The Electronic Broadsheet


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-all the news that fits the display

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Submitted to the Media Arts and Sciences Section, School of Architecture and Planning, in partial fulfillment of the requirements of the degree of Master of Science at the Massachusetts Institute of Technology, June 1991

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The Electronic Broadsheet

-all the news that's fit to display

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ABSTRACT

Developments in screen technology and computer hardware have given us color displays with resolutions up to 2000 lines and a screen area of broadsheet size. These computer newspapers gives us a range of new possibilities and pitfalls in content selection, imagery, typography, and human interaction.

This study describes the implementation of a display application that presents broadsheet-sized electronic newspapers to the reader. The program explores the possibilities that large screens offer, and the implications of using large screens are discussed.

The display application also takes advantage of the dynamic nature of a computer display. Much of the newspaper metaphor has been preserved, while the computer invites instant updates and user participation.

Current computer architectures do not provide adequate performance to drive the large monitor, and the electronic newspaper is augmented by dynamic screen updates and navigational tools to better competer with paper-based news distribution. Still, the large monitor has proved an excellent device for electronic newspapers as well as a general purpose X11 workstation. At 2000 lines we are reaching the threshold of paperlike access to information.

The display application is the user interface module of the Newspace project.

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1 INTRODUCTION

Recent advances in display technology include the development of both large and flat displays: CRT technology is approaching laser printer resolution; flat screen technologies are making rapid strides, mostly due to the popularity of portable displays and the perceived attractiveness of a large flat screen television. Such technologies enable one to rethink the way in which electronic information is accessed.

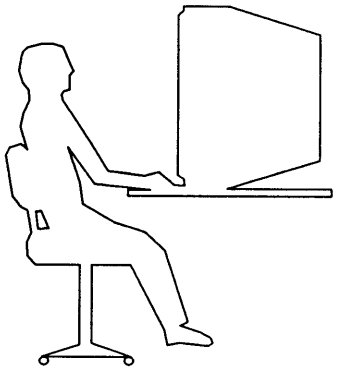

Figure 1: The large monitor as it's being used today.

In this thesis I discuss how large computer displays will change the human interface of computer applications. I have been using a broadsheet-sized color monitor as the primary display on my workstation for more than a year now. Through the X11 window system, the screen gives me access to all normal computer applications, e.g., electronic mail, word processors, drawing programs, and games—lots of them! Using a generous programming editor window, I developed a news presentation system that takes advantage of the screen's similarities with a newspaper front page.

The X11 Window System (X11) is the de facto standard on UNIX workstations.

The display has four times more pixels than an average X11 workstation, and it is used differently. The difference cannot be measured in square centimeters only; when using the large display, screen space management shifts emphasis from screen area conservation to screen overview. Suddenly the peripheral vision becomes a communication channel [Mollitor 90], and new metaphors become available for interacting with the computer. See figure 2. One of these metaphors, the newspaper metaphor, is discussed in detail in this thesis.

[Mollitor 90] Mollitor, R C: Eloquent Scenery: A Study of Pheripheral Visual Communication; SM Thesis, MIT Media Lab, 1990

The hypothesis in this project is that large screens are better for electronic newspapers than smaller ones, and that they are increasingly competitive with newsprint.

1.1 Digital News

News has been available to consumers in digital form for some time now. On-line systems like Compuserve offer news from several wire services, and many newspapers provide subscription access through a modem. Some of these systems also let users specify topics of interest to offer a certain degree of personalization. Still, most people prefer to receive the paper version on the doorstep every morning instead of reading news off a screen. This project applies state-of-the-art technology to see if it is possible for an electronic newspaper to start competing with paper.

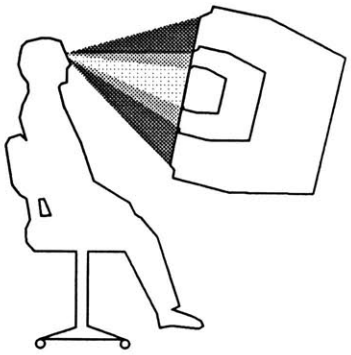

Figure 2: The large screen leaves more of the screen surface in the peripheral vision—a challenge and opportunity. The large screen is compared with a standard Macintosh and PC display.

There are many reasons why paper-based newspapers are preferred to their electronic counterparts. The paper-based version is cheaper, it's easier to fold over a breakfast table, and it's illustrated. The front page gives readers an instant overview over the most important stories, and the headlines make it possible to scan large amounts of information quickly. Paper-based news distribution has a long tradition and centuries of experience stand behind today's formats. Pages, headlines, columns, and fonts have been tuned in form and function. They all are a part of a user-friendly and universally accepted product. I believe the newspaper metaphor is highly applicable to large screen interaction in general, a topic which will come up throughout this thesis.

Current screen-based news distribution lacks many of these properties. Limitations in display technology have barred the presentation of a full-sized page with attractive text and images of acceptable legibility. This is about to change. Developments in screen technology and computer hardware have given us color displays with resolution up to 2000 lines and a screen area as big as a newspaper broadsheet-sized page. These features enable the computer display to rival paper for the first time and present an opportunity to present full-size on-screen electronic newspapers.

The single biggest obstacle for computer displays to compete with paper is the physical properties of the media. Paper is a very flexible medium that can be folded, torn and eaten. No

known display technology approaches these properties—even if we extrapolate ten or twenty years ahead. Therefore, in order to compete with paper, an electronic newspaper needs additional functionality in areas in which paper cannot compete, e.g.:

- personalization
- dynamics
- user participation
- navigation.

The latter one, navigation, is essential to the implemented presentation system. Little work has previously been done in this area and I examine navigation in virtual space diligently.

1.2 Context

Over the past years the Electronic Publishing Group in the MIT Media Laboratory has been conducting a series of media experiments that explore personalized newscasts. These projects are described in [Lippman 86], [Lippman, Bender 87], and [Bender, Chesnais 88] and are collectively referred to as "Newspeek". The most recent project, "Newspace"—the name is borrowed from the virtual space in which articles are displayed— is an attempt take advantage of advances in display technology to create a scalable electronic newspaper [Bender et al. 91]. The project addresses news gathering, manipulation, and presentation; The Electronic Broadsheet is an implementation of a presentation module for a large display under the Newspace project. See project outline in figure 3.

Personalized news filters select news according to the reader's interests and levels of knowledge. The selected news is passed over to a display application that is responsible for formatting the news and presenting it to the reader. The presentation is sensitive to the preferences of the reader and the display equipment available. A major part of this thesis project has been to implement the presentation system for a broadsheet-sized monitor.

[Lippman 86] Lippman, A; Electronic Publishing; MIT Media Lab, 1986

[Lippman, Bender 87] Lippman, A; Bender, W; News and Movies in the 50 Megabit Living Room; paper presented at Globecom, IEEE, Tokyo, Japan, 1987

[Bender, Chesnais 88] Bender, W; Chesnais, P: Network Plus; Paper presented at SPSE Electronic Imaging Devices and Systems Symposium, Los Angeles, January 1988

[Bender et al. 91] Bender, W; Lie H W; Orwant J L; Teodosio, L; Abramson, N: Newspace: Mass Media and Personal Computing; To appear in USENIX, Nashville, June 1991

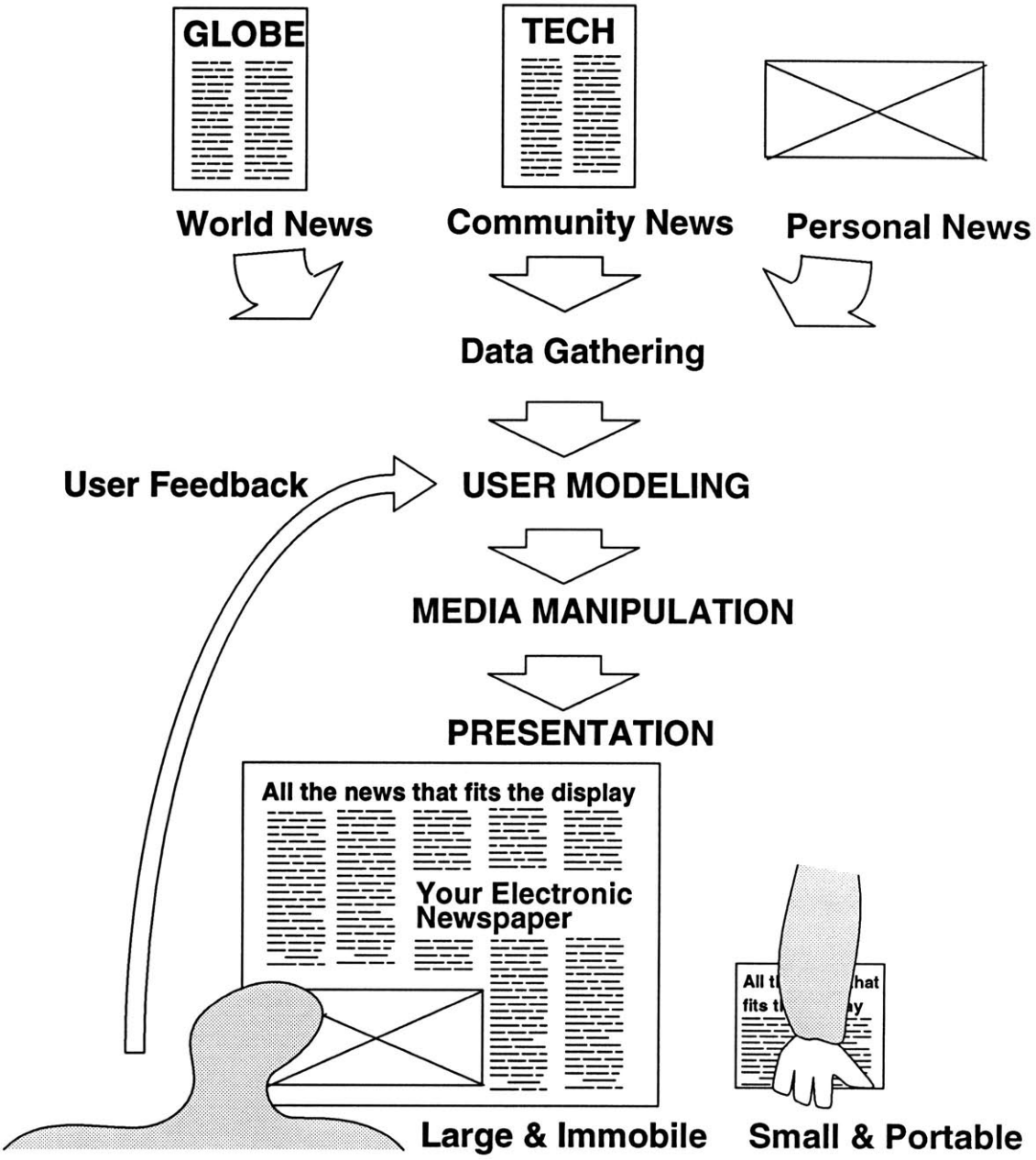

Figure 3: Outline of the Newspace project. Once data streams are converted to a common format, rudimentary content analysis is performed, decomposing the data into objects. The data is passed to the user model, which presents a subset of the news to the media manipulation module, which in turn provides the display with a coherent, complete presentation. User interaction with the display module, as well as events external to the news application provide feedback to the user model.

Other projects [Hoffert, Gretsch 91] [Erickson, Salomon 91], in addition to previous Newspeek projects, have also taken news in digital form and presented it screen-base newspapers. The innovation in this project is the size and nature of the screen; I explore the impact large screens have on human-computer interaction in general and especially electronic newspapers.

[Hoffert, Gretsch 91] Hoffert, E M; Gretsch, G: The Digital News System at EDUCOM: A Convergance of Interactive Computing, Newspapers, Television and High-Speed Networks; Communications of the ACM, No. 4, April 1991

[Erickson, Salomon 91] Erickson, T; Salomon, G: Designing a Desktop Information System: Observations and Issues; ACM/SIGCHI'91 Conference Proceedings, pp 49-54, May 1991

1.3 Definition of Terms

This report does not use a difficult language and the concepts and ideas presented are easy to grasp by people familiar with newspapers and computers. However, there are some terms that need to be clarified. Some are key concepts that borrow their names from an everyday vocabulary with no clear definition, while others are terms introduced in this thesis. Synonyms used throughout the thesis are listed in parentheses after the terms.

The Electronic Broadsheet implements the user interface of an electronic newspaper—**readers** (reader = user) read it directly on the computer **display** (display = screen = monitor) instead of on paper. The newspaper consists of **articles** (article = story). Each article is made up of one or more of the following: **text, still pictures and video sequences**. An article has a **headline**, various **tags** (e.g. the name of the author), and one or more **columns** containing text and/or illustrations. A video sequence contains several picture frames that are being displayed continuously in sequence at the request of the user.

The primary display for the Electronic Broadsheet is a color display with a resolution of 2048*2048 pixels (2048*2048 display = 2k display ≈ 2000-line display). Before articles can be displayed on the screen they must be rendered into **pixmaps** that are 8 bits per pixel (bpp) deep. The monitor displays the pixmaps at 100 dots per inch (dpi). The size of the monitor is comparable to the newspaper **broadsheet**, i.e., the format used by the western elite press.

Pages in The Electronic Broadsheet are laid out in a **newspace**—a concept that also lends its name to the group of projects in which The Electronic Broadsheet is a presentation module. When referred to as the project Newspace I capitalize the word, else it refers to the virtual two-dimensional space in which news articles are laid out. The secondary display provides the reader with a map of the newspace. The 2k monitor pans over the newspace to display a selected page.

The resolution of the secondary screen is 1280x1024—referred to a 1K monitor. The different **sections** of The Electronic Broadsheet occupy one **page** each in different areas of the newspace.

1.4 Organization of this Paper

In the first part of this thesis report I analyze some merits and flaws of the newspaper format in general, and particularly the broadsheet format used by the western elite press. I also describe my hypothetical ideal newspaper in an imaginary world with a plethora of digital transmission channels, a surplus of processing power and elevated display technology.

The second part of the thesis describes resources currently available for digital news manipulation and presentation, and how The Electronic Broadsheet was implemented under the given constraints. It is far from the perfect product, but it offers some features of the ideal newspaper.

PART I: THE IDEAL ELECTRONIC NEWSPAPER

2 THE NEWSPAPER METAPHOR

The user interface of newspapers has been developed and standardized throughout centuries. Despite sociological differences, publishers and editors from different parts of the world can meet to discuss the content, role, and technology of newspapers—just as readers from different parts of the world can pick up a local paper and immediately know how to read it if the written language is known. The different elements of the newspaper interface are collectively known as the "newspaper metaphor". It is important to understand how the various elements of the newspaper work together before trying to transcode them into new media.

2.1 Newspaper Building Blocks

The **front page** is the most distinct feature of the newspaper format. It was invented 300 years ago [Gürtler 84], and has changed little since then. Without exception, industry predictions of the future of the newspaper include a front page [DESIGN 88]. The upper part of the front page is covered by the **nameplate** that carries the newspaper's name. Traditionally, the nameplate is positioned at the top of the page, centered, and often set in an old font type that reflects the dignity of the medium.

[Gürtler 84] Gürtler, A: The history of newspaper design; Swiss Typographic Journal, 1984

[DESIGN 88] DESIGN: Newspaper Design—2000 and Beyond; American Press Institute, 1988

The area below the nameplate is dominated by the **headlines** of the most important stories. The size of the headline font reflects the relative importance of an article. The article itself is printed under the headline. Since American newspapers put more articles on the front page than there is room for, only the first part of the article is printed. To read the last part, the reader must jump to an inside page.

Some tabloid newspapers use the front page to advertise for articles on inside pages, or carry only one article on the front page. Their existence is interesting, but when discussing newspapers I refer to the elite press' traditional broadsheet format.

The articles are laid out in **columns** of fixed width. This makes line lengths shorter than e.g. in books, and leading can be reduced since the horizontal retrace is shorter and easier

to follow for the human eye. These factors make it possible to put more text on each page. The fixed width of the columns also makes it easier to tile articles of different size and shape.

While the front page contains articles from several categories, inside pages are more specialized. Main categories have their own section, such as "sport" and "business". Within these sections are found additional detail, related topics, and juxtapositions.

Together, the elements of the newspaper form a user-friendly product that is universally accepted and highly functional for its purpose.

2.2 The Newspaper Interface

The basic building blocks of the newspaper turns into an advanced user interface when skilled editors and typographers collaborate on the product. When preparing the newspaper, and especially the front page, editors process the information to accommodate all readers. A reader that only spends a few minutes browsing the news will easily pick out the main stories by skimming the headlines, which summarizes the content.

The size of a newspaper broadsheet makes it possible to display huge amounts of information. By scanning the front page, the reader can get an overview of the most important issues in a matter of seconds. Large quantities of news can be searched with little or no predetermined focus. The process of scanning helps the user to uncover and read articles of interest, without incurring significant overhead on the part of the reader either in terms of time or effort.

Simply by switching from scanning to reading, the user is able to change modality from overview to detail. The front page is your menu in which the selections are available immediately. If the reader finds that the wrong selection was made, i.e., the wrong article is being read, the menu is still there to choose from.

The newspaper is a static medium for one way communication only. Still, by turning to a section page a reader can drastically change the content of the page being looked at. The stories on the page become more specialized, and in one sense the reader has interacted with the editors of the newspaper. By turning to the section, the reader requests more information, and the editor provides more coverage. Of course, the interaction is predefined and limited to the content of the newspaper edition.

Newspapers provides a facile and forgiving interface by not demanding anything from the reader, and they update themselves without requests. It's a forgiving interface; even if a subscriber ignores the paper for a week, the journalists and editors will still produce new editions.

