CHAPTER 2: EMERGENCE AND EVOLUTION OF THE DIGITAL MEDIUM

2.1 The pioneers of digital media and digital technology

The purpose of this chapter is to present a brief summary of the emergence and evolution of the digital medium, and to define the main contributions made by the pioneers, who were mainly mathematicians and engineers, in terms of its conceptualization[1]. We will attempt to summarize the contributions to the terminology of the field and the concepts of multimedia, hypermedia, Internet, hypertext and interactive narrative. Due to the importance of their contributions to the conceptualization, of hypertext and interactive narrative respectively, we will look specifically at the contributions by Theodor P. Landow and Xavier Berenguer. There is a table providing a summary at the end of each subject that identifies the most important individuals and their personal contributions.

In the documentary genre, which began in the late nineteenth century with the invention of the cinematograph by the brothers August and Louis Lumière, the emergence of the digital medium occurred half a century later, but it developed at an exponentially quicker pace. The difference between analogue and digital media lies in how they operate: until the arrival of digitization, all media operated based on analogue methods, i.e. by replica or imitation. Analogue is equivalent to **transcription**. Encoding information on analogue basis involves transcribing a given magnitude to another system, consisting of a new magnitude proportional to the first, but more manageable.

Traditionally, in the analogue medium, an artist or author has a model or a reality and transcribes it (or transforms it) to physical media such as photographic paper (photographs), stone (sculpture) or paint (painting). In digital media, the process is no longer a question of transcription, but rather of **conversion**: the encoding of information entails the conversion of physical magnitudes into binary numerical parameters. The model becomes a series of numbers

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[1] The outline used to structure the different phases relating to the history of the digital medium and the selection of its most significant individuals are part of the programme and theory of the subject *Interactive fiction and nonfiction* , taught by Professor Xavier Berenguer, as part of the Pompeu Fabra University doctorate course in Cinematographic Theory, Analysis and Documentation (2006-2008). Available online at: http://www.upf.edu/pdi/dcom/xavierberenguer/cursos/interact/principal.html

(which are always 0 or 1) without any physical variable. As a result, during the digital conversion process, different physical items such as text, images and sounds are converted into bits of information (a kind of unique information package, which leads us to think that there is ultimately only one medium and interactive programs, as argued by Berenguer in 1997, are "unimedial"). In short: in analogue transcription there is always a physical medium (paper, rock, fabric, etc.), while in digital conversion only a series of numbers occupy the computer's processor. A digital medium is defined as all the practices originating in an analogue or digital medium that become a specific numeric code after processing of their signal (a combination chain between 0 and 1).

It is possible to speak in terms of new media thanks to a **series of contributions by mathematicians and engineers** who invented[2] and used **tools and languages** which today we call computer systems, which laid the foundations of this new communication environment known as the digital medium. Broadly speaking, the pioneers were the following authors: Charles Babbage, Herman Hollerith, Alan Turing, Norbert Wiener, Claude Shannon, Konrad Zuse, Jack Kilby and Joseph Carl Robnett Licklider. Table 2.1 is a diagram showing the most important contributions by each of these authors.

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[2]Note that in many cases, the individual concerned did not invent the instrument or language, but instead led or coordinated a design and / or development team. This idea, which links the inventor to his invention, is called the "heroic theory of invention," and has been heavily criticised by authors advocating a social perspective on technology (seen in terms of a product that emerges from working networks and is reconfigured to work and society), and is in contrast to the "theory of multiple discovery," which posits that most scientific discoveries are made by different people simultaneously) (http://en.wikipedia.org/wiki/Heroic_theory_of_invention_and_scientific_development and http://en.wikipedia.org/wiki/Multiple_discovery)

Table 2.1 DIGITAL MEDIA PIONEERS

INDIVIDUALS	INVENTIONS	CHRONOLOGY AND MAIN CONTRIBUTION
Charles Babbage	Difference engine, analytical engine.	(1791-1871) First idea of a computer.
Herman Hollerith	*IBM*, *Tabulating Machine Company*	(1860-1929) Automated processing of large amounts of information.
Alan Turing	Automatic Computing Engine, *Turing Test*	(1912-1954) Father of Artificial Intelligence.
Norbert Wiener	Network systems	(1894-1964) Theory of cybernetics, automation, feedback.
Claude Shannon	Relays, Bits	(1916-2001) Father of the electronic communications era, mathematical theory of communication.
Konrad Zuse	Z-1,Z-2, Z-3, Z-4, Z-5 computers, etc., decrypting machines (*ENIGMA*)	(1910-1995) The first programmable binary electromechanical computer.
Jack Kilby	Integrated circuits, microprocessor, microelectronics	(1924-2005) Invention of microprocessors and microelectronics.
J.C.R. Licklider	*ARPANET*, Internet	(1915-1990) Concept of the intergalactic network and forerunner of the modern Internet.

2.1 Digital media pioneers

2.2 Consolidation of the interactive program. Hypermedia, multimedia and the case of the Internet

2.2.1 Origins and consolidation of interactive programs

In the nineteenth century, new visual reproduction technologies paved the way for subtle means of integration of spectacular things by means of the direct participation of the viewer as an individual, and social definitions of the private versus the public sphere were therefore reconstructed. Some nineteenth-century inventions, some of which were very peculiar, such as the *praxinoscope,* and others based on communication technologies such as the telegraph and telephone, clearly and concisely anticipated interactivity-based ideas and technologies similar to those of the present day, such as the Internet, virtual reality and digital TV on demand.

The fact that collective viewing influenced many of the inventions of the nineteenth century, as also occurred during the twentieth century, is due simply to commercial factors - namely the desire for greater profits from showings with collective rather than individual audiences. An example of this is Thomas Edison's commercial marginalization of the French *Kinetoscope* in 1894 (a peep show that could only be viewed by one person), in favor of the Lumière brothers cinématographe, which could be viewed by many people simultaneously, or the lack of help from Hollywood for Morton Heilig's *Sensorama* in 1962, as at the time it was more concerned with new research on how to expand the screen (*Cinemascope*, 3-D, etc.) in order to recover the audience that it had lost due to the mass introduction of television.

As Xavier Berenguer (1997) points out, the seminal ideas of interactive programs and their scope are basically due to two individuals: first, **Vannevar Bush**, who in the 1940s, when computers were only used to calculate the trajectories of bullets and bombs, imagined a digital system called the "Memex" for storing large interconnected knowledge bases, which could be accessed from various and multiple levels; and **Ivan Sutherland** in the 1960s, who invented the digitization of images and designed goggles for wandering around within the images. According to Berenguer, "Bush's ideas are the basis for modern systems of information exchange, closer to people's natural way of relating information, while Sutherland is the father of the technology which allows putting these ideas into practice and the first to discover the horizons of interactive communication" (Berenguer, 1997).

Another important figure is **Ted Nelson**, who coined the term "hypertext" in 1965. Nelson also devised another utopian database, called "Xanadu." Despite the fact that "Xanadu" never existed, Nelson's simultaneous reflections on methodological and linguistic order are essential in the development of interactive programs.

The serious and definitive approach to technically feasible interactivity came about with the technologies invented by **Douglas Engelbart** (the mouse, windows, etc.) and by **Alan Kay** (the first graphic interfaces), in the early seventies.

In the audiovisual field, the direct forerunner of the interactive program is **interactive video**. The impetus for the transition from interactive video to interactive multimedia was provided by the compression and transmission of images, in order to reduce the volume of information contained in moving images, and to increase the speed of transfer of information between devices. As Berenguer said in "Writing interactive programs" (1997), "in the digital conversion process, text, images and sounds are all converted into bits of information, meaning that in the end there is just one medium and interactive programs are "unimedia" (Berenguer, 1997).

