KUNGL TEKNISKA HÖGSKOLAN
Royal Institute of Technology
Numerical Analysis and Computing Science

CID-63, KTH, Stockholm, Sweden January 2000

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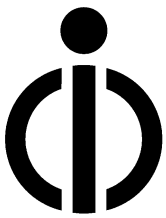
Anders Hedman and Sören Lenman



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Anders Hedman and Sören Lenman
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Report number: CID-63
ISSN number: ISSN 1403-073X
Publication date: January 2000
E-mail of author: ahedman@nada.kth.se, lenman@nada.kth.se
URL: http://cid.nada.kth.se

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CID, Centre for User Oriented IT Design
Nada, Dept. Computing Science
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In *Proceedings of AUSWEB 99, the 5th Australian World Wide Web Conference*, Ballina, Australia, April 18-20 1999, pp. 170-177

Visions of Hypermedia Architecture— Beyond Correctness

Anders Hedman

Center for User-Oriented IT-Design (CID
Department of Computer Science (NADA)
Royal Institute of Technology (KTH),
Stockholm, Sweden.
Tel: +46 8 790 92 83
E-mail: ahedman@nada.kth.se

Sören Lenman

Center for User-Oriented IT-Design (CID
Department of Computer Science (NADA)
Royal Institute of Technology (KTH),
Stockholm, Sweden.
Tel: +46 8 790 92 83
E-mail: lenman@nada.kth.se

KEYWORDS: Hypermedia architecture, orientation, accommodation, visualization, sensitization.

INTRODUCTION

Digital worlds on the World Wide Web (and elsewhere) in all their shapes and forms have gained greater momentum. This becomes evident from new terms in the general computer science discourse: digital libraries, digital communities, virtual worlds, and virtual reality. We believe, however, that an understanding of the requirements of digital worlds cannot be detached from a specific kind of subjective stance since digital worlds are necessarily digital information environments. This kind of subjectivity is indicated by the word "environment".

COMPUTER ARTIFACT DESIGN

There was a time in the field of computer science when software design was the sole privilege of engineers. That time has come to pass now. The road from the inception of the computer science field to today has been a road of theories, methodologies and ideologies. In the early days the focus of design was naturally on the software systems. They were difficult enough to design without taking the psychology of the user into account. Moreover, the early technologies and the lack of development tools did not allow for developing anything like advanced graphical and dynamic user interfaces.

After roughly fifty years of computing [Carlsson 96] we have the chance to experience a Copernican-like revolution. Today the focus is often said to be on "usability". The early days of computing focused more on the pure engineering aspects of design. The spotlight is on the user today. If we insist on a model of the user qua rational cognitive agent Schneider 98, Dix 93, Baecker 95], however, we will not be able to solve problems that lies within the subjective sphere of interactivity. We are like the man trying to find his lost keys under a street light rather than in the bushes were he knew he lost them.

BEYOND CORRECTNESS

In one digital worlds project [Hedman 97] we found that users disliked hierarchical structures. When we let users interact informally with a demonstration prototype of a dynamic web-based community they invariably complained about the rigid hierarchical structures. The complaints did not focus on the navigational inefficiency of the structures, but rather on their structural rigidity. The reactions were strong enough for us to abandon the project and go back to the drawing board. When similar hierarchical structures were deployed in a digital library application [Hedman 98, Hedman 99], no complaints were made.

Why was it users complained about the hierarchical structures in one application, but not the other? After all the structures were completely isomorphic. Our tentative answer is that one application was seen as a digital environment and the other was not. The library was simply viewed as a tool to handle information. The digital world was perceived as a place providing personal accommodations.

With regards to the HCI of digital worlds certain aspects are mostly cognitive. Users wish to be able to orient themselves and be able to find information. Some factors worthy of being mentioned in this respect are:

- Perspicuity (structural, procedural and social)
- Logical, predictable structures
- Perceptualization (ways of encountering information and structure)

The cognitive requirements are such that they do not depend on the psychology of the user per se. Thus we assume that all users want their digital environments to be perspicuous, logically arranged and encountered through adequate ways of perceptualization. These are requirements of a rational user. On such a perspective we neglect to take into account any background factors having to do with the associativity of the user. Our way out of this dilemma is to turn to the 'philosophy' which has embraced associativity in computer science–hypermedia.

