II. The Interface

In 1984 the director of Blade Runner Ridley Scott was hired to create a commercial which introduced Apple Computer's new Macintosh. In retrospect, this event is full of historical significance. Released within two years of each other, Blade Runner (1982) and Macintosh computer (1984) defined the two aesthetics which, twenty years, still rule contemporary culture. One was a futuristic dystopia which combined futurism and decay, computer technology and fetishism, retro-styling and urbanism, Los Angeles and Tokyo. Since Blade Runner release, its techno-noir was replayed in countless films, computer games, novels and other cultural objects. And while a number of strong aesthetic systems have been articulated in the following decades, both by individual artists (Mathew Barney, Mariko Mori) and by commercial culture at large (the 1980s "post-modern" pastiche, the 1990s techno-minimalism), none of them was able to challenge the hold of Blade Runner on our vision of the future.

In contrast to the dark, decayed, "post-modern" vision of Blade Runner, Graphical User Interface (GUI), popularized by Macintosh, remained true to the modernist values of clarity and functionality. The user's screen was ruled by strait lines and rectangular windows which contained smaller rectangles of individual files arranged in a grid. The computer communicated with the user via rectangular boxes containing clean black type rendered again white background. Subsequent versions of GUI added colors and made possible for users to customize the appearance of many interface elements, thus somewhat deluding the sterility and boldness of the original monochrome 1984 version. Yet its original aesthetic survived in the displays of hand-held communicators such as Palm Pilot, cellular telephones, car navigation systems and other consumer electronic products which use small LCD displays comparable in quality to 1984 Macintosh screen.

Like Blade Runner, Macintosh's GUI articulated a vision of the future, although a very different one. In this vision, the lines between human and is technological creations (computers, androids) are clearly drawn and decay is not tolerated. In computer, once a file is created, it never disappears except when explicitly deleted by the user. And even then deleted items can be usually recovered. Thus if in "meatspace" we have to work to remember, in cyberspace we have to work to forget. (Of course while they run, OS and applications constantly create, write to and erase various temporary files, as well as swap data between RAM and virtual memory files on a hard drive, but most of this activity remains invisible to the user.)

Also like Blade Runner, GUI vision also came to influence many other areas of culture. This influence ranges from purely graphical (for instance, use of GUI elements by print and TV designers) to more conceptual. In the 1990s, as the Internet progressively grew in popularity, the role of a digital computer shifted

from being a particular technology (a calculator, a symbol processor, an image manipulator, etc.) to being a filter to all culture, a form through which all kinds of cultural and artistic production is being mediated. As a window of a Web browser comes to replace cinema and television screen, a wall in art gallery, a library and a book, all at once, the new situation manifest itself: all culture, past and present, is being filtered through a computer, with its particular human-computer interface.[57]

In semiotic terms, the computer interface acts as a code which carries cultural messages in a variety of media. When you use the Internet, everything you access — texts, music, video, navigable spaces — passes through the interface of the browser and then, in its turn, the interface of the OS. In cultural communication, a code is rarely simply a neutral transport mechanism; usually it affects the messages transmitted with its help. For instance, it may make some messages easy to conceive and render others unthinkable. A code may also provide its own model of the world, its own logical system, or ideology; subsequent cultural messages or whole languages created using this code will be limited by this model, system or ideology. Most modern cultural theories rely on these notions which I will refer to together as "non-transparency of the code" idea. For instance, according to Whorf-Sapir hypothesis which enjoyed popularity in the middle of the twentieth century, human thinking is determined by the code of natural language; the speakers of different natural languages perceive and think about world differently.[58] Whorf-Sapir hypothesis is an extreme expression of "non-transparency of the code" idea; usually it is formulated in a less extreme form. But then we think about the case of human-computer interface, applying a "strong" version of this idea makes sense. The interface shapes how the computer user conceives the computer itself. It also determines how users think of any media object accessed via a computer. Stripping different media of their original distinctions, the interface imposes its own logic on them. Finally, by organizing computer data in particular ways, the interface provides distinct models of the world. For instance, a hierarchical file system assumes that the world can be organized in a logical multi-level hierarchy. In contrast, a hypertext model of the World Wide Web models the world as a non-hierarchical system ruled by metonymy. In short, far from being a transparent window into the data inside a computer, the interface bring with it strong messages of its own.

As an example of how the interface imposes its own logic on media, consider "cut and paste" operation, standard in all software running under modern GUI. This operation renders insignificant the traditional distinction between spatial and temporal media, since the user can cut and paste parts of images, regions of space and parts of a temporal composition in exactly the same way. It is also "blind" to traditional distinctions in scale: the user can cut and paste a single pixel, an image, a whole digital movie in the same way. And last, this operation also renders insignificant traditional distinctions between media: "cut

and paste" can be applied to texts, still and moving images, sounds and 3D objects in the same way.

The interface comes to play a crucial role in information society yet in a another way. In this society, not only work and leisure activities increasingly involve computer use, but they also converge around the same interfaces. Both "work" applications (word processors, spreadsheet programs, database programs) and "leisure" applications (computer games, informational DVD) use the same tools and metaphors of GUI. The best example of this convergence is a Web browser employed both in the office and at home, both for work and for play. In this respect information society is quite different from industrial society, with its clear separation between the field of work and the field of leisure. In the nineteenth century Karl Marx imagined that a future communist state would overcome this work-leisure divide as well as the highly specialized and piece-meal character of modern work itself. Marx's ideal citizen would be cutting wood in the morning, gardening in the afternoon and composing music in the evening. Now a subject of information society is engaged in even more activities during a typical day: inputting and analyzing data, running simulations, searching the Internet, playing computer games, watching streaming video, listening to music online, trading stocks, and so on. Yet in performing all these different activities the user in essence is always using the same few tools and commands: a computer screen and a mouse; a Web browser; a search engine; cut, paste, copy, delete and find commands. (In the introduction to "Forms" chapter I will discuss how the two key new forms of new media — database and navigable space — can be also understood in relation to work--leisure opposition.)

If human-computer interface become a key semiotic code of the information society as well as its meta-tool, how does this affect the functioning of cultural objects in general and art objects in particular? As I already noted ("Principles of New Media," 4.2), in computer culture it becomes common to construct the number of different interfaces to the same "content." For instance, the same data can be represented as a 2D graph or as an interactive navigable space. Or, a Web site may guide the user to different versions of the site depending on the bandwidth of her Internet connection. (I will elaborate on this in "Database" section where a new media object will be defined as one or more interfaces to a multimedia database.) Given these examples, we may be tempted to think of a new media artwork as also having two separate levels: content and interface. Thus the old dichotomies content — form and content — medium can be re-written as content — interface. But postulating such an opposition assumes that artwork's content is independent of its medium (in an art historical sense) or its code (in a semiotic sense). Situated in some idealized medium-free realm, content is assumed to exist before its material expression. These assumptions are correct in the case of visualization of quantified data; they also apply to classical art with its well-defined iconographic motives and representational conventions.

But just as modern thinkers, from Whorf to Derrida, insisted on "non-transparency of a code" idea, modern artists assumed that content and form can't be separated. In fact, from the 1910s "abstraction" to the 1960s "process," artists keep inventing concepts and procedures to assure that they can't paint some pre-existent content.

This leaves us with an interesting paradox. Many new media artworks have what can be called "an informational dimension," the condition which they share with all new media objects. Their experience includes retrieving, looking at and thinking about quantified data. Therefore when we refer to such artworks we are justified in separating the levels of content and interface. At the same time, new media artworks have more traditional "experiential" or aesthetic dimensions, which justifies their status as art rather than as information design. These dimensions include a particular configuration of space, time, and surface articulated in the work; a particular sequence of user's activities over time to interact with the work; a particular formal, material and phenomenological user experience. And it is the work's interface that creates its unique materiality and the unique user experience. To change the interface even slightly is to dramatically change the work. From this perspective, to think of an interface as a separate level, as something that can be arbitrary varied is to eliminate the status of a new media artwork as art.

There is another way to think about the difference between new media design and new media art in relation to the content — interface dichotomy. In contrast to design, in art the connection between content and form (or, in the case of new media, content and interface) is motivated. That is, the choice of a particular interface is motivated by work's content to such degree that it can no longer be thought of as a separate level. Content and interface merge into one entity, and no longer can be taken apart.

