Information on the NII is not just for Viewing!

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Abstract

The electronic information highway exploits the power of computer mediated communication to provide wide-spread access to large amounts of information. Using the computer —an information processor— as an intermediary in information exchange has a significant advantage when providing equal access to people with disparate capabilities. The computer can ***display*** the information in a manner best suited to an individual's needs. Use of structurally rich, display-independent electronic encodings is a prerequisite in enabling such universal access.

The last 18 months have seen an explosive growth in the amount of information accessible on the World Wide Web (WWW) —a hypertext system linking vast repositories of information. When discussing the question of ensuring accessibility of this resource, attention has focused on the development of accessible WWW clients. However, such clients in themselves will not ensure accessibility; Information available on the WWW that is encoded using visual-presentation based formats, e.g., bitmap images (GIFs), Postscript and PDF (Portable Document Format), will continue to remain mostly inaccessible. This is because presentation-based encodings assume that the information will only be *viewed* on a visual display and therefore capture a minimal amount of structural information.

This paper outlines the challenges to be overcome by information providers on the NII to ensure universal accessibility of the services they offer.

1 Introduction

The global Internet is a vast repository of electronic information waiting to be accessed. The information available has been growing exponentially, and this growth has been fueled to a large extent by the availability of easy-to-use navigational tools like the various point and click WWW hypertext browsers.

The high visibility of browsers such as the Netscape Navigator and the original NCSA Mosaic (graphical WWW browsers) amongst others has led to a common belief that the Internet and the WWW are synonymous with programs like Mosaic. Since access to Graphical User Interfaces (GUI) has been a serious problem for people with visual impairments in the last few years, the above has resulted in a general feeling that vast portions of the WWW are inaccessible. We point out that the accessibility of the information available on the WWW is separate and distinct from the accessibility of various navigational tools.

This is not to say that making clients such as Netscape and Mosaic accessible is unimportant; we point out that though the former is necessary for universal accessibility of information on the NII, it is not sufficient. This is because even if the various popular browsers are made accessible, information that is archived as purely visual presentations, e.g., as Postscript or PDF (Portable Document Format) files will continue to remain inaccessible. Here is an outline of the rest of this paper. Section 2 looks at WWW clients and making them accessible. Section 3 addresses the question of archiving information in a form that will ensure universal accessibility. We illustrate the various points with examples of both accessible and inaccessible resources currently available on the WWW. Section 3 sets forth some guidelines for information providers to ensure that the services they provide are usable by the maximum number of users. We conclude the paper with some closing remarks in section 3. The paper also contains a bibliography, but with one difference; since this is a paper about publishing on the NII, all the references listed are online resources. You can access a version of this paper in HTML, —with all the references activated as hot links— on the WWW by accessing the author's home page at *URL* http://www.research.digital.com/CRL/personal/raman/raman.html.

2 WWW Clients

The WWW is a client/server hypertext information system. This means that the information resides on a remote machine (server) and is accessed by a program (client) that is run on the user's machine. The client program is responsible for retrieving the information from the server and "displaying" it on the user's workstation.

Here is a list of popular WWW clients. Each client is accompanied by a brief one-line description covering its current level of accessibility using speech interfaces.

- Netscape Navigator: Available for all major GUI's. At present, some speech access programs are available for the Windows and Macintosh platforms.
- NCSA Mosaic and its variants. (Same as above).
- IBM Web Explorer. WWW client for IBM WARP. Speech access is provided by IBM Screenreader.

- Lynx. A tty-based WWW character-cell browser. Can be used with conventional Dos-based screen-reading tools, but lacks some functionality.
- Emacs W3: An Emacs subsystem for surfing the WWW. Works well with conventional screen-reading programs.

As can be seen from the above, the WWW is not entirely closed to persons with visual impairments. At the same time, the level of access clearly leaves much to be desired. I myself use the Emacs W3 browser, and except for being unable to see the pictures on the WWW, this browser gives me complete access to any information that is archived without assuming a pure visual presentation. We will address the question of such archival in greater detail in section 3.