Hypermedia once revolutionized our ways of thinking about information. It was the visions of people like Vannevar Bush, Ted Nelson, and Douglas Engelbart that opened up the field of mechanized associative information structures. They took the first steps away from the traditional ways of structuring information so emphasized before. They taught many of us that there is no correct way of structuring information, but only a giant field of possibilities. Inherent in much of the three giants of hypermedia is a kind of thinking that goes well beyond the user qua rational cognitive agent. Vannevar Bush wanted to save science from unmanageable information overload, Douglas Engelbart had visions of extending the human intellect and Ted Nelson conceived of giant public electronic libraries.

Inherent in the seed of hypermedia are the ideas that we need not think of information as having foundations, starting or end-points. How else could we conceive of information? Information has always, and will always be situated in networks, irrespective of its particular mode of

existence. Printed matter, spoken words, flickering images on a computer screen–these are all modes of information, but what is common to these modes is that they could not exist unrelated to other information. At a basic philosophical level, ideas and concepts can not be conceived of without relating them to other concepts and ideas [Searle 93, Searle 95]. On a somewhat higher level of abstraction, articles, magazines, and books are similarly related to other such entities. We see connections between the various works and we interpret them in the light of such relations.

Our model of digital worlds requirements builds on the associatively holistic tradition. As we move into the realm of digital worlds, we must rethink our very core concepts regarding the user as:

- A cognitive agent
- Goal driven
- Rational

Non-rational, subjectively determined behavior should be seen as the norm rather than the exception [Laurel 97, Nardi 96, Winograd 97]. Thus all design of digital words should be considered from a subjective stance embracing associativity as a truly essential characteristic of such environments.

NON-RATIONAL FACTORS AND ACCOMODATION

In lack of terminology we would like to describe the general subject matter as falling under a proposed label: accommodative design. What we mean by this kind of design can be roughly delineated as design from a perspective of:

- Estethics
- Culture
- Background and values

Whether a user prefers one digital hypermedia environment or another is on our proposed model not simply a matter of user-qua-rational-user requirements. We focus on the user experience within digital environments rather than the way they rationally process information. Instead we propose a subjective model:

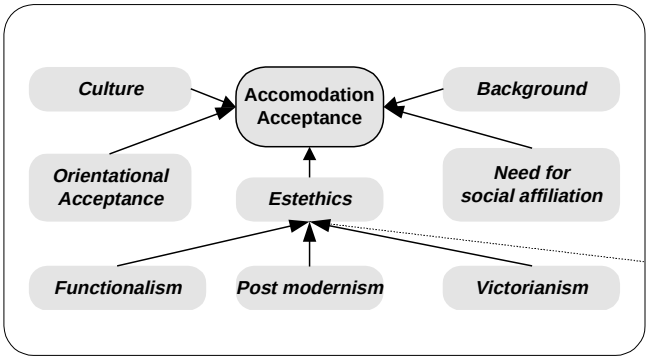

Figure 1 – Accommodation acceptance

We think of the subjective factors as determining how well a user accommodates to a digital community environment. Accommodation is seen as something unique to the user–a complex attitude to a digital environment–not lending itself to formal reduction. Just as there is in general no correct way of arranging information, there is no correct way of accommodating a digital environment. In our view attitudes stem from associativity and rather than modeling the user qua rational agent we think of the user qua associative agent.

ACCOMODATION VS ORIENTATION

Our conceptual basis for studying digital environments is based on the notions of accommodation and orientation. We see them as equally important to understand, and at the same time difficult to study. Admittedly, the concepts are hard to define and they overlap. Moreover, so far we have found no previous research that quite captures what we mean by accommodation. By accommodation we do not mean the way a user can adapt to the environment. Those who have studied Piaget's notion of accommodation might think our notion is the same as his [Bringuier 89]. We, are however, not primarily interested in those processes which lead a subject to be able to cope and master the challenges posed by her surroundings. Nor do we assume deterministic systematicity behind accommodation. Our notion of accommodation is more closely tied to attitudes and the willingness to accept or the readiness to reject an environment. In this sense the value of understanding processes becomes retrospective rather than prospective. If a user reveals accommodative dispositional attitudes then we ask ourselves why within a retrospective framework. Is it something within her general background, which triggered these attitudes? How can we analyze and trace out the relations between such background factors and the accommodative dispositional attitudes? We believe that it is possible to trace out taxonomy of archetypal background factors (accommodative determinants) that will help us understand better the dispositional attitudes of accommodation. Such a taxonomy is not meant to be thought of as deterministic, but as a framework for discussion.

