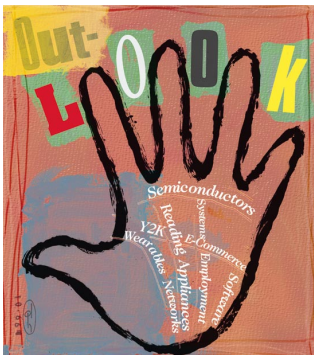

As We May Read

The Reading Appliance Revolution

Reading appliances allow people to work on electronic documents much as they would on paper. They therefore provide an alternative to the standard "browse or search and then print" model of reading online. By integrating a wide variety of document activities, such as searching, organizing, and skimming, and by allowing fluid movement among them, reading appliances eliminate disruptive transitions between paper and digital media.

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In the 1970s, Alan Kay and his colleagues at Xerox PARC envisioned a dynamic, interactive electronic book. Now, nearly 30 years later, that vision has become a reality. A new kind of personal information appliance—the reading appliance—is emerging as a tool for serious readers.

But is the world ready for reading appliances? Paper books are not only useful but are also a romantic icon of modern culture. Furthermore, previous attempts to replace reading on paper with reading online have failed: So-called paperless offices consume far more paper than they did before the introduction of PCs, while electronic books, such as Sony's Data Discman and Franklin's Bookman, have failed outside niche markets.

Despite these past failures, we believe reading appliances are viable. Human factors researchers at our laboratory and elsewhere are analyzing the benefits of paper documents and creating a foundation for designing paper-like computers. Advances in mobile hardware—driven by demand for increasingly sophisticated laptop computers—have made it possible to build the necessary hardware. Additionally, the Web has created a market for online reading by introducing millions of people to it, and books, magazines, newspapers, advertisements, and other printed matter can be produced and read at very low cost.

But reading appliance designers face two problems:

- People clearly prefer reading on paper to reading on their PCs.
- Paper is easier and more comfortable to use than portable computers, no matter how paper-like computers are.

The questions we need to ask, then, are "Which, if any, of paper's qualities must reading appliances imitate to be successful?" and "What are the advantages of reading online and how can computers help people read?"

WHAT IS READING?

No technology is more ubiquitous than the printed word; we often take reading for granted. Although reading is fundamentally seeing and comprehending words and sentences, people read for different reasons and in different ways. Studying a textbook is not like reviewing a court brief. We read to be entertained, to be inspired, to find facts, to follow directions, to prepare for a discussion, or to keep up-to-date.

To understand different kinds of reading, it may be useful to characterize reading along two dimensions: the nature of engagement with a text and the breadth of the activity across texts. The educator Mortimer J. Adler describes our engagement with a text as varying from active to passive.[1] Active reading combines reading with critical thinking, learning, and decision making, whereas passive reading is less careful and requires less effort. Active reading tends to involve writing, especially note-taking and annotation.

The second dimension—breadth across texts—varies with each reader and each type of reading. Reading a single text involves bookmarking and navigating, whereas reading multiple texts involves piling, sorting, filing, and navigating.

Table 1 shows that conventional reading situations can be categorized in this way. Passive-single reading is often associated with entertainment, as when we enjoy a novel. Passive-multiple is often associated with keeping informed, as in keeping up with e-mail. Active-single is often associated with learning, as in studying a textbook. Active-multiple involves complex decision making and building a greater understanding of a problem or discipline, sometimes through research.

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Table 1. Categories for reading situations.

	Passive	Active
Single text	Enjoying a novel, reading a poem aloud	Studying a textbook, reviewing a proposal, diagnosing with a manual
Multiple texts	Keeping up with e-mail, browsing the newspaper, surfing the Web	Researching a problem, surveying a field, keeping up-to-date professionally

Table 2. Some of the problems readers face.

	Passive	Active
Single text	Understanding the text	Understanding the text, finding information within a text, summarizing
Multiple texts	Understanding the text, carrying lots of documents, finding interesting documents	Understanding the text, carrying lots of documents, finding relevant documents, structuring lots of information

These dimensions are useful for exploring the problems facing readers, some of which are noted in Table 2. At the very least, readers approaching a single text need to grasp the text's meaning and to understand unfamiliar words and concepts. Multiple-text reading raises the issue of distributing, carrying, and locating texts. Active reading raises problems of finding information within a text and responding to it in some way—by summarizing what you learned, for example. Compounding these problems, active-multiple reading introduces a need to structure large quantities of information.

