

Smart Documents

Timely Information Access For All

T. V. Raman
Advanced Technology Group
Adobe Systems

November 13, 1996

Abstract

Immediate and timely access to up-to-date information is likely to prove critical for the success of both individuals and societies in the coming century. As the flood of information increases, the *half-life* of up-to-date information diminishes correspondingly. Thus, where a weekly news journal once sufficed to keep people “well informed”, the information age is characterized by constantly updating sources of information.

Success or failure in this age will ultimately be determined by the level of access that one has to the latest and most reliable sources of information. Where access to the latest information is a strong advantage, users deprived of such information suffer from a correspondingly serious handicap. The most visible manifestation of this is in the case of ready information access by the visually impaired.

Until now, information interchange has been mediated by a passive intermediary —printed paper. Ideas expressed on paper therefore remain *dead* until perused by a human. Printed paper is also useless to someone who cannot see, and until now making information *accessible* has been a time-consuming and expensive process. As a consequence, only those items of information that remain relevant for a sustained period of time e.g., text books, could be converted to Braille or recorded on audio tape.

Thus, information with a relatively short half-life, e.g., the latest newspapers, have always remained inaccessible to the blind. Such a deficiency could be a serious drawback in the information age, and would threaten to further set back an already disadvantaged group.

The very enabler of the information revolution, computing technology, also promises to provide a solution in no uncertain manner. In the world of electronic documents, ideas are no longer interchanged via a passive intermediary. Instead, information interchange is mediated by an agent capable of computing on the information.

The social impact of this change is enormous. The computer as the intermediary in information exchange can enable smart documents that capture information and present it:

- where the user wants,
- when the user wants, and
- the way the user wants!

As in client-server computing, the information provider can play the role of *server* and make information available on the network; the user as the *client* can access this information in a manner best suited to the individual's needs and abilities.

Where availability of the latest information online to the average user is a convenience, to users with special needs these online sources represent information to which timely access would be otherwise impossible. Such immediate availability of information will have a profound impact on the way we live, work, profit, learn, govern, and communicate. Ultimately this evolution will ensure that the oncoming flood of information raises all boats.

1 Introduction

Once upon a time, ideas were exchanged by word of mouth and passed down verbally through the generations. In this era, information had the ephemeral quality of existing only in the minds of people. The written word enabled the evolution of mechanisms to capture and pass down accumulated knowledge; the key feature of this phase was the ability to reliably record and recall information.

In the era where documents were prepared by qualified scribes, carefully prepared written scrolls represented the means by which information was stored for posterity. Paper (or papyrus) represented both the repository of information, as well as the vehicle used to disseminate information. In this phase of the information revolution, the written document was available but to a few; the number of people capable of publishing information were even fewer. This state of affairs went through another dramatic change with Gutenberg's mainstreaming of the printing press; spreading information via the written word suddenly became a lot easier, and as a consequence, printed documents became a more generally available means for communicating ideas.

The concomitant increase in the availability of written information was enormous. In the age of the scribe, the effort involved in publishing meant that only documents that were perceived as being *timeless* could be preserved as handwritten scrolls. With the advent of the printing press, the set of written documents grew to encompass information that would otherwise not have been represented by the written word. Notice that as publishing becomes easier, the *life span* of information that people can afford to publish falls correspondingly.

As the next phase in this revolution, electronic information promises to empower *everyone* to publish. The corresponding increase in the availability of information is enormous. As this tide of information rises, the life span of any single item of information falls steadily; where once a written scroll was perceived as representing timeless content, a well-formatted printed advertisement often represents no more than a piece of worthless junk mail in the era of desktop publishing.

The flood of information is not the only feature of the current phase of the information revolution. Even though most information is still communicated by means of printed documents, the paper on which the information is printed is no longer the sole *repository* of the information. In the age of electronic information, printed paper merely represents one of the several vehicles used to disseminate information. The information itself resides in an electronic form that is in principle *display* independent.

This has a profound impact on how we produce, archive, retrieve and consume

information. Information is no longer merely stored on paper for consumption by future generations; instead, electronic communication provides the means to capture information in a *computable* form. When this information exchange is mediated by an intelligent intermediary—the computer—it opens up the possibility of producing and consuming information in a multiplicity of formats.

2 Information Is Not Just For Viewing!

The availability of information in a computable form as opposed to a purely visual representation means that electronic information can be more than just *viewed* on a flat two-dimensional display. Where information is only available in its visual form, e.g., as printed paper, it requires an intelligent human in order to make use of the ideas represented by the pattern of black and white dots appearing on the page. Computing technology can offset some of these difficulties; for instance, the visual image of the page can be digitized to produce an array of black and white dots, and Optical Character Recognition can be applied to discern the characters and words from this pattern of dots. However, the underlying structure of the information, as well as its meaning and purpose remain elusive.