Journalists write most stories in the "inverted-pyramid style"—the main points of the story are described in the first paragraphs, the last ones are written with the editor's scissors in mind, i.e., they may be cut. Therefore, by reading a paragraph or two, the reader will comprehend a disproportionately large part of the news. Minimum effort is required to digest 10% of the print, and there is little penalty in skipping the remaining 90%, but the information is there if the reader has the time and interest.

An alternative to the "inverted-pyramid" is the narrative style sometimes used by American newspapers.

2.3 The Computer Interface

There are fundamental differences between the newspaper interface and that of the usual computer information retrieval system. Computers offer largely sequential access under direct control of the user. No assumptions are made by such systems as to the user's intent, therefore the presentation of the data is not tightly coupled to its retrieval.

Computer interfaces also make use of menus of various kinds where the user chooses a specific element from a list, after which the computer executes the selection. Typographical cues are rarely used to differentiate items. If the computer performs a successful search, the result is displayed on a small screen with few typographical clues.

Then, the computer requires the user to issue several commands, like pan or scroll, to show the full result of the retrieval. In comparison with a newspaper front page, the computer menu falls short.

Modern computer programs are event-driven, i.e., nothing will happen unless the user issues commands, e.g., a mouse click or button press. The interface keeps the user active and in control, and if the user is inactive, most computer programs will remain passive. Editions of a newspaper, in comparison, will keep coming without user feedback.

While newspapers are a universally accepted and understood product, computer code requires specific hardware and specific versions of the operating system to run properly. The user interface of computer programs varies enormously from system to system. Even programs based on the popular "desktop metaphor" cannot be interchanged freely—neither by computers nor humans.

As long as computer manufacturers sue each other on the basis of "look&feel," graceful user transition between different systems is not likely to happen [LPF 90].

[LPF 90] League for Programming Freedom: Against User Interface Copyright;1990

3 HOW CAN NEWSPAPERS BE IMPROVED?

As we have seen, traditional newspapers often compare favorably with their hi-tech counterparts, and the newspaper metaphor is one of the cornerstones in The Electronic Broadsheet. Still, the newspaper format has its shortcomings and in this chapter I discuss how my ideal newspaper would be different from the newspapers we know today.

3.1 Dynamics

Newsprint is a static medium. After the ink is put on paper it doesn't move—except onto the fingers of the reader. This has two important implications: articles don't get updated and the medium can't show moving pictures. Television signals, on the other hand, transmit moving images from the broadcaster to the receiver instantly. Assisted by satellite technology, television newscasts are able to report live from any corner of the world. During the recent Gulf war, television networks transmitted news from the Middle East continuously and were the primary source of news—even military leaders admitted getting news from CNN. Traditional newspapers will never be able to compete with TV screens under such conditions. In retrospect, however, one must admit that little of the live coverage from Saudi Arabia was high quality reporting, and many hours were wasted watching a newscast that could have been compressed by a magnitude without losing significant information.

In fairness to the reporters: military restrictions were imposed upon them.

The case illustrates both the strong and weak side of television newscasts; they can capture the moment in real time like no other medium, while the linear nature of the newscast makes browsing impossible.

The ideal newspaper will be a dynamic medium both with regard to article updates and moving images. News will reach readers moments after it is made available, and video

sequences should be a natural part of the news presentation. Both these demands imply that the transmission medium of the ideal newspaper will be electronic.

3.2 Personalization

Usually, the term "news" is used about events on a local, national and global level. It is important to read newspapers and watch newscasts on TV to be considered up-to-date, but it's not sufficient. Messages from your bank and your manager is also important information—information that is normally transferred through other channels. The bank sends you a monthly statement while today's managers may send an electronic message. This kind of information is also essential to keep abreast; an extended definition of news should include all information a person needs to be considered up-to-date. The ideal newspaper will display selected information from the extended definition of news.

Extended definition of news: *all the information that a person needs to be considered up-to-date.*

3.2.1 Filters

One approach to personalized news selection is to "filter" a stream of incoming articles. Only those stories that presumably interest the reader get through. The filter is a necessity since no one is interested in reading thousands of articles per day.

The idea of removing articles from the view of the reader is hard to accept for some people; they claim it will narrow horizons. It is important to keep in mind that the pool of news that articles are selected from is many times larger than the size of a newspaper. Therefore, the range of articles may, depending on the reader's profile, be wider than the range of articles found in newspapers today.

Also, current newspapers use filters: the editor selects information that is to be published in the newspaper, and the choices are made on the basis of an imaginary average reader. Anthony Smith observes:

> "Only about 10 percent of the total information collected every day in the newspaper's newsroom and features desk (all of which is held on-line, i.e., in continuous direct communication with a computer) is actually used in the paper, and yet, according to most surveys, the reader only reads 10 percent of what has gone into his paper. It seems, therefore, that the whole agony of distribution is undergone in order to feed each reader just one percent of the material that has been so expensively collected." [Smith 80]

[Smith 80] Smith, A: Goodbye Gutenberg: The Newspaper Revolution of the 1980s; Oxford 1980

Also, see section 3.2.3.

3.2.2 Research Agents

Reading news is sometimes a creative process that spawns further interest in the topic. The newspaper should be able to automatically recognize these interests—or, there should be an easy way of conveying the interests. In addition to updating the dynamic filters, sometimes a more active and immediate approach is necessary to fetch relevant background information. While the electronic news pool is ever growing, it mostly covers new events. News articles do not provide sufficient background material to get a thorough understanding of the problem discussed from reading one article. Background data is peripheral to news coverage.

However, background information is needed to be considered up-to-date and therefore falls under the extended definition of news. Using the filter metaphor, one would have to send **all** possible background information through the filter to find relevant data. Obviously, this is not possible. Instead, **agents** provide a convenient metaphor for active data gathering.

An ideal future newspaper doesn't necessarily need to provide all relevant background data when reporting on a subject; few people would have the time to exploit the data fully. Instead, articles should include references to relevant information, e.g. a record number into an electronic library. The system could then dispatch "agents"—small pieces of code that would fetch background information from electronic sources when requested.

By representing the user, agents reveal sensitive information about interests and reader habits. By systematically registering agents' requests and their owners, a library can build an extensive database of a user's reading habits. Therefore, privacy issues should be stressed when designing these systems. See also section 3.6.

3.2.3 Serendipity

An issue of great concern for visitors seeing the Newspace project is serendipity. While browsing traditional newspapers, articles catch their eyes, even if they initially were not interested in the topic. They suspect that this will not happen in an electronic newspaper (re: section 3.2.1). Their concern is justified: an article selection mechanism that only selects stories from subjects the reader already is interested in will narrow horizons. One way of addressing the issue is to design a conscientious selection mechanism

that always picks a certain number of stories outside the current scope of the reader. The "consciousness" quota could be based on:

- priority: if a story about WWIII comes in, the reader should know about it even if international conflicts is not on the list of interesting topics
- local/global context: both local and global news are important for raising good world citizens. Both these categories should be represented in all personalized newspapers, although some may question the authority behind forcing subjects onto a reader.
- a random factor: some totally random articles will enliven any newspaper

Serendipity will be addressed in the user modeling / article selection module of Newspace, but the presentation format also concerns the issue. When using a large monitor with room for many articles there is also room for mistakes. An article that is totally out of place when covering a tabloid-sized screen may very well be ignored by readers on the 2k. The interface is forgiving, and the selection mechanism is allowed to take chances.

3.3 Format Transcoding

Paper is a very flexible medium that can be folded, torn, and eaten. Since traditional paper distribution was eliminated as the transmission channel for our ideal dynamic paper (see section 3.1), we must replace it with something just as flexible. This can not be accomplished with any single known technology—even if we extrapolate ten or twenty years ahead. Instead, the new newspaper should be able to transcode news into different output devices. If the reader needs a foldable paper to go, the natural device would be the closest laser printer. If the reader wants something portable, but dynamic, a notebook computer makes sense. If the reader is stationary, a large paperlike screen is the medium of choice. Transcoding between various formats is not trivial

since the functionality offered by different hardware vary, e.g., most notebook computers do not yet have color screens. See chapter 11 for a discussion on some of these issues.

3.4 Two-way Communication

Users of electronic mail enjoy two-way communication; "reply" is an intrinsic function in all electronic message systems. Traditional newspaper distribution channels, on the other hand, are inherently one-way links. If subscribers want to respond to newspaper articles they must use other channels—like sending a letter to the editor or canceling the subscription. Using digital links to carry news will make two-way communication between information producers and information consumers feasible. There are several people a reader could want to respond to after reading an article:

- The author—the name of the author is often mentioned in today's newspaper, but there is seldom a reply address. The ideal newspaper article should include an electronic address.
- The editor—some of the functions of today's editor will be taken over by a computer in tomorrow's newspaper. Still, there will probably be someone screening and juxtaposing information claiming the title "editor".
- People described or quoted in the article.
- People who read the same stories as yourself—they are likely to have similar interests and opinions.

One example to illustrate the last point: an article about a proposed highway project in your backyard is likely to pop up on your front page. In order to fight the development plans you have to team up with other people that are against the plans. By sending a message to everyone who read the article you are likely to reach people in the same situation as yourself. One could limit the target group by sending the message to those that read the article **and** lives within 2 km.

..and thereby possibly excluding the industrious planners

Even though this functionality is technically possible, the question is not merely technical. It raises the issue of who owns the information in the user model database. See section 3.6 for a discussion on this topic.

If all described channels for reply become available, the clear distinction between information producers and consumers might fade since consumers will be able to easily distribute information themselves.

3.5 Statistics

Since the personalized newspaper will adapt to and follow the changing interests of the readers, the front page presented to each reader will vary vastly. Today, a subscriber of The New York Times (NYT) knows that opinions expressed in the editorial sections reflect prevailing beliefs in the American society. The "underground press", on the other hand, prints alternate views and the reader is well aware of the biased opinions. When news articles from these two sources suddenly appear side by side, the distinction will be harder to make.

One way of addressing this problem is to emulate the pre-electronic form of the medium, e.g., print all NYT headlines all-caps like the paper version does today. This can provide the reader with certain clues, but distinctions will not be unique and can be overrun by user preferences.

Another interesting solution is to collect readership statistics electronically. A reader could be given an estimated "mainstreamness" factor per article, and an overall "rating". The factors indicate how similar/different the news presented is to other people's presentations. The data will also be a rich source for sociologists. Collecting the information needed for such a utility is not trivial, and a number of ethics questions can be raised, but the idea is intriguing.

3.6 Ownership of User Modeling Data

Personalized newspapers consult a user profile when selecting articles to be displayed in the newspaper. The profile by definition contains personal information about the reader and this information is often sensitive. One question that quickly arises is who owns the data. Many groups may be interested in collecting information found in the personal profile; a group that easily comes to one's mind is advertisers. Personalized advertising may enrich the content of the newspaper and provide funding. Still, personal information should be closely guarded.

I believe that each reader should be considered the owner (where "ownership" means roughly the same as copyright) of all personal information stored in the profile, including name, address, reading habits and areas of interests. This question is complex and the scope if this thesis does not allow for the discussion the topic deserves, but I would like to point out one way to possibly obtain the functionality without releasing any personal information. The electronic conferencing system known as USENET [Coursey 91] handles more than 11Mb of messages every day, and it is not possible to find out what messages a user reads unless you have access privileges to the user's files. Each site subscribes to a set of conferences and the corresponding messages are transmitted whether someone reads them or not. By moving the selection process close to the reader one can buy privacy at the cost of bandwidth. As bandwidth grows cheaper, privacy will remain valuable.

[Coursey 91] Coursey, D: Riding the Internet; INFOWORLD, February 4, 1991

4 NAVIGATION

In an ideal newspaper, readers use less time searching through news and more time concentrating on the actual content. One way of achieving this is to provide pertinent navigational clues. First, let us examine how readers navigate through traditional newspapers.

4.1 Navigational Clues in Traditional Newspapers

To navigate through newspaper pages can be a frustrating experience. A Sunday edition of The Boston Globe contains around 200 broadsheet pages. Only a small percentage of the information is interesting to the average reader (see section 3.2.1) but finding that information can be hard. Newspapers give their readers some navigational clues. Many include an index and "pointers" on the front page as well as page numbers on every page. Bigger newspapers contain multiple sections that often are structured with regard to their content, e.g., the "arts" section.

Since newspapers use a rather fixed format from day to day readers navigate more easily through a familiar newspaper. This will also be exploited by the ideal paper, but it is not sufficient.

4.2 Maps

A map is a 2-dimensional representation of a domain at a smaller scale. The represented domain can be of two or more dimensions. Most often the domain is a piece of land, but it can also be a mathematical object, e.g. the Mandelbrot set [Mandelbrot 82].

Maps are isomorphic, i.e., the map is identical with or similar to the domain it represents in form or structure [Fishler, Firshein 87]. This property is also called iconic or analogical. Cartographers try to create a scaled-down view of reality to assist users in the understanding of spatial relationships.

[Mandelbrot 82] Mandelbrot, B: The fractal geometry of nature; W.H. Freeman, San Francisco, 1982

[Fishler, Firschein 87] Fishler, M A; Firschein, O: Intelligence - The Eye, the Brain, and the Computer; Addison Wesley 1987

One important aspect of maps is the information they do not convey. Maps are selective, they present a selective view of reality only showing some features of the domain [Hodgkiss 81]. The cartographer selects the features that will become amplified while most of the information in the domain is discarded. A road map will try to give the user navigational clues that may be useful when driving a car by amplifying major roads, cities, and state borders. A topographic map tries to escape flatland by including contour lines to visualize the third dimension.

[Hodgkiss 81] Hodgkiss, A G: Understanding Maps, A systematic history of their use and development; Wm Dawson & Son Ltd, 1981

Colors play an important role in maps. Tufte [Tufte 90] lists four ways color can enhance a map and uses a topographic mountain map as an example:

[Tufte 90] Tufte E R: Envisioning Information; Graphics Press, 1990

> [..] the fundamental uses of color in information design: "to label" (color as noun), "to measure" (color as quantity), "to represent or imitate reality" (color as representation), and "to enliven or decorate" (color as beauty). Here color "labels" by distinguishing water from stone and glacier from field, "measures" by indicating altitude with contour and rate of change by darkening, "imitates reality" reality with river blue and shadow hachures, and visually "enlivens" the typography by quite beyond what could be done in black and white alone.

A standard code for the use of colors in maps has evolved. Topographic information is printed in brown, water features are shown in blue and cultural (man-made) features in black and red. An interesting by-product of this use of colors is that one, by taking color separates of maps, can isolate features and produce special purpose maps [DOI 80]. By removing one or more separates one will amplify the remaining information in much the same way as the map-making process amplifies selected features.

[DOI 80] Map Data Catalog; U.S. Department of the Interior, 1980

4.2.1 Different Types of Maps

Most maps are drawn using lines and to some extent shading. These rendered images are known as "line maps" as distinguished from photomaps which are derived from a

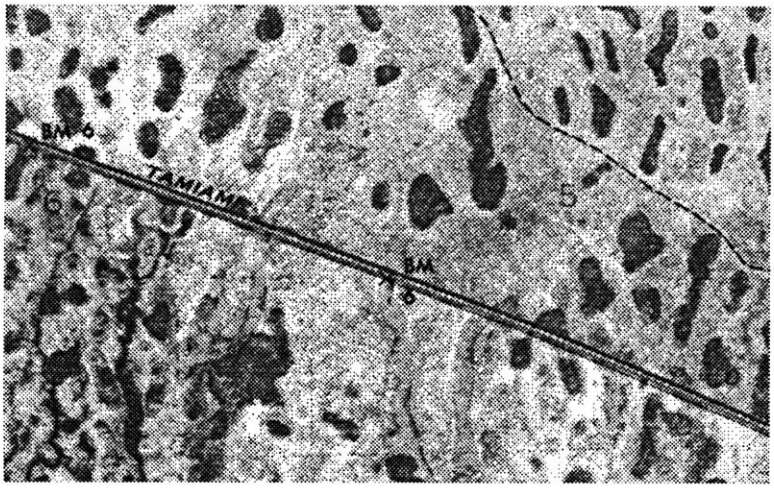

Figure 4: Photomap from Everglades. Roads and names are rendered on top of the photo.

photograph. Color-enhanced information, e.g. a reference system, is often rendered on top of the photograph to ease the use of a photomap. Photomaps are often used in areas with few contours and a low density of cultural features, e.g. flat swamp terrain. Photomaps are also used in weather reports to indicate cloud movements in the atmosphere. State lines are rendered on top of the satellite photos, and the photomaps are often shown in sequence to visualize cloud movements.

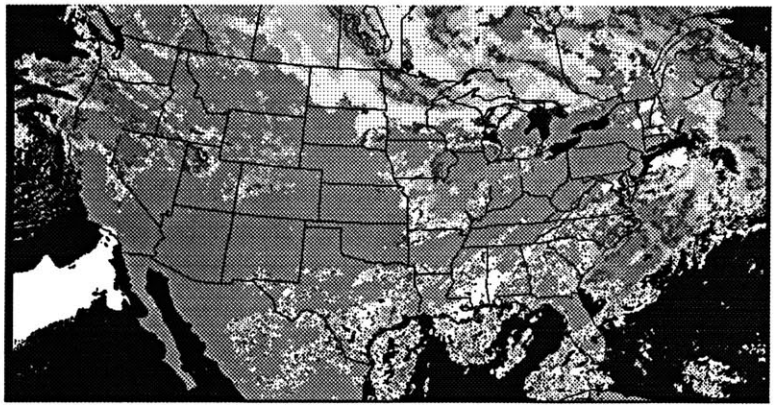

Figure 5: Weather map composed of satellite images with state lines superimposed.