These problems present opportunities for reading appliances. For example, computation can support active reading by providing ways to search, to summarize, and to understand texts. Information networks and mass storage can support multiple-text reading by providing access to many texts. By contrast, passive-single reading benefits less from reading appliances. But before we discuss how reading appliances might be useful, we need to address why paper continues to be the medium of choice for many reading activities and explain how reading appliances can be made usable.

THE ERGONOMICS OF READING

PCs were once expected to lead to paperless offices, but instead they are responsible for producing an ever-increasing amount of paper documents. In fact, research firm Dataquest estimates that printers and copiers generated over a trillion pages in the US in 1997. Predictions of a paperless office were naive because technologists did not understand how people use paper. Over the past four hundred years, the material aspects of paper books and documents have evolved to the point where people are not consciously aware of reading technologies. To understand how technologies support or hinder reading, the Human-Computer Interaction (HCI) community has been studying the ergonomics of reading. This research has been guiding the design of reading appliances.

Reading comfort

Most people agree that reading from paper is more comfortable than reading from a PC display, largely because of the difference in sharpness and resolution. Another important difference is form factor: Readers can easily move paper documents to avoid glare and to bring the text to a better focal length or shift to a more comfortable position. In contrast, most computer displays are stationary, so that readers must move themselves instead of the display and must hold themselves in that single position for unnaturally long periods of time.

It is clear that the ergonomics of reading from desktop PC displays is quite different than reading from paper. Form factor and its relation to comfort is a particularly important issue for reading appliances. A handheld, lightweight, high-resolution display that allows effortless positioning is the first step toward designing reading appliances with a paper document metaphor—as opposed to a desktop metaphor—that can imitate some of the qualities of paper.[2] The paper document metaphor underlies commercial reading appliances such as SoftBook Press' SoftBook, NuvoMedia's Rocket eBook, and Everybook's Dedicated Reader, as well as our own XLibris research prototype shown in Figure 1 and diagrammed in Figure 2.

Page orientation and fixed layout

Another trait that distinguishes paper from desktop reading is page layout. Paper documents are laid out on fixed-size pages, and the layout often communicates the type of the document—such as whether the document is a business letter or a legal brief—and where to find important information on the document, like a return address. A fixed layout promotes spatial memory that helps readers find old information, like a fact that was on the bottom of a page with figures. Pages also facilitate navigation: Turning and riffling pages is easy and natural. In these and other ways, paper pages give readers an excellent overall sense of a document.

This sense is often lost online. Most monitors cannot display a full page of text legibly, which often leads to awkward scrolling and zooming. Word processors and Web browsers not only scroll, but also commonly reflow the text on a page, which can disorient the reader. Although scrollable windows have advantages for some tasks, fixed-page layout is another desirable attribute for reading appliances to emulate.

Free-form annotations

Active reading usually involves underlining, highlighting, and annotating the text or writing in a separate notebook. Marking on paper helps readers make the text their own and is a widespread practice associated with understanding written information.[3] In short, active readers write.

Unfortunately, online annotation is quite different from paper-based annotation. Interfaces for annotating often involve selecting a command, pointing with a mouse, and typing on a keyboard. They generally require much more effort than scribbling with a pen. Text annotations are not as visually distinct from the

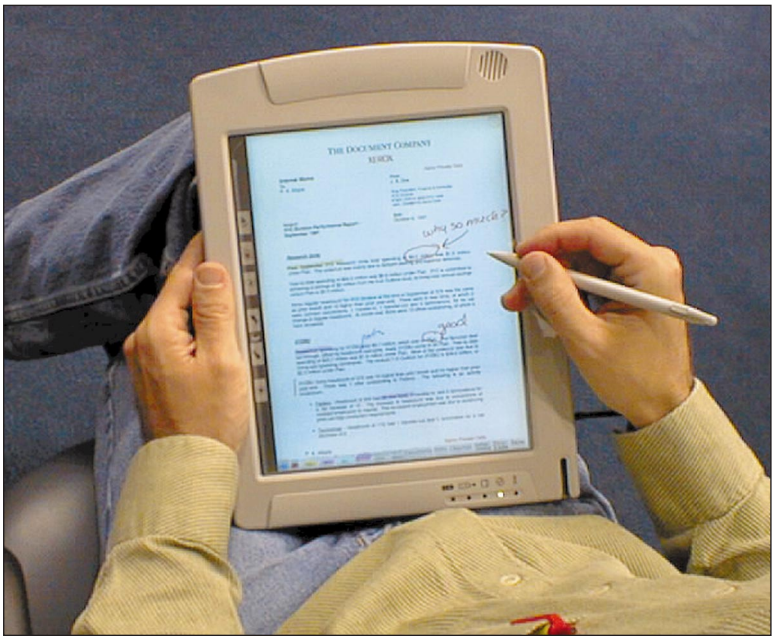


Figure 1. The XLibris active reading appliance imitates the physical experience of working with paper: Readers can hold the device on their lap and tilt it to avoid glare. They can mark on the electronic documents with a variety of pens and color highlighters and can riffle through a document's pages, checking references as they read or flipping pages to see a relevant figure.