One of the main difficulties is that accommodation and orientation can not be understood in isolation from each other. The phenomena are enmeshed with each other and cannot be clearly separated. Every three dimensional ordinary environment from baseball fields to forests and shopping malls provides us with accommodational as well as orientational cues. The same is true for any such environments simulated in digital environments. It appears we can also reverse the analysis and make the claim that accommodation is dependent on orientation, because if we are completely unable to orient ourselves in an environment then we will not be able to accommodate to it, thus orientational blindness leads to accomodational indifference. On our view the concepts go hand in hand and there is no way to reduce the one to the other. The strife towards such a reduction is as futile as that challenged by the proverbial riddle of the hen and the egg.

VISUALIZATIONS AS ORIENTING STRUCTURES

Our approach to visualization, which represents a continuation of earlier work [Lenman, See, Century & Pennycook 1996], emphasizes that users require different views of information at different times, depending on preferences, circumstances and tasks, and that procedures for switching between views must be user-controlled, rapid and appear seamless. Thus, an important aim is to make it possible for users to easily create views for exploring existing information structures, for generating new content and structures and for communication and collaboration. On this model, the parameters of visualization that needs to be considered are semantic zoom, filter and metaphor.

Semantic zoom refers to how much detail about content and structures is shown in a given view. The purpose of semantic zoom is to provide a bridge between orienting

overviews and closer views. For example, a user could quickly zoom out to get a contextual, orientating view, grasping the large picture of the structure, and then zoom in on a specific item. Such a mechanism is one way to simplify navigation in hierarchical information structures. An advanced, earlier system using this principle is Pad++ [Bederson 95].

Filter refers to what kind of content is shown in a view. For example, a user could choose to see only content related to "digital libraries". All other information in the view could then be filtered out completely, or shown in some subdued rendition. Filtering in visualizations can be regarded as a complement to searching, a way to keep the general picture while searching for specific information. It supports working with large amounts of information in flat, network views, as an alternative or a complement to hierarchical views of information structures.

Metaphor refers to the frame of reference used to organize the information in a view. A variety of metaphors can be used for visualizing the same content, e.g., a general information space, folders and subfolders in a desktop metaphor, or rooms, shelves and books in a digital library in a shared, three-dimensional digital world. The purpose of a metaphor is to reduce complexity in organizing information and to aid users memory by exploiting prior knowledge from different domains. However, forcing a single, detailed metaphor can be both cumbersome and counterproductive [Waterworth 89], and it is important to provide users with alternative ways of perceiving information.

Our current interest is in applying the visualization model to three-dimensional information spaces There are two lines of investigation that mostly are concerned with how different metaphors could be used to provide orienting structures. One line of work explores abstract visualizations: molecule-like, abstract representational forms, both as means for viewing existing structures of information and for generating new ones. This work is based on Visage [Algevere, Bäckström, Ehn, Hellvig, Nilsson, Wabyick, Weijnitz, 1997], a Java engine for automatically generating visualizations in VRML of documents and link-structures on the web. Currently very simple principles are used for representing information and links and for arranging them in 3D-space. As to documents, only two kinds are distinguished: HTML documents, which are represented as spheres, and non-HTML documents, which are represented as boxes. Links are represented by extended cylinders. The spatial arrangement is not related to the semantic content of the document; representations are simply placed where they fit. This will of course be elaborated upon in future versions. Recently work has also been initiated to create a shared editor using this technology [Trujillo 1998].

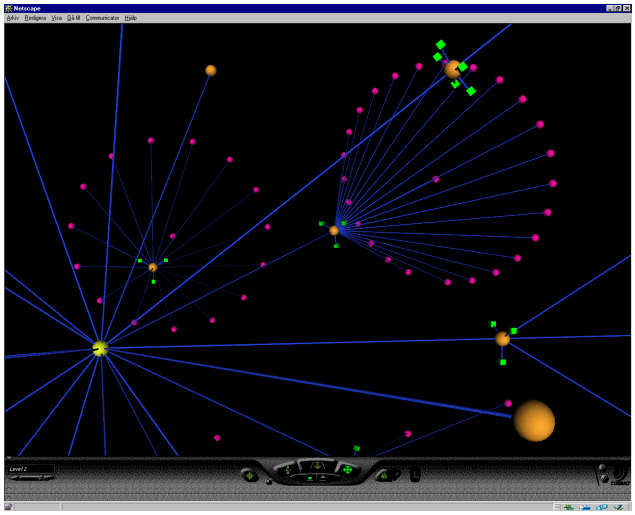

Figure 2 – Visage Visualization

Another line of work, taking the point of departure at the opposite end of the spectrum of metaphors, explores the use of shared 3-dimensional spaces for visualization, based on real-world metaphors. Orienting structures can be represented, e.g., as buildings with rooms, bookshelves and books. Users are visualized as avatars, and simultaneous users can see each other, and communicate in real time through text chat. The Active Worlds technology[1] is currently used for prototyping, but a number of suitable tools for this purpose are rapidly becoming available. An interesting problem concerns automated construction of digital worlds, i.e., how to algorithmically generate structures in accordance with a certain real-world metaphor.