First designed by Henry C. Beck in 1931, the London Underground Diagram has gained widespread popularity [Walker 80]. It is used by millions of people in London every day and has been imitated by most cities with a subway system. The diagram is commonly referred to as a map, but it is not drawn to scale and is therefore not isomorph. If enlarged to the actual size of London it would diverge significantly from the actual geography of the city—a fact soon discovered if one tries to use the diagram as a walking map. Isomorphism is sacrificed to give downtown areas better coverage, i.e., the density of information is roughly the same all over the diagram while downtown areas in reality have a much higher density of Underground installations. The result is a product that is highly functional for its purpose.

[Walker 80] Walker, J A: The London Underground Diagram; Iconographic, no 9-10, 1980

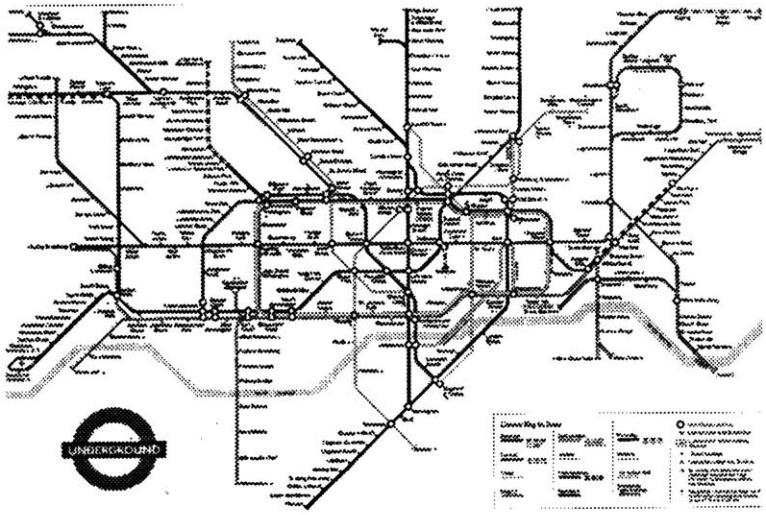

Figure 6: London Underground Map.

4.3 Maps in Virtual Worlds

Realizing the potential of maps as navigational tools in an interactive environment, the SDMS project in the MIT Media Lab implemented a virtual "Dataland" [Bolt 84].

[Bolt 84] Bolt, R: The Human Interface; Van Nostrand Reinhold, 1984

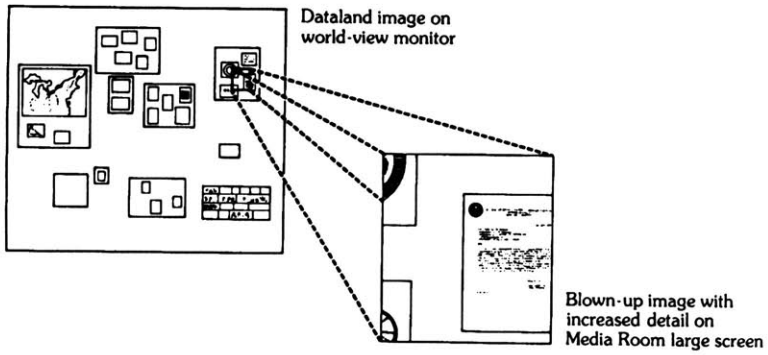

Figure 7: SDMS' Dataland. From [Bolt 84].

However, Bolt argues that there is no map in Dataland:

> Importantly, the items in Dataland are *facsimile* in nature: books look like books, calendars like calendars, and so on. Dataland is not a map of the data. It is the data. The nature of the display is "out there," visually self-evident.

In my opinion, the representation in Dataland has the characteristics of a photomap. However, the naming issue is of secondary concern to the user—what counts is the spatial clues present in the representation. Bolt reports that new users found navigation in Dataland to be intuitive and almost immediately could focus on **what** information was there to look at, not how to get at it.

Another approach to virtual maps is described in [Henderson, Card 86]

Maps are useful tools for spatial orientation in both real and virtual spaces. One way, maybe the best, of making navigation through news easier is to provide a map. News

[Henderson, Card 86] Henderson Jr, D A; Card, S K: Rooms: The Use of Multiple Virtual Workspaces to Reduce Space Contention in a Window-Based Graphical User Interface; ABM Transactions on Graphics, Vol. 5, No. 3 July 1986, 1986

articles naturally lend themselves to two-dimensional representations, and a good map should be present in the ideal newspaper.

PART II: MY IMPLEMENTATION

The ideal paper is far from reality. Presentation technology cannot yet take on the challenge of providing an electronic newspaper as described in the first part of this thesis. But, the continuously advancing technology has provided us with "paperlike" displays that can start competing with newsprint. The Electronic Broadsheet is an attempt to transcode the newspaper metaphor into an electronic medium using state-of-the-art presentation technology. The second part of this thesis describes the implementation of the Electronic Broadsheet.

5 SYSTEM OVERVIEW

The following chapter gives an overview over the implementation by briefly describing the system setup, describing two possible user scenarios, and comparing the current implementation with the ideal newspaper from the first part of this thesis.

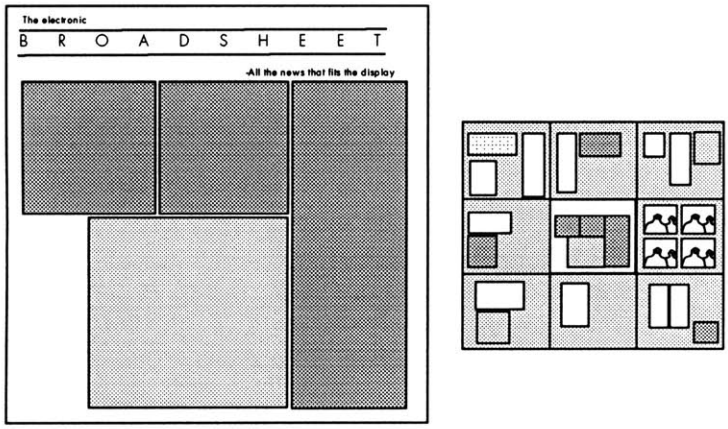

Figure 8: The large monitor displays a page, while the second screen gives an overview of all pages in the newspace. The center square is high-lighted to indicate which page is currently being viewed.

5.1 System Setup

The most visible part of the physical setup is the 2000-line color monitor. With its overwhelming size and resolution it dominates the location. The monitor is the driving force behind this project, and is a factor in all decisions. The user reads news articles off this monitor, but it can also be used for "normal" computing like word processing and text editing.

Beside the main display is a smaller color screen that gives the reader an overview of the news available. Since the newspaper has several section pages and only one page can be displayed at a time on the main screen, the map tells the reader about news articles on other pages. The space onto which the pages are laid out is the "newspace". See figure 8.

By clicking with the mouse the reader can indicate interest in certain articles. If a story of interest is found on the front page and there are more stories concerning the same issue on a section page, the system will pan over to the corresponding section page. The user can go back to the front page anytime.

5.2 News Path from Source to Screen

The Newspace project receives around 3000 news articles per day. This is more information than anyone wants to digest. Therefore, personalized filters screen the content of the articles to find the articles that have the highest match with each reader's personal profile [Orwant 91]. The articles that pass the filters are dispatched to the display application.

The communication between the article selection process and The Electronic Broadsheet is simple and clean. Communicating with the article selection process over a local network, the display application receives articles that are to be displayed. In return, the display application sends the user's response to the articles shown, e.g., what articles that have been read, how long time was spent on each story etc.

[Orwant 91] Orwant, J L: Doppelgänger: A User Modeling System; SB Thesis, MIT Department of Electrical Engineering and Computer Science, 1991

The user communicates with the display application by indicating interest in certain articles. By moving the mouse into the article that is currently being read, the display application calculates know how long time is spent reading each article. By clicking in the article, the reader expresses particular interest in the story. The user's motivation for following these rules is to get even better filters selecting news tomorrow.

5.3 Scenarios

The Electronic Broadsheet is intended to be personalized, not only with regard to content (quality) selection, but also reader habits like reading speed, frequency of reading etc.

The following scenarios illustrate how the system may adapt itself to different users. The two people described live slightly ahead of our time and have access to sophisticated equipment, but all aspects of the electronic newspaper described are implemented in The Electronic Broadsheet.

5.3.1 The Professional News Reader

"After the mandatory cup of coffee in the morning, Judy sits down in front of the display and starts another working day. Her employer is a major chemical conglomerate and her job in the public relations department is to follow the newspaper media coverage of the daughter companies. She gets most of the information she needs from the screen. This morning one of "her" companies has had an explosion in one of their plants. Two stories covering the event have made it to the front page. The articles are accompanied by figures that show that the accident was caused by a leak from an old pipeline. No question, this will be the topic of the day. A quick glance at the map tells her that several other articles, probably concerning the same case, are waiting for her on the section page. She can see from the faded tint that they have been sitting there for a while—good she got here a little early this morning. She also notices that the stories come from

major wire services. That means work! Judy points at one of the articles and the section page corresponding to the unfortunate company comes up.

After reading the remaining articles in the section, Judy knows there is nothing she can or should do. Her weekly report about the media image of the company will for months to come describe the consequences of the accident and how to deal with the negative publicity, but she can use the next hour or two to catch up with the rest of the world.

When she returns to the front page it looks quite different. The articles she read have disappeared - replaced by more recent news. Every now and then a new article comes up. She can see them pop up on the map, while old articles are taken down. When starting to use the system she was worried about losing important information when unread articles were taken down. After a while she realized that only articles with low priority or outdated information were eliminated. Often they were replaced by more recent versions concerning the same issue.

Suddenly a picture of her manager pops up on the personal mail page. She recognizes his face even if it's scaled down on the map. His accompanying message, which just wanted to make sure she was on the right track, reminds her of the report he expects tomorrow. Reading news is not everything she does. There is always a report due and some thought in the back of her head that has to be spelled out. The word processing page is handy for this, no news articles will disturb her there..."

5.3.2 The Casual Reader

"Bill comes home just after 6pm. As a gardener he spends most of his working day outside wasting few thoughts on what goes on in the rest of the world. However, after dinner he sits down in front of his monitor to go through the most important stories of the day. His main interests concern the environment and recently there has been plenty of good coverage. Today's top story describes the indictment of a

chemical plant leader charged with negligence that eventually caused an environmental disaster. "Just about time this news got out to everyone," he says to himself not realizing that most people got a totally different front page from his.

The front page also contains electronic mail from members in the botanical society. They are identified not by their picture, but by their favorite plant. The yellow tulip made it to the top—that's the society president's identification. Today she didn't have much of importance to say, just some random ideas for the next meeting. Bill replies with some of his random thoughts.

More environmental news pops up as he reads his personal mail. Enough is enough—he decides to take a break from disasters. Thank goodness for the comics page..."

5.4 What was not Implemented

Current technology does not allow for the implementation of the ideal paper as described in part I. Also, sloppy programmers hinder development. Here is a list of some important elements that have not been implemented so far:

- The frame buffer is able to show small video segments. This powerful medium is undoubtedly a part of the newspaper of tomorrow, but today it is a cumbersome source. It is hard to automate the process of digitizing news from television—the only source we have at this point. As a result, there is only a few video sequences available and they have little news information value. They are shown to visitors as a part of the Newspace demo, but is not fully integrated in the newspaper presentation.
- Pictures and figures are also important information in today's papers. Currently, the Newspace project has access to a news figure source, but setting up the system to

automatically grab new diagrams has turned out to be a problem. A solution is in progress, and will hopefully be integrated in the near future.

- Electronic mail has not been included as a regular service. Mail can be sent to a demo user, formatted and displayed on the screen, but there is no way to reply to messages without turning to regular UNIX utilities.
- After an article has been formatted, the Electronic Broadsheet only knows about it as a pixmap, i.e. it doesn't know which words a story contains or where they are displayed. In order to increase user feedback granularity this will have to be changed.
- Some user parameters, such as the rate at which articles fade is not variable in the current implementation.

6 THE LARGE MEDIUM

The viewing area of the 2k monitor is almost as high as a broadsheet newspaper and a little wider. When seeing the display for the first time most people are struck by its size and resolution. The display is the driving force behind this project and is state-of-the-art technology. It is a unique device, but its physical properties leave much to be desired. It may be suitable for a Chinese wall newspaper, but it will not fit on your desktop.

6.1 Physical Dimensions and Setup

The monitor measures 694 * 673 * 760 mm (w/h/d) and weights ca 98 kg [SONY 89]. To make this huge piece of glass and metal as flexible and portable as paper is impossible; at least three people are required to move it. However, one can imagine several physical setups that improve the reader's ergonomics.

[Sony 89] SONY DDM-2801C Operating Instructions; Sony Corporation, 1989

The monitor is currently hosted by a custom-built stand that came into being prior to the Newspace project. Below the monitor is a retractable shelf onto which the keyboard and mouse is placed. The secondary screen has a similar lower stand.

6.1.1 The Ideal Physical Setup

A servo-powered crane that can move the monitor in three dimensions and also adjust the angle of the screen surface would be the ultimate setup to overcome the bulkiness of the display, see figure 9. The reader could "power-steer" the monitor with the tip of a finger to get a close-up view of a certain article, or move it away to get an overview. The crane provides a dynamic environment that would be similar to moving the paper around; the operation resembles how readers move newspapers. Unfortunately, this solution is mechanically too advanced for the scope of the project.

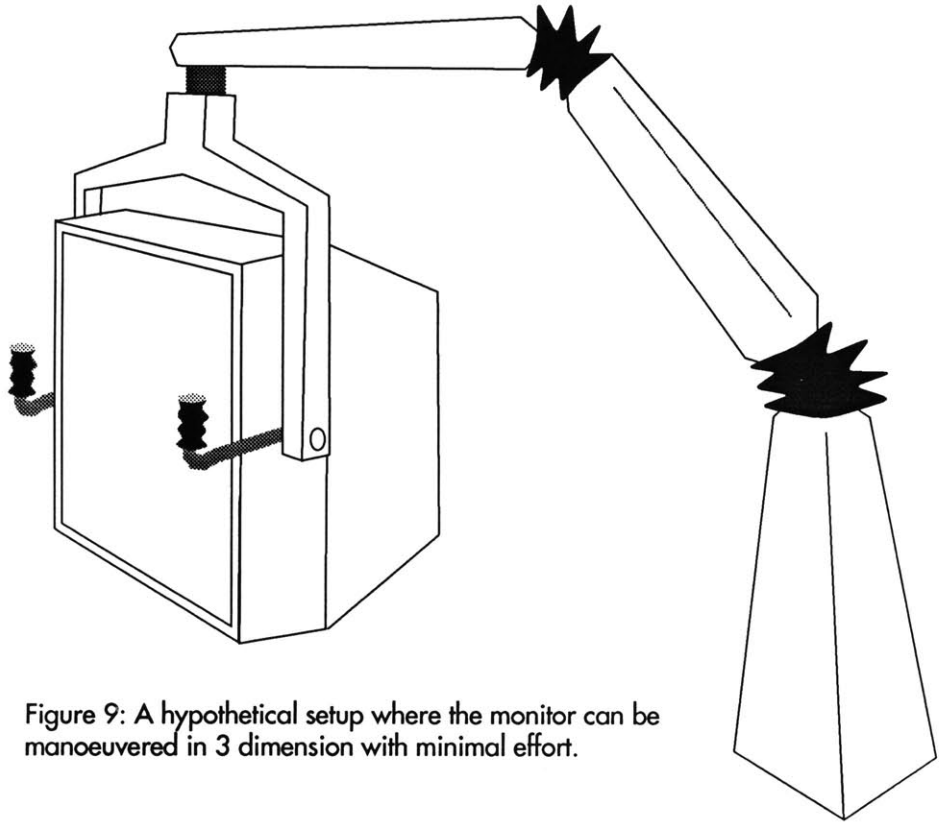

Figure 9: A hypothetical setup where the monitor can be manoeuvered in 3 dimension with minimal effort.

6.1.2 The Compromises

By making the **reader** move in three dimensions instead of the bulky display, the problem is simplified a lot. This leaves only the tilt angle to be adjusted, and that is a reasonably simple operation that could be implemented. However, the solution is still peripheral to the main goal of the project, and I believe the resources required are better invested in other parts of the project.

By setting a fixed tilt angle, the problem is further simplified. This solution seems to work for normal computer screens; although it is possible to adjust the tilt, it is rarely done. Instead, readers of different heights adjust their chairs to obtain a better reading position. The favorite angle for computer displays is close to the vertical one. This is also the intended angle for the 2000-line monitor. The display is not designed for safe operation if the tilt exceeds a certain angle.

Contaminations inside the tube may cause the electron guns to short-circuit and cause damage to the display—and possibly to the reader!

Newspapers, on the other hand, are safely operated at any inclination. Most people prefer an angle somewhere between the vertical and horizontal to keep all articles within a reasonable distance and to minimize the "keystone" effect. See figure 10.

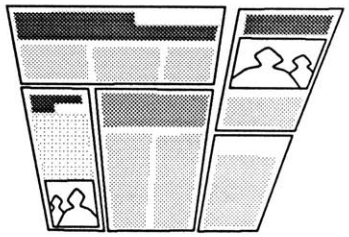

Figure 10: "Keystoned" articles

Ergonomics is an increasingly important field for computer system designers. A workstation should be constructed with the human body in mind. When trying to tilt the 2k monitor, one faces severe ergonomic challenges. As the tilt angle increases, the reader has to sit relatively higher. Also, as one will see from figure 10, the more tilt, the less leg room.