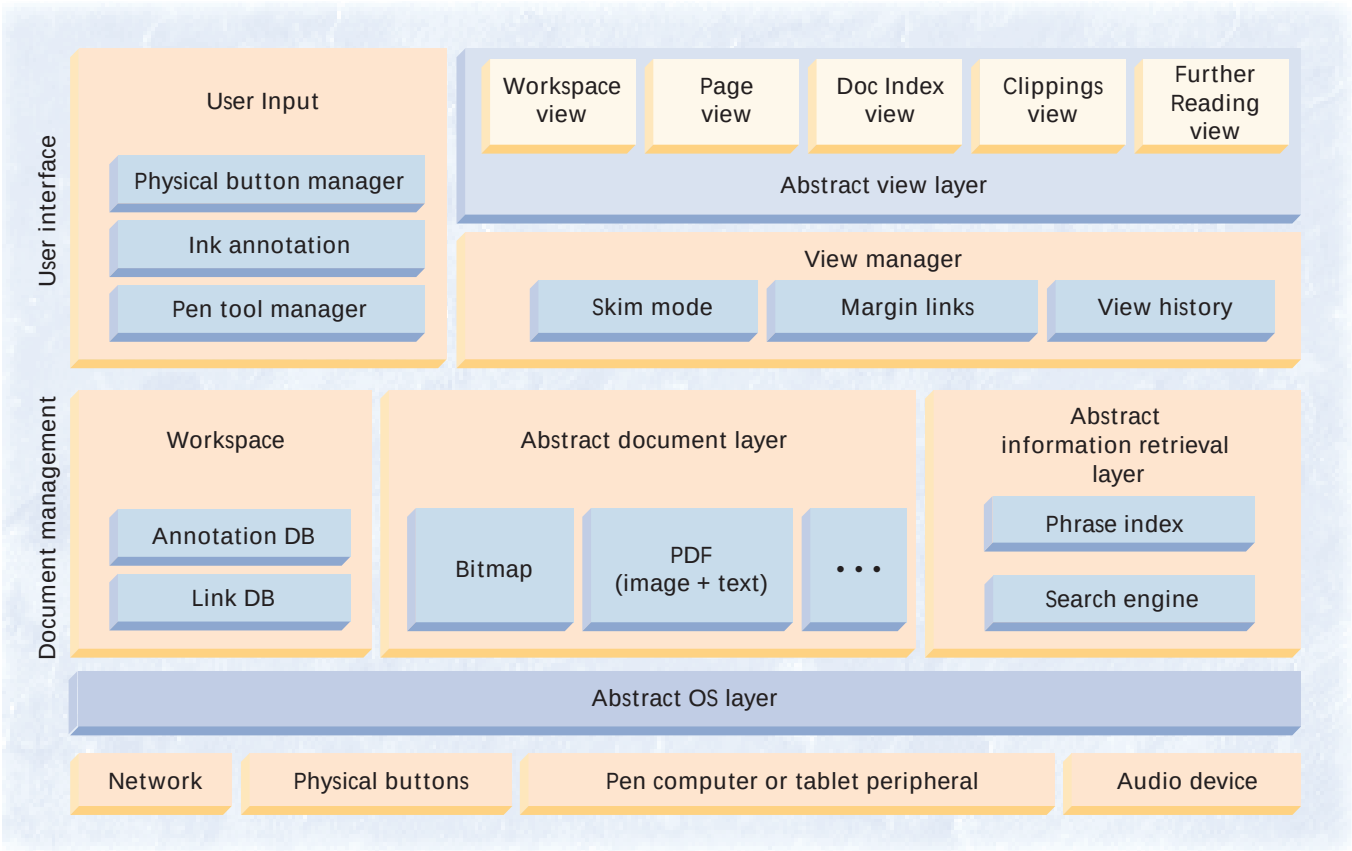
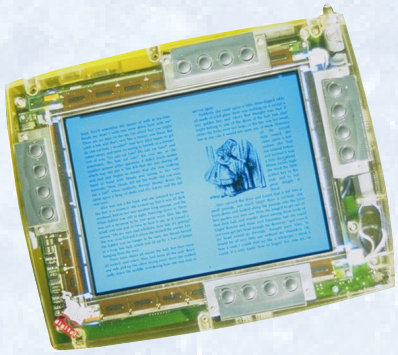


