Hypertext and hypermedia

Neil Ridgway
7 September 1998

The term hypertext has been used, over the last 30 years, to describe an extension to the traditional form of flat or linear text. For example, a book can be described as being linear because it is usually read from the beginning to the end. Recent developments in computer systems, however, have allowed programmers to develop new ways in which traditional text can be viewed. Conklin [17] describes how these systems allow references to be created between different chunks of text, which can be in the same or another document. This type of text is called nonlinear text or hypertext because the path through the document can branch-off to other documents via these references.

Three of the main contributors to the area of hypertext were Vannevar Bush, Douglas Engelbart and Theodore Nelson. Conklin [17] discusses each of their hypertext systems and they were:

1. *Bush's Memex system.* In 1945 Vannevar Bush predicted a rapid growth in the amount of scientific literature and the need to create a way in which this large body of information should be browsed. In his article, see Bush [18], Bush describes how the human mind works by associating related pieces of information. He applied this concept to a machine, called the Memex, which allowed the user to tie two relevant pieces of information, from two separate documents, together. This idea of association is credited as being the first attempt to describe hypertext.

2. *Engelbart's oN Line System (NLS/Augment).* In 1963, Engelbart described a computer system that would augment man's intellect, by allowing the user to interact with the system using special cooperative devices. As a result the amount of information that a user could manipulate and understand would steadily increase, effectively amplifying the native intelligence of the user. The NLS system was implemented five years later at the Stanford Research Institute. It allowed users to create any number of links between elements within a document and between the documents themselves. See Engelbart and English [19] for more details.

3. *Nelson's Xanadu System.* During the development of the NLS, Ted Nelson was also developing his own ideas about augmentation. Nelson's system would only allow the storage of documents in their original format and any modifications made to these documents, e.g. a different paragraph etc. By using links between these modifications and the original documents, previous versions could be easily reconstructed. New links could easily be created between different bodies of text and therefore new pathways could be formed through the material. It was from this system of linking large bodies of text together that Ted Nelson created the term hypertext. Nelson's book, see Nelson [20], describes his ideas in more detail.

The term hypermedia can be described as an extension to hypertext. Hypertext systems allow users to author, edit and follow links between different bodies of text. Hypermedia systems, however, are similar to hypertext systems, except that the user can use other forms of media as well. For example, the authoring of links between an audio file and a body of text.

Halasz [21] describes how Engelbart's NLS/Augment system can be called a first generation system because it used workstations with little or no graphics capabilities and it focused primarily on text. An overview of these systems can be found in Conklin [17]. Halasz goes on to say that in the early 1980's, second generation systems began to emerge, which used workstations with more advanced user interfaces and graphics. As a result these new systems would allow users to create references between different types of media, e.g. text, pictures etc., and hence they were called hypermedia systems. Example hypermedia systems are NoteCards [21], KMS [22] and Intermedia [23].

These second generation hypermedia systems originally used proprietary document formats to store the data. The links themselves were embedded into these documents, which made them considerably easier to transport. However this approach can cause several problems, especially with networks and distributed systems. For example, when a document is moved from one computer on the network to another, all links pointing to this document will have to be updated. Otherwise users will not be able to follow links to this document. Similar problems will occur if documents are deleted and the links are not updated or removed. The use of embedded links also made it very difficult to extend these systems, to support other types of media. External programs, that were not fully integrated into these systems, would have to be used. As a result of these problems, the second generation systems were called closed hypermedia systems. Goose [24], Beitner [25] and Halasz [21] describe these systems in more detail.

"Open" hypermedia systems

Goose [24] describes that in 1987, at a international hypertext conference, researchers started to express their concerns about the problems mentioned in the previous section. Several ideas were discussed, see Halasz [21]; for example new search and query mechanisms, management of dynamic information, more integration of existing applications etc. As a result of these discussions, several American research groups defined, in 1989, a reference model for hypermedia. It was called the Dexter Hypertext Reference Model, see Halasz and Schwartz [26] and it was designed to:

1. Define both formally and informally the common abstractions found in a range of existing hypertext systems, e.g. NoteCards, Intermedia, KMS etc.
2. Serve as a standard, so that the functionality and characteristics of existing hypertext (and non-hypertext) systems could be compared.

3. Serve as a template, for the development of standards. These would assist in the interoperability and interchange between different hypertext systems.

The Dexter reference model is widely regarded as being one of the most important developments in hypermedia research.

A paper by Malcolm et al. [27] describes how hypermedia could be used in industry to integrate large amounts of data from specialist tools and applications. Malcolm, however, describes how the current (second) generation of hypermedia systems were incompatible with each other, as well as the tools and applications used in industry. As a result, Malcolm et al. defined several issues that needed to be addressed, e.g the ability to access and link across different platforms (interoperability), templates for common hypermedia structures and interaction with operating systems and networks etc.

Goose [24] describes that in 1991, at another hypertext conference, Halasz revisited his original ideas, see [21], that he placed before the hypermedia community. Halasz reviewed the progress that had already been made and he also discussed the contribution made by Malcolm et al. [27]. As a result of these discussions Halasz presented several new areas of research, which focused primarily on the the development of "open" systems with independent communicating processes and the way in which large amounts of information could be managed and visualised on workstation screens. With the development of more "open" hypermedia systems, researchers would be able to overcome some of the problems associated with the second generation of hypermedia systems, see Section 2.6.1.

In [24], Goose gives a detailed overview of several hypermedia systems, that have embraced some of the concepts of "open" hypermedia. These include the World Wide Web, see Section 2.4, Hyper-G, Intermedia and Multicard. The following section describes why the audio domain has been neglected in hypermedia systems and how several "open" hypermedia systems have managed to overcome this.

[See Web site for references.]