The Englishman **Alan Turing** can be considered the father of artificial intelligence, although this term was not used until after 1956. After that, various individuals made a name as pioneers of this concept, with the most important figures being **Morton Heilig**, **Joseph Weizenbaum** and **Raymond Kurzweil**. Table 2.2 summarizes the contributions of these authors above and the origins of interactive programs (and we should also remember that they became the forerunners of artificial intelligence).

Table 2.2 ORIGINS AND CONSOLIDATION OF INTERACTIVE PROGRAMS

INDIVIDUALS	INVENTIONS	TIMEFRAME AND MAIN CONTRIBUTION
Morton Heilig	*Sensorama*, *Sonorama*, virtual reality, interaction, virtual helmet	(1923,-). Various audiovisual simulation systems and the forerunner of virtual reality.
Joseph Weizenbaum	*ELIZA* speaking program	(1948,-). A pioneer in early Artificial Intelligence research.
Raymond Kurzweil	Artificial intelligence devices, *MATRIX*	(1948, -). Systems technology. Creator of the concept of intelligent machines, spiritual machines and the future *matrix* network.

2.2 Important figures in the origins and consolidation of the interactive program

2.2.2 Hypermedia, multimedia and the case of the Internet

The term **multimedia** has been applied for many years to the simple juxtaposition of different sensory channels in an integrated project. For example, products such as a language course based on text booklets, television programs and voice tapes, projections that synchronize the images of several slide projectors and several audio channels and theatre performances that include originally unrelated elements, such as static or cinematographic projections, etc. are described as multimedia. In the context that concerns us here, "multimedia is a concept that arises from the common digitization and integration resulting in a single computer medium of text, audio, graphics, photographs and animated images. We deliberately omit other sensory stimuli that impossible to represent using a conventional computer with monitor and speakers". (Ribas, 2000:37)

According to the definition provided by Wikipedia,[3] Multimedia is a system that uses more than one medium at the same time during the presentation of information, such as text, images, animation, video and sound. This concept is as old as human communication, as for example, during normal conversation we speak (sound), write (text), we look at the person we are speaking to (video) and we make gestures and movements with our hands (animation). With the rise of multimedia applications for computers, this word has become part of everyday language. When a computer program, a document or a presentation combines the resources properly, it significantly improves attention, learning and understanding, as it more closely resembles our normal way of communicating as human beings, by using various ways to understand an object or concept.

One way of managing this multimedia information is hypertext. In hypertext, nodes are often physically the same as computer files, or at least a part of their contents. Following on from the statement that the interactive program is unimedial, Ribas (2000:37) says that "the homogeneity created by digitalization in the treatment of various media means that in a network linking computer files, what the digital content of those files represents is in principle structurally irrelevant." We can therefore define a **hypermedia** as "a network of interconnected pieces of multimedia information."

Most authors tend to use the terms hypertext and hypermedia interchangeably. It is precisely this homogeneity between that is George P. Landow's grounds for justifying this synonymy:

"Since hypertext, which links one passage of verbal discourse to images, maps, diagrams, and sound as easily as to another verbal passage, expands the notion of text beyond the solely verbal, I do not distinguish between hypertext and hypermedia" (Landow, 1995:15).

And in his subsequent revision of the text, he adds (2005):

"The expression *hypermedia* simply extends the notion of text in hypertext by including visual information, sounds, animation and other forms of data [...]. *Hypertext* denotes an information medium that links verbal and nonverbal information. In this network, I shall use the terms *hypermedia* and *hypertext* interchangeably." (Landow, 2005:25)

Hypermedia is the term used to designate a set of methods or procedures for writing, designing or measuring content that contains text, video, audio, maps or other media, and can also interact with users. An image with text and hyperlinks is an example of hypermedia. One of the first hypermedia systems to be created was the *Aspen Movie Map*[4]. The hypermedia approach of

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[3]Available for consultation online at: http://es.wikipedia.org/wiki/Multimedia. Other related concepts, such as hypermedia, hypertext and operating systems and the world wide web can also be consulted.

[4]For more information, see online: http://www.naimark.net/projects/aspen.html

these contents places them above all in the categories of human media for communication and interaction. A hypermedia space is an area with no physical dimensions, which hosts, reinforces and structures the activities of individuals. In specific contexts, hypermedia is identified as an extension of the term hypertext, in which audio, video, text and hyperlinks that are generally not sequential are interwoven to form a continuum of information, which can be considered virtually infinite. Taking the reflections of Josep Blat as his starting point, Ribas makes a distinction between a hypermedia application and a hypermedia system:

"Following Josep Blat (Blat, 2000) we will define a **hypermedia application** as a specific network of interconnected multimedia information. However, we will normally consider a **hypermedia system** to be a tool that can be used to create applications, among other things" (Ribas, 2000:38).

The use of multimedia techniques facilitated the development of **hypertext**, a way to link topics using words in texts, thereby enabling access to specific topics of interest in one or more documents without having to read them completely, merely by clicking the mouse on highlighted words (underlined or in a different color) related to the search. The program immediately displays other documents on the screen that include text related to this word. It is even possible to add bookmarks. The order of reading and the appearance of data on screen are thus controlled, in a similar way to the way in which we relate thoughts, in which the brain responds to a free association of ideas, and not in a single linear way.

However, interactive links are not only limited to texts. They can also interact with sounds, animation and Internet services related to the subject being searched, which has given rise to the new concept called hypermedia, resulting from the fusion of the concepts of hypertext and multimedia. It is possible to conceive of hypermedia systems in terms of the organization of textual, graphic and sound information by means of links that create associations between related information within the system.

Multimedia content can be divided into two categories: **linear** and **nonlinear** content. Linear content involves the user having no control over the navigation, as in a film; nonlinear content provides interactivity for the user, who can control the progression, as in the case of a video game. It is also known as hypermedia content.

The evolution of the Internet

The Internet is a vast network of interconnected computer networks, which enables the sharing of information, programs, sending messages, etc.., regardless of the location of its users. This entire telecommunications revolution began in the 1960s, with the ideas of **J.C.R. Licklider** mentioned above.

As Manuel Castells noted in his speech entitled "The Internet and the Network Society" during the opening session of the doctoral program on the information and knowledge society at the Open University of Catalonia in 1999:

"The Internet refers to the global information system that is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/follow-ons and is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite or its subsequent extensions/follow-ons, and/or other IP-compatible protocols; and provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein" (Castells, 1999).

The origins of the Internet lie in a project of the United States Army, which created a communications system to interconnect its computers. The main objectives were to be able to simultaneously access specific information in different parts of the country, and to prevent a possible attack from knocking out the military telecommunications network. This led to the creation of the ARPANET (the Advanced Research Projects Agency Network), the first communications network. It was a system of nodes connected to a single system, so that even if one link was destroyed, it could use another circuit (another link as a possible alternative) to reach the correct destination. The information travelled in packets (pieces of messages), a fragmentation system that guarantees the information's arrival using a protocol called TCP/IP (Transmission Control Protocol - Internet Protocol). ARPANET subsequently ceased to be of interest as a strategic instrument for war or any other governmental interests, and instead promoted the development of means for sharing technical and human resources oriented towards scientific research. After several universities such as UCLA and the Massachusetts Institute of Technology (MIT) became involved, the project was named INTERNET. There were a million users in the world in 1989, 100 million ten years later, and the increase today is exponential.

The milestones in the history of the Internet are:

1962: J.C.R. Licklider proposes the first idea of interconnection between different computers for sharing any information.

1969: Four American universities (UCLA, Santa Barbara, Utah and the Stanford Research Institute) create the first ARPANET connection.