Figure 2. The XLibris architecture is made of four layers: hardware, OS, document management, and user interface. The system is designed around abstract interfaces that provide compatibility and extensibility. The abstract document layer recognizes a number of different document formats and the abstract information retrieval layer allows experimentation with various commercial and custom-built search engines.

As envisioned by World Electronics, EveryBook will come in three different versions designed for slightly different markets. The Professional Study version will cost $1,500 and is expected to be available within the first quarter of 1999; the College Study and Personal editions won't be available until the year 2000 and will cost less. According to the company, the Professional Study version uses an AMD Elan SC400 processor that runs at 100 MHz; a Tottori-Sanyo XGA (1024 × 768) full-color passive matrix screen; 5 Mbytes of AMD flash memory; 64 Mbytes of DRAM; and an Epson or Centennial 520-Mbyte Microdrive.



The Lectrice—a prototype project at Digital—was designed to enable experiments testing the researchers' hypothesis that a well-designed, high-resolution reading appliance could compete with paper as a reading medium. The Lectrice used a version of the 25-MHz MIPS R3000 processor by LSI Logic with a built-in graphics core; 16 Mbytes of DRAM; 1 Mbyte of VRAM; a 1024 × 768 color LCD from Sharp; a Sonic Ethernet chip to give a 10baseT connection; a PCMCIA bus with 2 slots; and battery support for more than an hour of operation. Shown here is the one-of-a-kind Lectrice with a clear case, displaying Alice in Wonderland in landscape orientation.

document as ink marks, and online annotations can cause changes in document layout. Furthermore, an essential aspect of ink on paper is its lack of modality: You can write anything you want anywhere on the page.

The ability to make unstructured, free-form, idiosyncratic ink marks is another crucial feature of any reading appliance that aims to support knowledge work. Although such marks may not have explicit meaning to the computer, they have rich semantic meaning for people and enhance visual and episodic memory.[4]

Physical mobility

A doctor making hospital rounds is able to carry paper documents but not usable electronic ones. This is because desktop PCs are not portable and laptops, while portable, are awkward for reading. But doctors do have a need to read electronic texts: A recent study concluded that patients for whom prompt Medline searches were conducted have significantly lower costs and shorter hospital stays.[5]

Doctors are not the only people who need mobile information access. Even office workers do lots of document work away from their desks. Reading appliances can meet these mobile information needs.

Multiple display surfaces

Readers often work with more than one page at a time. With paper, people do this unconsciously by flipping between pages in a book or by moving papers around on a desk. Reading appliances can support the former with electronic bookmarks, but if you have used bookmarks in a Web browser, you know that these often require more effort to use than their paper counterparts. Reading appliances can support the latter by including additional digital displays, but since each display costs far more than a piece of paper, reading appliances do not suffice. Designers should expect reading appliances to coexist with paper.

Sharing

Among the many activities that coincide with reading, collaboration is worth special mention because paper seems ideally suited for sharing. Much of the work in offices and schools involves handing and mailing paper around. For the most part, paper provides an easy and inexpensive solution that is unlikely to be bettered by reading appliances.

Indeed, when readers want to share documents, there is no need for new standards or new hardware: The world is already compatible with paper. This means that the activities for which we use paper may not all be replaced by a reading appliance. It is difficult to imagine handing out reading appliances in the same way we hand around paper, although new ways of sharing (such as beaming documents) may arise.

THE BENEFITS OF READING APPLIANCES

Today we can build electronic reading appliances that imitate the best qualities of paper, but why would people give up paper to use such devices? By bringing the paper metaphor to the digital world, readers can exploit some of the best capabilities of computer technology: the ability to distribute and receive documents

The NewsPad is being developed as a prototype within the European Union NewsPad project through the European Commission's Open Microprocessor Initiative. The project's goal is to foster the development of electronic alternatives to traditional newspapers—comparably portable but able to deliver multimedia-rich content, including sound, video, and animation. Acorn's NewsPad, shown here, is about the size of a sheet of paper and houses a color SVGA active-matrix LCD panel (800 × 600). The Acorn NewsPad relies on a 40-MHz ARM 7500 processor; 4 Mbytes of ROM; 496 bytes of nonvolatile RAM; and a 420-Mbyte IDE hard drive.

easily and on the road; the ability to organize, to search, and to filter documents; and the capability of supporting different modes of reading.