Finally, the idea of content pre-existing the interface is challenged in yet another way by new media artworks which dynamically generate their data in real time. While in a menu-based interactive multimedia application or a static Web site all data already exists before the user accesses it, in dynamic new media artworks the data is created on the fly, or, to use the new media lingo, at run time. This can be accomplished in a variety of ways: procedural computer graphics, formal language systems, Artificial Intelligence (AI) and Artificial Life (AL) programming. All these methods share the same principle: a programmer setups some initial conditions, rules or procedures which control the computer program generating the data. For the purposes of the present discussion, the most interesting of these approaches are AL and the evolution paradigm. In AL approach, the interaction between a number of simple objects at run time leads to the emergence of complex global behaviors. These behaviors can only be obtained in the course of running the computer program; they can't be predicted beforehand. The evolution paradigm applies the metaphor of the evolution theory to the generation of images, shapes, animations and other media data. The initial

data supplied by the programmer acts as a genotype which is expanded into a full phenotype by a computer. In either case, the content of an artwork is the result of a collaboration between the artist/programmer and the computer program, or, if the work is interactive, between the artist, the computer program and the user. New media artists who most systematically explored AL approach is the team of Christa Sommerer and Laurent Mignonneau. In their installation "Life Spacies" virtual organisms appear and evolve in response to the position, movement and interactions of the visitors. Artist/programmer Karl Sims made the key contribution to applying the evolution paradigm to media generation. In his installation "Galapagos" the computer programs generates twelfth different virtual organisms at every iteration; the visitors select an organism which will continue to leave, copulate, mutate and reproduce.[59] The commercial products which use AL and evolution approaches are computer games such as Creatures series (Mindscape Entertainment) and "virtual pet" toys such as Tamagochi.

In organizing this book I wanted to highlight the importance of the interface category by placing its discussion right in the beginning. The two sections of this chapter present the examples of different issues raised this category -- but they in no way exhaust it. In "The Language of Cultural Interface" I introduce the term "cultural interfaces" to describe interfaces used by stand-alone hypermedia (CD-ROM and DVD titles), Web sites, computer games and other cultural objects distributed via a computer. I think we need such a term because as the role of a computer is shifting from being a tool to a universal media machine, we are increasingly "interfacing" to predominantly cultural data: texts, photographs, films, music, multimedia documents, virtual environments. Therefore, human-computer interface is being supplemented by human-computer-culture interface, which I abbreviate as "cultural interface." The section then discusses the how the three cultural forms -- cinema, the printed word, and a general-purpose human-computer interface — contributed to shaping the appearance and functionality of cultural interfaces during the 1990s.

The second section "The Screen and the User" discusses the key element of the modern interface — the computer screen. As in the first section, I am interested in analyzing continuities between a computer interface and older cultural forms, languages and conventions. The section positions the computer screen within a longer historical tradition and it traces different stages in the development of this tradition: the static illusionistic image of Renaissance painting; the moving image of film screen, the real-time image of radar and television; and real-time interactive image of a computer screen.

The Language of Cultural Interfaces

Cultural Interfaces

The term human-computer interface (HCI) describes the ways in which the user interacts with a computer. HCI includes physical input and output devices such a monitor, a keyboard, and a mouse. It also consists of metaphors used to conceptualize the organization of computer data. For instance, the Macintosh interface introduced by Apple in 1984 uses the metaphor of files and folders arranged on a desktop. Finally, HCI also includes ways of manipulating this data, i.e. a grammar of meaningful actions which the user can perform on it. The example of actions provided by modern HCI are copy, rename and delete file; list the contents of a directory; start and stop a computer program; set computer's date and time.

The term HCI was coined when computer was mostly used as a tool for work. However, during the 1990s, the identity of computer has changed. In the beginning of the decade, a computer was still largely thought of as a simulation of a typewriter, a paintbrush or a drafting ruler -- in other words, as a tool used to produce cultural content which, once created, will be stored and distributed in its appropriate media: printed page, film, photographic print, electronic recording. By the end of the decade, as Internet use became commonplace, the computer's public image was no longer that of tool but also that a universal media machine, used not only to author, but also to store, distribute and access all media.

As distribution of all forms of culture becomes computer-based, we are increasingly "interfacing" to predominantly cultural data: texts, photographs, films, music, virtual environments. In short, we are no longer interfacing to a computer but to culture encoded in digital form. I will use the term "cultural interfaces" to describe human-computer-culture interface: the ways in which computers present and allows us to interact with cultural data. Cultural interfaces include the interfaces used by the designers of Web sites, CD-ROM and DVD titles, multimedia encyclopedias, online museums and magazines, computer games and other new media cultural objects.

If you need to remind yourself what a typical cultural interface looked in the second part of the 1990s, say 1997, go back in time and click to a random Web page. You are likely to see something which graphically resembles a magazine layout from the same decade. The page is dominated by text: headlines, hyperlinks, blocks of copy. Within this text are few media elements: graphics, photographs, perhaps a QuickTime movie and a VRML scene. The page also includes radio buttons and a pull-down menu which allows you to choose an item from the list. Finally there is a search engine: type a word or a phrase, hit the

search button and the computer will scan through a file or a database trying to match your entry.

For another example of a prototypical cultural interface of the 1990s, you may load (assuming it would still run on your computer) the most well-known CD-ROM of the 1990s — Myst (Broderbund, 1993). Its opening clearly recalls a movie: credits slowly scroll across the screen, accompanied by a movie-like soundtrack to set the mood. Next, the computer screen shows a book open in the middle, waiting for your mouse click. Next, an element of a familiar Macintosh interface makes an appearance, reminding you that along with being a new movie/book hybrid, Myst is also a computer application: you can adjust sound volume and graphics quality by selecting from a usual Macintosh-style menu in the upper top part of the screen. Finally, you are taken inside the game, where the interplay between the printed word and cinema continue. A virtual camera frames images of an island which dissolve between each other. At the same time, you keep encountering books and letters, which take over the screen, providing with you with clues on how to progress in the game.

Given that computer media is simply a set of characters and numbers stored in a computer, there are numerous ways in which it could be presented to a user. Yet, as it always happens with cultural languages, only a few of these possibilities actually appear viable in a given historical moment. Just as early fifteenth century Italian painters could only conceive of painting in a very particular way — quite different from, say, sixteenth century Dutch painters — today's digital designers and artists use a small set of action grammars and metaphors out of a much larger set of all possibilities.

Why do cultural interfaces — Web pages, CD-ROM titles, computer games — look the way they do? Why do designers organize computer data in certain ways and not in others? Why do they employ some interface metaphors and not others?

My theory is that the language of cultural interfaces is largely made up from the elements of other, already familiar cultural forms. In the following I will explore the contributions of three such forms to this language during its first decades -- the 1990s. The three forms which I will focus make their appearance in the opening sequence of the already discussed prototypical new media object of the 1990s — Myst. Its opening activates them before our eyes, one by one. The first form is cinema. The second form is the printed word. The third form is a general-purpose human-computer interface (HCI).

As it should become clear from the following, I use words "cinema" and "printed word" as shortcuts. They stand not for particular objects, such as a film or a novel, but rather for larger cultural traditions (we can also use such words as cultural forms, mechanisms, languages or media). "Cinema" thus includes mobile camera, representation of space, editing techniques, narrative conventions, activity of a spectator -- in short, different elements of cinematic perception, language and reception. Their presence is not limited to the twentieth-century

institution of fiction films, they can be already found in panoramas, magic lantern slides, theater and other nineteenth-century cultural forms; similarly, since the middle of the twentieth century, they are present not only in films but also in television and video programs. In the case of the "printed word" I am also referring to a set of conventions which have developed over many centuries (some even before the invention of print) and which today are shared by numerous forms of printed matter, from magazines to instruction manuals: a rectangular page containing one or more columns of text; illustrations or other graphics framed by the text; pages which follow each sequentially; a table of contents and index.

Modern human-computer interface has a much shorter history than the printed word or cinema -- but it is still a history. Its principles such as direct manipulation of objects on the screen, overlapping windows, iconic representation, and dynamic menus were gradually developed over a few decades, from the early 1950s to the early 1980s, when they finally appeared in commercial systems such as Xerox Star (1981), the Apple Lisa (1982), and most importantly the Apple Macintosh (1984).[60] Since than, they have become an accepted convention for operating a computer, and a cultural language in their own right.

Cinema, the printed word and human-computer interface: each of these traditions has developed its own unique ways of how information is organized, how it is presented to the user, how space and time are correlated with each other, how human experience is being structured in the process of accessing information. Pages of text and a table of contents; 3D spaces framed by a rectangular frame which can be navigated using a mobile point of view; hierarchical menus, variables, parameters, copy/paste and search/replace operations -- these and other elements of these three traditions are shaping cultural interfaces today. Cinema, the printed word and HCI: they are the three main reservoirs of metaphors and strategies for organizing information which feed cultural interfaces.