1973-1977: The basic technological concepts for establishing the first ARPANET international connection between an English and a Norwegian institution are developed.

1982-1987: The creation of the common Internet language and protocol: TCP/IP, by Bob Kahn and Vint Cerf.

1991: Appearance of the World Wide Web, which allows images, text and sound to be combined in one document.

1994: The Netscape Navigator browser is launched onto the market. These programs enable viewing and browsing of web pages and their links.

2004: The concept of Web 2.0 or collaborative platforms appears.

The following individuals and their specific contributions to the medium should be mentioned as regards the concepts of multimedia, hypermedia and the creation of the Internet: Douglas Engelbart, Ted Nelson, Jaron Lanier, Tim Berners Lee, Steve Jobs and Steve Wozniak (see diagram in Table 2.3).

Table 2.3 HYPERMEDIA, MULTIMEDIA, AND THE CREATION OF THE WWW 2.3

INDIVIDUALS	INVENTIONS	CHRONOLOGY AND MAIN CONTRIBUTION
Douglas Engelbart	Mouse, windows, online help, word processing, advanced MAIL, digital collective production SYSTEM	(1925,-). Support systems integrated in the interface, software *Arpanet*.
Ted Nelson	*Xanadu* system, hypertext structure	(1937, -). Creator of the concept of hypertext, the precursor of the Internet and positioning using keywords.
Tim Berners Lee	Internet, *HTML*, *TCP/IP*, *W3C*	(1955,-). Creator of the *World Wide Web*, the code for writing web pages, the standardization of the *TCP / IP* protocol and the *W3C* regulatory council.
Jaron Lanier	Virtual reality, *HCI*, virtual gloves, visual programming	(1960,-). Father of virtual reality.
Steve Jobs	*Apple*, *Macintosh*, *NeXT*, *Pixar*, *iMac*, *iPod*, *iPhone*, *iPad*	(1955,-). Creator of the company *Apple*, of the first personal computer with the *Macintosh* system and the production companies *Next* and *Pixar*
Steve Wozniak	*Apple*, *Apple II*, hardware, software	(1950,-). Co-founder of *Apple*, creator of the *Apple II*, hardware and software developer

2.3 Major contributions to the definition of hypermedia, multimedia and the Internet

2.3 Hypertext: origins, concepts and development

2.3.1 Origin and development of the concept of hypertext

In his 1945 article "**As we may think**," Vannevar Bush first introduced the crucial idea of hypertext: his imaginary system, "Memex " was based on a nonlinear structure of documents, equivalent to the associative nature of the human spirit, with interesting added capabilities for

exploring and recording textual or graphical information[5]. Twenty years later, Douglas Engelbart made the first serious proposal for the implementation of Bush's ideas. His basic idea was to use a computer in the manipulation of information, to achieve a real improvement of human intellectual capacities that would affect their working environment, with the full inclusion of the hypertext system (Ribas, 2000:35).

During the 1960s, Douglas Engelbart and Ted Nelson developed a program that was able to implement the concepts of hypertext and hypermedia. After the invention of the first personal computers in the 1980s, IBM launched the guide and link system for its computers, while Mackintosh developed the "Intermedia" and "HyperCard."

The term hypertext was coined by Ted Nelson in the article *No More Teacher's Dirty Looks* (Nelson, 1970), to refer to a system in which text, voice, images and video are able to interact with readers. As well as inventing the terms hypertext - for any piece of non-linear writing - and hypermedia, Nelson also devoted many years to building "Xanadu," a type of "complete universal library" that was a forerunner of the Internet, which enabled people to link up and collaborate all over the world using text, images and sound. He was the first to think in terms of functionalities or ideas that are today included as a matter of course, such as being able to look at the "history" of a document modified by several authors, guaranteeing their rights, or being able to link a document to all of those that are related to it in the same work context. The basic original idea of hypertext affected the means of accessing information, through it, freely, but consciously.

2.3.2 The definition of hypertext

According to Ribas (2000:36), **hypertext** can be defined as "a network of interconnected pieces of textual information." Hypertext can therefore be defined as a system for organizing information based on the ability to move around within a text and visit different texts by means of keywords.

Its basic components are called **nodes**. These are the basic and atomic documents within the network. The criterion for this atomic differentiation is the meaning. Nodes are semantic units: each node expresses a single idea or concept from the point of characteristic view of the content.

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[5]Vannevar Bush used the word "Memex" in the article *"As We May Think"* in the July 1945 issue of the magazine *The Atlantic Monthly*, regarding the need to create mechanically connected information processing machines to help academics and executives to deal with what was becoming an explosion of information. It is available online at:http://net.pku.edu.cn/~course/cs410/reading/bush_aswemaythink.pdf.

Links are the parts of the network interconnecting the nodes and allowing the user to move node to node. There is usually a small portion of the source node to which the link is connected. This small part, which could be a word, a phrase, or a part of the image, is called the link's **anchor** (Ribas, 2000:37).

The origin of the concept dates back to **Theodor H. Nelson**, who in the 1960's proposed a possible system of "non-sequential writing, text that branches and allows choices to the reader" which he called hypertext (Nelson, 1981:2 and 1997:12). However, it was not consolidated until the mid-1980s, when personal computers began to have enough capacity to operate with small hypertext systems (Moulthrop, 2003:24). As Nelson says:

"By 'hypertext', I mean non-sequential writing - text that branches and allows choices to the reader, best read at an interactive screen. As popularly conceived, this is a series of text chunks connected by links which offer the reader different pathways." (Nelson, 1981:1-2)

Landow (2005:25) adds that hypertext denotes "text composed of blocks of text - what Barthes terms a *lexia* - and the electronic links that join them."

And in *Hyper/Text/Theory* (1995), he alludes to the comments of the linguist and professor Geoffrey Nunberg in his book *The Future of the Book* (1998):

"The electronic link, the defining factor in this new information technology, produces multilinear or multisequential - not nonlinear - reading. By permitting readers to choose their ways through a particular set of lexias, hypertext in essence shifts some of the author's power to readers" (Nunberg, 1998:230).

Maria Jose Vega, in her book *Literatura hipertextual y teoría literáriia* [*Hypertext literature and literary theory*] (2003), provides one of the most recent definitions of the concept of hypertext, in which she stresses that it is "a network of reemissions without a beginning or end":

"(Hypertext) consists of text and links that can be opened or activated to send to other texts (or to other types of visual or auditory information) [or nodes], which, in turn, contain links that refer to further texts [or nodes], and so on. In theory, the network of reemissions has no beginning or end: each hypertext aims to make it possible to continue reading another or other hypertexts, which in turn are linked to others, and so on *ad infinitum*. Links do not only relate different texts to each other, but also texts and other non-verbal media" (Vega, 2003: 9).

Stuart Moulthrop, in the chapter *In the Zones: Hypertext and the Politics of Interpretation* [*El hipertexto y la política de la interpretación*] in Vega's book (2003), proposes a definition of hypertext based on the central concept of an "encyclopedia", but without a definite structure:

"A hypertext is in some ways like an encyclopedia, a collection of writings through which the reader is free to move in almost any sequence. But unlike a printed encyclopedia, the hypertext does not come to the reader with a predefined structure. The 'articles' in a hypertext are not arranged by title or subject; instead each passage contains links or reference markers that point toward other passages. These markers may be words in the text, keywords implied by the text, or special symbols. Invoking the link, by typing a phrase on a keyboard or sending some

indication through a pointing device (or "mouse"), brings the indicated passage to the screen." (Moulthrop, 2003a: 23)

According to Vega (2003:10), from the standpoint of non-sequential writing ideas and textual interrelation, hypertext is not just the result of the new electronic media and, by extension, computers, but there are also many cases of non-sequential writing in the pages of conventional books. In short, she believes that the definitions of hypertext based on the idea of non-sequential writing and textual interrelation are insufficient. What really defines the difference hypertext and traditional text is:

"The medium, which is now electronic, the capacity to store information and above all, recover it on a multiple and immediate basis, as hypertext is [...] an enormous library rather than a book, and as a result, multiplies the pathways for reading radically and immediately. In this case, the quantitative difference - of custody, of accessibility, or interrelation- does aim to achieve a very important qualitative leap" (Vega, 2003: 10-11).