Distribution and mobile access

Printing, distributing, retailing, and retail returns are major expenses for publishers. Electronic book and document distribution, on the other hand, can be both timely and cost-effective. The general model is that a person connects a reading appliance to the Internet and downloads pages.

One of the problems of electronic distribution is protecting intellectual property: The ease with which a legitimate publisher can distribute content also makes it easy for people to redistribute content illegally. But there are technical solutions, including designing a unique decryption key into each reading appliance.[6] In this way, reading appliances both facilitate distribution and protect electronic content.

Relying on paper often requires planning. A person can only carry a few documents at a time and must know in advance which ones will be needed. Reading appliances, on the other hand, can store all of a person's working documents and supporting reference material. Furthermore, paper documents are static, whereas reading appliances with built-in networking capabilities can provide access to current information. Reading appliances can connect to the Internet via wireless networks, via cellular telephones, or through the office LAN, depending on how quickly the reader wants the information and how much they are willing to pay for it.

Organizing, searching, and filtering

PCs can help us organize large collections of information. First, the ability to search a full-text index of document contents reduces the need to file documents carefully. And computer-managed metadata—like creation and access dates—can help people filter their documents in useful ways. Computers also let us do things that we can't do in the physical world, such as putting a document in two places at once by using links, aliases, or shortcuts.

Once a text is stored electronically, it is possible to perform computer text operations such as word searches. Moreover, a reader can query many documents and even query network-based repositories. Specialized information-retrieval techniques create another reason for people to switch to reading appliances. For example, XLibris introduced the idea of "further reading" lists that are generated from a reader's free-form annotations.

When readers reach the end of a document, they often want to know more. The document may not emphasize the topic they are most interested in, or may spark an interest in a new topic without providing enough depth or detail. The editors of *Scientific American*, for example, help readers go into more depth by adding a reading list at the end of each article. But *Scientific American*'s reading lists rely on the editor's ability to predict the reader's interests.

The XLibris reading appliance augments this traditional editorial practice by automatically generating further reading lists for each document, as shown in Figure 3. Unlike *Scientific American*'s references, these lists reflect the interests of a specific reader at a specific point in time. XLibris recognizes readers' free-form ink annotations and uses the annotations to compute queries. Although it is possible to use a defined vocabulary of explicit marks that the reader must learn, we

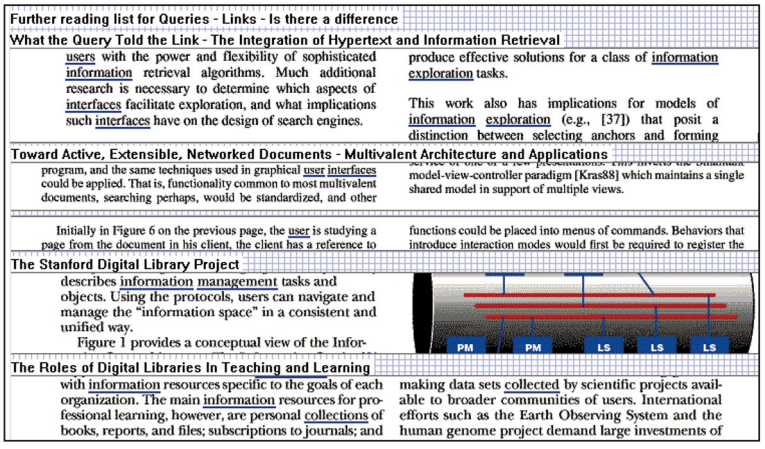


Figure 3. A "further reading" list in XLibris. Each related document is presented as a clipping of the most relevant passages with matching terms underlined.

The Habits of Highly Successful Electronic Books

Roy Want, Xerox PARC
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A vision of electronic books has perhaps existed for as long as the vision of the paperless office. Both were ideals that would incorporate the latest innovations and replace existing paper artifacts while transforming society. While we haven't yet realized the quixotic dream of the paperless office, there is something compelling about an electronic book that would allow us to flip through pages of an entire library, insert bookmarks, and easily annotate the text.