Most of todays WWW clients have been designed with a visual interface in mind. Though a fair degree of access can be provided via generalized screen-reading programs, we point out that in the general case this approach can break down. This is especially true when the information being displayed is structurally rich; e.g., technical documents containing mathematics, tables etc. This is because in the case of structurally rich information that has been displayed visually, a screen-reading program that merely speaks the contents of the visual display fails to convey the structural information that is essential for the user to understand the content. A typical example of this is provided by general screen-reading programs attempting to speak a displayed table.

The above shortcoming is not readily apparent on the WWW today, since most of the information available is not structurally very rich. As the WWW matures and begins to be used for professional publication services, the above shortcoming is likely to become more readily apparent.

3 WWW Servers

The WWW server is an information repository and is accessed by WWW clients. The ability of the client to "display" the retrieved information in a manner best suited to the user is a direct function of the format in which the information is archived.

The primary advantage of this architecture is that the client is free to display the information in a manner best attuned to the user's needs. Thus, the information can be displayed visually on a computer monitor, output in Braille, printed out on paper, or spoken by a speech synthesizer. By negotiating with the server, the client can request and retrieve the information in a format that it is best able to handle.

The above scenario is an excellent one for universal accessibility of electronic information; different users with disparate needs and abilities can access the same information. However, for this to come true, the information archived at the server should not assume any single final display format. Thus, if the information provider (server) assumes that users will *only* display their information visually, then the provider may choose to make available *only* a pure visual form of the information, e.g., a GIF file containing a snapshot of the information, a Postscript or PDF file capable of reproducing a high-quality visual rendering etc. However, this will close out a large number of users from accessing the information as we point out below.

Information Exchange

Until now, information has been interchanged by rendering it on a visual display, e.g., a sheet of paper. This requires that one has to be able to "see" the visual layout in order to infer and understand the underlying structure present in the information.

The advent of electronic information presents an opportunity to improve on this situation. The computer, as an intermediary in the process of information interchange, can take over the task of displaying the information according to the individual user's needs and abilities. But in order to achieve this, the electronic encoding needs to capture high-level structural and semantic information. Here, we outline some of these needs, and point out pitfalls to avoid.

The advent of screen-access programs, —computer programs that allow a visually impaired person to "hear" the contents of a visual display, screen enlargers and Braille translation programs— has provided a degree of access. As a consequence, online availability of some of the latest information has made these immediately accessible. However, there are certain pitfalls to be avoided when designing document encodings in order to ensure universal accessibility. The encodings used by the information servers to disseminate information need to capture information in a display-independent manner.

Information that is stored in a display-independent manner, i.e., without assuming any particular mode of display, is universally accessible. Such universally accessible information can be viewed using a visual client, displayed using a larger font by a person having limited vision, translated to Braille, or listened to using an audio-enabled client.

On the other hand, storage formats such as Postscript or the Portable Document Format (PDF) —PDF is a document encoding format used by the Adobe Acrobat to enable document exchange between disparate computing platforms— assume only a visual mode of presentation and are inaccessible. This is because page-description languages like the above merely capture the visual appearance of a document and it requires a human looking at the physical rendering to reconstruct the underlying information structure. Thus, though excellently suited to produce good visual reproductions of a —a purpose for which they were explicitly designed— they are also unsuited for producing non-visual renderings of the information.

To make this more concrete, here is a specific example. A server that maintains a large collection of documents can provide the information either as graphical images of the printed page, or as high-level markup documents, e.g., marked up using HTML. If the former approach is used, the information will only be accessible through a visual client. On the other hand, a server that provides the information in a display-independent form is more flexible, since the choice of how the information is displayed is left to the client. Such display-independent information servers are crucial for providing universal accessibility.

Markup languages like the Standardized General Markup Language (SGML) and the Hypertext Markup Language (HTML) capture the structure present in a document, leaving it to a client program to produce an appropriate display. It is this separation of information capture and display that make these markup languages the best choice.

