CHAPTER 11

HYPERAMDIA SOFTWARE DEVELOPMENT TECHNOLOGIES

Farahat F. Farahat & Mohamed M. Essas

ABSTRACT

Hypermedia refers to a set of technologies that deals with a new method of: 1) organizing and 2) supplying associations between different elements of multimedia information.

It can deliver new freedom to users in exploring large amounts of mutimedia information at their own pace, and according to their own interests. Hypermedia will lead to very high levels of user interaction and consequently very low lattency/high bandwidth (BW) within the communication channel.

This paper presents: 1) the fundamentaI properties, that a system have to drserve the name **"hypermedia system"**, and 2) the features and technologies of hypermedia in the light of application requirements.

1 - INTRODUCTION

An explosion of interest in multimedia, hypertext, and hypermedia systems and software (SW) have been seen in the last few years. In 1987, the first major conference on hypertext took place at the university of North Carolina. Since that time, large amount of literature has been created and different commercial systems are now becoming available. It is now time to speculate about what is needed to develop the promise of hypertext and hypermedia systems.

Hypermedia has the potential to revolutionize the development and delivery of applications as well as the sophistication and usability of those applications.

In this paper, the fundamental properties, that a system must have to deserve the name **"hypermedia system"**, will be presented. Industrial users of such systems should demand hypermedia systems that meet this set of requirements. System' de-

signers should meet these criteria and extend them. Consequenty, the technology will go forward and every body will benefit.

2 - HISTORICAL OVERVIEW

Almost (53) years ago, Vannevar Bosh wrote an article (Bush, 1945) in which a system was described.

This system was called **Memex** which could be said to have multimedia capabilities (typed items, photographs, and have written annotations on microfilm). The system also had associative memory and links representing "Trails" between its objects. It is fair to credit Bush with being the parent of these concepts even though the technology did not exist to implement them at time.

In the 1960s [Englebart, 1984, Englebart and English, 1968], the Augment System of Douglas Englebart had appeared. This system employed a mouse and an optional one-handed board keyset, and offered genuine hypertext capability. It was so much harder that the first system (which employed multiple media) would be identified, since the list of candidate systems is unclear. Ted Nelson's first saw that these principles could be extended to a hypertext network of all of society's documents [Nelson, 1981]. Moreover, he expressed his visions in colourful language ("If computers are the wave of the future, displays are surfboards" (Van Dam, 1988)

In 1987, the Hypercard program [Goodman, 1990] was supplied to all purchasers of Macintosh computers. While Hypercard may be regarded as a primitive hypermedia system, its widespread availability stimulated, interest in this area, and thousands of Hypercard stacks were created.

Notecards was developed at xerox from a different conceptual basis. It was intended as a supporting system for collecting and organizing ideas, each represented by a card and organized by links.

Intermedia was a major multi-user hypertext system intended to focus on scholarly and educational applications. With its annotation service, link browser and linguistic tools, it intended to be both an authoring and reading tool. Certain implementation decisions have prevented intermedia from being adopted more universally. These are documented in Haar et al [1992].

The extensive multimedia work done in Project Athena at MIT was contemporaneous with the development of Intermedia.

The decade of the **1990s** was bringing larger systems which work on multiple platforms, serve scores of users, and were becoming commercially significant.

Companies like MacroMedia and Gain Technology have comprehensive sets of products and are moving in different directions.

There are also important applications of these technologies in SW engineering. An early application was Neptune, and a current example is Ensemble, an environment for the uniform analysis and synthesis of SW and multimedia (MM) documents. It is a framework for the integrated support of interactive development of complex natural language and formal language document. The system has direct manipulation capabilities as well as services for formal description of syntax, semantics, and transformations of structured objects and representations. Users can edit and view compound documents of many types of components represented in a variety of media. Views can display the logical structure of a document as in a tree-structured representation or a view might display the output of a transformational process such as a printed view of a program.

3 - DEFINITIONS

1- The computer systems (CS) are operating by visiting a sequence of "pages", sometimes called cards or scenes.

2- A "simple page" might be a page containing text, graphics, animations and other objects.