Weight, battery life, and display quality

Carrying a book, or even several, still feels lighter than most laptops, which are typically four to eight pounds. Much of this weight comes from the batteries required to drive the displays and the glass in the displays themselves, which together usually amount to about two-thirds of the total laptop weight. Furthermore, battery capacity improvements tend to be unpredictable and to improve only by small factors with each new technology.

While we do not foresee battery technology taking huge leaps forward, we have observed interesting enabling trends in display technologies. Removing the backlight used with transmissive LCD displays, for example, reduces the display power consumption by well over 75 percent. Reflective color LCDs, which don't require a backlight, are now becoming available, although they tend to have very directional reading properties. Reflective LCD displays in monochrome seem to be the choice of today's market. Even newer monochrome displays with bistable properties such as MIT E-Ink's electrophoretic display and Xerox's Electric Paper are examples of state-of-the-art technologies currently in the advanced development phase.

Laser-printed text is typically 300 dpi, while we find that most PC screens have a resolution of around 75 dpi. Similarly, the contrast ratios for text on white paper is typically 20:1 (and can be as high as 30:1), while traditional electronic displays vary from 5:1 to 10:1, with some of the newer bistable technologies at 6:1 presently. Not surprisingly, people have therefore preferred to read print rather than electronic displays. Recent advances, however, now advertise LCD displays that easily match or exceed a 10:1 contrast ratio and have resolutions of up to 200 dpi. Microsoft's just-announced ClearType technology increases font resolution on conventional LCDs by as much as three times. Higher resolution flat-panel LCD displays are also available at up to 300 dpi, although at present their cost and form factor make them infeasible for e-books.

Storage capacity and network connectivity

In terms of storage capacity, there are traditionally two choices: solid state memory or rotating disk media. Disk media can be used, but there are better choices when weight is a critical factor. Flash memory, for example, will likely be an important element of future e-books, especially with the advancements made over the past few years. Although expensive at present, the cost per gigabyte can be expected to plummet, making flash memory cards a favorite for content delivery. We can imagine PC-card books selling like CDs, tiny cover graphics and all.

In addition to acquiring content through a memory cartridge, online delivery will be an important feature. Most advertised e-books have chosen to include a telephone modem, taking advantage of the most ubiquitous form of communication available to consumers. Future e-books will have high-speed network connections. Wireless networks will enable continuous connectivity and—although they tend to have low bandwidth—they can deliver content as a background activity at night when a network isn't busy. Satellite data networks such as Iridium and Teledesic, available in the not-too-distant future, may also play a role in this market, allowing global access to electronic content.

Interface, input, and price

Assuming the above combination of technologies results in a light, high-quality reading device containing multiple books, how might we further enhance the reading experience? Poking at tiny scroll bars and opening virtual windows simply won't do. We need to be able to turn pages easily and annotate text and insert bookmarks naturally. Pen input, which earned a bad reputation in the early 1990s because of poor text recognition algorithms, will play an important role in facilitating the electronic ink that will mark e-book documents.

Early indicators show that e-books will weigh between one and three pounds, will last a minimum of several hours without recharging, will have high-quality displays, and will contain thousands of pages of content. The latest prototypes borrow various book attributes, including leather covers, dual displays, and paperback sizes. Their viability and ultimate success will depend not just on their design, but on how their content is sold, how available it is, and what usage rights will restrict its distribution.

Perhaps most important of all, however, will be the price. Pricing models will likely vary widely from a fairly low-cost investment tied to a book-of-the-month type fee to four-figure, one-time payments. What is clear is that the future electronic book market is beginning to take shape with exciting new products on the horizon. The electronic book is no longer a myth.

instead use heuristics that are based on general annotation practices: An underlined or circled phrase or a circled or barred passage each generate slightly different queries for the search engine.

Marks that select specific words translate into queries that emphasize those words over others in the same sentence. Marks that select longer passages generate queries that search for similar phrases. In our prototype, a term-weighted query is then issued on a full-text index of all documents present on the reading appliance. In principle, the search can be extended to other digital libraries on the Internet. Search results are presented as a list of passages linked to full documents, thereby supporting a smooth transition between searching and reading.

Modes of reading

Computers can also help with reading. First, computers can simply increase the type size of an electronic text, making reading less tiring. Another aspect of read-

ing is grasping the structure, and computers can help by showing outlines and summaries. A major part of reading is understanding the text. Computers can help with dictionary definitions or foreign language translations. Thus, computer-assisted reading is another reason for people to switch to reading appliances.