Bringing cinema, the printed word and HCI interface together and treating them as occupying the same conceptual plane has an additional advantage -- a theoretical bonus. It is only natural to think of them as belonging to two different kind of cultural species, so to speak. If HCI is a general purpose tool which can be used to manipulate any kind of data, both the printed word and cinema are less general. They offer ways to organize particular types of data: text in the case of print, audio-visual narrative taking place in a 3D space in the case of cinema. HCI is a system of controls to operate a machine; the printed word and cinema are cultural traditions, distinct ways to record human memory and human experience, mechanisms for cultural and social exchange of information. Bringing HCI, the printed word and cinema together allows us to see that the three have more in common than we may anticipate at first. On the one hand, being a part of our culture now for half a century, HCI already represents a powerful cultural

tradition, a cultural language offering its own ways to represent human memory and human experience. This language speaks in the form of discrete objects organized in hierarchies (hierarchical file system), or as catalogs (databases), or as objects linked together through hyperlinks (hypermedia). On the other hand, we begin to see that the printed word and cinema also can be thought of as interfaces, even though historically they have been tied to particular kinds of data. Each has its own grammar of actions, each comes with its own metaphors, each offers a particular physical interface. A book or a magazine is a solid object consisting from separate pages; the actions include going from page to page linearly, marking individual pages and using table of contexts. In the case of cinema, its physical interface is a particular architectural arrangement of a movie theater; its metaphor is a window opening up into a virtual 3D space.

Today, as media is being "liberated" from its traditional physical storage media — paper, film, stone, glass, magnetic tape — the elements of printed word interface and cinema interface, which previously were hardwired to the content, become "liberated" as well. A digital designer can freely mix pages and virtual cameras, table of contents and screens, bookmarks and points of view. No longer embedded within particular texts and films, these organizational strategies are now free floating in our culture, available for use in new contexts. In this respect, printed word and cinema have indeed became interfaces -- rich sets of metaphors, ways of navigating through content, ways of accessing and storing data. For a computer user, both conceptually and psychologically, their elements exist on the same plane as radio buttons, pull-down menus, command line calls and other elements of standard human-computer interface.

Let us now discuss some of the elements of these three cultural traditions -- cinema, the printed word and HCI -- to see how they have shaped the language of cultural interfaces.

Printed Word

In the 1980's, as PCs and word processing software became commonplace, text became the first cultural media to be subjected to digitization in a massive way. But already in the 1960's, two and a half decades before the concept of digital media was born, researchers were thinking about having the sum total of human written production -- books, encyclopedias, technical articles, works of fiction and so on -- available online (Ted Nelson's Xanadu project[61]).

Text is unique among other media types. It plays a privileged role in computer culture. On the one hand, it is one media type among others. But, on the other hand, it is a meta-language of computer media, a code in which all other media are represented: coordinates of 3D objects, pixel values of digital images, the formatting of a page in HTML. It is also the primary means of communication

between a computer and a user: one types single line commands or runs computer programs written in a subset of English; the other responds by displaying error codes or text messages.[62]

If a computer uses text as its meta-language, cultural interfaces in their turn inherit the principles of text organization developed by human civilization throughout its existence. One of these is a page: a rectangular surface containing a limited amount of information, designed to be accessed in some order, and having a particular relationship to other pages. In its modern form, the page is born in the first centuries of the Christian era when the clay tablets and papyrus rolls are replaced by a codex — the collection of written pages stitched together on one side.

Cultural interfaces rely on our familiarity with the "page interface" while also trying to stretch its definition to include new concepts made possible by a computer. In 1984, Apple introduced a graphical user interface which presented information in overlapping windows stacked behind one another — essentially, a set of book pages. The user was given the ability to go back and forth between these pages, as well as to scroll through individual pages. In this way, a traditional page was redefined as a virtual page, a surface which can be much larger than the limited surface of a computer screen. In 1987, Apple shipped popular Hypercard program which extended the page concept in new ways. Now the users were able to include multimedia elements within the pages, as well as to establish links between pages regardless of their ordering. A few years later, designers of HTML stretched the concept of a page even more by enabling the creation of distributed documents, where different parts of a document are located on different computers connected through the network. With this development, a long process of gradual "virtualization" of the page reached a new stage. Messages written on clay tablets, which were almost indestructible, were replaced by ink on paper. Ink, in its turn, was replaced by bits of computer memory, making characters on an electronic screen. Now, with HTML, which allows parts of a single page to be located on different computers, the page became even more fluid and unstable.

The conceptual development of the page in computer media can also be read in a different way — not as a further development of a codex form, but as a return to earlier forms such as the papyrus roll of ancient Egypt, Greece and Rome. Scrolling through the contents of a computer window or a World Wide Web page has more in common with unrolling than turning the pages of a modern book. In the case of the Web of the 1990s, the similarity with a roll is even stronger because the information is not available all at once, but arrives sequentially, top to bottom, as though the roll is being unrolled.

A good example of how cultural interfaces stretch the definition of a page while mixing together its different historical forms is the Web page created in 1997 by the British design collective antirom for HotWired RGB Gallery.[63] The designers have created a large surface containing rectangular blocks of texts in

different font sizes, arranged without any apparent order. The user is invited to skip from one block to another moving in any direction. Here, the different directions of reading used in different cultures are combined together in a single page.

By the mid 1990's, Web pages included a variety of media types — but they were still essentially traditional pages. Different media elements — graphics, photographs, digital video, sound and 3D worlds — were embedded within rectangular surfaces containing text. To that extent a typical Web age was conceptually similar to a newspaper page which is also dominated by text, with photographs, drawings, tables and graphs embedded in between, along with links to other pages of the newspaper. VRML evangelists wanted to overturn this hierarchy by imaging the future in which the World Wide Web is rendered as a giant 3D space, with all the other media types, including text, existing within it.[64] Given that the history of a page stretches for thousands of years, I think it is unlikely that it would disappear so quickly.

As Web page became a new cultural convention of its own, its dominance was challenged by two Web browsers created by artists — Web Stalker (1997) by I/O/D collective[65] and Netomat (1999) by Maciej Wisniewski.[66] Web Stalker emphasizes the hypertextual nature of the Web. Instead of rendering standard Web pages, it renders the networks of hyperlinks these pages embody. When a user enters a URL for a particular page, Web Stalker displays all pages linked to this page as a line graph. Netomat similarly refuses the page convention of the Web. The user enters a word or a phrase which are passed to search engines. Netomat then extracts page titles, images, audio or any other media type, as specified by the user, from the found pages and floats them across the computer screen. As can be seen, both browsers refuse the page metaphor, instead substituting their own metaphors: a graph showing the structure of links in the case of Web Stalker, a flow of media elements in the case of Netomat.

While the 1990's Web browsers and other commercial cultural interfaces have retained the modern page format, they also have come to rely on a new way of organizing and accessing texts which has little precedent within book tradition — hyperlinking. We may be tempted to trace hyperlinking to earlier forms and practices of non-sequential text organization, such as the Torah's interpretations and footnotes, but it is actually fundamentally different from them. Both the Torah's interpretations and footnotes imply a master-slave relationship between one text and another. But in the case of hyperlinking as implemented by HTML and earlier by Hypercard, no such relationship of hierarchy is assumed. The two sources connected through a hyperlink have an equal weight; neither one dominates the other .Thus the acceptance of hyperlinking in the 1980's can be correlated with contemporary culture’s suspicion of all hierarchies, and preference for the aesthetics of collage where radically different sources are brought together within the singular cultural object ("post-modernism").

Traditionally, texts encoded human knowledge and memory, instructed, inspired, convinced and seduced their readers to adopt new ideas, new ways of interpreting the world, new ideologies. In short, the printed word was linked to the art of rhetoric. While it is probably possible to invent a new rhetoric of hypermedia, which will use hyperlinking not to distract the reader from the argument (as it is often the case today), but instead to further convince her of argument's validity, the sheer existence and popularity of hyperlinking exemplifies the continuing decline of the field of rhetoric in the modern era. Ancient and Medieval scholars have classified hundreds of different rhetorical figures. In the middle of the twentieth century linguist Roman Jakobson, under the influence of computer's binary logic, information theory and cybernetics to which he was exposed at MIT where he was teaching, radically reduced rhetoric to just two figures: metaphor and metonymy.[67] Finally, in the 1990's, the World Wide Web hyperlinking has privileged the single figure of metonymy at the expense of all others.[68] The hypertext of the World Wide Web leads the reader from one text to another, ad infinitum. Contrary to the popular image, in which computer media collapses all human culture into a single giant library (which implies the existence of some ordering system), or a single giant book (which implies a narrative progression), it maybe more accurate to think of the new media culture as an infinite flat surface where individual texts are placed in no particular order, like the Web page designed by antirom for HotWired. Expanding this comparison further, we can note that Random Access Memory, the concept behind the group's name, also implies the lack of hierarchy: any RAM location can be accessed as quickly as any other. In contrast to the older storage media of book, film, and magnetic tape, where data is organized sequentially and linearly, thus suggesting the presence of a narrative or a rhetorical trajectory, RAM "flattens" the data. Rather than seducing the user through the careful arrangement of arguments and examples, points and counterpoints, changing rhythms of presentation (i.e., the rate of data streaming, to use contemporary language), simulated false paths and dramatically presented conceptual breakthroughs, cultural interfaces, like RAM itself, bombards the users with all the data at once.[69]

In the 1980's many critics have described one of key's effects of "post-modernism" as that of spatialization: privileging space over time, flattening historical time, refusing grand narratives. Computer media, which has evolved during the same decade, accomplished this spatialization quite literally. It replaced sequential storage with random-access storage; hierarchical organization of information with a flattened hypertext; psychological movement of narrative in novel and cinema with physical movement through space, as witnessed by endless computer animated fly-throughs or computer games such as Myst, Doom and countless others (see “Navigable Space.”) In short, time becomes a flat image or a landscape, something to look at or navigate through. If there is a new rhetoric or

aesthetic which is possible here, it may have less to do with the ordering of time by a writer or an orator, and more with spatial wandering. The hypertext reader is like Robinson Crusoe, walking through the sand and water, picking up a navigation journal, a rotten fruit, an instrument whose purpose he does not know; leaving imprints in the sand, which, like computer hyperlinks, follow from one found object to another.

