain information about specialized contexts such as its environment context and a representation of the user's context. Environment context is information useful to the system in ubiquitous and mobile computing domains and outside the scope of this paper. A user's interaction and task abilities and preferences affect the channels that the user chooses to (or must) use to interact with a system [6]. The system's model of user context may contain an abstraction of these skills and preferences. It may be based on current or previous interactions with the user, and/or derived from an analysis of the user's chosen channels. It may assist the system in cooperating with the user to complete the task. Since the presence of ATs can help the system's current understanding of the user towards creating a more accessible interaction without changing the system, the user's context is one target of AT.

The system's interaction components provide the basic interaction styles and media to be used by the system's processing component to produce the system's interface. Each interaction style and/or type of media may be used any number of times as needed within the resulting interface [6]. By making use of standard interaction components it is easier to support accessibility needs through the use of ATs. Each interaction style and media type has its own accessibility issues that need to be taken into account. Interaction styles are rendered through media to produce the channels that the system interface provides to the user.

A system's interface instantiates the set of interaction styles being used (i.e., the set of channels actually provided by a system from which a user chooses). This interface provides the management needed to ensure that each user-selected channel cooperates with the others when providing the whole interface. It should create a synergy among the channels and restrict the presentation of mutually exclusive channels. This synergy can provide a means for the system to avoid giving the user so much information that they suffer cognitive overload.

3. EXPANDING THE UARM TO INCLUDE AT

Assistive technologies function to open the valve between systems and users, as illustrated in Figure 4. An AT serves as a proxy within the interaction between the user and the system by providing contexts compatible to each of the user and the system to perform the translation of specific media types/channels in each direction. For this reason, AT is not shaped as a box, but as a modified valve. It is hoped the AT becomes an invisible partner within the interaction[1].

[1] The user may know that an AT was connected to their system. However, the connection is seamless such that the user's experience of the system is similar to that of users who use no ATs and do not experience a handicapped interaction.

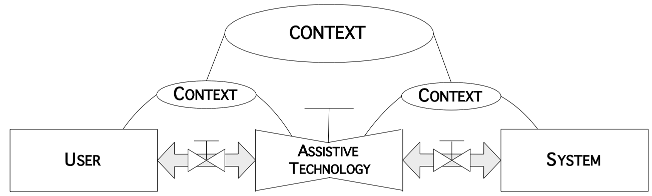

Figure 4. Assistive Technology in the UARM[2]

ATs can be analyzed in terms of their role as special cases of systems. An AT may combine the processing, data, and interaction components parts, as illustrated in Figure 5.

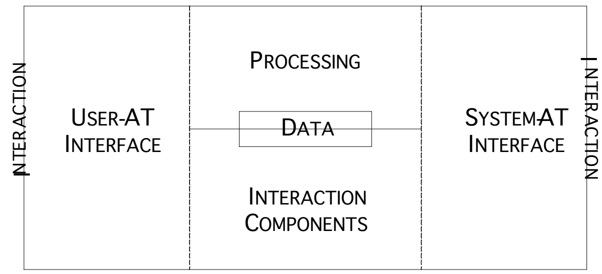

Figure 5. A Model of Assistive Technology

The data part is only present when the AT is "programmable" (i.e., software-based). Many hardware-based ATs do not use programmable data to control their operations. The stored data is used by the processing part to select appropriate interaction components.

The primary use of the processing part of the AT is to take the content received by one interface, transform the content, and then send the content to the opposite interface. This transformation is necessary to match the user's context with the system's capabilities and context.

The User-AT Interface is similar to the interface of a traditional system in that it involves a set of available channels from which a user chooses. The System-AT Interface is also like that of a traditional user in that it accesses a set of available channels provided by the system. The AT interaction components provide the basic styles and types of media that can be used by its processing part to instantiate the two interfaces. This set of components is core to how the given AT performs its transformation tasks. Each interaction style and/or media type may be used any number of times within the resulting interfaces.

3.1 AT Processing

AT have combinations and variations of two major processing modes each of which may be combined with others.

Pass-through mode allows a channel, whether it is listened to or not by the AT, to pass through the AT. Generally, the content of the channel would not be modified as it passes through. Since ATs typically specialize to a subset of all available channels, this is the mode that will influence all channels the AT is not interested in.