This new medium of communicative interaction involves not only the transformation of traditional models of textual production and organization - as we move from linearity and sequentiality to **multisequentiality** - but also the traditional types of discursive reception and evaluation, as there are now multiple reading pathways and they are not the same in the two reception mechanisms. First, hypertext allows us to accelerate our access to writing in general, automating and simplifying the task of moving around complex and non-sequential texts. Second, and perhaps the most important characteristic from the perspective of the interpreter, hypertext provides the reader with various pathways for reading and by extension, expanding works with vague boundaries and limits (Vega, 2003: 9: 9). According to this point of view, hypertext, by presenting a network of texts or nodes that readers can use to move around freely in all directions, releases them from the closed and limiting sequentiality of traditional writing.

In computer science, hypertext is a paradigm in the user interface, which presents documents which according to Nelson's definition, can "branch or perform on request." The most common form of hypertext in documents is the hyperlink or automatic cross-references leading to other documents. If the user selects a hyperlink, this makes the computer program display the linked document within a short period of time.

In short, based on the original definition of Ted Nelson, hypertext is a digital document that can be read in a non-sequential or multisequential way. A hypertext consists of nodes or sections, and links or anchors. Nodes are the parts of the hypertext that contain information accessible to the user. The links are the links established between nodes which facilitate sequential and non-sequential reading using the nodes in the document. The anchors are the trigger points for the links. Hypertext may have other features, but these three components are the minimum contents. Among the other additional items are summaries and indices. For example, there are level 1 and

2 hypertexts, depending on the number of items needed. At present, the leading expression of hypertexts is browsable web pages.

Ribas (2000:41) believes that nodes and links are the two basic elements of any hypertext, but their roles are quite different, albeit complementary. As regards the objective selection of nodes, he says:

"[...] it is always relatively easy to find objective reasons for the choice of nodes, the breakdown of a set of information into basic fragments. The most common criteria are of a conceptual nature - the well-known semantic of information and presentation, screen size, legibility conditions, or purely functional, such as a differentiated computer file" (Ribas, 2000:41)

But as regards the choice of links, the author says "it is always a subjective process and hence the difficulty of automatically obtaining interesting hypertexts." Most of the semantics and the meaning of the hypertext lie in the choice of how the items of information are linked. In general, it contains the part of meaning that comes from structuring the information in the form of hypertext.

According to the original idea of Marc Nanard (1995) cited by Balpe (1996:34), a very elegant way of considering hypertexts is as simultaneous containers of information and knowledge. Nodes are the medium for information, links are the medium for knowledge and anchors are the connection between the two.

Table 2.4 summarizes the contributions of the following individuals: Vannevar Bush, John Cage, Fred Waller and Ivan Sutherland. It is important to mention the cases of John Cage and Fred Waller, although they are not directly associated with hypertext, they are examples of movements that are related to experimentation in the sound and visual fields respectively.

Table 2.4 HYPERTEXT, ORIGINS, CONCEPTS AND DEVELOPMENT

INDIVIDUALS	INVENTIONS	CHRONOLOGY AND MAIIN CONTRIBUTION
Vannevar Bush	Differential analyzer, MEMEX machine	(1890-1974) Inventor of the first analogue computer.
John Cage	Use of silence, aleatoric music, prepared piano	(1912-1992). Revolutionary genius of contemporary music.
Fred Waller	*Cinerama*	(1886-1954) First audiovisual simulation system.
Ivan Sutherland	Infographics, sketchpad, interaction, three-	(1938-) Father of computer

	dimensional model, visual simulation, computer-aided design (CAD), virtual reality	graphics.

2.4 Origins, concept and development of hypertext

2.4 George Landow's approach to hypertext

George Landow's approach to hypertext [6] is based on an analysis of the concepts set out in two of his seminal works: *Hyper/Text/Theory* (1997), one of the first canonical books on hypertext, in which he sets out much of his theoretical argument, which relates literary theory and hypertext; and *Hypertext 3.0: critical theory and new media in an era of globalization* (2005), which updates and expands a collection of texts compiled by the author on various aspects of hypertext. The latter book was published a decade ago under the title of *Hypertext 2.0: The convergence of contemporary critical theory and technology* (1995). As Landow himself says in the introduction to the book, it was necessary to produce new versions of it (2.0 and 3.0), in order to update and expand the concepts discussed in the first version (1.0). George Landow is a writer who has provided many resources available online[7], which enable a precise approach to hypertext theory, literary theory and the limitations of the traditional ways of teaching.

2.4.1 Hypertext and literary theory

One of the central points in his analysis focuses on aspects related to literary theory. The title of his book, *Hypertext 2.0: The convergence of contemporary critical theory and technology* (1995) refers to the process of "convergence" between contemporary literary theory (Barthes,

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[6] In the field of literary theory and its integration using hypertext thanks to new technologies, Landow is one of the undeniable academic leading lights. Landow is Professor of English language and art history at Brown University (Providence, USA). Indeed, his academic background enables him to cover a complex field: the application of new hypertextual technologies in the field of humanities, and specifically in literature. Landow's analysis includes well-defined areas such as the conceptual development of hypertext, its implications regarding literary theory and institutions, educational applications and political issues.

[7] Landow is a writer with a high profile on the Internet. As well as the many sources available for consultation containing related information, the three pages he has created himself are worthy of special mention: an educational website (victorianweb) that includes more than 40,000 documents on art, architecture, design, economics, politics, social history, religion, technology, science, etc. (see http://www.victorianweb.org/); another with materials on postcolonial theory and literature, culture and society in Africa, Australia, the Caribbean, India and other regions that have produced literature in English (see http://www.postcolonialweb.org/); and finally, the most interesting from the perspective of this study, a website that includes content relating to the history of information technology, literature and the theory of new media, hypertext fiction and nonfiction, and discussions of cyborgs and cyberpunk science fiction in fiction, film and television. It is the result of large-scale projects undertaken by students, and includes hundreds of documents and images (see the following email address: http://cyberartsweb.org/cpace). http://www.cyberartsweb.org/cpace/).

Derrida, Bajt, Jameson, etc.) and elements of the new digital medium. The limitations of the traditional media have become obsolete, as the new medium provides an approach and implementation featuring its entire technological essence, as it includes a new form of communication - hypertext. One of the basic assumptions in Landow's research is that the limits that have always been attributed to literary work were not entirely its own, but were instead determined by the medium in which they were produced.

Another major contribution by Landow's work is his suggestion that in literary theory (and in some associated practices) there is a desire to end the limitations imposed by the printed form on the work. As examples, he mentions the search for the end of linearity, fragmentation and dispersion, which can be found in some works that optimistically anticipated the possibilities of a new medium and which are embodied in hypertext.