Cinema

Printed word tradition which has initially dominated the language of cultural interfaces, is becoming less important, while the part played by cinematic elements is getting progressively stronger. This is consistent with a general trend in modern society towards presenting more and more information in the form of time-based audio-visual moving image sequences, rather than as text. As new generations of both computer users and computer designers are growing up in a media-rich environment dominated by television rather than by printed texts, it is not surprising that they favor cinematic language over the language of print.

A hundred years after cinema's birth, cinematic ways of seeing the world, of structuring time, of narrating a story, of linking one experience to the next, are being extended to become the basic ways in which computer users access and interact with all cultural data. In this way, the computer fulfills the promise of cinema as a visual Esperanto which pre-occupied many film artists and critics in the 1920s, from Griffith to Vertov. Indeed, millions of computer users communicate with each other through the same computer interface. And, in contrast to cinema where most of its "users" were able to "understand" cinematic language but not "speak" it (i.e., make films), all computer users can "speak" the language of the interface. They are active users of the interface, employing it to perform many tasks: send email, organize their files, run various applications, and so on.

The original Esperanto never became truly popular. But cultural interfaces are widely used and are easily learned. We have an unprecedented situation in the history of cultural languages: something which is designed by a rather small group of people is immediately adopted by millions of computer users. How is it possible that people around the world adopt today something which a 20-something programmer in Northern California has hacked together just the night before? Shall we conclude that we are somehow biologically "wired" to the interface language, the way we are "wired," according to the original hypothesis of Noam Chomsky, to different natural languages?

The answer is of course no. Users are able to "acquire" new cultural languages, be it cinema a hundred years ago, or cultural interfaces today, because these languages are based on previous and already familiar cultural forms. In the

case of cinema, it was theater, magic lantern shows and other nineteenth century forms of public entertainment. Cultural interfaces in their turn draw on older cultural forms such as the printed word and cinema. I have already discussed some ways in which the printed word tradition structures interface language; now it is cinema's turn.

I will begin with probably the most important case of cinema's influence on cultural interfaces — the mobile camera. Originally developed as part of 3D computer graphics technology for such applications as computer-aided design, flight simulators and computer movie making, during the 1980's and 1990's the camera model became as much of an interface convention as scrollable windows or cut and paste operations. It became an accepted way for interacting with any data which is represented in three dimensions — which, in a computer culture, means literally anything and everything: the results of a physical simulation, an architectural site, design of a new molecule, statistical data, the structure of a computer network and so on. As computer culture is gradually spatializing all representations and experiences, they become subjected to the camera's particular grammar of data access. Zoom, tilt, pan and track: we now use these operations to interact with data spaces, models, objects and bodies.

Abstracted from its historical temporary "imprisonment" within the physical body of a movie camera directed at physical reality, a virtualized camera also becomes an interface to all types of media and information beside 3D space. As an example, consider GUI of the leading computer animation software — PowerAnimator from Alias/Wavefront.[70] In this interface, each window, regardless of whether it displays a 3D model, a graph or even plain text, contains Dolly, Track and Zoom buttons. It is particularly important that the user is expected to dolly and pan over text as if it was a 3D scene. In this interface, cinematic vision triumphed over the print tradition, with the camera subsuming the page. The Guttenberg galaxy turned out to be just a subset of the Lumières' universe.

Another feature of cinematic perception which persists in cultural interfaces is a rectangular framing of represented reality.[71] Cinema itself inherited this framing from Western painting. Since the Renaissance, the frame acted as a window onto a larger space which was assumed to extend beyond the frame. This space was cut by the frame's rectangle into two parts: "onscreen space," the part which is inside the frame, and the part which is outside. In the famous formulation of Leon-Battista Alberti, the frame acted as a window onto the world. Or, in a more recent formulation of French film theorist Jacques Aumont and his co-authors, "The onscreen space is habitually perceived as included within a more vast scenographic space. Even though the onscreen space is the only visible part, this larger scenographic part is nonetheless considered to exist around it."[72]

Just as a rectangular frame of painting and photography presents a part of a larger space outside it, a window in HCI presents a partial view of a larger document. But if in painting (and later in photography), the framing chosen by an artist was final, computer interface benefits from a new invention introduced by cinema: the mobility of the frame. As a kino-eye moves around the space revealing its different regions, so can a computer user scroll through a window's contents.

It is not surprising to see that screen-based interactive 3D environments, such as VRML words, also use cinema's rectangular framing since they rely on other elements of cinematic vision, specifically a mobile virtual camera. It may be more surprising to realize that Virtual Reality (VR) interface, often promoted as the most "natural" interface of all, utilizes the same framing.[73] As in cinema, the world presented to a VR user is cut by a rectangular frame. As in cinema, this frame presents a partial view of a larger space.[74] As in cinema, the virtual camera moves around to reveal different parts of this space.

Of course, the camera is now controlled by the user and in fact is identified with his/her own sight. Yet, it is crucial that in VR one is seeing the virtual world through a rectangular frame, and that this frame always presents only a part of a larger whole. This frame creates a distinct subjective experience which is much more close to cinematic perception than to unmediated sight.

Interactive virtual worlds, whether accessed through a screen-based or a VR interface, are often discussed as the logical successor to cinema, as potentially the key cultural form of the twenty-first century, just as cinema was the key cultural form of the twentieth century. These discussions usually focus on the issues of interaction and narrative. So, the typical scenario for twenty-first century cinema involves a user represented as an avatar existing literally "inside" the narrative space, rendered with photorealistic 3D computer graphics, interacting with virtual characters and perhaps other users, and affecting the course of narrative events.

It is an open question whether this and similar scenarios commonly invoked in new media discussions of the 1990's, indeed represent an extension of cinema or if they rather should be thought of as a continuation of some theatrical traditions, such as improvisational or avant-garde theater. But what undoubtedly can be observed in the 1990's is how virtual technology's dependence on cinema's mode of seeing and language is becoming progressively stronger. This coincides with the move from proprietary and expensive VR systems to more widely available and standardized technologies, such as VRML (Virtual Reality Modeling Language). (The following examples refer to a particular VRML browser — WebSpace Navigator 1.1 from SGI.[75] Other VRML browsers have similar features.)

The creator of a VRML world can define a number of viewpoints which are loaded with the world.[76] These viewpoints automatically appear in a special menu in a VRML browser which allows the user to step through them, one by one. Just as in cinema, ontology is coupled with epistemology: the world is designed to be viewed from particular points of view. The designer of a virtual world is thus a cinematographer as well as an architect. The user can wander around the world or she can save time by assuming the familiar position of a cinema viewer for whom the cinematographer has already chosen the best viewpoints.

Equally interesting is another option which controls how a VRML browser moves from one viewpoint to the next. By default, the virtual camera smoothly travels through space from the current viewpoint to the next as though on a dolly, its movement automatically calculated by the software. Selecting the "jump cuts" option makes it cut from one view to the next. Both modes are obviously derived from cinema. Both are more efficient than trying to explore the world on its own.

With a VRML interface, nature is firmly subsumed under culture. The eye is subordinated to the kino-eye. The body is subordinated to a virtual body of a virtual camera. While the user can investigate the world on her own, freely selecting trajectories and viewpoints, the interface privileges cinematic perception — cuts, pre-computed dolly-like smooth motions of a virtual camera, and pre-selected viewpoints.