Transformation mode involves the AT listening to a channel. The AT then takes the content of the listened channel and transforms it into a new medium. The process used for

[2] For greater legibility, the effect of the environment, which impacts all three of the valves, is not displayed in Figure 4 as it was in Figure 1.

transformation can be fixed, user-selectable, or user-modifiable. This newly transformed content is then passed on to the client through a new channel. The previous channel may be closed. However, when combined with pass-through mode, the client will receive both channels. An AT may choose one or more output channels to use for a given input channel. This choice may be automatically made by the AT or under user control.

Many hardware-based ATs perform automatic transformation of channel content as appropriate to their hardwired behavior. For example, a glare filter, an AT that reduces the amount of glare from environmental lighting that is reflected back to a user by a screen, has no intelligent features whatsoever.

User-controlled transformation allows the client to set the parameters or focus of any transformation. That is, a client may, through a set of transformation rules and/or preferences, influence how the AT is to perform the transformation of content. Such transformations are most easily performed by software-based or programmable ATs. For example, a screen reader with voice output may have several options that are set by its user such as the voice gender.

In the UARM, the function of the user's interface is to create, select, and manage the combination of channels (through the user's physical senses) that are used to interact with systems and ATs. The user's interface provides management of the various channels to allow the transmission/reception of multiple messages at the same time, and allows the user to focus on particular channels [6].

Since the communication possibilities and/or needs of a user at a given time may be greater than the user's capabilities, an AT information management function may optimize the set of channels being used to help the user avoid information overload. This management may include filtering and/or ignoring various competing channels or placing focus on specific channels.

4. TOWARDS A COMMON ACCESSIBILITY PROFILE

The idea of a CAP comes from the need to describe both user-system accessibility and user-AT-system accessibility across all users and systems. The CAP is based on interactions, which may involve multiple channels. There are two main types of channels {system to user, user to system}. When AT is added to these two basic channel types, it takes the place of one side. The AT takes the place of the system for the user {AT to user, user to AT}, for some or all interactions. The user interacts with the AT (hopefully seamlessly) as if it is the full system or a regular part of the system. The AT also takes the place of the user of the system {AT to system, system to AT} for some or all interactions. The system interacts with the AT as if the AT is the user. Thus, the addition of AT increases the number of channel types, the number of channels and the interfaces to them.

4.1 Channel Interfaces

Channels only exist where the user, system, and any ATs have compatible interfaces. Interfaces to, and actions on, a channel can be specified in terms of five attributes:

Channel Interface/action =
{source,
direction,
media,
style,
usability}

Source describes the origin {user, system} of the channel interaction or actions {AT, environment} on the interaction. An interaction can begin at the user, system, or AT. In addition, actions can originate from an AT or the environment. Direction indicates whether an interaction is an input to or output of the source.

Media describes how the content of the interaction is to be rendered. The three basic media types, audio, still image, moving image, can be classified based on whether or not they possess realistic and/or verbal qualities (e.g., text is a verbal still image).

Style describes the rendering of particular content objects within the selected medium. Style, which should default to include all styles, can identify a single style or multiple specific styles, where appropriate.

Usability of the channel is described in terms of effectiveness, efficiency, and satisfaction of use. Usability information for each of these three components can be derived from reference sources and users. Expressing these usability measures as numeric values between 0 and 1, with 1 being fully adequate and 0 being fully handicapped will allow computation of an accessible measure.

4.2 Accessible Interfaces

Both ATs and the environment can act on channels. An AT acts on a channel, or a set of channels, by transforming interactions {system to user, user to system}. These transformations are intended to result in accessibility improvements. When the environment acts on channels, its influence is most noticeable when it handicaps (acts negatively on) interactions. For example, a noisy environment will negatively affect an auditory channel and may overwhelm it.

In addition to having multiple channel interfaces, ATs generally include transformations between their input and output channels. These transformations can be specified in terms of:

{input channel interfaces,
transformation,
output channel interfaces}

Consideration of this model, led to the realization that, when transformation is recognized as a special case of processing, a similar specification also applies to users and systems: {input channel interfaces, processing, output channel interfaces} as illustrated in Figure 6.

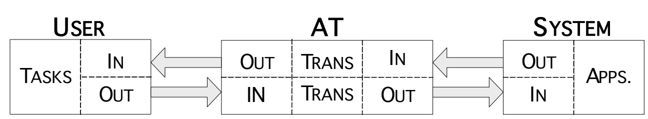

Figure 6. Accessibility Interfacing and Processing

There are two aspects of processing that might affect accessibility to a system: the operating systems (all, some, or one) and/or the application programs (all, some, or one) involved. Likewise, user needs for accessibility can be expressed in terms of the operating system / application programs that they need to access.