Computers can also help readers skim documents. Skimming typically involves looking for interesting or relevant terms on a printed page in order to gain a quick impression of the page or of the document contents. When skimming, the reader's eyes search for key words and short, exemplary passages. Sometimes the reader becomes engaged and shifts into deep reading or is distracted and moves into faster skimming or into riffling.

XLibris' skimming mode highlights phrases and sentences characteristic of the document being skimmed. XLibris calls out key phrases because they can be read at a glance and reflect the topic of the text. Magazines and newspapers offer similar types of highlighting. *The Wall Street Journal* and *People* magazine, for example, help readers find information by boldfacing company or celebrity names. XLibris also highlights key sentences to support the transition from skimming to deep reading. Key sentences can help readers decide whether a passage is worth reading.

Skimming mode uses shades from gray to black to reflect a statistically computed "importance value," shown in Figure 4. Visually, common words and phrases fade away into light gray and more important terms stand out in darker shades of gray and black. Important phrases tend to occur often in one document, but rarely in other documents. In this article, for example, the term "reading appliance" would have a high value.

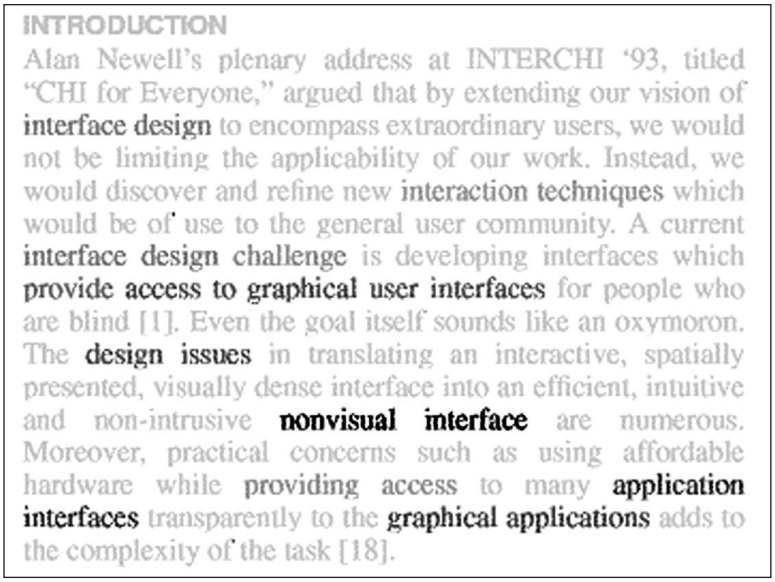


Figure 4. A skimming view of a document in XLibris. The darker the term, the more representative it is of the document as a whole.

Reviewing annotations

If we look at the way people work with documents, we see three common approaches to marking:

- annotating a page,
- taking notes in a notebook, and
- writing on loose-leaf paper or index cards.

Annotations highlight key information but tend to be lost in piles of paper. Notebooks are compact and can be reviewed quickly, but taking notes is tedious and prone to errors. Unbound notes can be reorganized flexibly, but they capture even less context than a notebook because they lack a note-taking chronology.

XLibris introduces the concept of a reader's notebook that combines the best features of annotating directly on the page, of taking notes in a separate notebook, and of organizing index cards. As with paper documents, readers mark on the page—in the context of the document—without tedious and error-prone copying. As with a bound notebook, readers can review concise annotations by time. And as with note cards, filtering and sorting the annotations allow readers to reorganize their information as their needs change.

The XLibris Reader's Notebook function—shown in Figure 5—extracts clippings of annotated text and lays them end-to-end in a multipage view. Each clipping is linked to the annotated page so the reader can move easily between notes and documents. Each clipping includes some surrounding text and is labeled with document title and page number to help the reader understand the meaning of the marks.