The area of computer culture where cinematic interface is being transformed into a cultural interface most aggressively is computer games. By the 1990's, game designers have moved from two to three dimensions and have begun to incorporate cinematic language in a increasingly systematic fashion. Games started featuring lavish opening cinematic sequences (called in the game business "cinematics") to set the mood, establish the setting and introduce the narrative. Frequently, the whole game would be structured as an oscillation between interactive fragments requiring user's input and non-interactive cinematic sequences, i.e. "cinematics." As the decade progressed, game designers were creating increasingly complex — and increasingly cinematic — interactive virtual worlds. Regardless of a game's genre — action/adventure, fighting, flight simulator, first-person action, racing or simulation — they came to rely on cinematography techniques borrowed from traditional cinema, including the expressive use of camera angles and depth of field, and dramatic lighting of 3D computer generated sets to create mood and atmosphere. In the beginning of the decade, many games such as The 7th Guest (Trilobyte, 1993) or Voyeur (1994) or used digital video of actors superimposed over 2D or 3D backgrounds, but by its end they switched to fully synthetic characters rendered in real time.[77] This switch allowed game designers to go beyond branching-type structure of earlier games based on digital video were all the possible scenes had to be taped beforehand. In contrast, 3D characters animated in real time move arbitrary

around the space, and the space itself can change during the game. (For instance, when a player returns to the already visited area, she will find any objects she left there earlier.) This switch also made virtual words more cinematic, as the characters could be better visually integrated with their environments.[78]

A particularly important example of how computer games use — and extend — cinematic language, is their implementation of a dynamic point of view. In driving and flying simulators and in combat games, such as Tekken 2 (Namco, 1994 -), after a certain event takes place (car crashes, a fighter being knocked down), it is automatically replayed from a different point of view. Other games such as the Doom series (Id Software, 1993 -) and Dungeon Keeper (Bullfrog Productions, 1997) allow the user to switch between the point of view of the hero and a top down "bird's eye" view. The designers of online virtual worlds such as Active Worlds provide their users with similar capabilities. Finally, Nintendo went even further by dedicating four buttons on their N64 joypad to controlling the view of the action. While playing Nintendo games such as Super Mario 64 (Nintendo, 1996) the user can continuously adjust the position of the camera. Some Sony Playstation games such as Tomb Rider (Eidos, 1996) also use the buttons on the Playstation joypad for changing point of view. Some games such as Myth: The Fallen Lords (Bungie, 1997) go further, using an AI engine (computer code which controls the simulated “life” in the game, such as human characters the player encounters) to automatically control their camera.

The incorporation of virtual camera controls into the very hardware of a game consoles is truly a historical event. Directing the virtual camera becomes as important as controlling the hero's actions. This is admitted by the game industry itself. For instance, a package for Dungeon Keeper lists four key features of the game, out of which the first two concern control over the camera: "switch your perspective," "rotate your view," "take on your friend," "unveil hidden levels." In games such as this one, cinematic perception functions as the subject in its own right.[79] Here, the computer games are returning to "The New Vision" movement of the 1920s (Moholy-Nagy, Rodchenko, Vertov and others), which foregrounded new mobility of a photo and film camera, and made unconventional points of view the key part of their poetics.

The fact that computer games and virtual worlds continue to encode, step by step, the grammar of a kino-eye in software and in hardware is not an accident. This encoding is consistent with the overall trajectory driving the computerization of culture since the 1940's, that being the automation of all cultural operations. This automation gradually moves from basic to more complex operations: from image processing and spell checking to software-generated characters, 3D worlds, and Web Sites. The side effect of this automation is that once particular cultural codes are implemented in low-level software and hardware, they are no longer seen as choices but as unquestionable defaults. To take the automation of imaging as an example, in the early 1960's the newly emerging field of computer graphics

incorporated a linear one-point perspective in 3D software, and later directly in hardware.[80] As a result, linear perspective became the default mode of vision in computer culture, be it computer animation, computer games, visualization or VRML worlds. Now we are witnessing the next stage of this process: the translation of cinematic grammar of points of view into software and hardware. As Hollywood cinematography is translated into algorithms and computer chips, its convention becomes the default method of interacting with any data subjected to spatialization, with a narrative, and with other human beings. (At SIGGRAPH '97 in Los Angeles, one of the presenters called for the incorporation of Hollywood-style editing in multi-user virtual worlds software. In such implementation, user interaction with other avatar(s) will be automatically rendered using classical Hollywood conventions for filming dialog.[81]) To use the terms from the 1996 paper authored by Microsoft researchers and entitled "The Virtual Cinematographer: A Paradigm for Automatic Real-Time Camera Control and Directing," the goal of research is to encode "cinematographic expertise," translating "heuristics of filmmaking" into computer software and hardware.[82] Element by element, cinema is being poured into a computer: first one-point linear perspective; next the mobile camera and a rectangular window; next cinematography and editing conventions, and, of course, digital personas also based on acting conventions borrowed from cinema, to be followed by make-up, set design, and the narrative structures themselves. From one cultural language among others, cinema is becoming the cultural interface, a toolbox for all cultural communication, overtaking the printed word.

Cinema, the major cultural form of the twentieth century, has found a new life as the toolbox of a computer user. Cinematic means of perception, of connecting space and time, of representing human memory, thinking, and emotions become a way of work and a way of life for millions in the computer age. Cinema's aesthetic strategies have become basic organizational principles of computer software. The window in a fictional world of a cinematic narrative has become a window in a datascape. In short, what was cinema has become human-computer interface.

I will conclude this section by discussing a few artistic projects which, in different ways, offer alternatives to this trajectory. To summarize it once again, the trajectory involves gradual translation of elements and techniques of cinematic perception and language into a de-contextualized set of tools to be used as an interface to any data. In the process of this translation, cinematic perception is divorced from its original material embodiment (camera, film stock), as well as from the historical contexts of its formation. If in cinema the camera functioned as a material object, co-existing, spatially and temporally, with the world it was showing us, it has now become a set of abstract operations. The art projects described below refuse this separation of cinematic vision from the material

world. They reunite perception and material reality by making the camera and what it records a part of a virtual world's ontology. They also refuse the universalization of cinematic vision by computer culture, which (just as post-modern visual culture in general) treats cinema as a toolbox, a set of "filters" which can be used to process any input. In contrast, each of these projects employs a unique cinematic strategy which has a specific relation to the particular virtual world it reveals to the user.

In The Invisible Shape of Things Past Joachim Sauter and Dirk Lüsenbrink of the Berlin-based Art+Com collective created a truly innovative cultural interface for accessing historical data about Berlin's history.[83] The interface de-virtualizes cinema, so to speak, by placing the records of cinematic vision back into their historical and material context. As the user navigates through a 3D model of Berlin, he or she comes across elongated shapes lying on city streets. These shapes, which the authors call "filmobjects", correspond to documentary footage recorded at the corresponding points in the city. To create each shape the original footage is digitized and the frames are stacked one after another in depth, with the original camera parameters determining the exact shape. The user can view the footage by clicking on the first frame. As the frames are displayed one after another, the shape is getting correspondingly thinner.

In following with the already noted general trend of computer culture towards spatialization of every cultural experience, this cultural interface spatializes time, representing it as a shape in a 3D space. This shape can be thought of as a book, with individual frames stacked one after another as book pages. The trajectory through time and space taken by a camera becomes a book to be read, page by page. The records of camera's vision become material objects, sharing the space with the material reality which gave rise to this vision. Cinema is solidified. This project, than, can be also understood as a virtual monument to cinema. The (virtual) shapes situated around the (virtual) city, remind us about the era when cinema was the defining form of cultural expression — as opposed to a toolbox for data retrieval and use, as it is becoming today in a computer.

Hungarian-born artist Tamás Waliczky openly refuses the default mode of vision imposed by computer software, that of the one-point linear perspective. Each of his computer animated films The Garden (1992), The Forest (1993) and The Way (1994) utilizes a particular perspectival system: a water-drop perspective in The Garden, a cylindrical perspective in The Forest and a reverse perspective in The Way. Working with computer programmers, the artist created custom-made 3D software to implement these perspectival systems. Each of the systems has an inherent relationship to the subject of a film in which it is used. In The Garden, its subject is the perspective of a small child, for whom the world does not yet have an objective existence. In The Forest, the mental trauma of emigration is transformed into the endless roaming of a camera through the forest which is actually just a set of transparent cylinders. Finally, in The Way, the self-

sufficiency and isolation of a Western subject are conveyed by the use of a reverse perspective.

In Waliczky's films the camera and the world are made into a single whole, whereas in The Invisible Shape of Things Past the records of the camera are placed back into the world. Rather than simply subjecting his virtual worlds to different types of perspectival projection, Waliczky modified the spatial structure of the worlds themselves. In The Garden, a child playing in a garden becomes the center of the world; as he moves around, the actual geometry of all the objects around him is transformed, with objects getting bigger as he gets close to him. To create The Forest, a number of cylinders were placed inside each other, each cylinder mapped with a picture of a tree, repeated a number of times. In the film, we see a camera moving through this endless static forest in a complex spatial trajectory — but this is an illusion. In reality, the camera does move, but the architecture of the world is constantly changing as well, because each cylinder is rotating at its own speed. As a result, the world and its perception are fused together.