In *Hyper/Text/Theory* (1997), Landow sets out to coordinate and bring together this collection of texts, in order to give a sense of linear narrative to the book, beginning with a more descriptive and theoretical aspect, and ending with the more graphic part, using numerous practical examples in order to apply the formulated theories. In this book, he describes what hypertext is and its implications for society. Using the definition of a digital hypertext system, the work covers the concept of *nonlinearity*, by which it is possible to access one piece of information from another by means of the link. This provides the reader with many alternative pathways when seeking information, and ends the conventions that prevailed prior to the creation of hypertext. According to Landow, hypertext consists of several individual blocks of text, which enables it to be linked with modern literary theory and criticism. According to the author, this phenomenon is the result of dissatisfaction with the printed book and hierarchical thinking.

In *Hypertext 3.0: critical theory and new media in an era of globalization* (2005), Landow updates the canonical text on the theory of hypertext that he wrote in the late twentieth century. In the 1990s, and in the early years of this century, he made an innovative contribution because he was the first to establish relationships and parallels between literary theory and computer technology. In this third edition (Landow, 2005), he includes new material on the development of Internet-related technologies, and places special emphasis on its increasing global expansion and the social and political implications of this trend, which he analyses from a postcolonial perspective. He also discusses blogs, interactive films, and the relationship between hypermedia and games.

If it is to comply with hypertext theory, according to Landow (2005:271), linearity must be ended completely, and a kind of forest created that gives readers options when choosing their

pathway and personalizing their reading. Hypertext narrative takes on many forms, depending on the reader's choice, participation and development, the inclusion of hypermedia, the complexity of the structure in the network and the degree of variation in the plot. As a result of all these factors, hypertext calls into question literary and cultural theory and schools of thought that have prevailed since Aristotle. In this new paradigm, works are not structured in terms of a beginning, an end, a sequence or a single unit (Landow, 2005:274). Recent printed texts and new fiction are now creating a new perception that will tend to replace the old texts in literary theory. Landow (2005:276), referring to modern writers, says:

"One should feel threatened by hypertext, just as writers of romances and epics should have felt threatened by the novel and Venetian writers of Latin tragedies should have felt threatened by *The Divine Comedy* and its Italian text." (Landow, 2005:276)

2.4.2 New technologies make hypertext possible as an open, nonlinear and infinite system

According to Landow, and based on the premise that technology determines forms of thought and their expression, the arrival of a new technology leads to new cultural forms. Hypertext, with its networks of nodes and links, enables the hierarchy of the printed structure to be overcome. Because it is not a closed system, it shifts responsibility for decisions to the receiver. Hypertext is an open system that allows the receiver to construct their own reading pathways, jumping from lexia to lexia, according to their own personal interests. Written text has a beginning and an end, but in hypertext this is not exactly the case - they are created at each reading, depending on the pathways created by the reader. According to Landow, text is coming to an end and hypertext is continuing to expand, thanks to the ability of both its authors and even its readers to add new lexias. The importance of this discourse no longer lies in its present innovation, since most interactive technologies are collaborative, but in the fact that Landow had already formulated and articulated this approach and articulate about literary theory two decades ago (Landow 1995)

According to Landow (2005:155), the structure of hypertext contains no logical order or an established pattern for reading. Navigation devices can provide a starting point and orientation, but the whole is made up of individual textual units, which with others construct a nonlinear metatext. A version of a classic text presents a centrality with a main text, and the others are appendices that complement the text. In hypertext, the appendices become other equally important main texts.

2.4.3 Redefinition of relationships and the new relationships between authorities

Landow also discusses the new political relations established by hypertext. He believes that text implicitly entails specific power relations between the different parties involved (editor, author,

reader); however, hypertext requires a redefinition of the relationships that are established between them, and gives greater decision-making power to the reader, who can then choose different ways of reading (Landow, 2005: 83). And in conclusion, he says:

"Electronic linking shifts the boundaries between one text and another as well as between the author and the reader and between the teacher and the student. It also has radical effects on our experience of author, text, and work, redefining each. Its effects are so basic, so radical, that it reveals that many of our most cherished, most commonplace, ideas and attitudes toward literature and literary production turn out to be the result of that particular form of information technology and technology of cultural memory that has provided the setting for them" (Landow, 2005:83).

In this regard, when establishing divisions to classify the characteristics of the genre being studied, we have based ourselves on these new relations, and as Landow says, we have given more importance than is traditionally conferred to the role played by the receiver of the work, who is no longer described as a passive spectator, but instead becomes an active user and participant. Landow's assumption, which is also present in the later analysis by Xavier Berenguer, is central in defining and characterizing the interactive multimedia documentary and presenting a suitable analysis model, which includes decision-making by the interactor as an essential part of the navigational and interactive process.

In this respect, authorship becomes decentralized and/or shared. According to Landow (2005:167), the figure of the active reader means that active participation by an active author is necessary, with the latter becoming a reader of the readers who can choose to review, link, expand or reduce their inputs to the network. Landow points out:

"Like contemporary critical theory, hypertext reconfigures - rewrites - the author in several obvious ways. First of all, the figure of the hypertext author approaches, even if it does not merge with, that of the reader: the functions of reader and writer become more deeply entwined with each other than ever before. This transformation and the near merging of roles is but the latest stage in the convergence of what had been two very different activities. [...] Hypertext, which creates an active and even intrusive reader, carries this convergence of activities one step closer to completion; but in so doing, it infringes on the power of the writer, removing some of it and granting it to the reader." (Landow, 2005:167)

2.4.4 Offline and online applications: a natural evolution

Landow proposes two hypertext models. First, there is the *closed model* which has various links, but which is linked to itself, and prevents the user from accessing external content. The second model is *open* and allows the user to access content beyond the original hypertext. The book extols the virtues of the CD-ROM, as it enables a great deal of information to be stored in a very small space, but it highlights the problem of access to information, because the limited storage space on this medium means regular replacement of the CD-ROM is necessary. Landow praises

the usefulness of networking, because this enables various computers to access information without having to rely on external data media.

Hypertext can be classified in two basic structures. The first has a linear direction of information, while the second involves scattered information, i.e. in a network. The axial structure is the result of a linear organization of information, but if we consider the links between the various axial structures, these create a networked structure, which includes a whole range of varied items. This is due to hypertext's greater capacity to reuse information. Landow also highlights the advantages of creating an electronic as compared to a paper edition, as data recovery is much faster and it can be linked to with other content, to obtain additional information.

2.4.5 Multiple deployment of the hypertext work: critical aspects of authorship

According to Landow, hypertext offers readers the opportunity to choose their pathway from several possibilities, and dissolves the rigid single-direction base of traditional literature. A core idea in his approach is ascertaining what he believes is one of the main problems of hypertext: the fact that a user can choose multiple paths randomly, but often does not read the entire text available because of the many possible branches of information. This means that two people can read the same text and reach different conclusions, depending on the route they have followed.

There are four types of non-linear texts: simple nonlinear text, discontinuous nonlinear text or hypertext, and determinate cybertext and indeterminate cybertext.

The most basic form of nonlinear text can be found in a work that branches and provides two different paths to choose from. Because of the many possibilities and variants offered by hypertext, it is possible that some texts go unnoticed or are never read. Despite all the theories surrounding hypertext, it remains a simple system since it is only a link between various concepts. However, it is possible to make a distinction between three varieties: the general concept, the implanted concept (often a computer application) and the text contained in a system (and defined by it). When we talk about hypertext, attempts are often made to link it with a physical space, but the essential concept of hypertext lies in the non-existence of space as it merely jumps from one concept to another.

A cybertext is a text that modifies itself, although there are some functions that are controlled by a cybernetic, human or mechanical agent. In general terms, they can be classified as two types: those that can be anticipated and those that cannot. An example can be seen in word processing programs, which give an answer based on questions from the user, and thus establish a conversation between man and machine, based on the latter's artificial intelligence. As a result,

it is possible to state that the action determines the argument/response and the user determines its pathway.