3- A "page" would be made up of some number of simple pages. In a system that works with programs, e.g., Ensemble, a "page" might represent a "module" in the programming lauguage.

4- A hypertext system is a system as described above for which a user may also:

1- Create or delete pages,

2- Insert or delete one or more lines between two previously defined pages.

3- Edit pages,

4- Visit a page by following a link.

Thus, it is fair to talk about traversing a graph of pages in a hypertext document.

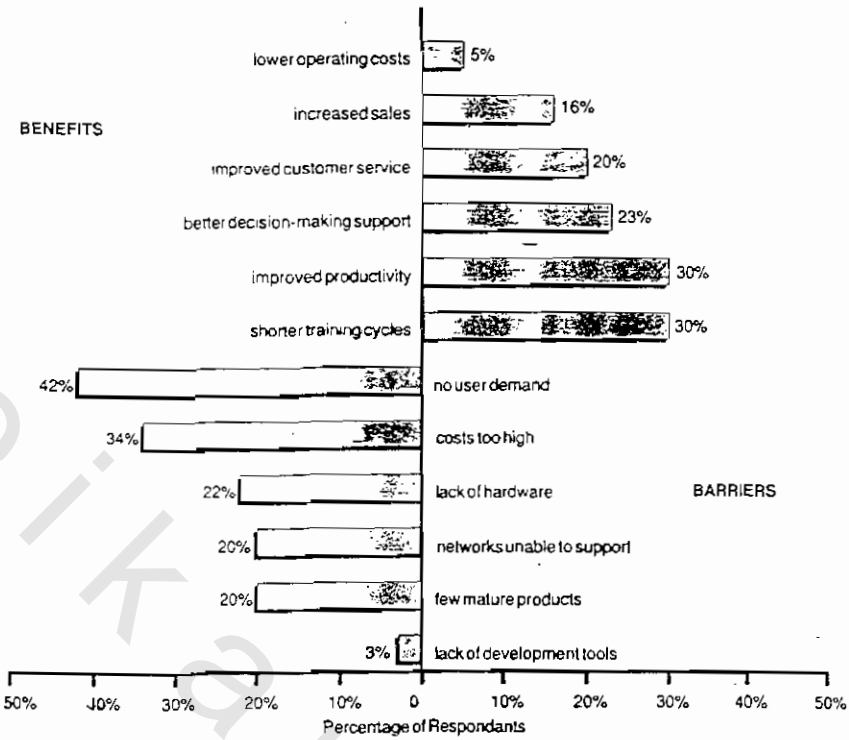
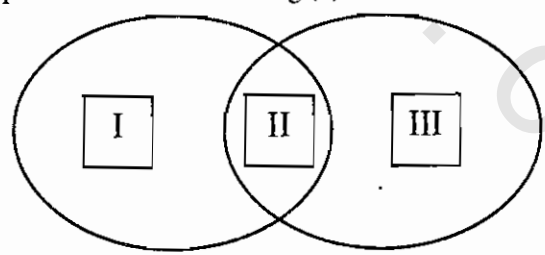


Figure 1 : Benefits & Barriers of Multimedia Applications.

5- A Multimedia system is a system as above where the pages may be of different individual media types or compound pages may include many media types.

There are many MM applications such as:

Banking, insurance,... etc, refer to table (1). The benefits and barriers of MM applications are shown in Fig.(1).



I = Multimedia (MM).

II = Hypermedia (HM).

III = Hypertext (HT).

Fig. (2): the relation among MM, HT and HM.

Application	Media Profile						Network Requirements		
	voice	data	text	image	audio	video	distributive	interactive	bandwidth
banking	*	*	*	*			H	M	M
insurance	*	*	*	*			H	M	M
medical imaging		*	*	*			L	M	H
real estate		*	*	*	*	*	H	H	M
education	*	*	*	*	*	*	M	M	M
distance learning	*	*	*	*	*	*	H	H	H
advertsing			*	*	*	*	H	H	H
publishing				*	*	*	H	H	H
travel agency				*	*	*	H	H	M
co-operative working	*	*	*	*	*	*	L	H	H
library			*	*	*	*	H	M	M
sales			*	*	*	*	H	H	M
training			*	*	*	*	H	M	M
medicine	*	*	*	*	*	*	M	M	M
hypermedia	*	*	*	*	*	*	H	H	H

Table (1)

The list of MM types should be openended since the computer field advances dramatically whenever new media types are introduced [think of 1/0 devices such as the laser printer which drove the development of desktop publishing].