HCI: Representation versus Control

The development of human-computer interface, until recently, had little to do with distribution of cultural objects. Following some of the main applications from the 1940's until the early 1980's, when the current generation of GUI was developed and reached the mass market together with the rise of a PC (personal computer), we can list the most significant: real-time control of weapons and weapon systems; scientific simulation; computer-aided design; finally, office work with a secretary as a prototypical computer user, filing documents in a folder, emptying a trash can, creating and editing documents ("word processing"). Today, as the computer is starting to host very different applications for access and manipulation of cultural data and cultural experiences, their interfaces still rely on old metaphors and action grammars. Thus, cultural interfaces predictably use elements of a general-purpose HCI such as scrollable windows containing text and other data types, hierarchical menus, dialogue boxes, and command-line input. For instance, a typical "art collection" CD-ROM may try to recreate "the museum experience" by presenting a navigable 3D rendering of a museum space, while still resorting to hierarchical menus to allow the user to switch between different museum collections. Even in the case of The Invisible Shape of Things Past which uses a unique interface solution of "filmobjects" which is not directly traceable to either old cultural forms or general-purpose HCI, the designers are still relying on HCI convention in one case — the use of a pull-down menu to switch between different maps of Berlin.

In their important study of new media Remediation, Jay David Bolter and Richard Grusin define medium as "that which remediates."[84] In contrast to a modernist view aims to define the essential properties of every medium, Bolter and Grusin propose that all media work by "remediating," i.e. translating, refashioning, and reforming other media, both on the levels of content and form. If we are to think of human-computer interface as another media, its history and present development definitely fits this thesis. The history of human-computer interface is that of borrowing and reformulating, or, to use new media lingo, reformatting other media, both past and present: the printed page, film, television. But along with borrowing conventions of most other media and eclectically combining them together, HCI designers also heavily borrowed "conventions" of human-made physical environment, beginning with Macintosh use of desktop metaphor. And, more than an media before it, HCI is like a chameleon which keeps changing its appearance, responding to how computers are used in any given period. For instance, if in the 1970s the designers at Xerox Park modeled the first GUI on the office desk, because they imagined that the computer were designing will be used in the office, in the 1990s the primary use of computers as media access machine led to the borrowing of interfaces of already familiar media devices, such as VCR or audio CD player controls.

In general, cultural interfaces of the 1990's try to walk an uneasy path between the richness of control provided in general-purpose HCI and an "immersive" experience of traditional cultural objects such as books and movies. Modern general-purpose HCI, be it MAC OS, Windows or UNIX, allow their users to perform complex and detailed actions on computer data: get information about an object, copy it, move it to another location, change the way data is displayed, etc. In contrast, a conventional book or a film positions the user inside the imaginary universe whose structure is fixed by the author. Cultural interfaces attempt to mediate between these two fundamentally different and ultimately non-compatible approaches.

As an example, consider how cultural interfaces conceptualize the computer screen. If a general-purpose HCI clearly identifies to the user that certain objects can be acted on while others cannot (icons representing files but not the desktop itself), cultural interfaces typically hide the hyperlinks within a continuous representational field. (This technique was already so widely accepted by the 1990's that the designers of HTML offered it early on to the users by implementing the "imagemap" feature). The field can be a two-dimensional collage of different images, a mixture of representational elements and abstract textures, or a single image of a space such as a city street or a landscape. By trial and error, clicking all over the field, the user discovers that some parts of this field are hyperlinks. This concept of a screen combines two distinct pictorial conventions: the older Western tradition of pictorial illusionism in which a screen functions as a window into a virtual space, something for the viewer to look into

but not to act upon; and the more recent convention of graphical human-computer interfaces which, by dividing the computer screen into a set of controls with clearly delineated functions, essentially treats it as a virtual instrument panel. As a result, the computer screen becomes a battlefield for a number of incompatible definitions: depth and surface, opaqueness and transparency, image as an illusionary space and image as an instrument for action.

The computer screen also functions both as a window into an illusionary space and as a flat surface carrying text labels and graphical icons. We can relate this to a similar understanding of a pictorial surface in the Dutch art of the seventeenth century, as analyzed by art historian Svetlana Alpers in her classical The Art of Describing. Alpers discusses how a Dutch painting of this period functioned as a combined map / picture, combining different kids of information and knowledge of the world.[85]

Here is another example of how cultural interfaces try to find a middle ground between the conventions of general-purpose HCI and the conventions of traditional cultural forms. Again we encounter tension and struggle — in this case, between standardization and originality. One of the main principles of modern HCI is consistency principle. It dictates that menus, icons, dialogue boxes and other interface elements should be the same in different applications. The user knows that every application will contain a "file" menu, or that if she encounters an icon which looks like a magnifying glass it can be used to zoom on documents. In contrast, modern culture (including its "post-modern" stage) stresses originality: every cultural object is supposed to be different from the rest, and if it is quoting other objects, these quotes have to be defined as such. Cultural interfaces try to accommodate both the demand for consistency and the demand for originality. Most of them contain the same set of interface elements with standard semantics, such as "home," "forward" and "backward" icons. But because every Web site and CD-ROM is striving to have its own distinct design, these elements are always designed differently from one product to the next. For instance, many games such as War Craft II (Blizzard Entertainment, 1996) and Dungeon Keeper give their icons a "historical" look consistent with the mood of an imaginary universe portrayed in the game.

The language of cultural interfaces is a hybrid. It is a strange, often awkward mix between the conventions of traditional cultural forms and the conventions of HCI — between an immersive environment and a set of controls; between standardization and originality. Cultural interfaces try to balance the concept of a surface in painting, photography, cinema, and the printed page as something to be looked at, glanced at, read, but always from some distance, without interfering with it, with the concept of the surface in a computer interface as a virtual control panel, similar to the control panel on a car, plane or any other complex machine.[86] Finally, on yet another level, the traditions of the printed word and of cinema also compete between themselves. One pulls the computer

screen towards being dense and flat information surface, while another wants it to become a window into a virtual space.

To see that this hybrid language of the cultural interfaces of the 1990s represents only one historical possibility, consider a very different scenario. Potentially, cultural interfaces could completely rely on already existing metaphors and action grammars of a standard HCI, or, at least, rely on them much more than they actually do. They don't have to "dress up" HCI with custom icons and buttons, or hide links within images, or organize the information as a series of pages or a 3D environment. For instance, texts can be presented simply as files inside a directory, rather than as a set of pages connected by custom-designed icons. This strategy of using standard HCI to present cultural objects is encountered quite rarely. In fact, I am aware of only one project which uses it completely consciously, as a though through choice rather than by necessity : a CD-ROM by Gerald Van Der Kaap entitled BlindRom V.0.9. (Netherlands, 1993). The CD-ROM includes a standard-looking folder named "Blind Letter." Inside the folder there are a large number of text files. You don't have to learn yet another cultural interface, search for hyperlinks hidden in images or navigate through a 3D environment. Reading these files required simply opening them in standard Macintosh SimpleText, one by one. This simple technique works very well. Rather than distracting the user from experiencing the work, the computer interface becomes part and parcel of the work. Opening these files, I felt that I was in the presence of a new literary form for a new medium, perhaps the real medium of a computer — its interface.

As the examples analyzed here illustrate, cultural interfaces try to create their own language rather than simply using general-purpose HCI. In doing so, these interfaces try to negotiate between metaphors and ways of controlling a computer developed in HCI, and the conventions of more traditional cultural forms. Indeed, neither extreme is ultimately satisfactory by itself. It is one thing to use a computer to control a weapon or to analyze statistical data, and it is another to use it to represent cultural memories, values and experiences. The interfaces developed for a computer in its functions of a calculator, control mechanism or a communication device are not necessarily suitable for a computer playing the role of a cultural machine. Conversely, if we simply mimic the existing conventions of older cultural forms such as the printed word and cinema, we will not take advantage of all the new capacities offered by a computer: its flexibility in displaying and manipulating data, interactive control by the user, the ability to run simulations, etc.

Today the language of cultural interfaces is in its early stage, as was the language of cinema a hundred years ago. We don't know what the final result will be, or even if it will ever completely stabilize. Both the printed word and cinema eventually achieved stable forms which underwent little changes for long periods of time, in part because of the material investments in their means of production and distribution. Given that computer language is implemented in software,

potentially it can keep on changing forever. But there is one thing we can be sure of. We are witnessing the emergence of a new cultural meta-langauge, something which will be at least as significant as the printed word and cinema before it.

NOTES

[1] http://www.nettime.org

[2] http://www.rhizome.org

[3] Phong, B.T. “Illumination for Computer Generated Pictures,” Communication of the ACM, Volume 18, no. 6 (June 1975): 311-317.

[5] Thomas S. Kuhn, The Structure of Scientific Revolutions, 2nd ed. (Chicago: University of Chicago Press, 1970).

