Ubiquitous Accessibility: Building Access Features Directly into the Network to Allow Anyone, Anywhere Access to Ubiquitous Computing Environments

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Abstract. Traditionally access to computers and electronic devices has relied extensively on the strategy of adapting the devices that the person with a disability needs to access or using a special version of the product. This was especially true for people with more severe or multiple disabilities. As we move to an environment where computers and information services are incorporated into our environments, and where people must be able to access the technologies they encounter throughout their day, we need to move to a different model that might be called "ubiquitous accessibility". Ubiquitous accessibility would involve building access features for all people directly into the ICT systems in the environment so that access could be invoked directly by the user when they needed it. This approach would need to involve a combination of access features that were built in and features that could be invoked on demand from the network.

Keywords: Ubiquitous accessibility, universal design, access for all, ubiquitous computing.

1 Introduction

Although computing at one time was centralized with remote access terminals, the trend in the last few decades has been to move to ever more personal computing devices. For those individuals who could not access these personal devices through their standard interfaces, adaptations were installed. Since each person had their own computer, each could adapt it with physical or software adaptations such as key guards, screen readers, screen enlargers, etc. With the advent of the portable computer and laptop, individuals were able to take their computer with them and able to access and use it in different environments. While this worked for some personal applications, there were already problems when individuals were required to run special software which is only available on university or company work stations. For example, students having to use special programs at a university would find that the licenses would not allow them to install the software on their personal computers. Further, the work stations in the laboratories were not set up for them to use. Even when they had the proper software, they would not be configured and personalized. More often than

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not, they did not have the special software or physical adaptations required. Also, they may have to use several different computers on different parts of campus, in different departments, running different software.

As we move further into the future, however, we may be moving away from personal workstations, even as we move to more "cloud-like" computing. With the ever-dropping cost of interface technologies and continually increasing flexibility and compactness for displays, we may soon find that we are carrying around computers or work stations less and relying more and more on the interfaces which we will find built into all of the environments in which we find ourselves. And as more daily living devices incorporate computer-like interfaces or are network devices themselves the ability to adapt each one – one at a time becomes impractical.

Some new strategy for access is needed to allow people to be able to invoke they access features that they need on any device they encounter. We need to have 'ubiquitous accessibility' as we move to ubiquitous computing.

2 Cloud Computing

The move to Web applications and "cloud computing" at first looks to be providing assistance with this problem. Instead of software being tied to particular computers or workstations, software can be tied to people or authorizations. It can then be run on any workstation, allowing the individual to have access through their own personal work station. But the focus of our efforts needs to go beyond "workstations" and look at computing and computer interfaces as something that will be ubiquitous; always around us wherever we go.

Although it seems far-fetched to think that there will be hardly a room or surface that is not electronically enabled (and that can be used as an interface) it was not that long ago that people carried lanterns or candles with them wherever they went if they expected to have light. If someone were to have told them that some day they wouldn't have to carry light with them, that they would be able to assume that there would be light in every room they went into and most places outdoor as well, that light would just be built into every room and place they went – they would have thought it very unrealistic. Yet today, none of us carries light with us in our daily lives, but in fact we assume that there will always be light wherever we need to go, with a few exceptions.

Display technologies are already proliferating, and information technology is rapidly merging with home entertainment, home control, telecommunication, transportation, and daily living appliances. Although not all are networked, fewer and fewer are not computer controlled and have computer operated interfaces on them. As these functions continue to blend and merge, we will generally find ourselves less willing to carry all these devices as we move around, and will begin to shift to a much more personally-liberating mode of invoking any of these functions from devices around us. We may carry a small personal device and rely on the displays and systems in our environment for everything else.

All of this is going to cause major disruptions in the way companies think of and market products, and there will be some awkward periods while existing companies try to hang on to the successful models of the past, while others try to gain new

footholds in the models of the future. In the end, however, the technology advancements will cause a shift.

We can see an example of this today in Microsoft and Google. The model of an installed operating system and installed applications has worked very well for Microsoft for many years. They play very well in that arena and would be happy to continue in the model as long as possible. Other vendors, like Google, however, are pushing toward cloud computing and virtual applications. They have successfully introduced the concept of software as a service that can exist in the network and be called up on any computer a person encounters. Security and network issues have slowed adoption, but these issues are being worked out. And now we are seeing a shift in Microsoft's approach and future plans.