Pot-holes on the NII

An incorrect choice of the encoding format used to capture and disseminate electronic information represents the biggest pot-hole on the NII today. Encoding formats that assume that the *only* way information will be accessed is by someone using a conventional display risk closing out a large percentage of the population from access to such information. An unfortunate example of this is the online tax form service made available by the Internal Revenue Service (IRS) and the US Department Of Treasury —Available at *URL* http://www.ustreas.gov/treasury/bureaus/irs/taxforms.html. This resource provides direct online access to all the federal and tax forms. Though tax-forms are perhaps not the kind of thing one would want to read out of pleasure, they are still an unfortunate part of all our lives. Tax forms on paper present a daunting challenge to persons with visual impairments, and at present it is practically impossible for someone with a print impairment to file their taxes without help.

Given this scenario, an electronic tax form repository is an extremely promising resource for persons with visual impairments. At little or no extra cost, these documents could be made immediately accessible. Yet, the archival and distribution format chosen, PDF, only encapsulates the visual representation of the tax forms. In this situation, making the popular WWW clients accessible does not help; a visually impaired user accessing this resource can perform a search for the appropriate tax form and have it displayed on the screen; unfortunately, once the form has been displayed, she will find that her speech access program only sees a blank screen!

This is because the form is displayed in its raw visual form, i.e., as a "picture" of what the printed form looks like. Thus, though this "display" of the form is well-suited to someone who can see the monitor, it's practically useless to someone using a speech interface. Thus, in this scenario, we have "successfully" replaced printed paper (which cannot be easily read by someone who cannot see) with a form of electronic paper, which is even harder to read!

The justification used for the above approach to the electronic dissemination of tax forms is "This is an experimental service", and "This does not replace the traditional forms on paper". Yet, it clearly represents an example of a lost opportunity; a significant advantage of introducing new technology —the ability to increase access — has been sacrificed in the cause of delivering high-quality visual reproductions of material that is currently available on paper. Thus, in this scenario, the NII degenerates from being a vehicle of information exchange to being an expensive replacement for a $0.29 postage stamp!

Yet another example of a useful WWW service that is currently inaccessible for the same reason is an online version of the New York Times, something that (unlike the tax forms) one would certainly read with pleasure! This is available daily on the WWW—Available at *URL* http://nytimesfax.com./. but the format used is once again PDF. Once again, the result is inaccessible. This is not to say that there are no accessible newspapers on the WWW. Notable among the success stories on the WWW both in terms of being accessible to all, as well as providing up-to-date information include *Time Daily* (Available at *URL* http://www.timeinc.com/time/daily/time/latest.html), *Money OnLine* (Available at *URL* http://www.timeinc.com/time/daily/money/1995/latest.html), and the *San Jose Mercury* (Available at *URL* http://www.sjmercury.com/whatsnew.htm), amongst others. All of these provide the information in HTML, allowing the WWW client to display the information in a manner chosen by the user.

Thus, there is a clear distinction to be made between the information servers and the clients used to access such servers. It is the responsibility of the information client to present the information in a manner appropriate to the individual user's needs and abilities. However, the information server needs to provide the information in a sufficiently high-level form so that it can be seamlessly accessed by different clients. Hence, it is wrong for an information server to assume any single mode of presentation.

Information Clients

Along with the adoption of accessible information encodings at the server end, there is a corresponding need to develop accessible information clients. Currently, there is no real effort in this direction; visually impaired users typically make do by getting a screen-access program to speak what is displayed by a visually oriented client. Though this approach works for simple documents containing minimal visual layout, the approach breaks down when dealing with more complex documents, e.g., tax forms, technical material and other sources of highly structured information.

The above breakdown occurs because all of the structural information is displayed by a visually oriented client by using visual layout cues which are lost when the display is directly spoken by a speech synthesizer or enlarged using a larger font. To read A detailed description of this problem and experience a solution that takes a revolutionary approach to speaking mathematics, visit *URL* http://www.research.digital.com/CRL/personal/raman/aster/aster-toplevel.html.

This WWW page gives examples of complex mathematics spoken by ASTER —Audio System For Technical Readings— a computing system that *audio formats* electronic documents to produce *audio documents.*

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