As a result of these factors, the monitor has not been tilted. Several attempts have been made, but it has not been possible to find a solution that fulfills both technical and ergonomic requirements,

6.1.3 The Keyboard

Only a pointer device is required to read and navigate in the newspace, but a keyboard is supported for other uses of the computer, e.g. replying to electronic mail messages. The stand that supports the workstation was designed with a keyboard in mind; it contains a retractable shelf under the monitor shelf.

6.1.4 The Mouse

Currently, a mouse is being used as the pointer device for the X11 workstation. It has turned out to be annoying. Since the size of the screen pointer is small compared to the total screen size it is easy to lose track of the pointer.

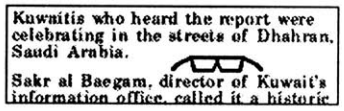

Figure 11: The cursor used in the Electronic Broadsheet is bigger that the standard X11 cursor, and it can be personalized.

The bigger cursor used in the Electronic Broadsheet improves upon this, see figure 11, but I believe it is intrinsically harder to relate mouse movements to pointer movements on larger screens, even if the screen size/pointer

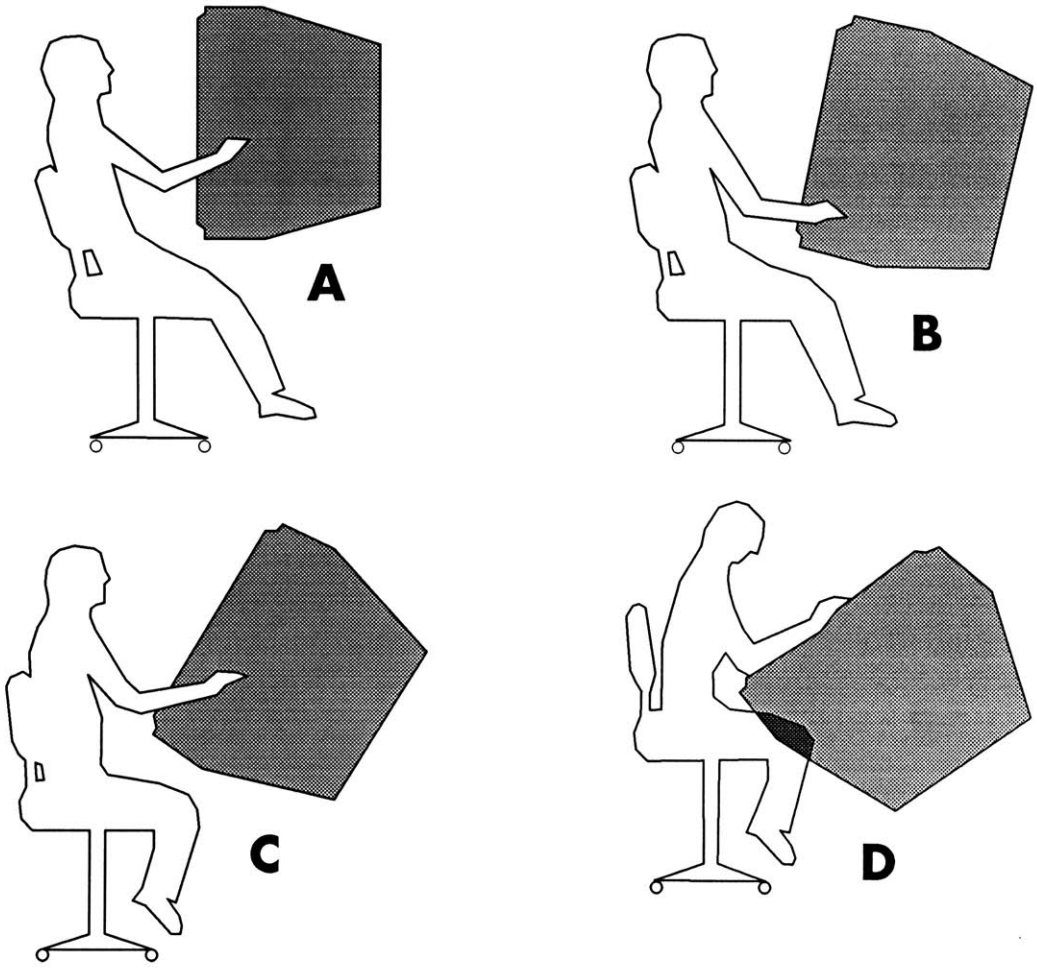

Figure 12: The figure shows the 2k display in four possible tilt angles. A shows the current setup. C and D are not recommended from the manufacturer. As the tilt angle increases, the reader has to sit relatively higher than the monitor. Also, notice the conflict of space in D.

size ratio is constant. The distance between the mouse and the cursor is much longer, and the ratio between the mouse movement and the cursor movement is higher.

For a discussion of alternate input devices, see chapter 10.

6.2 Hardware

The hardware configuration that drives the displays consists of a Sun Sparcstation 370 with 32Mb of RAM. The Sun hosts a VME frame buffer from Univision, model UDC-4012. The frame buffer drives the main monitor, a Sony DDM-2801C, which features 2048 lines of resolution and a 60 Hz progressively scanned refresh.The second monitor is a standard 1k color display.

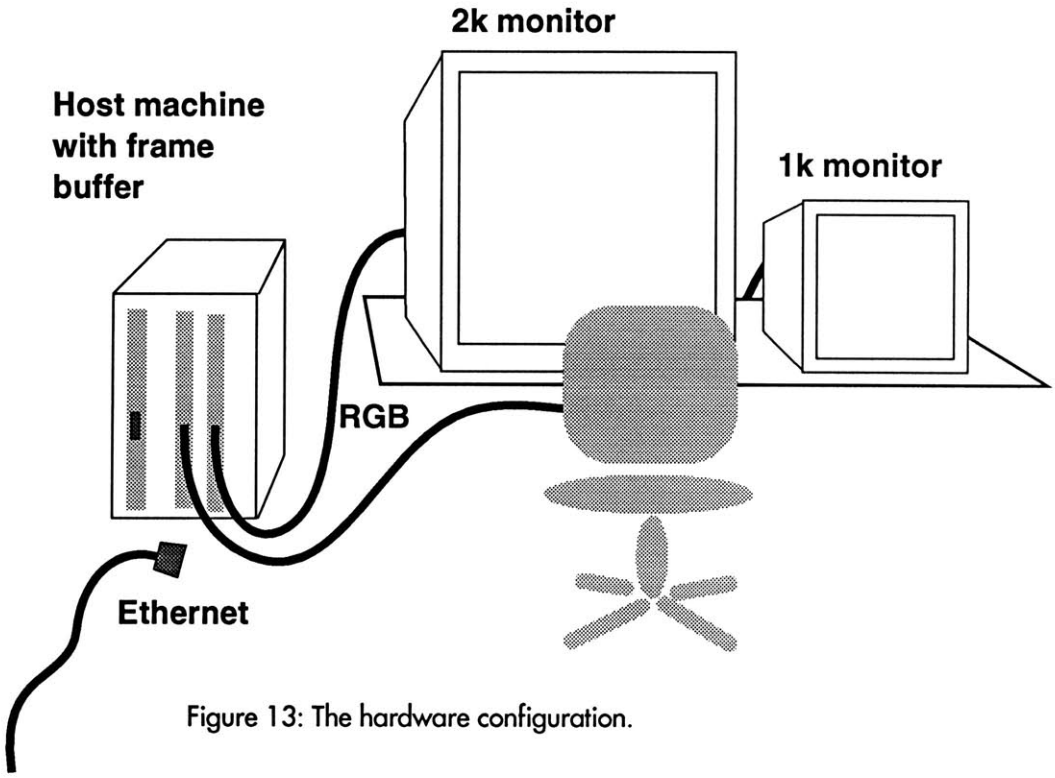

Figure 13: The hardware configuration.

6.3 Software Platform

The X Window System (X11) has established itself as the standard window system on UNIX workstations [Scheifler, Gettys 87]. To run X11 applications one needs a server application that stands between the client applications and the hardware, i.e., the display, keyboard and pointer device.

[Scheifler, Gettys 87] Scheifler, R W; Gettys, J: The X Window System; ACM Transactions on Graphics, Vol. 5, No. 2, 1987

The source code for MIT's sample server is freely available and was ported to the Univision board last year. The server allows the previously described configuration to be used as an X11 workstation and makes large amounts of existing software available. It also provides a standardized interface to the screen and input devices.

An alternate software platform would have been to interface the frame buffer directly. This would have opened for the use of a graphics acceleration chip in the Univision that the X11 server currently ignores. Also, the frame buffer hardware supports 12 bits per pixel, while the X11 server runs in a 8 bits per pixel mode. However, many of the graphics primitives that come for free with X11 would have to be written for the Univision.

At some point, a decision to implement the Electronic Broadsheet under X11 was made. X11 sets some constraints and is not always optimal in terms of performance, but I believe the functionality achieved in the current system would not have been possible in any other way unless many more resources had been allocated.

6.4 The Second Screen

The Sun host machine has a console monitor with a resolution of 1152*900 pixels. Since the map is a distinct self-contained unit it was decided to put the map on the secondary screen; an optimal solution with regard to screen real-estate.

After the above described solution was implemented, some have argued that the main screen should contain the map instead of using the second screen since moving between two screens of different character could become a distraction. Another option argued for is to use the second frame buffer in the double-buffered Univision and switch back and forth between the two. The last solution would make room for a large map, but the reader would not see the map and the newspace at the same time.

I did not find any of these ideas compelling enough to reimplement the map for the 2k monitor. However, the Newspace project aims at making news presentation scalable to any device, and chapter 11 discusses some issues that came up when porting the system to a one-screen system with a tabloid-sized monitor.

6.5 Implications for the User

The described setup has been used as an X11 workstation for more than a year now. The color display has four times more pixels than an average X11 workstation, and it is used differently from a normal workstation. This difference cannot be measured in square centimeters only. When using the large screen, screen space management will shift emphasis from screen area conservation to screen overview. The overlapping windows found in most window systems are replaced by a "bulletin board". This is an important observation that will change the way people use and write software.

7 THE DESIGN OF THE NEWSPACE MAP

As discussed in chapter 4, a map is a useful tool when navigating in virtual domains, and the large display also demands navigational tools. To improve reader navigation in newspace, I decided to always make a map available to the reader.

7.1 Scale

The scale is one of the first parameters to be set when designing a map. For the newspace map, the factors deciding the scale are the number of pages in the newspace, the size and resolution of the primary and secondary monitor, and the decimation algorithm.

The number of pages in the newspace is currently set to 9 (3*3) because:

- Presuming the same granularity of section separation as newspapers use today, a good guess is that most people will be interested in around six sections. This leaves two pages for other purposes in addition to the front page.
- Since pages in the newspace are square and the map monitor is close to square, the tightest packing is achieved using a square grid.

The primary monitor has a resolution of 2048*2048 pixels, while the secondary screen offers 1152*900. The largest map possible is then (2048*3)/900 = 6.83, but since the decimation is simpler to compute given integer decimation factors, 7:1 is scale of the pixmaps.

The corresponding number for other newspace sizes are:

pages	page grid	newspace	ratio
4	2*2	4096*4096	5:1
9	**3*3**	**6144*6144**	**7:1**
12	4*3	8192*6144	8:1
16	4*4	8192*8192	10:1
20	5*4	10240*8192	10:1

Since the pixel density is higher on the 2k than on the 1k monitor, the content of the map appears 20% larger than pixel ratios indicate.

Comparing how different map scales should influence the map design would be interesting extension of this project.

7.2 Map Metaphors

Several of the different map types discussed have been implemented as a part of the project.

The hardest decision to make was wether to create a line map (rendered), or a photo map (using image processing). See section 4.2 for a discussion of maps. The scale between the main display and the map is approximately 7:1. This means that a decimated version of an original news article pixmap is able to show the structure of the article, e.g., where the headline is, where the figures are, and how many paragraphs there are. In most cases it is not possible to read the headline. See figure 14.

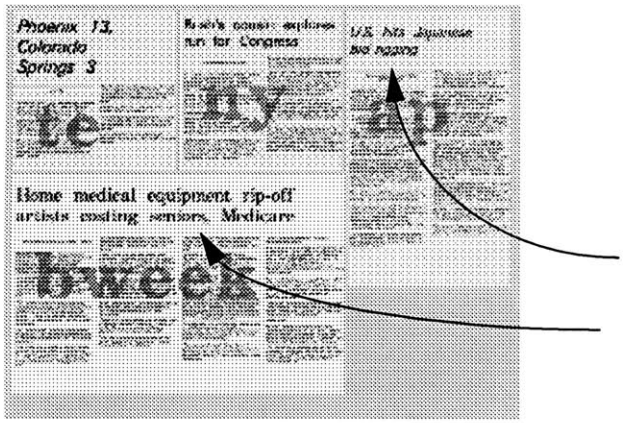

Figure 14: The figure shows decimated articles. The headlines are hard to read.

Some argues that all available bandwidth in the map should be utilized to get the headline across to the user; everything else is secondary information. Following this reasoning, it makes sense to render a new pixmap for use in the map. One is then free to use a relatively large font for the headline. This solution would require much good design work.

The solution settled upon tries to take advantage of the best of both alternatives. It uses a decimated "photo" of the original and renders the headline on top of that—if necessary the headline will be relatively larger than in the original. This solution is in several ways similar to the weather map described in chapter 4. It improves the legibility of the headline fonts designed for that size, and by increasing the font size.

7.3 What to display

By designing a suitable map one can give users access to a lot of information about the domain it represents without actually seeing it. Applied to The Electronic Broadsheet, this means that by carefully crafting the map the reader can save both time and frustration by reducing unwanted searching.

Cartographers have for centuries made a living from selecting a set of features of an area and rendering those features into a map. Selecting the right set of features is one of the first decisions the mapmaker has to make. Later, it has to be decided how these features should be rendered. A set of standards has evolved in cartography; this eases the design process and limits the number of solutions.

Since electronic newspaper maps don't have the same traditions, a significant part of the project has been dealing with the design of the map. There is a number of information items that readers may be interested in learning about without having to look at the actual article. There is also a limited number of design tools one can use to convey a message from the surface of a computer screen to the reader.

First, identifying the information items (from now or referred to as **items**) is not trivial. The system claims personalization, and there is an unbounded number of items that a reader may want to see. Naturally, the data available

about each article is limited, and we can also make some guesses about which items will be the most popular with the readers. The list includes:

- Time/Age
- Sections
- Importance/Urgency/Priority
- Source
- Distribution
- Size/Length

7.3.1 Display Tools

Identifying the design tools available to convey the information items is a little easier. A color display can only emit a limited bandwidth of electromagnetic radiation over a circumscribed 2D surface. Therefore, the design tools can be coarsely divided into two groups: chromatic and spatial.

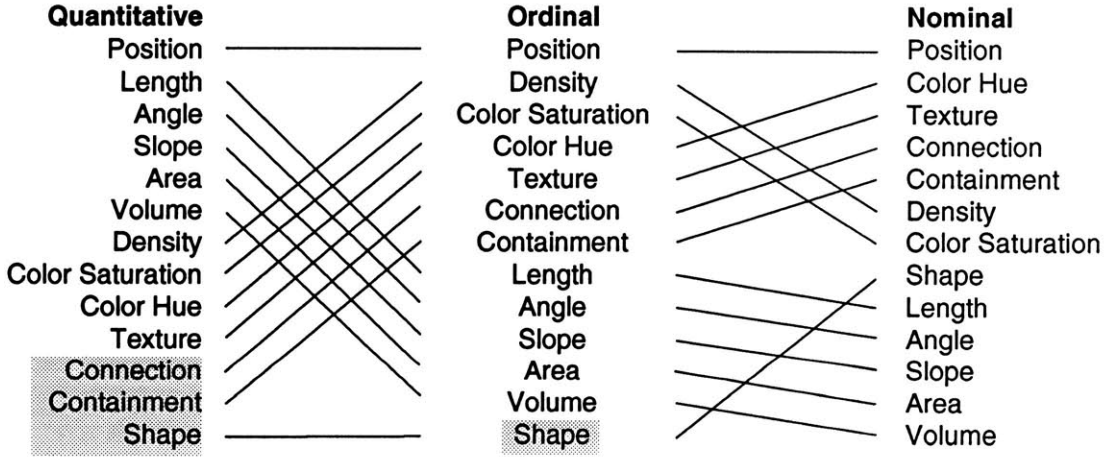

Figure 15: Ranking of perceptual tasks. Task shown in gray are not relevant for these types of data. From [Mackinlay 87].

Mackinlay [Mackinlay 87] ranks the design tools as perceptual tasks with regard to how well they perform presenting quantitative, ordeal and nominal data. See figure

[Mackinlay 86] Mackinlay, J; Automating the Design of Graphical Presentations of Relational Information; ACM Trans. on Graphics, vol 5 no 2 pp 110-141, April 1986

15. The data have not been empirically confirmed, and should be used with care. However, we can make a number of interesting observations from it:

- Position ranks on top in all list.
- Except position, the perceived quality of the tools vary a lot from list to list, e.g., hue is ranked at position 2, 4, and 9 out of 14 entries.
- Shape scores poorly—it is considered not relevant for quantitative and ordinal presentation, and below average for nominal presentation. Still, an important school in computer vision targets shape recognition.
- Intensity (or value) is not in the diagram. The term "density" cover parts of what is known as intensity.

Presuming figure 15 is correct, one should assume that connecting an information item with the suitable tool should be easy. However, there are several problems. First, classifying an item as quantitative, ordinal or nominal is not trivial. One example: is age quantitative or ordinal in the context of a newspaper map?

