Hypermedia and Associated Concepts

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INTRODUCTION

There has been considerable speculation of late that the design of hypermedia and Web-based systems warrants new methods different from those used in conventional software design (Kautz & Nørbjerg, 2003). However, much confusion abounds within this debate because fundamental concepts such as hypermedia, multimedia, and Web-based systems are rarely explicitly defined and it is often unclear what is actually meant. This article explains the following interrelated terms: multimedia, interactive multimedia, digital multimedia, interactive digital multimedia, hypertext, hypermedia, and Web-based systems. Such clarification is important because for research results to be comparable and scholarly discourse to be logical, there must be a common language.

BACKGROUND

The conceptual origins of hypermedia may be traced to a seminal postwar paper by Vannevar Bush (1945) titled "As We May Think" in which he set forth his vision of an information-management device called Memex. Inspired by Bush's ideas, Douglas Engelbart (1962/1991) wrote him a letter in 1962 about the concept of "an integrated man-machine working relationship, where close, continuous interaction with a computer avails the human of radically changed information-handling and -portrayal skills" (p. 237). This concept was realised as the Augment/NLS (online system) system, famously demonstrated in San Francisco in 1968. Featuring hypertext, split-screen windows, mouse-based input, and interactive, cooperative work using voice and video connections, it was a major milestone in the evolution of computing. Meanwhile, Ted Nelson (1965) was working at Xanadu on a computer-based file system "that would have every feature a novelist or absent-minded professor could want, holding everything he wanted in just the complicated way he wanted it held" (p. 85). Like Engelbart, Nelson (1987) was concerned not just with the support of individual work, but also collaborative information sharing. His vision was of a system in which "any user should be able to follow origins and links of material across boundaries of documents, servers, networks, and individual implementations" (p. 243).

Although there were notable advances in hypermedia technologies during the 1980s, it was not until 1991 when Tim Berners-Lee of CERN (European Centre for Nuclear Research) released his World Wide Web project into the public domain that a universal, unified environment such as envisaged by Nelson (1965) came into being. The Web is a global hypertext system founded upon the hypertext markup language (HTML), hypertext transfer protocol (HTTP), and uniform resource locators (URLs). In its earlier forms, the Web had basic architectural limitations and could only be properly regarded as a primitive, constrained hypermedia implementation. Through the emergence in recent years of standards such as the extensible markup language (XML), XML linking language (XLink), document object model (DOM), synchronized multimedia integration language (SMIL), and Web distributed authoring and versioning (WebDAV), as well as additional functionality provided by the common gateway interface (CGI), Java, plug-ins, and middleware applications, the Web is now moving closer to an idealized hypermedia environment (Bulterman & Rutledge, 2004; W3C, 2001, 2004).

EXPLANATION OF TERMS AND CONCEPTS

Multimedia

Hypermedia is formed by the convergence of two traditionally separate streams of research, namely, multimedia and hypertext. In order to better explain the concept of hypermedia, one must consider both of these streams. This section deals with multimedia; the next deals with hypertext.

Multimedia desktop computing is a relatively new concept, having only been around for a decade or so. The lack of a clear, consistent, commonly agreed-upon definition of multimedia is oft lamented. Simplistic definitions refer to the blending of sound, music, images, and other media into a synchronized whole. However, according to such a definition, the origins of multimedia would extend back to prehistorical cave ceremonies. More recently, the composer Wagner integrated various media into his Gesamtkünstwerk (Total Art Work) performances in the

1870s. By the 1960s, the term multimedia, alternatively known as cross-media, was being used to refer to live demonstrations by human speakers supported by combinations of slide projectors, motion-picture projectors, and audio-tape players.

To distinguish from artistic works, audiovisual presentations, theatre, and other noncomputer-based multimedia, one may use the term digital multimedia, meaning that the application is fully controlled by digital computers (Fluckiger, 1995). A further refinement of the definition of multimedia is the notion of interactive multimedia. Interactive multimedia systems enable end users to choose the information they see and receive by actively engaging with the system. In contrast, traditional television and comparable technologies such as videotape are passive because the end user has no control over the timing, sequence, or content and is not able or intended to interact (Dustdar & Angelides, 1998). However, interactivity is not unique to digital media. It has long been a feature of traditional media such as newspapers where readers must scan a page and decide what articles to read and in what sequence. For the sake of precision, the term interactive digital multimedia is therefore preferable to multimedia or interactive multimedia.

Another related and much misused term that warrants clarification is new media, defined by Williams, Strover, and Grant (1994) as applications of microelectronics, computers, and telecommunications that offer new services or enhancements of old ones. Considered thus, it is a broad term that comprises technologies such as videophones, electronic bulletin boards, and interactive television, though narrow interpretations often treat new media as synonymous with the World Wide Web (McMillan, 2002).

Figure 1 shows a simple diagrammatic representation of the overlapping relationships between multimedia, interactive media, digital media or new media, and interactive digital multimedia. Not all digital media can be regarded as multimedia; for example, SMS (short messaging service) messaging is digital but uses text only, unlike digital television that uses a combination of media (i.e.,

digital multimedia). Likewise, some applications of interactive media cannot be classified as multimedia.

Hypertext and Hypermedia

The term hypertext was coined by Nelson (1965), meaning "a body of written or pictorial material interconnected in such a complex way that it could not conveniently be presented or represented on paper" (p. 96). In technical parlance, Smith and Weiss (1988) define hypertext as "an approach to information management in which data is stored in a network of nodes connected by links" (p. 816). These nodes can contain text, graphics, audio, and video as well as source code or other forms of data. Hyperlinks, sometimes called hotspots or buttons, may take the form of one or more contiguous words in a passage of text, a picture or diagram or segment thereof, an interface object such as a button, or a segment of a media object. The point at which a hyperlink is located within a node is referred to as an anchor. The destination point of a hyperlink is also known as an anchor. Nodes are sometimes alternatively referred to as targets, pages, documents, cards, or frames. These technical terms are illustrated in Figure 2.

Figure 3 depicts the relationships between hypertext, hypermedia, interactive digital multimedia, and Web-based systems. In keeping with other authors (Vaughan, 2001), hypermedia is treated as a subset of interactive digital multimedia. Here, as elsewhere (Conklin, 1987; Fluckiger, 1995), hypermedia is also regarded as a specialized extension of the more general class of hypertext in the sense that hypermedia incorporates information of any type or format as opposed to just textual data. There is, however, some difference of opinion on this distinction, and the terms hypertext and hypermedia are often used interchangeably as though equivalent. This is understandable given that Nelson's (1965) definition of hypertext as earlier mentioned clearly does not preclude the use of multimedia data types. Indeed, Nelson alluded to the possibility of arranging nontextual media such as films and sound recordings into nonlinear sequences, but referred to such objects as hypermedia.

Figure 1. Associations in multimedia terminology
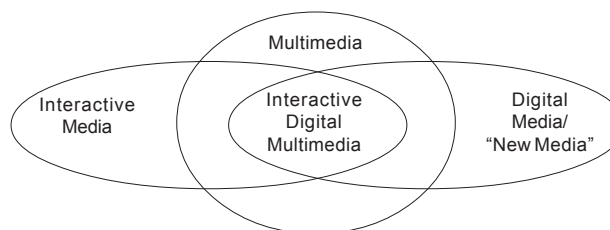
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