Non-linearity can be defined as a figure of speech related to the levels of the branch, link, the permutation, calculation and polygenesis. In addition, this line of discourse can also be divided using the story line, according to the number of references between them and whether they are singular, recurrent, multiple singular or iterative. All these tools are very useful for analyzing hypertexts. At this point, it is necessary to mention the various levels that enable a story to be represented, such as the discourse that has elapsed, the discourse that has been stored the story that has elapsed and the story stored, in which the items that have elapsed refer to a single event, which progresses on a linear basis, while the items stored are potential stories that can be developed in parallel with the main plot.

In short, Landow (2005:269) argues that the potential qualities of hypertext and hypermedia are multilinearity, their multiplicity of voices, conceptual wealth and a degree of control and centrality for the reader (especially with regard to informative hypertext.) And he adds:

"In addition, as we have seen, examples of hyperfiction and hyperpoetry reveal other sources of quality: individual links and entire webs that appear coherent, appropriate gaps among lexia, effective navigation and reader orientation, the persuasive metaphoricity and the exploration - and testing - of the limits of the medium" (Landow, 2005:269)

2.4.6 Hypertext and rhetoric

Readers interpret the text they read and adapt it to their context, which is distinguishing feature of the process of reading hypertext. On that basis, it is possible to establish a parallel between hypertext and rhetoric, which follows patterns for performing specific operations, such as *inventio*, *dispositio*, *elocutio*, *actio* and *memoria*. Gunnar Liestol's (1997) correlation of the five phases of rhetoric with hypertext is listed below:

- Inventio: selects and produces information in various media.

- Dispositio: combines items and structures links.

- Elocutio: responsible for the presentation of content.

- Actio: interaction of the user with information.

- Memoria: graphic representation for navigation.

According to another basic idea in the book *Hyper/Text/Theory* (1997), although hypertext appears to be disordered, the content is in fact ordered as regards the position of the nodes. Readers can thus choose their own path depending on their interests. The nonlinearity of hypertext is therefore relative since it is also necessary to take its order in space and time into consideration. However, there is no strict order in navigation, but there are a number of criteria

that influence the reader in terms of choosing one pathway rather than another. This is similar to articulated language, depending on the elapsed discourse.

With recent technological breakthroughs, hypertext has brought new qualities related to the world of written language, and has strengthened the link between the author and the reader. This has redefined the authority of the author and given the reader more control. Hypertext has provided various resources, such as reading, copying and browsing databases, but the information remains fixed and unalterable. By contrast, hypermedia allows the contents to be changed, with the advantages and disadvantages that this may entail, as they can be modified according to the individual preferences of the person editing the contents.

At this point it is possible to apply the concepts of *diegesis* (when someone speaks and does not conceal the fact that it is they who are telling the story) and *mimesis* (when someone tells a story, but creates the illusion that they are not the speaker) to the narrative of hypermedia. In conclusion, we can highlight three main aspects that both hypertext and hypermedia seek to fulfill: interactivity between the user and the information, integration of various media (text, images, sounds, etc.) and inclusion of a context.

2.4.7 The problem of defining a clear ending

Due to the linking of various content in hypertext, it is not always possible to define a clear ending on a hypertext pathway. Hypertext therefore does not lead to a clearly defined ending, but users are instead able to link to other content, depending on their interests.

The classic ending can be summarized as the interruption in a story. The story thus ends at a specific point by means of the suspension of the narrative. Various experimental works emerged during the twentieth century that address the issue of the ending of the work, which contradicted it or even failed to provide an ending in the strictest sense. Examples include the novels *Rayuela* (Julio Cortazar 1963) and *The good soldier* (Ford Madox Ford, 1915). These works create a direct link with the reader and radically change the established foundations of literary tradition, and make a complete break with the predominant conventions.

This therefore involves greater responsibility on the part of the writer, but also more power for the reader. In the ideal hypertext, in which reading is a lush forest of interconnected lexical units, the readers must decide where it ends while reading (Landow, 2005:286). Sometimes they do so because of fatigue and at other times due to logic. Landow adds:

In fact, the tendency of many a twentieth-century work to leave its readers with little sense of closure - either because they do not learn of the "final" outcome of a particular narrative or because they leave the story before any outcome that as readers and writers we have long

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learned to live (and read) with more open-endedness than discussions of narrative form might lead us to expect." (Landow, 2005:287)

An example is the work *Afternoon* (1990), by Michael Joyce. The reader is left to decide the ending. This hypertextual text contains multiple characters, scenes, situations, conflicting roles and various factors which readers use to create a time sequence. The most dramatic parts are at the start and end of other stories surrounding them (Landow, 2006:288)

Hypertext narratives can generate several alternative endings, which can adapt to the choices of their readers. Each narrative pathway is therefore determined by the decisions taken by the reader, and there is therefore a different ending for each type of action. Completing the reading of a work such as *Afternoon* gives readers the feeling that the story lacks an ending, since despite the fact that a reading pathway has been completed, not all the alternatives on offer have been explored. An incomplete ending has therefore been reached, because the reader has not read the entire story and has been forced to take certain decisions at specific points in the narrative, meaning that the other possibilities offered by the text have been ignored.

Broadly speaking, it is possible to conclude that interactive narratives do not provide a definitive ending, in the way that printed works do. This is in addition to the fact that the reader's experience is not guided or determined, but instead there is some degree of freedom in decision making. We can therefore see that hypertext narratives have an advantage over linear works, as they provide an opportunity for new experiences every time the story is read, because there is some scope for choosing actions. It is claimed that readers must choose an option to reach a possible ending, and not allow themselves to be influenced by a pathway based on an apparent choice that has not really been made by the user. The hypertext reader chooses an option rather than another depending on their expectations. A pathway is therefore chosen based on the belief that the choice will satisfy the reader's own anxiety for information. However, the problem that arises is that users will never satisfy their anxiety for information, because this information increases and expands with new content, which makes the reader undertake a seemingly endless journey.

In conclusion, according to Landow, the advent of the Internet has had very significant effects in schools, universities and institutions, but we are still a long way from the global interconnection that it can provide. He stresses that it is a mistake to consider digitization of content simply as an advantage in terms of portability, visualization and accessibility, as he says that we are witnessing a cultural and literary change that will reinforce our learning and educational skills, change our consumer habits, our human relationships and our interrelations with the entire world around us.

One of his core hypotheses is that hypertext, defined as lexical units that are interconnected by links, blurs the boundaries between reader and writer. Hypertext allows readers to participate much more actively in the narrative, choosing their own pathway and being able to enrich the text by means of contextualization, expanding the context and/or developing themes that may or may not be directly related to the text concerned. Hypertext thus promotes cooperation and collaboration between authors and readers.