Electronic documents draw their true strength from the fact that today most documents originate digitally. This means that documents are authored on a computer; as a consequence, the computer has more than the pattern of black and white dots to work with—computers can now get their hands at the true information that gives rise to the final form representation that we are used to seeing as black marks on white paper.

With access to such rich structural information, computers can present the information based on a user's needs and abilities. Thus, one can produce high-quality typeset output suitable for a high-end image-setter, or speak the information to a *functionally* blind user.

Notice the use of the term *functionally* blind user in the previous paragraph. A blind user is characterized by an inability to work with printed information. This deficiency can be viewed as a mismatch between the demands placed on an individual by her environment and the means and abilities the individual possesses to meet these demands. Taking this view, a person using a telephone to access electronic mail and an automobile driver unable to look at a computer monitor¹ are both (equally) *functionally* blind with respect to being able to read a printed

¹Automobile drivers should be looking at the road!

document.

Thus, the technology of audio documents which on the surface appears to be of relevance only to blind users is in fact useful to a far larger set of people. This is in fact not a one-off situation of technology designed for users with special needs impacting a far larger population —how many of us remember that the plain old telephone was a bi-product of attempts at developing a hearing aid!

Structurally rich electronic documents can be presented in several different media, and high-quality visual or aural output are just a few examples.

3 Multiple Views Of Electronic Information

Information has been traditionally displayed to a two-dimensional visual tablet. Visual formatting —the process by which information is visually laid out on the two-dimensional display in a manner that facilitates easy browsing based on the underlying information structure— has evolved over the centuries to its current sophistication. Open your favorite daily newspaper and observe the layout of the various news items in a manner designed to allow the eye to quickly spot topics of interest and browse them selectively.

As information technology evolves, it becomes necessary to perform similar high-quality formatting for other displays including computer monitors and speech output devices to name a few. Formatting information for the interactive visual display represented by the computer monitor is still in a state of flux. Once, it was thought that all that would be required would be to produce a high-fidelity online representation of the visual layout produced on paper. However, a computer monitor is hard to roll up and throw across your living room (unlike your favorite newspaper). In addition, the interactive nature of computer displays means that many of the assumptions made when laying out information to the static medium of printed paper need to be reconsidered.

The field of audio formatting —producing renderings of information optimized for an auditory display— is still in its infancy. The notion of audio formatting was first introduced in [Ram94] —visit `ASTER` (Audio System For Technical Readings) on the WWW² for an interactive demonstration. `ASTER` gave rise to many insights into the issues that come up in rendering information to an auditory display. Whereas visual interaction is characterized by a passive visual display that is actively perused by a human, auditory output scrolls linearly past a pas-

²URL <http://www.cs.cornell.edu/home/raman>

sive listener. This reversal of the active-passive relationship in auditory interfaces leads to many interesting questions concerning audio browsing —see the relevant publications found on the WWW³. The insight gained from developing and using A_ST_ER has been applied in designing a fluent spoken interface to the desktop —see [Ram96] for a description of the audio desktop provided by Emacspeak⁴.

4 Conclusion

Electronic communication in the world of networked computing, where structurally rich documents are stored and interchanged via an intelligent intermediary enables *smart documents*. Smart documents can be reused, searched and displayed to multiple media based on the user's requirements. Interactive interfaces based on this paradigm are in their nascent stage and present enormous potential. As a new dimension in human computer interaction, speech and audio promises to enrich our overall information experience in the coming century. The benefits of this information revolution are not restricted to the technologically advanced world; in fact their impact and potential benefit is likely to be far greater in parts of the world where lack of resources and a concomitant negative social attitude has meant that a large set of disabled individuals have long been placed at a socio-economic disadvantage.

References

- [Gib96] Wayte Gibbs. Envisioning speech. *Scientific American*, September 1996.
- [Hay96] Brian Hayes. Speaking of mathematics. *American Scientist*, 84(2), March–April 1996.
- [Ram94] T. V. Raman. *Audio System for Technical Readings*. PhD thesis, Cornell University, Ithaca NY., May 1994.
URL <http://www.cs.cornell.edu/home/raman> Audio formatted thesis produced by A_ST_ER, is available from Recording for the Blind (RFB order number FB190).

³URL <http://www.cs.cornell.edu/home/raman/publications>

⁴URL <http://www.cs.cornell.edu/home/raman/emacspeak>

- [Ram96] T. V. Raman. Emacspeak –a speech interface. *Proceedings of CHI96*, April 1996.
- [RG94] T. V. Raman and David Gries. Documents mean more than just paper! *Proceedings of the 2nd. International Workshop on the Principles of Document Processing*, 1994.
- [Van94] Greg C. Vanderheiden. Building disability access directly into next-generation information and transaction systems. *Keynote Speech, Association Of Computing Machinery (ACM) –Tokyo, Japan*, March 1994. URL <gopher://trace.wisc.edu/00/ftp/PUB/TEXT/TRACEPAP/ACMJAPAN.TXT> Trace R&D Center, University Of Wisconsin (Madison).