4.3 The Common Accessibility Profile

The Common Accessibility Profile (CAP) can be used to describe all components involved in accessibility {users, systems, ATs, and environments}. It is based on combining the concept of accessible interfaces and the concept of interface channels, as discussed above. The CAP is defined as:

CAP = {input channel interfaces {source,
direction, media, style, usability},
processing,
output channel interfaces {source,
direction, media, style, usability}}

The CAP of each component may involve one or more sets of specifications of combinations of input channels interfaces, processing, and output channel interfaces.

5. APPLYING THE CAP

CAPs can be used to evaluate handicaps, select AT's, and manage the use of ATs by systems. To apply a CAP, one must first acquire it.

5.1 Acquiring CAPs

A database of CAPs for systems and ATs can be developed from existing technical specifications. This can be further enhanced over time by adding user feedback, if the CAP database is made publicly accessible. User feedback such as consumer ratings and/or reviews can differentiate solutions, assesses their quality, and evaluate product appropriateness from a consumer perspective.

Such user feedback, even if sparse or incomplete in nature, can identify the need for new AT products as well as provide feedback to existing AT products.

The development of CAPs for users and environments can be performed through tools that work with the CAP database. Such tools can also help users to select the most appropriate ATs to improve their accessibility.

5.2 Applying the CAP to Identifying Handicaps

We can apply an algorithmic approach to the use of the CAP when identifying handicaps, as shown in Figure 7.

The starting point is an identified user and system. A user's tasks (1) lead to the selection of specific operating systems and/or application programs to be used. Where particular selections are not made, this defaults to the selection of all known systems, operating systems, and/or applications. These processing requirements are compared (2) to system processing capabilities to select the channels needed for interacting with the user. This involves identifying channels (3a) to send information to the user and identifying channels (3b) to receive user communication.

Once these channel selections have been made on the system side, there remains a need to check whether or not the user has the ability to use these channels (4a, 4b). In situations involving multiple users, considerations must be made for each user.

If users do not have the ability to use some subset of these channels, handicaps exist. Further handicaps can be identified by the addition of environmental noise CAPs. These CAPs may add environmental handicaps to channels.

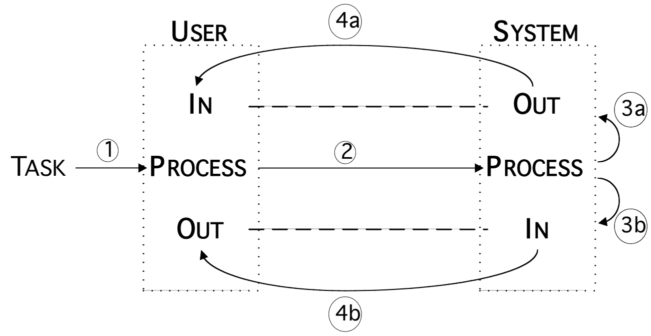

Figure 7. Identifying Handicaps Based on the CAP

All of the resulting handicaps are opportunities for ATs. Thus, by starting with user and system CAPs, one can identify user needs that are handicapped.

5.3 Applying the CAP to Selecting ATs

Given the CAPs of the user, system, and environment; the CAPs of potential ATs; and information on handicaps (in terms of channels), we can develop an algorithmic approach to the minimization of handicaps.

The set of handicaps previously identified, can be used to find an AT that best minimizes as many of the handicaps as possible and that interfaces with the system, the user, and the environment. For an AT to interface with the system, it needs to be compatible to the systems' properties (media, styles, operating systems and/or applications). To interface with the user, the AT should use skills that the user has (e.g., literacy). To interface successfully, the environment should not excessively handicap the accessibility of selected channels (e.g., noisy environments can handicap speech output),

Additional information that may be useful in selecting among ATs includes: the time to get the AT working, its cost, and the identification of any benefits to its use. Time needed to get an AT working includes both how long it takes to set up the AT for the initial installation and how long it takes when starting up the system to also start up the AT. Cost refers to the constraint of the consumer's budget and describes sources of funding. Benefits can be identified by a cost/benefit analysis. Desirable benefits include improvements in access and usability.

Once an AT has been selected, its CAP can be added to the CAP of the system. However, the addition of an AT may introduce new handicaps (e.g., the best choice may require a skill the user does not have) that may require additional ATs. Thus, the process of identifying handicaps should be repeated after an AT has been added. If there are any handicaps remaining, handicap minimization can be repeated until accessibility has reached an acceptable level.

CAPS can also be used to help select combinations of systems and ATs for use in multi-user settings, such as those provided by educational institutions.