Secondly, once the items are classified, several items might claim the same tool. This is likely to happen with position since it ranks highest for all three categories. But not all information can or should be coded through position alone, and the diagram does not answer in which order items should pick tools.

Jacobson and Bender [Jacobson, Bender 90] extends the Mackinaly diagram by devising a method of quantifying the relative expressive qualities of color combinations. They show that hue alignment, coupled with contrast of value, is strongly correlated with reading speed. Therefore, when displaying text, the contrast of value should be high, while other information can afford less contrast of value. Also, they report the off-complementary dyad when contrast of value is low to be viewed as energetic. Studies by Jacobson, Bender and Feldman [Jacobsen et al. 91] show how hue alignment and value can be combined to provide a wide rage

[Jacobson, Bender 90] Jacobson, N; Bender, W: Deterministic formation of visual color sensation; Proceedings of the SPIE, Vol. 1250, February, 1990

[Jacobson et al. 91] Jacobson, J; Bender, W; Feldman, U: Alignment and Amplification as Determinants of Expressive Color; Proceedings of the SPIE, Vol. 1453, February 1991

of legibility and highlighting capabilities. The authors of the two last referenced papers have been consultants in the color selection process.

A considerable amount of time has been spent juggling the relationship between items and design tools. The following description is sorted with regard to the information items, with a description of the solution following. This is not necessarily how the solution was pursued; it was sometimes easier to take a solution (design tool) and look for a problem (information item).

7.3.2 Time/Age

The term "newspaper" indicates that the age of the content is an important factor for the medium. Age can be represented relative to the current time ("an article was received 14 minutes ago"), or one can use the absolute calendar as a reference ("the article was received Apr 2, 9:38pm"). The first representation is more useful in the short term, while only the second is acceptable for archives. Since newspapers by definition emphasize the short term, the first representation is most useful in this project. If the goal was to create a research tool to search through news archives, the time/date would be the natural solution.

Ideally, the author should provide information about when the content was written. This is not true for most current sources, and the time is set when the article is displayed.

One property of paper, and especially newspaper pulp, is that it yellows when exposed to light. Therefore, an old newspaper will acquire a yellowish tint. When a new article pops up on the map its initial background color is relatively bright. As time passes the background hue of the icon will change to yellow and the value will decrease. In its current form, the aging process is fast; the time it takes from an article is displayed until it is maximum faded is only about 20 minutes. The rate of change should be adjusted to the reader's frequency of reading. To a reader that makes a living reading news (see scenario in 5.3.1) an article or piece of mail may be old after 20 minutes, but for a casual user (section 5.3.2) a 24-hour time frame seems appropriate—this is also the newspaper time frame.

When generating colors for the map, one must keep in mind that the reader will live with the colors over a long period of time. Subtle variations in hue, saturation or intensity will be recognized and appreciated; there is no need to "scream" in order to convey the message. This is a general rule that has been enforced throughout the design process.

7.3.3 Sections

Newspapers indicate the subject of an article in several ways. At a coarse level of granularity articles are categorized and put into one of several sections, e.g. the daily "sports" section or the weekly "real estate" section.

In The Electronic Broadsheet, sections are currently laid out in a 3 *3 two-dimensional grid with the front page in the middle. The surrounding pages each contains a section with topics similar to those found in traditional newspapers. This layout limits the number of sections to a maximum of 8. If the user wants to use some of the virtual space for other applications, the number decreases further. As discussed in section 7.1, six is a good guess for how many sections an average reader wants. However, this number may increase when huge amounts of information become available. Changing the number of section pages will change the scale of the map. Also, if the number of section pages is increased, each section will no longer border the front page.

7.3.4 Importance

Traditional mass-produced newspapers assign priorities to articles by guessing at what the average reader will be interested in reading. Our personalized newspaper guesses at what each individual reader will be interested in. The guess boils down to a number indicating the priority of an article at a certain time. Provided the guess is somewhat accurate it will be an important factor when the user plans the "path" through the newspaper. As time passes the importance of the article will decrease. For some types of articles this will happen very quickly, while e.g. personal mail may be important until it's read.

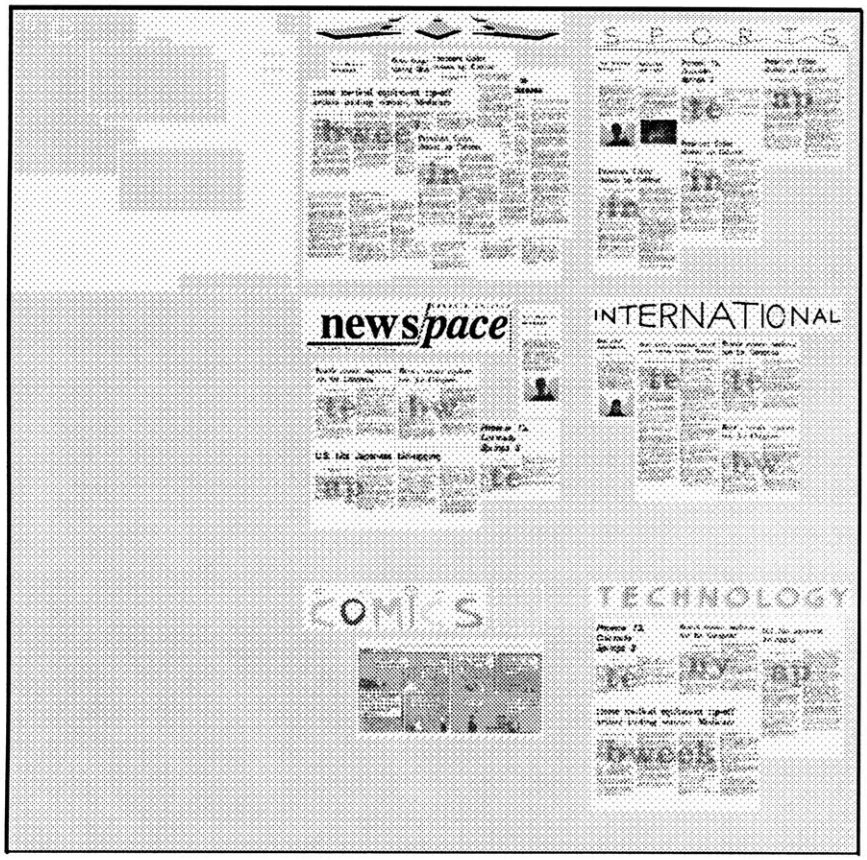

Figure 16: The full 3*3 map. The tiled front page is in the middle with the volcano page right above. The right pages are sections, while the lower middle page is reserved for comics. The upper left page is user for text editing and UNIX, while the other left pages are open. The high-lighted area shows what is currently displayed on the 2k monitor

The importance of an article is marked by the color of the icon border. By assigning this border a different hue from the background (blue versus the tan background) while keeping them isoluminent, important articles will "jump out" from the rest. See section 7.3.1.

7.3.5 Source

Compared to other media, newspapers are vague in their credits and references. Author or source is sometimes listed in the first or last line of the article, but this is not sufficient.

Source information is available at two levels. At the higher level, every article can be classified with regard to the wire service they origin from. Exceptions are electronic mail and USENET, but these are naturally considered separate sources.

In the Electronic Broadsheet, a "watermark" in the map icon is used to indicate the source of an article. The colored watermark is "woven" into the pixmap as a texture. Each source has a watermark. The initial letters are used for most sources while some, among them "email", have a hand crafted watermark.

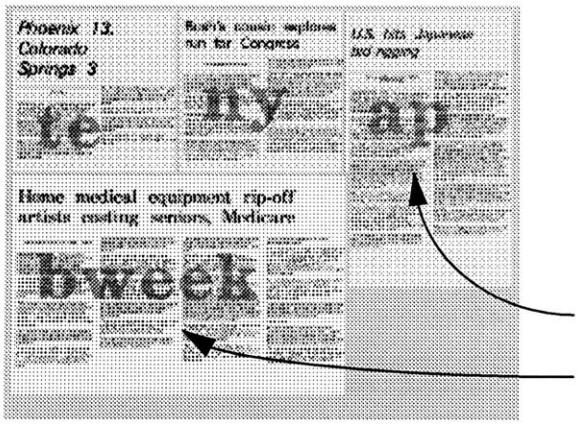

Figure 17: Watermarks indicate the source of the articles.

The watermark metaphor, which is one of several implemented alternatives, has turned out to be a visually attractive solution while giving easy access to a valuable piece of information.

The hues of the watermarks were selected to make them as distinct as possible while keeping the value equal. Since the number of sources (ca. 20) is greater than the number of distinct hues we can generate at the relatively low intensity chosen. Therefore, a source will not be uniquely identified by the color, but the hue will play an important part in the recognition process and help lower the cognitive load of the reader.

At the lower level of granularity, every piece of text has an author (possibly more than one). However, few readers would want to know the authors of an article in advance—maybe except for personal mail and columnists. Therefore, the map does not try to convey author names explicitly. Since a picture of the sender of electronic mail is added by other parts of the system (see chapter 8) the reader is often able to recognize familiar senders on the map.

7.3.6 Distribution

A constant challenge for recipients of electronic mail is to filter out important messages from the "junk mail". Personal mail is often important, while messages form mailing lists often can be ignored. Paper-based mail recipients have the same problem, but handwritten letters are often easier to distinguish from junk mail.

Interesting point: Paper-based junk mail often camouflage their message with a "handwritten" font and a real stamp to give it a more personalized appearance

Knowing the distribution of a message is a valuable clue for the user when planning what to read. Currently, the system does not tell the user about article distribution other than naming the recipients.

7.3.7 Size/Length

When posting messages to USENET or mailing lists it is customary to warn readers if a message is extra long. By doing so, the sender provides recipients with clues for making the decision to read an article or not. The same information is hard to find in newspapers and especially in magazines where page jumps make articles longer than they look at first glance.

Since maps, including the newspace map, are drawn to scale, it is easy to grasp the length of an article by glancing at the map. The fact that newspace articles are rectangular and always printed in full (see chapter 8 and 9) adds to this.

7.3.8 Summary of Design

Figure 17 summarizes the relationships between information items and design tools.

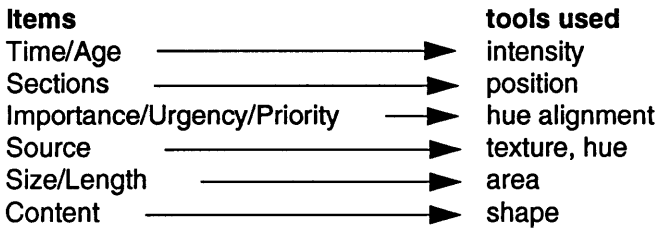

Figure 18: The figure shows how information items are depicted on the map. "Content" represents is the icon of the article.

7.4 The Electronic Map—Implementation

The pages in the electronic broadsheet are laid out in a "newspace", i.e., a two dimensional virtual plane. News articles naturally lend themselves to two-dimensional representations, and a map over the newspace is provided to ease navigation. The newspace map is based on a commonly used X11 window manager.

During the last year, the X11 community has seen the introduction of several so-called "virtual window managers". The interface is clearly based on the concept pioneered by SDMS (see section 4.3). The window managers allow X11 displays to have a virtual plane larger than the physical screen size. The user can pan the real screen over the virtual screen to view a different part of the plane. The user interface for all the virtual window managers is implemented through a map. The user can see the outline of all top-level windows in a special window that is an isomorph representation of the windows on the virtual plane. The implication of using a virtual window manager for the users is that they have more real estate to lay windows out on. Instead of using overlapping windows, the screen can pan over a large bulletin board with partial.

7.4.1 X11 Window Managers

One merit of the X11 Window System is that it clearly separates the different parts of a window system into different processes—e.g., the task of managing the windows and the screen space is handled by the window manager. The

window manager is with few exceptions an application just like any other X11 client The window manager is given authority to control the layout of windows on the screen. Other clients indicate their preferred position and size and this will normally be granted. However, the window manager can any time decide to move or resize a client window.

For a good overview over X11 Window System Concepts see Xlib Programming Manual [Nye90].

[Nye 90] Nye, A: Xlib Programming Manual; O'Reilly & Associates, 1990

One of the first window managers available, TWM released by Tom LaStrange in April 1988, gained widespread popularity by offering the same functionality and ease of use as found in earlier window systems line Xerox Star and Apple Lisa [Håfjeld et al. 88]. Recognizing its de facto position among window managers, the X Consortium adapted the program and extended the functionality for release 4 of X11.

[Håfjeld et al. 88] Håfjeld, B; Kaplan, E S; Lie, H W: A Survey of Window and Desktop Managers; TF-report no 54/88, Norwegian Telecom Research Dept., 1988

Dave Edmondson of Imperial College modified the freely available source code for TWM to add the virtual feature. The new version, called VTWM (Virtual TWM), was made available in the summer of 1990 and quickly gained popularity. It was the first free window manager with virtual features. See Appendix A for background information.

Solbourne had earlier released their proprietary SWM (Solbourne Window Manager). At some point Solbourne claimed to have the rights to the "virtual desktop utility feature", a claim that was heavily disputed on the network at the time. In later clarifications from Solbourne they claimed to have the rights to the name "virtual desktop," not the concept. Solbourne has later allowed the release of source code from TVTWM, written by LaStrange, now of Solbourne. See Appendix A for background information.

7.4.2 Changes to VTWM

Based on the freely available code for VTWM, the NVTWM (Newspace VTWM) was developed to manage windows in the newspace.

The current release of VTWM creates a map of the virtual plane according to the user's specifications of scale and position. If VTWM manages more than one screen, each screen has its own map. Since it was feasible for the project to use a second screen for the map (see physical setup) VTWM had to be modified to allow a map from one screen to be displayed on another.

VTWM's representation of windows in the map consists of an isomorph rectangular area (technically an X11 window), optionally equipped with a name label. The user can specify background color and a label font. While this might be

sufficient information in a programming environment where windows seldom are deleted or created, it is not sufficient in a news environment where new news comes in every minute. One way of increasing the information content in the window representations is to change the background pixmap. X11 already provides the functionality for clients to indicate icon pixmaps. While the use of icons is one way to manage a limited screen area, the virtual desktop model replaces traditional icons for most users. Using the icon pixmap functionality to set the background of the window representation was a natural modification to VTWM.

8 FORMATTING

The purpose of the formatting process is to take an ASCII-based text, with optional illustrations, and render it into a pixmap that can directly be displayed on a bit-mapped computer screen. The formatted "image" contains elements of the newspaper metaphor, e.g., a headline, source indication, columns etc. Typography is a key issue.

A general problem when formatting news articles is that not all information is available when one needs it. For example, when selecting which headline font to use, it is, among other things, important to know how wide the article will be. To know the width of an article the formatter must know the number of columns. Before it selects the number of columns, the formatter should know what headline font is to be used—we're back where we started.

Another dilemma one faces when formatting text is legibility vs. word density. Newspapers use a high word density while legibility suffers. A good example is the front page of NYT [Merill 80]. There is a minimum of white space, and headline fonts are often condensed. Margins are minimal, and the overall impression is "dark". See also figure 22.

[Merrill 80] Merill, J C; The world's great dailies: profiles of fifty newspapers; New York: Hasrings House 1980

The Newspace project receives approximately 3000 articles a day from around 10 different sources. The articles all come in electronic form, but there is no established standard format. Therefore, they are first transferred into a common intermediate ASCII-based format developed for the Newspace project.

8.1 Input

The common intermediate file format used as a starting point for the formatter is based on the "datfile" standard. A datfile is technically a UNIX file system directory that contains a descriptor file and a data file. When used to store news

articles, the data file contains the content of the article. The descriptor file contains various information relating to the data file, e.g., the headline, author (if known) and source.

This file format is the starting point for the formatting process that ends in the rendered pixmap displayed on the screen.

8.2 Soft Fonts

All text rendered by the formatter uses soft fonts, also known as fuzzy fonts, antialiased fonts or grayscale fonts [Negroponte 80] [Schmandt 80] [Bigelow, Day 83]. Grayscale fonts introduce a new way of thinking about text on computer displays. The monitor is no longer considered a discrete device with a fixed matrix driving it. Instead, the characters are scaled onto a continuous space; any partly covered pixel by the edge of a character is quantized into a grayscale value. Soft fonts don't improve resolution, but rather, improve addressibility of the existing resolution. This is important to properly render the letter forms, as well as position the letter forms on the display. Ergonomic studies show that they are easier to read [Bender et al. 87], and without the use of soft fonts on the display it would be much harder to claim competitiveness with paper.

[Negroponte 80] Negroponte, Nicholas: Soft Fonts; Proceedings Society for Information Display, 1980

[Schmandt 80] Schmandt, C: Soft Typography, Architecture Machine Group, MIT 1980

[Bigelow, Day 83] Bigelow, C; Day, D: Digital Typography; Scientific American 249(2), 106-119, August 1983

[Bender et al. 87] Bender, W; Crespo, R A.; Kennedy, P J.; Oakley, R: CRT Typeface Design and Evaluation; Human Factors, 1987

All soft fonts used in the Electronic Publishing group are derived from 320*320*1 pixel master fonts, which corresponds to a pointsize of 230 on the 2k display. Two proportionally spaced font families are available; Helvetica and Century-Schoolbook. They come in *roman*, *italic* and *roman bold* variations and can be scaled to any size. Ideally, the formatter should have access to any point size. This scheme would require either large amounts of disk storage capacity (Helvetica 160pt. uses more that 3Mb of storage space) or an excess of processing cycles. Unfortunately, none of the above are available. Instead, the current implementation keeps a limited set of soft fonts in memory

at all times. This minimizes both processing and disk transfers, while providing a variety of typefaces, both for headlines and body text.