STUDY OF ORIENTATION AND ACCOMODATION

In order to study the notions of orientation and accommodation as they apply to digital environments, we have recently initiated a project were students from the University of Stockholm will have the opportunity to make use of course material from within a digital worlds environment. A setting such as this with a group of students enrolled in a distance learning course enable us to evaluate our model and engage in empirical research. In order to do this we have placed a web-based digital library [Hedman 98, Hedman 99] within a digital world. The students can access the library with its course materials through the digital world, but they can also move out into the digital world from the digital library. Traditionally distance education over the Internet has not involved digital worlds. Most courses have been built around hyperlinked web pages. In such settings the students will, in our view, not have a chance to experience accommodation to any greater degree. Without strong accommodation we hypothesize that the setting can not be fully experienced as a place of learning, but rather as an orientational structure harboring information–an information nexus.

Our aim is to go beyond an information nexus and provide place of learning. Such a place will be characterized by the information available, as well as the accommodations provided. For example, the students may decide to visit the library as a quick way of obtaining information, but when they feel a need to communicate with other students they might venture out into the digital world were they could discuss the course materials with other students and instructors. The digital world, however, provides for more than social interaction. It is also a place were students can

walk around in an exhibition hall with learning materials. Such three dimensional exhibitions provide for ways of organizing and interacting with learning materials.

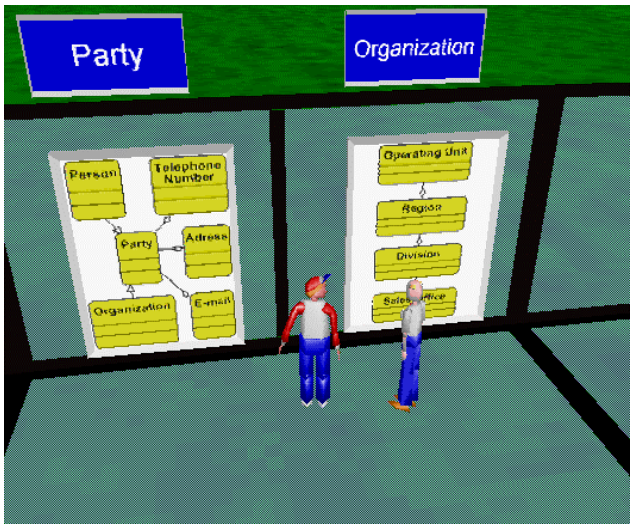

Figure 3 – In the exhibition hall

The ways in which users can orient themselves within an exhibition hall cannot be de-coupled from the process of leaning. The person familiar with cognitive psychology is likely to have stumbled on the notion of cognitive maps as a way of memorizing and accessing information. Roughly, such maps are spatial representations that a person deploys as a memory aid. Thus if one wishes to hold a speech, for example, one can visualize a familiar spatial setting such as a campus, and then mentally place different parts of the speech in different locations on it. Holding the actual speech then becomes a matter of walking through the campus picking up the relevant parts of the speech as one is holding the speech. The mental representation in such a case serves as an orienting structure helping one to navigate through the parts of the speech. In a similar vein, we wish to see how students could deploy parts of a digital world as orienting structures for learning materials.

CLOSING WORDS

Hypermedia has revolutionized our ways of structuring and working with information. The works of Bush, Engelbart and Nelson has opened up our eyes to associative ways of organizing information. What has largely been neglected, however, is the idea that what fueled the fire of the hypermedia revolution was insights regarding our ways of working with information. The visionaries of hypermedia were all aware of our powers of association. Thus Nelson has long argued that the world of literature has always existed in an associative network, and Engelbart wished to augment our intellects through associative texts as did Bush. In a sense what we are advocating here is that we take a step back into "the head" and reexamine what bearing associativity has on our interaction with hypermedia and digital worlds. It is the neglect of the associative mind within the HCI of digital worlds that we find troublesome. What associations a particular human being makes in a digital world, what attitudes arise from those associations, and her emotions is something that goes beyond correctness and the user qua rational agent.

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[1] http://www.activeworlds.com