6- A hypermedia system is defined as a comprehensive MM system that also has hyperlinks between its "pages".

There are other definitions for the hypertext system, multimedia system and the hypermedia system as follows:

- A hypertext system is mainly determined through non-linear links of information. Pointers connect the nodes. The data of different nodes can be represented with one or several media types. In a pure text system, only text parts are connected. Thus, hypermedia is understood as an information object which includes links to several media.

- A MM system contains information which is coded at least in a continuous and discrete medium. For example, if only links to text data are present, then this is not a MM system. It is a hypertext.

A video conference, with simultaneous transmission of text and graphics, generated by a document processing program, is a MM application. Although it dose not have any relation to hypertext and hypermedia.

- A hypermedia system includes the non-linear information links of hypertext systems and the continuous and discrete media of MM systems. Fig.(2) emphasizes the relation among MM, hypertext (HT) and hypermedia (HM).

4 - ESSENTIAL ELEMENTS OF HM

There are twelve rules or criteria by which one can compare and evaluate hypermedia systems. These rules can be classified as follows:

1 - Multimedia Rule,

2 - Object Rule,

3 - Scripting Rule,

4 - Multiuser Rule,

5 - Scalability Rule,

6 - Interoperability Rule,

7 - Hyperlink / Hyperview Rule,

8 - Technology Independence Rule,

9 - Extensibility Rule,

10-Multilingual Rule,

11-Performance Support Rule, and

12-Standards Rule.

4.1. Multimedia Rule:

A hypermedia system should support both user-driven and time-driven input and output of the full range of sensory-rich multimedia types, including not only those items that are stored internally in the system but also those externally in other data sources.

4.2. The Object Rule:

A hypermedia system should employ object metaphors for system interaction, system storage, and application creation.

4.3. The Scripting Rule:

A hypermedia system should provide a rich, user-accessible scripting language for extending and modifying the behaviour of the system and its application elements.

4.4. The Multi-User Rule:

A hypermedia system should support the collaborative building of applications by multiple concurrent authors on networks of heterogeneous computers and the execution of those applications by multiple concurrent users.

4.5. The Scalability Rule:

Applications developed with a hypermedia system should continue to work well and with predictable performance characteristics when deployed in production environments that contain much more data and many more concurrent users than existed in the prototype or pilot version of the application.

4.6. The Interoperability Rule:

. Hypermedia applications should be able to exchange both data and control not only among themselves, but also with external applications and data stores such as SQL relational data bases.

4.7. The Hyperlink / Hyperview Rule:

A hypermedia system should allow users to establish different media types, to browse and navigate those relationships in an ad-hoc-linear manner, to determine

readily one's location among them at any time, and to return easily to any prior location or a navigated path.

4.8. The Technology Independence Rule:

A hypermedia system should provide independence from any particular vendor's technologies and guarantee that the hypermedia applications will continue to work without change as the underlying technologies evolve.

4.9. The Extensibility Rule:

A hypermedia system should be easily extensible and contractible in functionality and user interface in order to solve wide classes of application problems and to accommodate users of all types.

4.10. The Multilingual Rule:

A hypermedia system should support user interaction, user communication, and data storage and retrieval in languages other than American English language.

4.11. The Performance Support Rule:

A hypermedia system must accommodate both novices and power users, allowing them to author visually and to debug user-friendly applications that can become self-contained electronic performance support systems for their users. A hypermedia system must also be its own electronic performance support system.

4.12. The Standards Rule:

A hypermedia system should support and comply with all relevant formal and market standards. Standards reduce the number of choices to a tractable number. In so doing, they allow product vendors to innovate and add truly useful features to their products instead of devoting time to proprietary implementations of common functionality. And standards-adherence by vendors gives the consumers of their products the confidence that the products will be compatible with other products in those areass.