3 AT as a Service

Assistive technology companies have long used a model of purchased hardware and software which are installed on a particular computer. Some assistive technologies, in fact, restrict the number of computers that a piece of software can be run on. However, other companies and initiatives, such as SAToGo [6] and Raising the Floor [8] and its partners [5], have introduced virtual technologies that can be invoked on computers without requiring any installation. This not only allows more mobility for individuals without requiring them to carry their specialized work stations wherever they go, but also for the first time provides access to individuals have fewer resources and who, in fact, do not have computers of their own. These latter individuals are able to use whichever computers they can find in their environments or communities, and invoke the needed access features from the Internet.

3.1 Centralized, Robust Access Features

If access features exist in the "ether" and can be invoked on demand, then a very rich ecosystem is enabled, which has a much greater capacity to meet individual needs of users. This would be true even if the needs change over time, location, or task. Instead of accessibility being thought of as a single package, access could be viewed as a set of features or capabilities. If an individual is invoking their access features on something with a small display, they can invoke a different set of access features than if they are currently using a very large display. Similarly, if they are stable and seated in a work station-like environment, they may use one type of interface. If they are seated in a comfortable chair with less support, they may invoke a different set of access features. In the morning they may be stronger and use one mechanism for input, while in the afternoon they have to use a different set of access features. The different tasks that they are engaged in may similarly require them to use different feature sets.

With a centralized feature-based, rather than package-based, accessibility model, many more individuals with different types, combinations, and degrees of disability could be accommodated. In fact, many individuals not perceived to have disabilities may be using many of these features due to situation-induced functional limitations [7]. For example, a person may be reading a book when they have to prepare a meal. They may switch to auditory presentation and controls that can be easily carried out

with gross gestures. In a noisy environment they may go to an all-visual presentation mode. In an environment with a large display, they may use one mode of interaction, but use something different in an environment with a smaller display. As individuals age, they may naturally tweak their interfaces to keep them within range of their abilities in a quite natural way, rather than stretching and straining to use a single, standard interface until they are no longer able to use it, and then having to accept the stigma of being "disabled" and needing "special interfaces."

4 Services on Demand

This approach also allows the introduction of both more powerful computing services and human intervention. Network-based services allow central servers to be part of the system [1] [3] [4] as well as allowing a combination of computers and human services in a "try harder" approach [9] (see Figure 1).

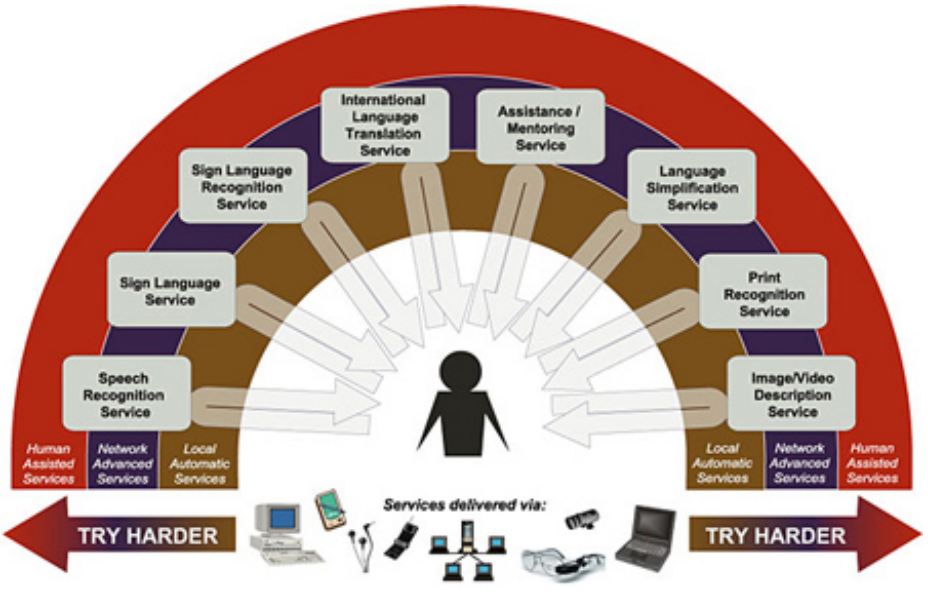

Fig. 1. A person can use a variety of devices to access a broad range of services that include services best provided locally, by network servers, or by remote humans

This approach allows for a much broader array of services than would otherwise be possible at any point in time. Services that may someday be available using personal devices could be provided by network-based systems that have more capability. And services that may someday be provided in an automated way could be provided via human intervention today. One example of this is CapTel, a network based telephone-captioning service available in the US [2]. Someday robust, speaker-independent speech recognition may be available on portable devices. But today it isn't even available on network based devices. A free service to people who are deaf or hard of

hearing in the US, however, provides captioning for telephone calls by linking in a special relay operator who listens in on the call and re-voices one side of the call into a computer very carefully. The computer then does text-to-speech that is corrected and sent on to the second caller who can both hear the person on the far end of the call and see captions of what they are saying.