2.5 Interactive narrative according to Xavier Berenguer

2.5.1 The three main qualities of digital media

As Xavier Berenguer says in his article "Promeses digitals" [*Digital promises*] (Berenguer, 1996), moving synthetic images were the major breakthrough in computer graphics during the 1980s. Their implicit advantage was the fact that it was not only possible to model and encode numbers, text, images, etc. but that computers allowed simulation in four dimensions (three spatial dimensions plus time), which are the same as the dimensions in which we perceive reality. This first great quality of the digital medium was therefore **spatial and temporal representation**. This major breakthrough led to the end of the rectangular window (the theatre stage, the book, photographic film, cinema screen, television monitor, etc.) and the malleability of time for representation purposes (and the ability to "draw movement" in particular). However, several authors, such as Ignasi Ribas, still maintain that despite the breakthroughs in spatial representation, especially in the context of games, the digital medium still lies within what he calls "the empire of the rectangle." Linking the ideas of Berenguer (1996) with the article "El discurso interactivo de difusión cultural: innovación y lectores electrónicos" [*Interactive discourse in cultural dissemination: Innovation and electronic readers*] by Ignasi Ribas (2009), with respect to various online media, he says:

"The typical discourse of the internet seems doomed to place the various media in rectangles: from the browser's window, inevitably related to the standard interface of the operating system, to the interior vertical, horizontal and central frames, joining discourses seems to be reduced to a game of fitting boxes into each other, a boring puzzle. The two-directional confluence with television, the box-medium par excellence, appears to lead us inevitably to this dominance of the rectangle, two Cartesian dimensions that delimit and create artificial boundaries to collaboration and integration between discourses" (Ribas, 2009:43)

The second great quality of the digital medium, according to Berenguer, is its **intangibility**, about which he says: "The ethereal condition of digitized information (ultimately light) falls within the most modern paradigm, in which everything is and is not. In practical terms, the computer can *see the invisible*" (Berenguer). Finally, the article mentions **interactivity** as a third quality of the digital medium. It is at this point where the user changes how the work is

read according to their actions. As regards this point, which he considers the most important, Berenguer says:

"In informational terms, film, video and television have a higher density than oral and written language, but retain these languages' structure of sequential presentation. However, interactivity involves the viewer's participation in the work; as a consequence, the author has to imagine - and update - contexts, environments, spaces and structures where it takes place. While the benefits of interactivity in the field of education are unarguable (and certainly far-reaching), in fiction this involves *non-linear narrative*, a formula that has only recently been discovered" (Berenguer, 1996).

As can be seen by the author's comments above, the design process of interactive content must conceive of the interactive work in tree-like and relational terms. The article concludes with the statement that when the three main qualities of digital content, spatialization, intangibility and interactivity, are implemented in all their wonder (and especially in real time), we will then witness a spectacle known as "virtual reality", an immersive aural and visual space, where it is possible to exchange experiences of knowledge, entertainment and relationship. On this latter point, Berenguer anticipates three critical issues that arise when the three great digital qualities occur simultaneously: the multiple combination enables a triple exchange (learning, playing and interacting with others).

2.5.2 Games and the origin of interactive narrative

The origins of interactive narrative date back several centuries. In the thirteenth century, there were already clear examples of individuals anticipating concepts that would be developed much later, such as Ramon Llull and Gottfried Wilhelm, and among contemporary writers, authors such as Julio Cortázar and Jorge Luis Borges.[8].

In his article "A decade of interactive media" (Berenguer, 2004), Berenguer suggests that because the interactive medium is more visual than the literary, hypertext research from the literary perspective seemed to a certain extent to have stagnated. Before the first educational interactive films and documentaries, there was talk of literary interactive films and fiction, hence the term **hypertext**. Berenguer believes that the term **interactive fiction** was first used to promote the game *Zork*, in 1982. Despite the narrative limitations of this game, the adventure genre to which it belongs (like *Myst*) is one of the benchmark models, a model according to

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[8]Other notable pioneers of interactive narrative include Jonathan Swift, Lawrence Stern, Stephan Mallarmé, Jules Gabriel Verne, Lewis Carroll (Charles Lutwidge Dogson), Jack London, James Joyce (John Griffith Chaney), William Burroughs, Italo Calvino and Milorad Pavic.

which the interaction gradually reveals the story. He also uses the games world of *SimCity* as a benchmark, which Berenguer describes as follows:

"In this game there is no predefined plot, but the story is constructed through the interaction, so that each player experiences a different story. This formula, originally applied to the development of a city, has been successfully applied to other scenes; in the latest, *The Sims*, it is applied to a family simulation. It is therefore a first dramatic simulation and the closest interactive experience closer to fiction in the traditional sense. It also implies the application of narrative to genuinely digital quality: the generation of content" (Berenguer, 2004).

He also mentions *MUD* (*Multi User Dungeons*), where experiences develop in accordance with the interaction, as in *SimCity*, but in addition, they also develop within a community of players, so that players do not only play against the computer, but also against other players, thus making entertainment become a space for socialization. In short, in the gaming world, the essential references for interactive narrative are *Myst*, *SimCity* and the *MUD*. Another aspect to consider is the concepts related to compatibility between narrative and *playability*. According to Berenguer:

"Theoretically, the differences are great. For example, the differences in the treatment of time. In narrative time is commonly referred to in the past, while games happen in the present. Narrative jumps about in time and tends to compress it. The game, on the other hand, follows strict *real time*. There are also differences in the way in which the space for the action is treated. The spatial environment forms a fundamental part of the game, but in narrative it may be irrelevant." (Berenguer, 2004)

At the end of the text, Berenguer presents the contribution that may be considered the core of this article: he says that each particular program has greater or lesser interaction. He considers three possible levels and defines them as **weak, medium and strong interaction**. He explains this as follows:

"The diffusion of information, for example, requires a weak type (it would be absurd to put obstacles in the way of finding out the meaning of a word in a dictionary). On the other hand, the documentary and work of non-fiction lend themselves to a medium level of interaction (ideal for the rhythm of assimilation), while fiction and free creation in general allow the strongest from of interaction." (Berenguer, 2004)

This classification of the level of interaction is one of the most interesting contributions in the author's texts, and it will be taken into account in this study for the proposal and application of an analysis model focused on the interactive multimedia documentary.

2.5.3 Ways of narrating: linear and nonlinear narrative

Interactivity implies a kind of narrative known as "non-linear", which is different from the narrative created for the first time centuries ago, in Greek comedy. Berenguer describes it as follows:

"While the end results are very different, the starting point for the author of an interactive work is the same as that for the author of an audiovisual work: – a more or less chaotic set of visual, aural and textual elements. But while audiovisual programs demand the structuring of these elements in linear form, the interactive program requires non-linear structures (tree, network, etc.) and generally requires the organization of the content in a *database*, as it is called in IT terms. (Berenguer, 2004)

As Berenguer says in "Escriure programes interactius" [*Writing interactive programs*] (Berenguer, 1997) the interactive medium is a type of medium that adapts perfectly to the information, education, documentary and entertainment formats. However, he wonders how interactivity may affect narrative, and raises the following question: what is the cinematographic potential for new medium?

In this article (1997), Berenguer discusses another concept of great importance in his discourse. He argues that **any type of narrative**, whether interactive or otherwise, and even those that are delivered intermittently over time, **is received by the viewer in a linear way**. By extension, all narrators face the same problem: creating and deploying a series of events in time and space. The only difference is that he is sees is that **interactive systems must provide more than one deployment at a time, and the more varied they are the better**. The calligram is a perfect example of the intended message: its structure is designed as a very basic sample of a diversified work that enables multiple readings.

2.5.4 Models of non-linear narrative

An important contribution by Berenguer is his argument in his article "Històries per ordinador" [*Computer stories*] (Berenguer, 1998). He discusses four models that adapt to different possible structures of non-linear narrative, which are **branched, interrupted, object-oriented** and **conservative** non-linear narrative.

"A first model of non-linear narrative- writes Berenguer (1998) - is known as *branched*, and is in the form of a tree in which each leaf represents a minimum unit of the story of events (a *lexia* of the story) and each branch is a possible connection between them. At certain points in the narrative, the interactor is invited to decide on the course of the story, the ending of which may (or may not) be common to the various combinations of substories." (Berenguer, 1998)

This would be the **classical model based on choosing one's own adventure**. You choose one route or you choose another: one choice directly excludes other possibilities, and cannot be

undone. An example of this would be the a series of books which at the end of each chapter, leaves the reader to choose between two or three options, and jumps to different pages, like a manual interactive book, depending on the decision chosen. Berenguer gives the example of the Bruguera booklets, from the "Escull la teva aventura" [*Choose your adventure*] series, and says that the model is particularly suited to the Internet (in fact, the HTML code with which all the pages on the Internet are programmed does not allow any other kind of hypertextuality). However, their contribution is limited from a narrative point of view. One of the problems that this model presents is the danger that the interactor "ends up drowning in a sea of confusion and that the story disappears" (Berenguer, 1998).