[6] By virtual worlds I mean 3D computer-generated interactive environments. This definition fits a whole range of 3D computer environments already in existence: high-end VR works which feature head-mounted displays and photo realistic graphics; arcade, CD-ROM and on-line multi-player computer games; QuickTime VR movies; VRML (The Virtual Reality Modeling Language) scenes; and graphical chat environments such as The Palace and Active Worlds.

Virtual worlds represent an important trend across computer culture, consistently promising to become a new standard in human-computer interfaces and in computer networks. (For a discussion of why this promise may never be fulfilled, see “Navigable Space” section.) For example, Silicon Graphics developed a 3-D file system which was showcased in the movie Jurassic Park. Sony used a picture of a room as an interface in its MagicLink personal communicator. Apple's short-lived E-World greeted its users with a drawing of a city. Web designers often use pictures of buildings, aerial views of cities, and maps a interface metaphors. In the words of the scientists from Sony's The Virtual Society Project (www.csl.sony.co.jp/project/VS/), "It is our belief that future online systems will be characterized by a high degree of interaction, support for multi-media and most importantly the ability to support shared 3-D spaces. In our vision, users will not simply access textual based chat forums, but will enter into 3-D worlds where they will be able to interact with the world and with other users in that world."

[7] Tzevan Todorov, Introduction to Poetics, trans. by Rchard Howard (Minneapolis: University of Minnesota Press, 1981), 6.

[8] Examples of software standards include operating systems such as UNIX, Windows and MAC OS; file formats (JPEG, MPEG, DV, QuickTime, RTF, WAV); scripting languages (HTML, Javascript); programming langauges (C++, Java); communication protocols (TCP-IP); the conventions of HCI (e.g. dialog boxes, copy and paste commands, help pointer); and also unwritten conventions,

such as the 640 by 480 pixel image size which was used for more than a decade. Hardware standards include storage media formats (ZIP, JAZ, CD-ROM, DVD), port types (serial, USB, Firewire), bus architectures (PCI), and RAM types.

[9] Vkutemas was a Moscow art and design school in the 1920s which united most Left avant-garde artists; it functioned as a counterpart of Bauhaus in Germany.

[10] Qtd. in Beumont Newhall, The History of Photography from 1839 to the Present Day. Revised and Enlarged Edition, fourth edition (New York: The Museum of Modern Art, 1964), 18.

[11] Newhall, The History of Photography, 17-22.

[12] Charles Eames, A Computer Perspective: Background To The Computer Age, 1990 edition (Cambridge, Mass.: Harvard University Press, 1990), 18.

[13] David Bordwell and Kristin Thompson, Film Art: An Introduction, fifth edition (New York: The McGraw-Hill Companies), 15.

[14] Eames, A Computer Perspective, 22-27, 46-51, 90-91.

[15] Eames, A Computer Perspective, 120.

[16] Isaac Victor Kerlov and Judson Rosebush, Computer Graphics for Designes and Artists (New York: Van Nostrand Reinhold Company, 1986), 14.

[17] Kerlov and Rosebush, Computer Graphics, 21.

[18] Roland Barthes,.Elements of Semiology (New York: Hill and Wang, 1968), 64.

[19] I discuss the particular cases of computer automation of visual communication in more detail in "Automation of Sight from Photography to Computer Vision," Electronic Culture: Technology and Visual Representation, edited by Timothy Druckery and Michael Sand (New York: Aperture, 1996); "Mapping Space: Perspective, Radar and Computer Graphics," SIGGRAPH '93 Visual Proceedings, edited by Thomas Linehan, 143-147 (New York: ACM, 1993).

[20] http://www.mrl.nyu.edu/improv/, accessed June 29, 1999.

[21] http://www-white.media.mit.edu/vismod/demos/smartcam/, accessed June 29, 1999.

[22] http://pattie.www.media.mit.edu/people/pattie/CACM-95/alife-cacm95.html, accessed June 29, 1999.

[23] This research was persued at diffirent groups at the MIT lab. See for instance home page of Gesture and Narrative Language Group, http://gn.www.media.mit.edu/groups/gn/, accessed June 29, 1999.

[24] See http://www.virage.com/products, accessed June 29, 1999.

[25] http://agents.www.media.mit.edu/groups/agents/projects/, accessed June 29, 1999.
[26] See my "Avant-Garde as Software," in Ostranenie, edited by Stephen Kovats (Frankfurt and New York: Campus Verlag, 1999.). (http://visarts.ucsd.edu/~manovich)
[27] For an experiment in creating diffirent multimedia interfaces to the same text, see my Freud-Lissitzky Navigator (http://visarts.ucsd.edu/~manovich/FLN).
[28] http://jefferson.village.virginia.edu/wax/, accessed October 24, 1999.
[29] Frank Halacz and Mayer Swartz, "The Dexter Hypertext Reference Model," Communication of the ACM (New York: ACM, 1994), 30.
[30] Noam Chomsky, Syntactic Structures, reprint edition (Peter Lang Publishing, 1978).
[31] "How Marketers 'Profile' Users," USA Today (November 9, 1999), 2A.
[32] See http://www.three.org. Our conversations helped me to clarify my ideas, and I am very grateful to Jon for the ongoing exchange.
[33] Marcos Novak, lecture at "Interactive Frictions" conference, University of Southern Californa, Los Angeles, June 6, 1999.
[34] Graame Weinbren, In the Ocean of Streams of Story, Millennium Film Journal 28 (Spring 1995), http://www.sva.edu/MFJ/journalpages/MFJ28/GWOCEAN.HTML.
[35] Rick Moody, Demonology, first published in Conjunctions, reprinted in The KGB Bar Reader, qtd. in Vince Passaro, "Unlikely Stories," Harper's Magazine vol. 299, no. 1791 (August 1999), 88-89.
[36] Albert Abramson, Electronic Motion Pictures. A History of Television Camera (Berkeley: University of California Press, 1955), 15-24.
[37] Charles Musser, The Emergence of Cinema: The American Screen to 1907 (Berkeley: University of California Press, 1994), 65.
[38] Mitchell, The Reconfigured Eye (Cambridge, Mass.: The MIT Press, 1982), 6.
[39] Mitchell, The Reconfigured Eye, 6.
[40] Mitchell, The Reconfigured Eye, 49.
[41] Ernst Gombrich analses "the beholder's share" in decoding the missing information in visual images in his classic Art and Illusion. A Study in the Psychology of Pictorial Representation (Princeton: Princeton University Press, 1960).

[42] The notion that computer interactive art has its origins in new art forms of the 1960s is explored in Söke Dinkla, "The History of the Interface in Interactive Art," ISEA (International Symposium on Electronic Art) 1994 Proceedings (http://www.uiah.fi/bookshop/isea_proc/nextgen/08.html, accessed August 12, 1998); "From Participation to Interaction: Toward the Origins of Interactive Art," in Lynn Hershman Leeson, ed. Clicking In: Hot Links to a Digital Culture (Seattle: Bay Press, 1996): 279-290. See also Simon Penny, "Consumer Culture and the Technological Imperative: The Artist in Dataspace, in Simon Penny, ed., Criical Issues in Electronic Media (Alabany, New York: State University of New York Press, 1993): 47-74.

[43] This argument relies on a cognitivist perspective which stresses the active mental processes involved in comprehension of any cultural text. For an example of cognitivist aproach in film studies, see David Bordwell and Kristin Thompson, Film Art: an Introduction; David Bordwell, Narration in the Fiction Film (Madison, Wisconsin: University of Wisconsin Press, 1989).

[44] For a more detailed analysis of this tend, see my article "From the Externalization of the Psyche to the Implantation of Technology," in Mind Revolution: Interface Brain/Computer, edited by Florian Rötzer (München: Akademie Zum Dritten Jahrtausend, 1995), 90-100.

[45] Qtd. in Allan Sekula, "The Body and the Archive," October 39 (1987): 51.

[46] Hugo Münsterberg, The Photoplay: A Psychological Study (New York: D. Aplleton & Co., 1916), 41.

[47] Sergei Eisenstein, "Notes for a Film of 'Capital,'" trans. Maciej Sliwowski, Jay Leuda, and Annette Michelson, October 2 (1976): 10.

[48] Timothy Druckrey, "Revenge of the Nerds. An Interview with Jaron Lanier," Afterimage (May 1991), 9.

[49] Fredric Jameson, The Prison-house of Langauge: a Critical Account of Structuralism and Russian Formalism (Princeton, N.J.: Princeton University Press, 1972).

[50] Jurgen Habermas, The Theory of Communicative Action, trans. Thomas McCarthy (Boston, Beacon Press, c1984-).

[51] Druckrey, "Revenge of the Nerds," 6.

[52] Sigmund Freud, Standard Edition of the Complete Psychological Works (London: Hogarth Press, 1953), 4: 293.

[53] Edward Bradford Titchener, A Beginner's Psychology (New York: The Macmillan Company, 1915), 114.