To improve legibility and appearance, the formatter kerns all text. Two-dimensional kerning tables have been computed by other members of the Electronic Publishing group. The simple algorithm that generates the data works well with smaller fonts, but could be improved for bigger fonts and certain letter combinations.

8.3 Headlines

The purpose of the headline font is to attract attention and to give an indication of the importance of an article. For a headline to work as intended the font plays a vital part. There exists no easy algorithm to select the right font automatically.

When choosing the best headline font, the formatter takes into account the following factors:

- article priority: important articles need bigger font sizes to attract deserved attention.
- the width of the article (i.e., the number of columns): there has to be room for the selected font, but the white space should be kept to a minimum.
- content: articles with a "soft" content often get a serif font as headline, while "hard" news stories uses sans. This rule is not absolute and is not enforced by all publications.
- variety: using only one headline font in a newspaper would result in a boring page and the headlines would fail to attract attention.

The final decision is made through a simple voting system where each factor has weighted votes.

Besides selecting the font, the formatter also selects the number of lines to split the headline string into. Most newspaper headlines occupy one or two lines—sometimes three or four. See section 8.9 for a description on the algorithm used to stack the paragraphs.

Studies show that upper-case text (all-caps) is less legible than lower-case text, and this is also true for headlines [English 44]. Lower-case words contain more distinct forms and uses less space. Readers are also more familiar with lower-case text. A difference in legibility of about 20% have been shown. It is therefore tempting to transpose headlines from "uppercase sources" into lower-case. This has not been implemented, for two reasons. The process will take away some information—the sources that uses upper-case headlines (e.g. NYT) are consistent and some readers might use the case to recognize a source. Secondly, implementing the transpose function is not trivial since the all-caps text contain less information because of the smaller range of characters.

[English 44] Earl English: A Study of the readability of Four Newspaper Headline Types; Journalism Quarterly 21:217-229, 1944

8.4 Body Text

8.4.1 Columns

Columns is another technique newspapers use to squeeze more text onto a page. By making lines shorter, leading can be minimized without the reader losing vertical position when retracing lines. Also, columns make layout easier by increasing the horizontal resolution of a page. Together with the nameplate and front page, columns are the most distinct feature of the newspaper metaphor. For these reasons, I decided to keep columns in the Electronic Broadsheet.

8.4.2 Paragraphs

The formatter treats each paragraph as a unit and will not split a paragraph in parts. This idea, used by Michael Lesk in the "SuperBook" project, is another example of sacrificing real-estate for legibility. Although readers always have accepted split paragraphs, I believe the assumed improvement in legibility is worth the wasted space. It also gives pages a "lighter" look (see figure 23). See section 8.9 for a description of the algorithm used to stack the paragraphs.

Michael Lesk of Bellcore in cooperation with Cornell University

8.4.3 Alignment and Hyphenation

Most newspapers and magazines set the body text justified (flush-left / flush-right). Uneven spacing between words, coupled with hyphenation, minimizes white space and maximizes word density.

On the other hand, left-aligned text (flush-left / ragged right) is by most considered easier to read [Parker 90]. The irregular line endings create a ragged margin that leaves some white space and gives the text an "open" look.

[Parker 90] Parker, Roger C: Looking good in print; Ventana Press, Chapel Hill, NC, 1990

Eric Gill, in a classic essay promoting good taste, human involvement and typographic arts, strongly objects to the common practice of using justified columns:

> "Now uneven space is in itself objectionable—more objectionable than uneven length of lines, which is not in itself objectionable. We make no objection to uneven length of lines in blank verse or in a handwritten or typewritten letter."
>
> "But even spacing is of more importance typographically than equal length. Even spacing is a great assistance to easy reading; hence its pleasantness, for the eye is not vexed by the roughness, jerkiness, restlessness and spottings which uneven spacing entails, even if such things be reduced to a minimum by careful setting." [Gill 36].

[Gill 36] Gill, E: An essay on typography, First published 1931, a revised edition issued 1936 of which a photo-lithographic copy was published by David R. Godine, Publisher Inc., Boston, 1988

Since legibility is a major concern, more so than word density, the formatter produces left-aligned lines.

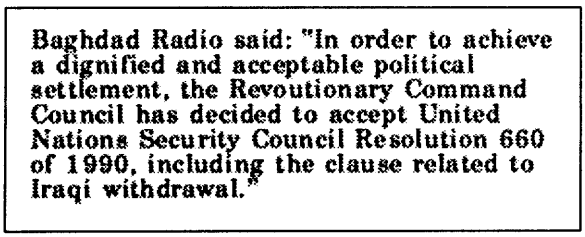

Figure 19: The formatter produces flush-left / ragged-right columns.

Hyphenation is another a technique that can decrease legibility. Most typographers take it for granted, and, for an unknown reason, readers seem to accept split words. Since the formatter is not allowed to split paragraphs there is no reason why it should split words. Therefore, line lengths in The Electronic Broadsheet vary more than in most publications and there has been reactions to the ragged right margins. To settle these issues, a user study should be performed as an extension to this project

8.5 Tags

To indicate the source and/or author of the story, a text field bounded by two horizontal lines, is added to the beginning of the first column. The design is borrowed from The Boston Globe.

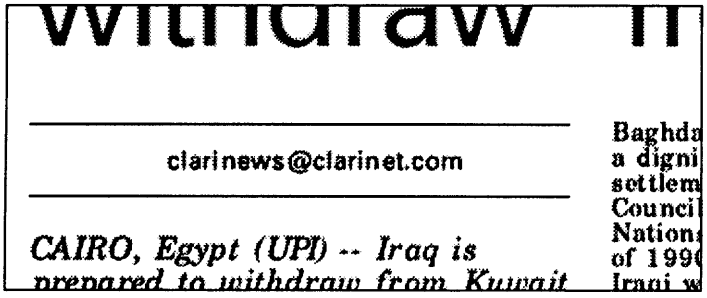

Figure 20: Source Tag in an article. The name of the author is not known, so the formatter adds the electronic address to the information provider.

As described in part one of this thesis, the ideal paper contains much information that is currently not available from the electronic sources, e.g. the electronic address of the author.

8.6 Illustrations

If a picture file is listed as accompanying the article, the formatter will simply copy the image as if it was the last paragraph in the story. This simple scheme works fine in the

current configuration where pictures are few, but should be reworked if pictures become an important part of the newspaper.

The maximum width of an accompanying illustration is the same as the column width since illustrations are handled as paragraphs internally in the formatter.

8.7 Proportion

One goal of designers is to create pages in which the proportions of the elements are pleasing to the eye. The Greeks worked out the proportions of their temples in classical dimension, and so do some page designers today. A rule-of-the-thumb says that square articles should be avoided; a 3:5 ratio is more pleasing to the eye [Baskette86]. This ratio works well both for horizontally and vertical articles, in fact, it is important to use both to prevent a page form becoming "one-dimensional". At the same time, several influential newspapers use a vertical design and do not seem to suffer, among them are USA Today, New York Times and the Wall Street Journal.

[Baskette 86] Baskette, F K: The art of editing; New York; Macmillan 1986

Odd-shaped stories are often used in newspapers to utilize all available space on a page—often because ads have cluttered the page. Odd-shaped articles cause uneven wraps of text and tend to make the design more complex. Therefore, all articles are formatted into a rectangular shape.

In order to fit the article into a grid, the height of an article is adjusted at the end of the formatting process. By adjusting the position of the headline, tags and paragraphs, the formatter fills in extra white space, if any.

8.8 Icons

A decimated version of the article with its described changes (see chapter 7.2) is also generated by the formatter. As discussed, the icon pixmap and headline are rendered on top of a watermark and the job is performed by the formatter.

The output of the formatter is the same as the input: a "datfile". The fact that datfiles handle the same information in different forms is somewhat intriguing. The icon pixmap is stored as a subdatfile of the rendered article.

The formatter always outputs the whole article. If the front page layout scheme is changed to sometimes display partial articles, the formatter will have to be changed.

8.9 Blocktimize Algorithm

The blocktimize algorithm was initially developed to assist in laying out the headline. Multiline headlines should be equalized with regard to length to balance. The problem might seem trivial, but I have found no simple algorithm that guarantees the optimal solution.

Since the formatting process never breaks a paragraph, the same algorithm can be used to equalize the columns

First, let us generalize the problem into building blocks and towers. Given a set of blocks with different heights, their relative positions (we don't want the words to change position), and the number of allowed towers, how do we stack the blocks to minimize the height of the highest tower, i.e. optimize the blocks with regard to white space?

The following pseudo-code outlines the *blocktimize* algorithm I settled upon:

```
{
   tower_id pre_lo, pre_hi;
   tower_height pre_height, post_height;
   boolean finished;

   build_one_tall_tower_containing_all_blocks();
   finished = false;
   do
   {
      pre_lo=lowest_tower();
      pre_hi=highest_tower();
      pre_height=height_of_tower(pre_hi);
      propagate_block_from_to_tower(pre_hi,pre_lo);
      post_height=height_of_heighest_tower();
      if (post_height > pre_height) /* no improvement */
      {
         propagate_block_from_to_tower(pre_lo,pre_hi);
         finished = true;
      }
   } while(not finished);
}
```

The algorithm is visualized in figure 21.

When using *blocktimize* to split headlines, the word lengths become blocks and the lines in the headline becomes towers. If *blocktimize* is used to balance columns, column heights are blocks, while the columns are towers.

When formatting an article, *blocktimize* is called repeatedly with different number of towers, i.e. lines or columns, to find the optimal solution.

8.10 Implementation

The Electronic Broadsheet is an interactive system, while the formatting process is one that can run off-line. To keep all parts of the system on one machine while preserving

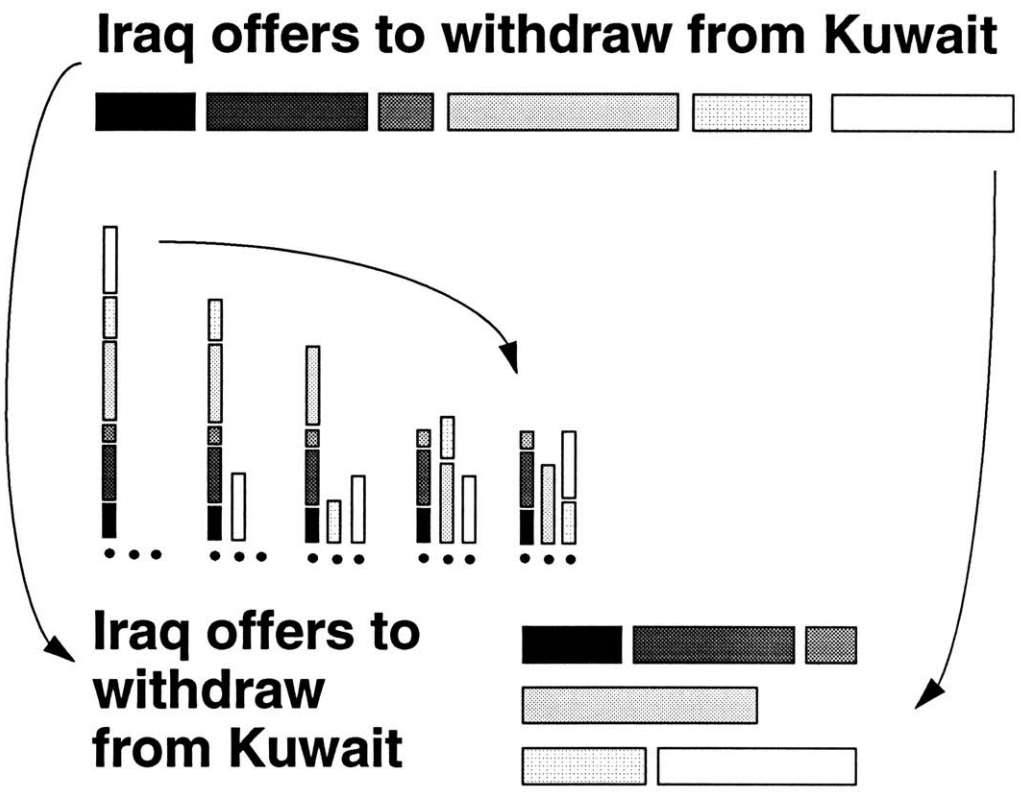

Figure 21: The figure illustrates the blocktimize algorithm. The words in the headline are turned into building blocks and shaded to visualize their internal order. The basic idea is easy to grasp once the blocks are made into vertical towers: propagate blocks until the lowest possible level is reached.

interactivity, a formatting process is forked off the main process for each article that is formatted. This scheme has several advantages:

See UNIX manual pages for more information on the `fork` system call

- It allows the main process to devote it's attention to events from the user and the window system.
- The soft fonts can be loaded and processed by the main process when it starts up—each formatting process will automatically be given a copy.
- The formatting process is quite complex in terms of memory allocation—by letting it die after finishing formatting the article, memory leaks can be ignored. This simplifies programming and testing, but is not acceptable

as a long term solution.

- To conserve CPU cycles and virtual memory, only one formatting process run at a time. When the formatting process is finished, a signal is sent to the parent process, and the parent process reads the output file that now contains an image of the formatted article.

A SIGCHLD signal is sent to a UNIX parent process after a child process dies.

9 LAYOUT

The layout of a newspaper is designed to attract readership and to optimize the newspaper's effectiveness in presenting information. Rules and conventions have evolved over the years and almost all western newspapers share well-established layout principles. The large screen allows for the use of newspaper layout techniques on a computer display.

9.1 Automating the Layout Process

Newspaper layout was one of the first newspaper processes automated with the help of computers. The application is obvious and the market is large. The problem is reasonably constrained; the program is given a set of news articles and advertisements. Advertisements are placed according to one set of rules, while news articles are placed in the remaining space (the "newshole") according to another set of rules. Since The Electronic Broadsheet does not contain advertisements, I do not discuss them.

Advertising is essential, both to make it economically feasible, and to enrich the content

Without the ads the problem is surprisingly similar to the computer game Tetris; blocks are to be placed to minimize white space.

Through grants from the American Newspaper Publishers Association, J F Reintjes of MIT and his students have done a substantial amount of work on automating newspaper layout. Their research focuses on assisting newspaper personnel in the layout process rather than automating the entire process:

> "At the other extreme, a fully automated layout system is conceivable where layouts would be created according to pre-conceived algorithms. Ideally, such a system would be the fastest and most efficient approach; however, we believe the layout process is too complex and day-to-day conditions are too varied to permit the design of an algorithm that can achieve acceptable layouts consistently and cost-effectively." [Reintjes et al. 77]

[Reintjes et al. 77] Reintjes, J F; Knudson, D R.; Kan, Hsin-Kuo: Computer-Assisted Layout of Newspapers; Electronic Systems Laboratory, MIT, 1977

9.2 Templates

When trying to automate newspaper page layout there are two basic approaches; algorithms and templates. Robert Polansky [Polansky 74] describes a sequential layout algorithm that develops a page one item at a time. A rectangular story envelope is constructed using a desired height-to-width ratio and the envelope is placed at a boundary of the remaining newshole. The algorithm then shifts the envelope and/or modifies its shape to eliminate any overlap with items previously positioned on the page. The process is repeated until all items assigned to the page are placed. The algorithm shows satisfactory results when the number of articles is low, but is of limited use when placing the last items on a page. Again, think of Tetris!

[Polansky 74] Polansky, R: Documentation of News-Layout Program; Electronic Systems Laboratory Memorandum NEWSI-20, MIT 1974

Kan [Kan 77] gives the layout process more information about the desired page design by introducing templates. Templates are dummy pages that have been designed with the overall page layout in mind. A library containing all allowed templates for a newspaper page would number between 100.000 and 1.000.000 entries. The estimate is the product of the number of different possible layout styles, ad dummies, story and picture sizes, and story and picture counts. Although is possible to store and process this amount of information, collecting the data in the first place would require a substantial amount of work.

[Kan 77] Kan, Hsin-Kuo: A computerized template-drive news-layout system for newspapers; Thesis E.E Sc.D., MIT 1977

By abstracting templates to contain geometrical data only, Kan reduced the number of templates to a few hundred. The new templates specify no metric data and each template can generate many different page layouts.

DeTreville [DeTreville 78] defines a template grammar that describes the set of legal templates. The purpose of the grammar is to outlaw templates that should be avoided. The descriptive grammar consists of a small set of rules, e.g., "The shape of a template must never become larger as one scans from top to bottom." A large number of templates are in the set of legal designs, from which the template to be used is selected in a semi-random way.

[DeTreville 78] DeTreville, J D: An analytical approach to computerized news layout for newspapers; Thesis E.E. Ph.D., MIT, Cambridge Mass 1978

9.3 The Layout of the Electronic Broadsheet

While the electronic newspaper borrows many elements from the newspaper metaphor, including the tiled layout, the process of laying out the pages is very different. Paper-based newspapers are issued in discrete editions, but the Electronic Broadsheet continuously receives articles. Accordingly, old or unimportant articles have to be removed and this complicates the shape of the newshole. It's a dynamic page and not your average Tetris game!

Unless news articles are constantly reformatted it is impossible to keep a dynamic page optimized with regard to open space. One story will be taken down and the new article will not cover the hole unless it is reformatted with the new space in mind. Doing so would delay the presentation, and the result could look awkward. But, virtual news space is cheap and since one white block will not multiply into large areas of white paper the problem is not critical.