There are two types of standards, namely, 1) formal standards and 2) market standards. The former are debated and agreed upon by formal standards organizations or industry consortia.

For example, the International Standards Organization (ISO) over the years has published standards in different areas. ISO has defined-8-bit encodings for Roman character sets, the architecture and functionality of network protocol stacks, and the syntax and semantics of the SQL, databse - access language.

Market standards undergo a different process. They become standards by virtue

of being purchased and used in significant quantities. For example, the X window System has become a market standard since all the important hardware manufacturers offer implementations of it and all the major software vendors now write user interface to conform with it. Instead of being voted upon with a show of hands by a standards committee, market standards are determined by the vote of dollars in the market place.

Hypermedia systems must comply with and support relevant formal and market standards.

Unfortunately, multimedia and hypermedia are still such a young set of technologies that the standards process for them has not yet run its course.

However, a few standards such as JPEC, MPEG, unicode, MIDL, Hy Time, and MHEG have emerged. Such standards must be supported in hypermedia systems and not replaced by equivalent proprietary methods.

5. CONCLUSIONS

Industrial strength applications are built today with tools such as 4GLs and forms pakages. It is belived that hypermedia systems as described herein can dramatically alter the process and speed of building such applications as well as the sophistication and usability of those applications.

Twelve criteria have been offered by which to judge putative hypermedia systems, refer to Table (1). Not all of these criteria have equal weight.

Rules 1,3 and 7 are essential and unchallenged. Rule 2 is largely agreed upon but other approaches may yet prove viable.

Comparing these 12 rules with the work of Halasz et al, on Note Cards in which he lists seven fundamental issues for hypermedia. The two approaches are very different due to the underlying assumptions differ radically.

NO.	Criteria
1	Multimode rule.
2	Object rule.
3	Scripting rule.
4	Multi-user rule.
5	Scalability rule.
6	Interoperability rule.
7	Hyperlink / hyperview rule.
8	Technology independence rule.
9	Extensibility rule.
10	Multilingual rule.
11	Performance support rule.
12	Standards rule.

Table (2). The twelve criteria for hypermedia systems.

Notecards is a system to help people organize their ideas. The users of Note Cards are assumed to be authors, designers, and researchers. On the other hand, hypermedia systems are envisioned as tools for building large industrial - strength performance - enhancing systems. All but one of the Halasz criteria are explicity or implicitly covered in the underlying rules. An apparant exception is his rule on "virtual structures".

Virtual structures are an attempt to overcome the static nature of the basic Note Cards model. A user of Note Cards must map his or her ideas into individual units which are stored one to a card. Each card gets a title and is placed into a "filebox". This means that the user must predefine a static stucture and Halasz calls this the "problem of premature organization".

REFERENCES

1- Michael A. Harrison, "The Essential Elements of Hypermedia", Multimedia Systems and Applications, Acdemic Press Ltd., 1995.

2- Wendy Hall, "Hypermedia Tools for Multimedia Information Management", Multimedia Systems and Applications, Academic Press Ltd., 1995.

3- Rob Walters, "Computer - Mediated. Communications: Multimedia Applications", Boston-London, Artech House Inc., 1995.

4- Kaj Cronbaek and Randall H. Trigg, "Hypermedia System Design Applying the Dexter Modé", Communications of the ACM,(Feb. 1994.)

5- Kaj Gronbaek, Jens A. Hem, Ole L. Madesen and Lennert Sloth, "Systems: A Dexter-Based Architecture", Communications of the ACM (Feb. 1994) pp. 65-74.

6- John J. Leggett and John L. Schnase, "Dexter With Open Eyes", Communications of the ACM, (Feb, 1994), pp 77-86.

7- E. Rivtin, and et als, "Navigating in Hyperspace: Designing a Structure-Based Toolbox", Communications of the ACM, (Feb. 1994,) pp 87-96.

8- Gerard Salton and et als, "Automatic Structuring and Retrieval of Large Text Files", Communications of the ACM, (Feb.1994), pp 97-108.