[54] George Lakoff, "Cognitive Linguistics," Versus 44/45 (1986): 149.

[55] Philip Johnson-Laird, Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness (Cambridge: Cambridge University Press, 1983).

[56] Louis Alhusser introduced his influential notion of ideological interpellation in his "Ideology and Ideological State Apparatuses (Notes Towards an Investigation), in Lenin and Philosophy, trans. by Ben Brewster (New York: Monthly Review Press, 1971).

[57] Stephen Johnson's Interface Culture makes a claim for the cultural significance of computer interface.

[58] Other examples of cultural theories which rely on "non-transparency of the code" idea are Yuri Lotman's theory of secondary modeling systems, George Lakoff's cognitive linguistics, Jacques Derrida's critique of logocentrism and Marshall McLuhan's media theory.

[59] http://www.ntticc.or.jp/permanent/index_e.html, accessed July 15, 1999.

[60] Brad. A. Myers, "A Brief History of Human Computer Interaction Technology," technical report CMU-CS-96-163 and Human Computer Interaction Institute Technical Report CMU-HCII-96-103 (Pittsburgh, Pennsylvania: Carnegie Mellon University, Human-Computer Interaction Institute, 1996).

[61] http://www.xanadu.net/the.project, accessed December 1, 1997.

[62] XML which is promoted as the replacement for HTML enables any user to create her customized markup language. Thus, the next stage in computer culture may involve authoring not simply new Web documents but new languages. For more information on XML, see http://www.ucc.ie/xml., accessed December 1, 1997.

[63] http://www.hotwired.com/rgb/antirom/index2.html, accessed December 1, 1997.

[64] See, for instance, Mark Pesce, "Ontos, Eros, Noos, Logos," keynote address for ISEA (International Symposium on Electronic Arts) 1995, http://www.xs4all.nl/~mpesce/iseakey.html, accessed December 1, 1997.

[65] http://www.backspace.org/iod, accessed July 15, 1999.

[66] http://www.netomat.net, accessed July 15, 1999.

[67] Roman Jakobson, "Deux aspects du langage et deux types d'aphasie", in Temps Modernes, no. 188 (January 1962).

[68] XLM diversifies types of links available by including bi-directional links, multi-way links and links to a span of text rather than a simple point.

[69] This may imply that new digital rhetoric may have less to do with arranging information in a particular order and more to do simply with selecting what is included and what is not included in the total corpus being presented.

[70] See http://www.aw.sgi.com/pages/home/pages/products/pages/poweranimator_film_sgi/index.html, accessed December 1, 1997.

[71] In The Address of the Eye Vivian Sobchack discusses the three metaphors of frame, window and mirror which underlie modern film theory. The metaphor of a frame comes from modern painting and is central to formalist theory which is concerned with signification. The metaphor of window underlies realist film theory (Bazin) which stresses the act of perception. Realist theory follows Alberti in conceptualizing the cinema screen as a transparent window onto the world. Finally, the metaphor of a mirror is central to psychoanalytic film theory. In terms of these distinctions, my discussion here is concerned with the window metaphor. The distinctions themselves, however, open up a very productive space for thinking further about the relationships between cinema and computer media, in particular the cinema screen and the computer window. Vivian Sobchack, The Address of the Eye: a Phenomenology of Film Experience (Princeton: Princeton University Press, 1992).

[72] Jacques Aumont et al., Aesthetics of Film (Austin: Texas University Press, 1992), 13.

[73] By VR interface I mean the common forms of a head-mounted or head-coupled directed display employed in VR systems. For a popular review of such displays written when the popularity of VR was at its peak, see Steve Aukstakalnis and David Blatner, Silicon Mirage: The Art and Science of Virtual Reality (Berkeley: CA: Peachpit Press, 1992), pp. 80-98. For a more technical treatment, see Dean Kocian and Lee Task, "Visually Coupled Systems Hardware and the Human Interface" in Virtual Environments and Advanced Interface Design, edited by Woodrow Barfield and Thomas Furness III (New York and Oxford: Oxford University Press, 1995), 175-257.

[74] See Kocian and Task for details on field of view of various VR displays. Although it varies widely between different systems, the typical size of the field of view in commercial head-mounted displays (HMD) available in the first part of the 1990's was 30-50^{o}.

[75] http://webspace.sgi.com/WebSpace/Help/1.1/index.html, accessed December 1, 1997.

[76] See John Hartman and Josie Wernecke, The VRML 2.0 Handbook: Building Moving Worlds on the Web (Reading, Mass.: Addison-Wesley Publishing Company, 1996), 363.

[77] Examples of an earlier trend are Return to Zork (Activision, 1993) and The 7th Guest (Trilobyte/Virgin Games, 1993). Examples of the later trend are Soulblade (Namco, 1997) and Tomb Raider (Eidos, 1996).

[78] Critical literature on computer games, and in particular on their visual language, remains slim. Useful facts on history of computer games, description of different genres and the interviews with the designers can be found in Chris McGowan and Jim McCullaugh, Entertainment in the Cyber Zone (New York: Random House, 1995). Another useful source is J.C. Herz, Joystick Nation: How Videogames Ate Our Quarters, Won Our Hearts, and Rewired Our Minds (Boston: Little, Brown and Company, 1997).

[79] Dungeon Keeper (Bullfrog Productions, 1997).

[80] For a more detailed discussion of the history of computer imaging as gradual automation, see my articles "Mapping Space: Perspective, Radar and Computer Graphics," and "Automation of Sight from Photography to Computer Vision."

[81] Moses Ma's presentation, panel "Putting a Human Face on Cyberspace: Designing Avatars and the Virtual Worlds They Live In," SIGGRAPH '97, August 7, 1997.

[82] Li-wei He, Michael Cohen, David Salesin, "The Virtual Cinematographer: A Paradigm for Automatic Real-Time Camera Control and Directing," SIGGRAPH '96 (http://research.microsoft.com/SIGGRAPH96/96/VirtualCinema.htm).

[83] See http://www.artcom.de/projects/invisible_shape/welcome.en, accessed December 1, 1997.

[84] Jay David Bolter and Richard Grusin, Remediation: Understanding New Media (Camridge, Mass.: The MIT Press, 1999), 19.

[85] See Svetlana Alpers, The Art of Describing: Dutch Art in the Seventeenth Century (Chicago: University of Chicago Press, 1983). See particularly chapter "Mapping Impulse."

[86] This historical connection is illustrated by popular flight simulator games where the computer screen is used to simulate the control panel of a plane, i.e. the very type of object from which computer interfaces have developed. The conceptual origin of modern GUI in a traditional instrument panel can be seen

even more clearly in the first graphical computer interfaces of the late 1960's and early 1970's which used tiled windows. The first tiled window interface was demonstrated by Douglas Engelbart in 1968.

[87] My analysis here focuses on the continuities between a computer screen and preeceding its representational conventions and technologies. For alterantive readings will take up the diffirences between the two, see exellent artcles by Vivian Sobchack, "Nostalgia for a Digital Object: Regrets on the Quickening of QuickTime," in Millennium Film Journal (Winter 2000) and Norman Bryson, "Summer 1999 at TATE," available from Tate Gallery, 413 West 14th Street, New York City. Bryson writes: "Though the [computer] screen is able to present a scenographic depth, it is obviously unlike the Albertian or Reneissance Window; its surface never vanishes before the imaginary depths behind it, it never truly opens into depth. But the PC screen does not behave like the modernist image, either. It cannot foreground the materiality of the surface (of pgments on canvas) since it has no materiality to speak of, other than the play of shifting light." Both Sobchack and Bryson also stresss the diffirence between traditional image frame and multiple windows of a computer screen. Bryson: "basically the whole order of the frame is abolished, replaced by the order of superimposition or tiling."

[88] The degree to which a frame that acts as a boundary between the two spaces is emphasized seems to be proportional to the degree of identification expected from the viewer. Thus, in cinema, where the identification is most intense, the frame as a separate object does not exist at all — the screen simply ends at its boundaries — while both in painting and in television the framing is much more pronounced.

[89] Here I agree with the parallel suggested by Anatoly Prokhorov between window interface and montage in cinema.

[90] For these origins, see, for instance, C.W. Ceram, Archeology of the Cinema (New York: Harcourt, Brace & World, Inc., 1965).

[91] Beaumont Newhall, Airborne Camera (New York: Hastings House, Publishers, 1969).

[92] This is more than a conceptual similarity. In the late 1920s John H. Baird invented "phonovision," the first method for the recording and the playing back of a television signal. The signal was recorded on Edison's phonograph's record by a process very similar to making an audio recording. Baird named his recording machine "phonoscope." Albert Abramson, Electronic Motion Pictures (University of California Press, 1955), 41-42.

[93] Echoes of War (Boston: WGBH Boston, n.d.), videotape.

[94] Ibid.