5 Limitations and Changes with This Approach

There are limitations to the concept of "purely" ubiquitous accessibility. People who need special physical interfaces will not be able to invoke them from the network. These individuals may have to carry their switches or interfaces around with them. However, what they carry with them may simply be transducers. And they may use different transducers for occasions when seated stably vs. when seated in a comfortable lounge chair, etc. These simple transducers can then be connected to their control software, which can indeed be invoked from the "ether" (i.e., from the Internet). This approach would allow them to have much less expensive and more flexible access to a much wider range of devices and systems in their environment. This could include information and communication devices as well as transportation and daily living devices that have computer controlled interfaces.

Moving to this model will cause a similar major sea change in assistive technology and be accompanied by the same concerns and problems around any such paradigm shift. Although there is discussion of the availability of free public assistive interfaces built into the network, so that everyone can have basic access, it is likely that there will also be a rich (but quite different than today) market for commercial assistive technology, that also would reside in the network and be invoked by the users who have paid for it (purchase or rental).

It is also possible that individuals needing special interfaces will in fact carry about with them more interface than individuals who do not need special interfaces. While many people may find that they can very easily use whatever interfaces they encounter in the environment, people who need special interfaces may find that it is easier for them to bring a larger part of their interface with them. For example, this might include not only transducers, but also special displays. They would then use these controls and displays instead of the controls and displays in the environment. This has some advantages, but also creates some challenges around device security, locus of control, product identity (marketing), etc.

As we move toward and plan for these new environments, however, we should keep all of these variations in mind and not simply assume that individuals with disabilities would be able to use the interfaces and systems they encounter in the environment simply with invocable modifications.

6 Summary

As we move toward more virtual applications and services that can play on whatever displays we find in our environments, we may find that we no longer carry our computing devices, or even our interfaces, around with us, but rather rely on the ubiquitous computing services and interfaces we will find integrated into almost any envi-

ronment we find ourselves in. In some cases we will *have* to use the interfaces in the environments we are in for logistical or security reasons. As we move to more ubiquitous computing and interfaces, we need to move away from the "patch the system in front of us" model and begin to think of ubiquitous accessibility. This model has many advantages, but is also quite different from what we have today, and will require not only different models and support mechanisms, but will also require a transition path from where we are today to where we will be in the future. It is also quite possible that, while completely virtual or ubiquitous accessibility may meet the needs of some, others will need to bring at least part of their interface with them. We will need to plan for these situations as well.

Although it is not clear exactly what form accessibility will take in the future, or the path that we need to take between what we have today and this future, it is clear that we do not have good answers today, and that we need to begin thinking and exploring soon, or people who need access features will be left behind again in the next big paradigm shift. The good news is that it appears as if where we will end up will not only allow more people to have more access for less money, but that the future will provide a potential for much more variability and incremental access across all dimensions, providing a better fit for more people and a viable economic model for individuals with more severe and multiple disabilities, who today constitute too small a market to be effectively served.

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References

1. Bigham, J.P., Prince, C.M.: WebAnywhere: A Screen Reader On-the-Go. In: Proceedings of the 9th International ACM SIGACCESS Conference on Computers and Accessibility, pp. 225–226. ACM Press, New York, NY (2007)
2. CapTel – Captioned Telephony, http://www.ultratec.com/captel/
3. Fairweather, P.G., Hanson, V.L., Detweilers, S.R., Schwerdtfeger, R.: From Assistive Technology to a Web Accessibility Service. In: Proceedings of the Fifth International ACM Conference on Assistive Technologies, ASSETS 2002, pp. 4–8. ACM Press, New York, NY (2002)
4. Hanson, V.L., Richards, J.T.: Achieving a Usable World Wide Web. Behaviour and Information Technology 24(3), 231–246 (2005)
5. Raising the Floor: Solutions & Tools, http://raisingthefloor.net/tools
6. SAToGo, http://serotek.com/softwaresolutions
7. Sears, A., Young, M.: Physical Disabilities and Computing Technologies: An Analysis of Impairments. In: Jacko, Sears (eds.) The Human Computer Interaction Handbook. Lawrene Erlbaum Associates, New Jersey (2003)
8. Vanderheiden, G.: Presentation (invited) to Joint ITU and G3ict Forum, on The Convention on the Rights of Persons with Disabilities: Challenges and Opportunities for ICT Standards, Geneva, Switzerland, April 21 (2008)
9. Zimmermann, G., Vanderheiden, G.: Modality Translation Services on Demand - Making the World More Accessible for All. In: RESNA 2001 Annual Conference Proceedings, pp. 100–102 (2001)