9.3.1 The Layout in the Sections

As described in chapter 5, The Electronic Broadsheet has one front page and several section pages. The layout in the section follows traditional layout rules and tiles the articles. Each page is laid out in a grid with a 5*8 resolution, and space is allocated as stories come in. The Electronic Broadsheet will search the grid for all possible positions. If more than one is found, it will use some simple rules to pick the final destination. The rules are:

- if the priority of the article is high, it will try to get a position in the upper part of the page
- if it's a one-column article it should go to one of the edges
- there should be a horizontal balance of articles

The layout program never moves an article after it has been placed since that could interfere with news reading. However, there are situations where one would want to move articles to make room for the new story. E.g., if a high priority article comes in and there is only room at the bottom

of the page, it would be better to move the top articles down instead of placing the new article at the bottom, which is where it goes now.

9.3.2 Recycling Real Estate

If there is no free room for the incoming article, the system will search through the articles already on the page to see if any of them can give way for new news. A map of all articles with priorities **higher** than the incoming article is made. If the new article can fit on the map without covering any of the marked slots, any current article covering the same space is discarded. See chapter 10 for a description of how an article is eliminated.

Figure 22: Traditional front page layout

9.3.3 The Layout of the Front Page

The traditional newspaper front page displays only the first part of the articles and make the reader jump to an inside page to continue the story. This has been shown to lose readers; one out of five in one study [Nelson 68]. Ideally, the whole story should be displayed to avoid jumps, but real estate on the front page is expensive and there is not enough room to show articles in full unless the number of front page stories is severely limited.

[Nelson 68] Carl J Nelson Research, Inc. The research results were reported by Chlinton R Bush in News Research for better Newspapers, ANPAF, Volume 3 1968

A possible solution is to format two versions of the article; one intended for the front page and one for the section page. This approach would require more processing power, and deciding how much of the article to put on each page is not trivial. Another approach is to format the whole article, but only display parts of it and let the user scroll through the content. Unfortunately, the performance of the current system is not adequate to handle the increased burden of scrolling; it is already burdened by the X11 server and a formatting process running simultaneously. Also, both of the above solutions would hide parts of the article for the user while reading. As long as it's possible to fit the article on a page, I believe it should be shown in full.

Recently, some papers have tried to simplify their content and user interface. Knight Ridder spent more than $2 million to make the "News" in Boca Raton, Fla. more desirable to younger readers, and all stories are now so short that they can be displayed in full [Palmer 91].

[Palmer 91] Palmer, T: Newspapers battle to survive in new age; Boston Globe, April 14, 1991.

Three different ideas of how the front page should look crystallized during the course of the project:

- The traditional: The newspaper front page is a highly successful channel of communication and should be transferred intact onto the screen. The most important articles are displayed with a tiled layout. This approach wastes screen space in a dynamic environment where articles come and go, but it is the most organized. Also, it is consistent with the layout in the sections.
- The volcano: The front page displays **all** articles in full with overlapping windows. Important stories float to the top of the stack, less important articles may be partly visible, while the articles with the least priority are totally overlapped. The page contains a lot of information and looks chaotic at times. By clicking in a partially visible

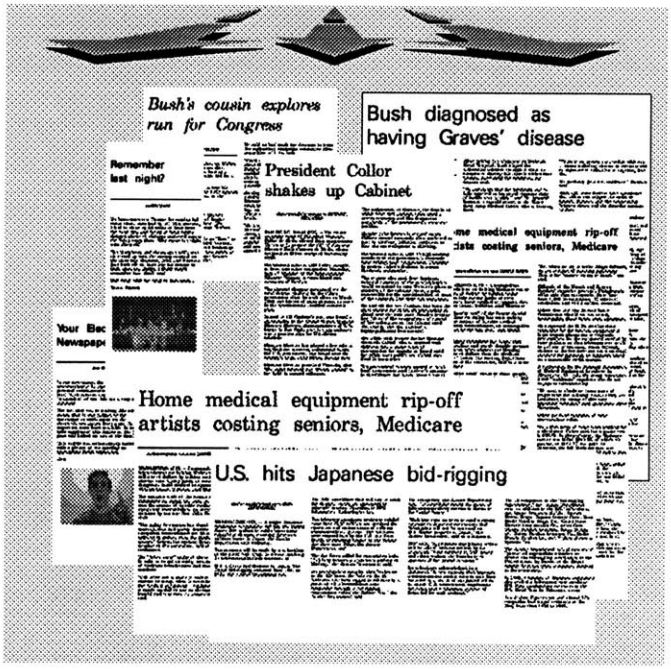

Figure 23: Screen dump of the volcano page

article, it will float to the top. This alternative quickly fills the front page with a segmented compound of articles. It is both serendipitous and chaotic.

- The headlines: As many articles as possible are stacked with the headline visible. By clicking and holding down the mouse button, a user can temporarily bring an article to the top of the stack. This approach offers a structured interface to a lot of data.

People feel strongly about front page design and opinions are diverse. The three alternatives all have their merits and some users might want to use them all.

9.3.4 Nameplates & Section Heads

To improve the look of the pages they all carry a nameplate on top. The nameplate identifies the front page as a part of the Newspace project while the section pages are labeled accordingly. Colors have been used indiscriminately. Appendix B shows some nameplate designs.

10 USER INTERACTION

Most of this paper is dedicated to how information is presented to the user; user input is of secondary concern. There are several reasons for this. While most software today is event-driven, the Electronic Broadsheet is a contiguous process that can run without any user involvement. The newspaper will update itself much like a traditional newspaper will be delivered to subscribers weather they read yesterday's edition or not.

Also, an important part of the Newspace project is the user modeling [Orwant 91]. The system keeps a dynamic model of each reader and consults the model when selecting what news to present. The more the system knows about the user, the less the uses needs to tell the system.

[Orwant 91] Orwant, J L: Doppelgänger: A User Modeling System; SB Thesis, MIT Department of Electrical Engineering and Computer Science, 1991

However, to adapt to a user's changing interests and habits, the system needs user feedback. Ideally, system feedback should be transparent to the user. The system should use eye tracking and gesture recognition as input channels, but this kind of user interface technology is not mature enough yet. We therefore have to settle for traditional explicit methods; the current configuration includes a mouse as pointer device.

10.1 Input Devices

Used on the large screen, the mouse is sometimes irritating to use:

- The hand and eye are far from each other, and it is therefore hard to relate hand and mouse movements.
- The mouse pad is very much smaller than the screen so one either has to lift the mouse to move far, or set the mouse/pointer movent ratio high. Neither solution is good.

Earlier newspaper projects in the EP group have been based on touch-sensitive screens as input devices. This makes sense since precision is of secondary concern, and pointing directly on the screen eliminates the need for relating hand and eye movements.

10.2 Articles of Interest

To trace the changing interests of the user, the system needs to know which articles the reader finds interesting. Users are encouraged to move the pointer into each article they read, and they can indicate special interest in the article by clicking in it. All user feedback is handed over to the user modeling module to update the personalized filters.

If the user indicates special interest in an article on the front page, the system will pan the view into the corresponding section page. The motivation for panning is that readers will probably be interested in reading related stories.

To make room for new articles, older stories sometimes have to be taken down. If a currently displayed article is to be eliminated, the user has to get a warning. Usually, articles can be taken down without telling the user; old articles just fade away and disappear. However, the user might happen to read the article that is to be eliminated. Therefore, the system must have some kind of warning mechanism if the old article is on the current page. This is done through fading the contrast of the article before taking it down. When an article fades, the user has a minute or so to indicate that the article should stay by clicking in it.

10.3 Explicit Movement Info

All section pages contain a "door" to the front page. The door is a window that when clicked will pan the view back to front page. The placement of the door has been a point of discussion; some users favor the door to have a fixed position on all pages. Another approach is to put the door along the border with, or in the corner closest to, the front page.

The doors are courtesy of vtwm.

11 SCALABLE NEWS: THE ELECTRONIC TABLOID

The ideal newspaper scales and transposes news to any reasonable output device available. At times, large and dynamic is appropriate, while at other times, small and portable is more suitable to the user. In designing the presentation system, the goal is to let the user, rather than the data provider, find a fitting balance between static and dynamic, large and portable displays. Figure 24 shows some of the formats available for paper- and screen-based publishing.

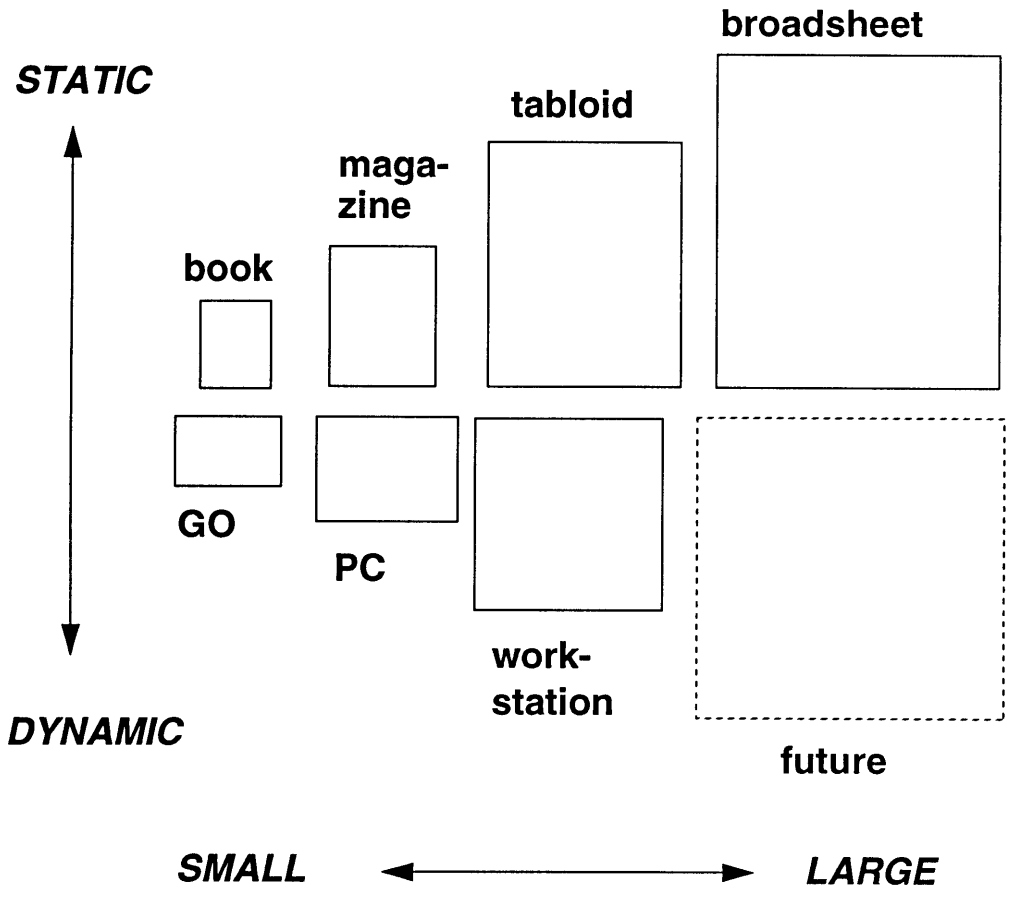

Figure 24: The figure shows common formats for paper publishing (top) and electronic publishing (bottom).

One extreme is the immobile 2k display which is comparable to a broadsheet newspaper in size. The other end is the highly portable stylus-based notebook computers. They weight less than 3 kilos have LCD screens comparable to books in size. One recent instantiation is the GO computer.

In between these two extremes most computers find their place. The PC is comparable to a magazine in display surface, and it is hard to imagine a business world without them. Workstations, popular in academic environments much because of their larger screen size, provide a tabloid-sized display.

To study how the news presentation will change when the size of the medium changes, the display application was ported to an IBM RS6000 with one tabloid-sized color monitor (1280 * 1024 pixels, also known as 1k). The technical part of the porting process was simple due to the availability of X11 and BSD libraries.

Berkeley Software Distribution (BSD) is a popular version of the UNIX operating system.

There are two major differences between the 2k and 1k system. For one, the difference in size between the main monitors is significant, more so than the numbers themselves indicate. Secondly, the 1k system has only one screen; there is no separate screen available for the map.

11.1 The Tabloid Screen

The tabloid screen contains about one fourth of the pixels available in the 2k system. It is given that the human interface will change dramatically.

While the large monitor can display around eight full tiled articles simultaneously, the 1k only displays two—which hardly makes a front page. Scanning the page is no longer an activity when there are two headlines. Compromising by not displaying all articles in full may be one way to improve upon this, in general, the newspaper metaphor is unfortunately not applicable to the 1k display.

11.2 The Missing Map

Lacking a dedicated map monitor, a part of the main monitor has to be used. This further decreases the newshole, but a map is essential for navigating in the Newspace. Simply moving the square map to the main screen is not a good solution since it leaves the newshole in an odd-shaped form. Instead, the map was reshaped and placed on the side of the screen—the right side seemed natural to me. The newspace now consists of five pages that form a vertical bar that; see figure 25.

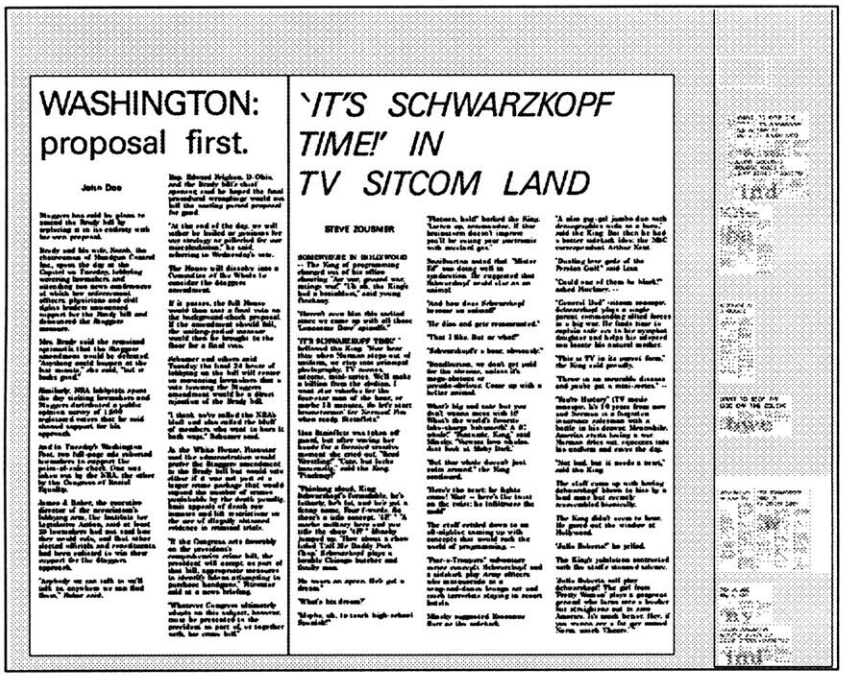

Figure 25: Screen dump of the electronic tabloid. The "scrollbar" can be seen on the right side.with the current page high-lighted.

The similarities with a scrollbar are striking, but with one major distinction. A traditional scrollbar indicates the current position in a linear space. The map, on the other hand, also tells about the **content** in the space. This is also an excellent idea to all scrollbar designers out there. Make a map!

Except for the Apple Macintosh, most scrollbars will also indicate how much of the linear space is visible in the window.

12 EVALUATION

The Electronic Broadsheet consists of approximately7000 lines of C code. It handles all aspects screen-based news presentation from low-level typesetting to multi-page layout and user interactivity. Taking advantage of advanced display hardware, the Electronic Broadsheet introduces a rival to paper's dominance as the preferred newspaper presentation media.

As a part of the Newspace project, The Electronic Broadsheet is the first presentation module to institute dynamically updated news from an independent user modelling server. The clearly defined interface between the presentation module and news manipulation modules will make news scalable by easing the design of presentation modules for other display hardware.

The Electronic Broadsheet can be evaluated from several standpoints:

- The 2k monitor offers unprecedented visual **bandwidth for the human interface**. No application will exploit the bandwidth fully; the human being on the other side is not capable of digesting unlimited amounts of information. Instead, the bandwidth optimization must be judged with regard to the human user. A rich visual language is utilized in the design of the articles and the map, and I believe the result is functional as well as visually pleasing. However, the Newspace is only two-dimensional and the map is by definition also two-dimensional. Constructing a three-dimensional Newspace and a corresponding map could increase the maximum bandwidth. The Rooms project at Xerox PARC has been extended into the third dimension [Card, Robertson, Mackinaly 91].
- Not having a design background, I don't possess the vocabulary to criticize the **visual design** elements. Others will judge better than me, but designing text, articles, pages and nameplates has been one of the most

[Card, Robertson, Mackinaly 91] Card, S; Robertson, G; Mackinaly, J.: The Information Visualizer, An Information Workspace; ACM/SIGCHI'91 Conference Proceedings, pp 181-188, May 1991.

challenging parts of the projects. The lack of colors in the data received form the news sources were substituted with colorful logos. Judging from the response from fellow students and faculty, personalized newspaper design should be available.

- From a **computer resource efficiency** the application scores poorly. There has been no time for optimization, and the heavy dependance upon system calls like `fork` should be reviewed.
- The ultimate evaluation of a newspaper is done by the **readers**. For the Electronic Broadsheet, the number of potential subscribers is strictly limited by the number of 2k monitors in the world; a number that is still very low. A formal user testing project should be performed to measure how the well Electronic Broadsheet performs versus paper-based news.

A newspaper will never be better than the quality of the articles presented; fancy design will not keep readers entertained for very long. As the Newspace project stands today it receives a high number of text articles, but few figures, and no photographs or video sequences. This tends to give pages a dull look which is hard to avoid without depending on locally produced news, like scanned maps and comics strips. In the future, emphasis should be put on widening the range of media sources.

Evaluating a project that has been on my mind for the last nine months is problematic; the bias is tremendous. The same mind is also able to come up with new ideas faster than it can implement them, and this creates a feeling of always lagging behind in an unfinished project. True, the application is not complete, and it can be improved in many ways, but it is at a point where it deserves to be presented.