"Another more elaborate way of organizing an interactive narrative is inspired by adventure games. Based on interruptions (which is why it is called *interrupted narrative*), the interactor finds evidence, which after it has been conceptually evaluated and organized, enables the story to be discovered. This evidence may be factual or may appear based on the multiple viewpoints of the protagonists; in short, the story is constructed based on various ways of presenting it and interpreting it" (Berenguer, 1998).

By means of these interruptions, the viewer learns about the story and the different characters involved in it. Technically, by means of mouse clicks, we pick up the story. The description of the model is completed with information about the action and the "buttons" to reveal it, which are located in virtual rooms and environments, which can only be reached after having identified and become familiar with certain passages of the story. Berenguer identifies the main problem with this model as the difficulty of having to give a "tempo" to the story: there is no intrinsic chronological reference in which the events can be ordered, such as the one we have when we read a book (the page order) or when we watch a film (the order of the frames). The viewer must arrange the pieces of the story's puzzle in a mental exercise, which is usually more intense than in a sequential narrative.

"A third method, which is the most promising and also the most demanding in terms of creating the story, takes its name from a modern way of programming computers: *object-oriented* narrative. This narrative, inspired by role-playing games and to a certain extent by games like the *Sims* is based on a generic plot that provides the framework for the story, the profile of the characteristics and "personality" of the protagonists involved, and the rules for resolving the encounters between them. There is usually more than one interactor involved, who are each responsible for one of the characters. Once it has started, the story fluctuates within a certain degree of chaos, with some degree of entropy, as in real life, depending on the interactions between the simulated characters; it is therefore impossible to speak of one resulting story, but instead many" (Berenguer, 1998).

This model is based on fluctuating stories. As can be deduced from the description of the model above, the characters evolve within a certain degree of entropy, a certain degree of chaos: they are virtual characters created and regulated by the computer environment. **There is a combination between the evolution of some parameters (in which the mathematical branch plays a crucial role) and the narrative factor, because the events narrated are not**

preprogrammed, but are instead stable and invariable models. The story does not change, but the real time in which we live does, and this is their main feature. One characteristic of this method is the existence of a memory of the interactors' actions, which is essential for maintaining some degree of control over the narrative discourse.

"[An interaction] is an interruption in the discourse that short-circuits the two universes of fiction. From the orthodoxy of traditional narrative, non-linearity is therefore inadvisable. That is why some people see more of a future not so much in giving the interactor the possibility to become involved in the story but instead in the way in which it is revealed; in short, in the opportunity to change the narrative rather than the narration. This is therefore, a *conservative* model of interactive narrative" (Berenguer, 1998).

One of the most difficult problems to solve in an interactive story arises from the interaction itself, and the interruptions it creates within the narrative experience. From a theoretical point of view, the distinction is made in narrative between the imaginary world that makes up the story (in specialized terms, the world of the *diegesis*) and the real world, where the story is being told (the world external to the *diegesis*). A narrative has the virtue of completely separating one world from another, and any confusion between them is dangerous, as far as the narrative is concerned, because it dispels the magic of the story and confuses the entire plot. Berenguer gives the following example, which clarifies the key concept on which the fourth model described is based: "For example, let us imagine a film in which during a love scene, the girl tells her lover - referring to the soundtrack - a romantic melody, for example: 'I can't hear what you're saying. Can you turn down the volume of the music?' Because the music belongs to the world of the viewer, and not the world of the narrative, the question creates an overlap between the two worlds and the story loses credibility as a result. An interaction involves a transgression of precisely this type" (Berenguer, 1998).

At the end of the article, he emphasizes that in any of four models considered or any possible combination of them, writing an interactive story consists of "describing people, objects, their respective properties, formulas of how they relate and scenarios for action." He equates interactive creation with being a "**choreographer of stories**" and stresses that it is important to remember that it is necessary to structure "the plot not as a single sequence of events, but as a multifaceted plot open to the interactors' participation." Linking up with the paradigm proposed in "A decade of interactives" (2004), the author says **that from the viewpoint of weak interaction, this participation consists of making decisions and acting to reveal the story; from the opposite perspective, of strong interaction, as in the case of object-oriented narrative, it consists of making contributions and changes to the story.**

Finally, by way of a conclusion, nonlinear models are considered as new ways of narrating alternatives, which are new to the broadcasters (the authors of the works) and the receivers (the

audience). This audience has **two attributes that characterize and define it: it is familiar with interaction and has been educated in front of computer screens, rather than the television**. According to Berenguer (1998), interactive narratives can be exciting in the same way as a traditional narrative, based on a generational change, an evolution of technology and an interactive culture, "a culture of communication works with the computer as a medium." By way of a prophecy, the author ends by suggesting a new level of interactive narratives and stories: "After informative, educational and leisure content offered interactively, this culture will lead to content with a sensory or aesthetic purpose, including narratives and stories. The Internet phenomenon will powerfully accelerate this perspective." (Berenguer, 1998)

In short, as stated in various articles and texts that are available online at the author's website[9] there are several core ideas, and we will highlight one of these, for subsequent application: we will divide the types of interactive language into **strong, medium and weak interaction**, based on the degree of openness and manipulation they present. As Berenguer (2004) points out:

On a low level, the interactor is limited to choose among options on a menu. A higher level consists of having to localize those options, or even respond to certain tests or overcome obstacles in order go forward in their exploration. On the higher levels, the interactor is subjected to greater demands – to participate as a leading character in an interactive environment, contribute to it and even modify it. One can therefore speak of *weak* interaction - this is the case in the majority of websites – and *strong* interaction, whose maximum expression (participation, contribution and community) is known as *virtual reality*. However, it is not necessarily a question of maximizing the *intensity* of the interaction. Each interactive genre, and each program in particular, corresponds to a weaker or stronger type of interaction. The diffusion of information, for example, requires a weak type (it would be absurd to put obstacles in the way of finding out the meaning of a word in a dictionary). On the other hand, the documentary and work of non-fiction lend themselves to a medium level of interaction (ideal for the rhythm of assimilation), while fiction and free creation in general allow the strongest from of interaction" (Berenguer, 2004).

The audiovisual medium has **reactive components**, i.e. they react to the viewer's actions, but do not allow the viewer to change the order of the discourse, or modify its contents. The interactive medium has **interactive components**. These components, as can be deduced from the paragraph above, may have a **level or type of interaction that is weak, medium or strong**.

According to Berenguer (2004) **the design of an interactive documentary consists of finding the optimal level at which the computer "talks," "thinks," and above all, "listens"**. To that end, it is necessary to bring together one or more people's audiovisual skills and computing skills.

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[9] Available for consultation online at: http://www.upf.edu/pdi/dcom/xavierberenguer/textos/principal.html

Finally, Berenguer (2004) believes that in the new scenario dominated by digital media, it no longer makes sense to talk about the viewer in the passive sense, but instead about a new type of user that can be defined based on the attributes of the **interactor**, **participant** and contributor (**Ribas - 2000 - also proposes the term designer**). The term user, without any further specification, does not include the aspect of having to maintain a very active participation and involvement in navigation, as the word "user" may very well acquire the connotations of a more passive viewer in the traditional sense, located in an online environment.