5.4 Applying the CAP to Managing ATs

CAPS can be used within a system's context to provide the system with information about how best to interface with its user and any ATs being used within the current environment.

CAPs can be created for different base and alternate configurations of users, environments, systems and ATs. These configuration CAPs can be entered directly into a system or created externally and then downloaded into these systems and/or accessed by these systems when required. They can be further loaded into ATs or accessed by ATs in situations where ATs are programmable.

5.4.1 Developing a Base Configuration

An initial base configuration of a situation can be described in terms of the set of CAPs representing all relevant systems, ATs, users, applications, and environments. This requires the identification of the basics that are needed for accessibility, any optimal connections between multiple ATs, and any user preferences to add.

The base configuration must include the most optimal connections among all the ATs. Optimal connections reduce handicaps. To identify these connections, the CAPs of each AT will need to be compared to ensure that no two ATs contradict each other. Such contradictions might increase rather than reduce handicaps.

User preferences may be realized through either AT programmable settings or AT-system configurations. The CAP of an AT can include information about available user preferences based on the different usability ratings provided for different channels. This information may assist in the optimal configuration of AT.

A base configuration CAP can be developed by selecting CAPs for appropriate system(s) and AT(s) from a standard database of CAPs and then entering CAPs for the intended user(s) and environment(s). A base configuration may be produced during the selection of ATs or later once the ATs have been procured and installed.

5.4.2 Developing Alternate Configurations

Once a base configuration has been established, it is possible to develop alternate configurations that respond to changes based on the needs of one or more specific users, applications, and/or environments.

Differences between users and even within a single user over time provide different accessibility needs. This is especially important in educational settings where multiple students with different accessibility needs may make use of a limited number of systems and ATs in an accessible lab. Different users have different abilities, skills, and/or preferences as well as different task needs when using the same system at different times [6]. As a result, alternate configurations may be developed for multiple users to share the same system. This allows users who need different AT configurations (including configurations without ATs) to use the system. Alternate configurations may be developed either proactively or in response to such short-term changes.

Users of a system may utilize specialized CAPs when switching among various applications according to the task they are performing. Alternate CAP configurations may be developed for different applications which make use of different media / styles with differing levels of usability. The use of specialized application specific CAPs can increase the accessibility of each individual application.

The physical environment within which the user is using the system may not remain stable. Alternate CAP configurations may be developed either proactively or in response to different environments. This allows the system to have ongoing awareness of its environment. The accessibility of mobile computing could benefit from the application of alternate CAP configurations that respond to changes in the environment.

The CAP for a new alternate configuration should start as a copy of the base configuration CAP. This new alternate configuration CAP can then be modified in one or more of the following manners: including additional (system / AT) CAPs from the standard database of CAPs, entering new and/or modifying existing (user / environment) CAPs, and/or deleting (system, AT, user, and/or environment) CAPs that do not apply to the new alternate configuration. There is also the need to be able to delete alternate configurations which no longer apply.

5.4.3 Reconfiguring Configurations

Changes to one or more of the system, AT, user, applications, and/or environment may result in the need to reconfigure the base and/or alternate CAP configurations. Changes can result from upgrades or replacements to the existing system (including additions or changes to the set of applications), the addition of new ATs and/or upgrades or replacements to existing ATs, changes in the regular environment, and/or permanent changes to the user(s).

As noted above, differences between users and even within a single user over time provide different accessibility needs. Progressive or permanent changes to one's abilities, skills, and/or preferences mean that each individual user may have different accessibility needs at different times. Such progressive or permanent changes to the user will involve a need to reconfigure their CAP configuration.

Educational institutions are likely to have the need to reconfigure existing configurations based on changes to the user population at least once per term or semester. Ensuring that a system can be changed when needed and can continue to meet the needs of multiple students will achieve the goal of serving the most students with the fewest resources.

Permanent modifications will change existing base and/or alternate CAPs. Temporary modifications can be accomplished by creating new alternate configurations.

6. CONCLUSIONS

The CAP focuses on the CAPabilities of users, systems, and ATs and the minimizations of handiCAPs from the environment and incompatibilities among users, systems, and ATs.

The CAP provides a basis for identifying and dealing with accessibility issues in a standardized manner. CAPS can readily be developed for existing systems and ATs and can be custom developed for specific users and environments.

CAPS can be applied to identifying handicaps and to selecting and managing the use of ATs for individual users and for select groups of specific users.

The CAP can be used to help select and support combinations of systems and ATs for use in multi-user settings, such as those provided by educational institutions.

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