12.1 Conclusion

At 2000 lines of resolution, computer displays start to compete with paper in size and legibility. When using the broadsheet-sized monitor, screen space management shifts

emphasis from screen area conservation to screen overview, and opens for new metaphors in the human machine communication; the newspaper metaphor seems particularly appropriate.

Augmented by navigational clues and dynamic screen updates, the Electronic Broadsheet takes on paper-based news distribution; it handles all aspects of screen-based news presentation from low-level typesetting to multi-page layout and user interactivity.

The newspaper application was ported to a 1k monitor, but the limited screen space was not sufficient to present news using the newspaper metaphor

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Appendix A

This Appendix contains messages from USENET and personal email regarding Solbourne's "claim" to the "virtual desktop". Also, Dave Edmonson's annnounce message regarding VRTW 3.0 (from which NVTWM is modified) is enclosed.

```
From emv@ox.com Tue Apr 2 12:10:29 1991
Date: Mon, 1 Apr 91 21:23 EST
From: emv@ox.com (Ed Vielmetti)
To: howcome@media-lab.media.mit.edu
Subject: vtwm

>From comp.archives Thu Aug 9 08:20:06 EDT 1990
Path: news-server.csri.toronto.edu!cs.utexas.edu!usc!zaphod.mps.ohio-
state.edu!math.lsa.umich.edu!math.lsa.umich.edu!emv
From: rms@AI.MIT.EDU
Newsgroups: comp.archives
Subject: [emacs] X marks the suit
Message-ID: <1990Aug9.031936.29383@math.lsa.umich.edu>
Date: 9 Aug 90 03:19:36 GMT
Sender: emv@math.lsa.umich.edu (Edward Vielmetti)
Reply-To: rms@AI.MIT.EDU
Followup-To: comp.emacs
Organization: University of Michigan, Department of Mathematics
Lines: 35
Approved: emv@math.lsa.umich.edu (Edward Vielmetti)
X-Original-Newsgroups: comp.emacs

Archive-name: vtwm/03-Aug-90
Original-posting-by: rms@AI.MIT.EDU
Original-subject: X marks the suit
Archive-site: expo.lcs.mit.edu [18.30.0.212]
Reposted-by: emv@math.lsa.umich.edu (Edward Vielmetti)

I hope this taste of the shape of things to come in the computer
industry will wake enough of us up before it is too late...


Date: Fri, 3 Aug 90 10:51:34 -0400 (EDT)
From: Nicholas John Williams <njw@ATHENA.MIT.EDU>
To: staff@ATHENA.MIT.EDU
Subject: TWM Virtual Desktop, Look & Feel Lawsuits etc.

As many of you know, there was a version of TWM available recently,
```

which had patches (written by Dave Edmondson of Imperial College) which added a "Virtual Desktop" facility. This allowed you to spread your windows out over virtual space and select which area to view at any one time. The feature was modelled after the Solbourne Window Manager, performing the same sort of tasks as their Virtual Desktop.

Wednesday, the patches allowing TWM to do this were placed into the contrib area on expo.lcs.mit.edu.

Following this, Dave Edmondson yesterday received a letter from Paul Lippe, the vice president of Solbourne stating that he had "engaged in unauthorized copying of Solbourne's virtual desktop utility feature".

Legal discussions are currently underweigh and, until further notice, the vtwm in the windowmanagers locker has been made unavailable.

Nick.
njw@athena.mit.edu
njw@doc.imperial.ac.uk

From toml@Solbourne.COM Sun May 12 02:14:16 1991
Date: Tue, 2 Apr 91 14:01:32 MST
From: toml@Solbourne.COM (Tom LaStrange)
To: howcome@media-lab.media.mit.edu (Hakon Lie)
In-Reply-To: howcome@media-lab.media.mit.edu's message of 1 Apr 91 19:47:10 GMT
Subject: Solbourne wm

> Remember the controversy regarding th Soulbourne window manager last
> summer? At some point they claimed to have rights to the "virtual"
> look & feel. I need a reference to this case for my thesis which deal
> with virtual environments.
>
> So, is you saved some email about the case or have other statements
> from involved parts, please let me know!

Yeah, I remember it. It wasn't "virtual look & feel" that started it all, it was the fact that a person copied the Virtual Desktop (a trademark) feature
of swm, and didn't bother to ask Solbourne or acknowledge where he got the idea from.

--
Tom LaStrange toml@Solbourne.COM

```
From toml@Solbourne.COM Sun May 12 02:22:51 1991
To: howcome@media-lab.media.mit.edu
Subject: Re: Solbourne wm
In-Reply-To: Your message of Tue, 02 Apr 91 16:43:06 -0500.
 <9104022143.AA24156@media-lab.media.mit.edu>
Date: Tue, 02 Apr 91 14:57:50 -0700
From: toml@Solbourne.COM

> Thanks for your reply, I was going to ask you for comments.

> Yeah, I remember it. It wasn't "virtual look & feel" that started it all,
> it was the fact that a person copied the Virtual Desktop (a trademark)
fea
 ture
> of swm, and didn't bother to ask Solbourne or acknowledge where he got th
 e
> idea from.

> Where the original ide comes from can be disputed. In the Media Lab we
> like to believe that SDMS (Spatial Data Management System) was frst.

Well I certainly never saw it but if it was done in the 70's I'd bet you
were frst.

> Anyway, the following draft text tries to summarize some of the events
> I fnd important. If you have comments or additional information, I'd
> be thankful. The text is intended to be a part of an MS thesis in the
> Media Lab where we use a modifed vtwm as an interface to an electronic
> newspaper.

> -h&kon


> [..]

> During the last year, the X11 community has seen the introduction of
> several so-called "virtual window managers" [Solbourne] [Dave
> Edmondson] [Tom LaStrange]. The interface is clearly based on the
> concept pioneered by SDMS, a project in the Media Lab > in the late
> 70's. The window managers allow X11 displays to have a virtual plane
> larger than the physical screen size. The user can pan the real screen
> over the virtual screen to view a different part of the plane. The
> user interface for all the virtual window managers is implemented
> through a map. The user can see the outline of all toplevel windows in
> a special window that is an isomorph representation of the windows on
> the virtual plane. The implication of using a virtual window manager
> for the users is that they have more real estate to lay windows out
> on. The overlapping windows found in most window systems are replaced
```

> by a bulletin board with a partial view.

> X.3.1 X11 WINDOW MANAGERS

> The X11 concept of a "window manager" is quite unique. The window
> manager is with few exceptions an application just like any other X11
> client (For an overview over X Window System Concepts see Xlib
> Programming Manual, [Nye88]). The window manager is given authority to
> control the layout of windows on the screen. Other > clients indicate
> their preferred position and size and this will normally be granted.
> However, the window manager can anytime decide to move or resize a
> client window.

> One of the frst window managers available, twm [LaStrange, when ,
> where, hp?], gained widespread popularity [Hafjeld, Kaplan, Lie] by

Most of the initial work was done while I was employed at Evans & Sutherland.
The frst public release was April 15, 1988.

> offering the same functionality and ease of use as found in earlier
> window systems [Star, Lisa, Mac]. Recognizing it's de facto position
> among window managers, the X Consortium adopted the program and
> extended the functionality for release 4 of X11.

> Dave Edmondson of Imperial College [Edmonson] modifed the freely
> available source code for twm to add the virtual feature. The new
> version, called vtwm (virtual twm), was made available in (june?) 1990
> and quickly gained popularity. It was the frst free window manager
> with virtual features, Solbourne [LaStrange] had earlier (when?)
> released their propietary swm (Solbourne Window Manager).

> At some point Solbourne claimed to have the rights to the "virtual
> desktop utility feature" [Stallman90], a claim that was heavily
> disputed on the network at the time. Solbourne later acknowledged that
> they had no ..... and have later allowed the release of source code
> from tvtwm, written by LaStrange, now of Solbourne.

>From what I understand, the only thing we laid claim to was the name "Virtual Desktop". If Dave Edmonson had called his the virtual outhouse I don't think any of this would have ever happened. I could be wrong, I never saw the lawyer letter that was sent to Edmonson, but that was my impression.

--
Tom L.

```
From emv@ox.com Tue Apr 2 12:10:38 1991
Date: Mon, 1 Apr 91 21:24 EST
From: emv@ox.com (Ed Vielmetti)
To: howcome@media-lab.media.mit.edu
Subject: vtwm

>From comp.archives Thu Aug 30 20:20:04 EDT 1990
Newsgroups: comp.archives
Path: news-server.csri.toronto.edu!math.l-
sa.umich.edu!math.lsa.umich.edu!emv
From: toml@ninja.Solbourne.COM (Tom LaStrange)
Subject: [xpert] tvtwm is available
Message-ID: <1990Aug30.164251.14639@math.lsa.umich.edu>
Followup-To: comp.windows.x
Sender: emv@math.lsa.umich.edu (Edward Vielmetti)
Reply-To: toml@solbourne.com
Organization: University of Michigan, Department of Mathematics
Date: Thu, 30 Aug 90 16:42:51 GMT
Approved: emv@math.lsa.umich.edu (Edward Vielmetti)
X-Original-Newsgroups: comp.windows.x
Lines: 211

Archive-name: tvtwm/30-Aug-90
Original-posting-by: toml@ninja.Solbourne.COM (Tom LaStrange)
Original-subject: tvtwm is available
Archive-site: expo.lcs.mit.edu [18.30.0.212]
Archive-directory: /contrib
Reposted-by: emv@math.lsa.umich.edu (Edward Vielmetti)

As many of you have no doubt seen, tvtwm has shown up in comp.sources.x.
But
as many of you also know, as soon as you send some software off, you fnd
some
more problems that you would like to get fxed. Anyway, the sources posted
to comp.windows.x are now a whole day old and there is already a patch fle
to bring it up to patchlevel 1. That will show up in comp.sources.x some-
time
in the near future.

I have also placed a copy in contrib/tvtwm.tar.Z on expo. The version on
expo is the latest stuff and is already at patchlevel 1, no need to apply
the
forthcoming patches.

What is tvtwm? It's a version of twm with a Virtual Desktop modeled after
swm (Solbourne Window Manager). It took me all of two and a half days to
get the major stuff written and its been in use for a whole three days
by Dave Lemke and some of his buddies at NCD (Thanks Dave!). I'm including
```

the README.tvtwm fle here so you can decide if you want to grab it.

--
Tom LaStrange

Solbourne Computer Inc. ARPA: toml@Solbourne.COM
1900 Pike Rd. UUCP: ...!{boulder,sun}!stan!toml
Longmont, CO 80501

---------- README.tvtwm ----------

For those of you like me who want to try software before reading the instructions, all you have to do to get started is add a single line to your .twmrc fle. Something like this:

```
VirtualDesktop "3000x2000"
```

Now for the verbose description:

This is yet another, different implementation of the Virtual Desktop concept for twm. I call this version tvtwm (Tom's Virtual twm). It is based on the R4 version of twm with up to fx-14 installed. This implementation is modeled after swm (Solbourne Window Manager) and includes the very nice ability to move windows into and out of the panner. It should be noted that none of this code came from the vtwm implementation. If you have problems and/or patches you can email me at the address at the end of this fle.

If we look at different implementations of the Virtual Desktop, I think we can relate them to soft drinks:

swm - Classic Coke "The Real Thing"
tvtwm - Diet Coke "Same as Coke but not as sweet"
vtwm - Diet Pepsi "Not as sweet as Coke, some people may prefer it to any favor of Coke"

There are pros and cons to the vtwm and swm/tvtwm implementations. Most revolve around whether or not to use an additional window for the scrolling desktop or to simply move windows around on the actual root window.

vtwm moves windows on the actual root window, swm/tvtwm use an additional window to perform the scrolling.

Pros:
vtwm Simple to implement.
Programs like xsetroot continue to work.

```
 tvtwm Half the network traffc when the desktop scrolls,
 only a ConfgureNotify event has to be sent.
 Faster scrolling of the desktop.
 Desktop background image will actually scroll.
 Opens the door for possible multiple Virtual Desktop
 windows.
Cons:
 vtwm Twice as much network traffc when the desktop scrolls,
 each window has to be moved and then a ConfgureNotify
 event must be sent.
 Slower scrolling of the desktop.
 Desktop background image does not scroll.

 tvtwm Programs like xsetroot no longer work, additional work
 needs to be done to fnd the Virtual Desktop window.
 Programs that attempt to fnd the size of the window
 manager decoration may fail if the traverse the window
 tree until they run into the actual root window.
```

The rest of the message is a user manual for tvtwm and is not relevant for this case.

```
From emv@ox.com Tue Apr 2 12:10:48 1991
Date: Mon, 1 Apr 91 21:26 EST
From: emv@ox.com (Ed Vielmetti)
To: howcome@media-lab.media.mit.edu
Subject: vtwm

>From comp.archives Fri Nov 23 20:20:04 EST 1990
Path: news-server.csri.toronto.edu!rutgers!att!tut.cis.ohio-
state.edu!zaphod.mps.ohio-state.edu!uakari.primate.wisc.edu!-
caen!ox.com!emv
From: dme@doc.ic.ac.uk (Dave Edmondson)
Newsgroups: comp.archives
Subject: [xannounce] vtwm release 3.0
Message-ID: <1990Nov23.234605.26799@ox.com>
Date: 23 Nov 90 23:46:05 GMT
Sender: emv@ox.com (Edward Vielmetti)
Reply-To: dme@doc.ic.ac.uk (Dave Edmondson)
Followup-To: comp.windows.x.announce
Organization: Imperial College Mafa
Lines: 55
Approved: emv@ox.com (Edward Vielmetti)
X-Original-Newsgroups: comp.windows.x.announce

Archive-name: vtwm/21-Nov-90
Original-posting-by: dme@doc.ic.ac.uk (Dave Edmondson)
Original-subject: vtwm release 3.0
Archive-site: expo.lcs.mit.edu [18.30.0.212]
Archive-directory: /contrib
Reposted-by: emv@ox.com (Edward Vielmetti)


This is to announce the availability of the gamma release of
vtwm, TWM with a virtual desktop. This is the second public release,
and is numbered 3.0 (make sense ?).
A compressed shar fle is available on expo.lcs.mit.edu
(18.30.0.212) as /contrib/vtwm.shar.Z. If anyone still wants a copy
of the older (beta) version, please send me mail.

Version 3.0 has been tested on the following platforms:
IBM 6150 with ACIS 4.3
Sun SPARC's with SunOS 4.x
Sun 68k's with SunOS 4.x
HP9000 seris 300 with HPUX 7.0
DECstation's with Ultrix 3.x and 4.0

A couple of notes on compiling:
* if you don't have strdup(), add -DNOSTRDUP
* if you are at Project Athena, add -DPIXEL_ALREADY_TYPEDEFED,
```

```
 due to a change in /usr/include/X11/Xmu/Drawing.h
* if at Project Athena, use gmake (GNU-make), the standard one
 complains about a line too long

As ever, I solicit bug reports and enhancement requests. A note from
our sponsors:
/*
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 * implied warranty.
 */

thanks, dave.
--
Dave Edmondson, Systems Support. Opinions are all my own.
Department of Computing, Imperial College of Science, Technology and Med-
icine,
180 Queen's Gate, London SW7 1BZ. phone: 071-589-5111 x5085 fax: 071-581-
8024
 email: dme@doc.ic.ac.uk, ..!ukc!icdoc!dme, dme@athena.mit.edu
 ''Be selective, be objective, be an asset to the collective'' -- Jazzy B
```

Appendix B


Hakon's Edition
newspace
-all the news that fits the display
TECHNOLOGY
INTERNATIONAL
SPORTS
DIGITAL
COMICS

Acknowledgements

There are many people, programs & 'puters that deserve acknowledgment for their support. Without them, this thesis would not have been written. I especially want to thank (with FrameMaker's suggested spelling in parenthesis) :

- Walter Bender, my advisor, for accepting me into his Garden—his inspiration, creativity and support throughout the sometimes confusing process was essential.
- My readers, Børre Ludvigsen, for rich comments and sincere advice, and Muriel Cooper for design hints.
- The members of the Electronic Publishing group, *orwant* (arrant), *teo* (doe), *lacsap* (lactose) + the UROPers (rapers), for providing a creative work environment.
- My officemates: *foof* (FIFO), *sanjay* (Santa), and *arista*. We shared an office, a messy nature, and all learned some foreign words.
- Fellow gardeners for sharing good food, music & ideas: *paddy, janet, uri* (euro), *judith, sbeck* (speck), *wad, abha* (abbey), *kabooom* (kabobs), *klee* (kale), *blount* (blond), *barry, lisa, ogura* (guru), *tuna, debby* (dopey), *holtzman* (talisman), *scottf* (scatter), *hewlett* (elate), *ijshen* (edition), *warlord, vmb* (vamp), *lip, leyna* (loony), *gillian*, and *janette.*
- Also thanks to *wave* for breaking the double-spaced tyranny, to *straz* (stars) for an essential network message, and to *mario, bradedel* (breaded), *dsmall* (dismal), *masuishi* (misuse), *martin*, and *che* (the).
- FrameMaker, the #1 program in which this report was created, and GNU-emacs into which most of the text was written.
- Milano, the Sun4 workhorse behind the display, and my Zenith laptop.
- Børre Stenseth and Per Ofstad for showing me that Apple II.
- Rune Fløysbonn and Bård Håfjeld for introducing me to X and FrameMaker. Also thanks to Erik Lillevold of TF.
- Last, but not least I want to thank my parents for their motivation, and Siri for tolerating my 36/12 phases.

Håkon (hokum)
howcome@media-lab.media.mit.edu