In designing clippings, we had to decide how much of the document should be shown for each annotation. Our current approach is to take the bounding rectangle of each ink stroke and expand it horizontally to the

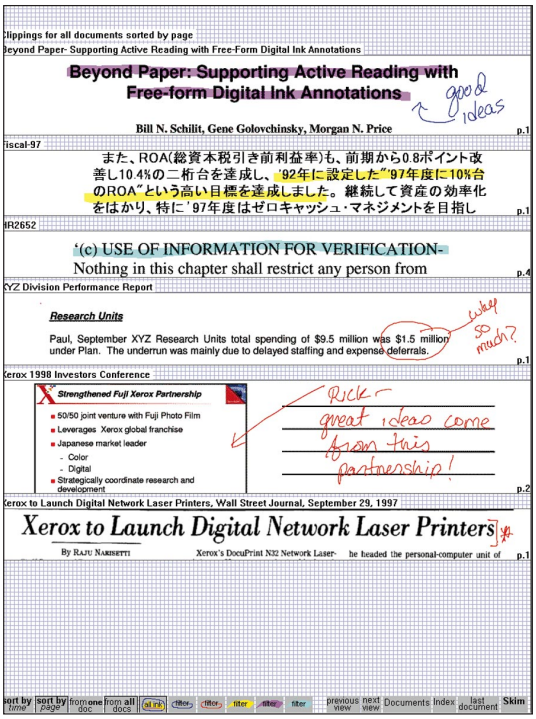


Figure 5. The XLibris Reader's Notebook function shows annotated clippings of documents laid end-to-end. Clippings are labeled with document title and page number and are linked to the corresponding pages.

NuvoMedia's RocketBook ($499) is designed to be a sort of electronic paperback. The 1.4-pound reader displays pages of text on a 4.5 × 3-inch monochrome screen. To load a book into the RocketBook (and also to recharge the batteries, which are good for about 17 hours of reading), you put the reader into a cradle attached to a Windows PC. You then purchase a book from an online bookstore—Barnes & Noble has already signed on—and download the text from the Web. Random House and St. Martin's Press will be among the publishers making titles available. This 22-ounce hand-held appliance can hold 4,000 pages (about 10 novels) of text and graphics at a time.

Librius' Millennium EBook will, according to the company, be able to hold up to ten books at a time and will include a backlight to allow reading in low-light areas. Millennium EBook is about the same size as a paperback book, weighs 12 ounces, and operates up to 18 hours on a single charge. Book titles are protected via a proprietary protocol process so that each book is personal to the individual purchaser and may not be read in another EBook. It is not possible to print or copy the titles stored in the EBook, nor can the books be displayed on or copied to storage on the PC itself. Librius offers the option of allowing designated titles to be downloaded to other reading devices, such as palmtop computers.

width of the page and vertically to include complete words. Snippets that overlap are merged together and result in reasonably sized clippings of annotated text.

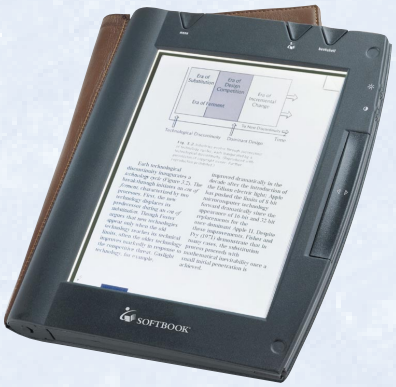
The Reader's Notebook can display clippings from one document or from all documents. Clippings can also be sorted and filtered. The system maintains a separate ink index, so these operations are rapid even for large document collections. By default, clippings are sorted by time so that new information appears at the end, as in a paper notebook. Clippings can also be sorted by page number. Searching through clippings sorted by page number is analogous to rummaging through a pile of annotated paper documents, but should be faster because readers need not deal with less important—that is, unannotated—information.

Finally, readers can filter the clippings by ink color to search for different kinds of marks or to group related items together. Some readers already use different pens to mark different types of information. For example, some lawyers highlight "pro" information in green and "con" information in red. The Reader's Notebook gives readers a quick and easy way to review and organize not only the documents they've read, but also their ideas and comments.

Network-based digital libraries increase the availability of information but people still tend to print the documents to work with them. Reading appliances provide a new platform for accessing digital libraries that preserve the benefits of having information online while preserving many of the advantages of paper. Electronic book and document readers will neither replace paper nor will they replace desktop computers. Instead, we predict, they will occupy their own unique and valuable role in our lives, bringing the paper and computer worlds closer together.

Even so, people will find it difficult to move from paper, a technology well suited to reading, to reading appliances, which are as yet unproven. We are unlikely to see massive adoption of reading appliances for certain kinds of reading, such as pleasure reading. But other types of reading—especially active reading across multiple documents—present a much better reason to use reading appliances, where computation and communication technologies can increase our ability to perform highly valued knowledge work—including learning, analysis, and decision making.

Because these appliances allow people to work on



SoftBook Press' SoftBook has an 8 × 6-inch screen, weighs nearly 3 pounds, and gets about 4.5 hours from a battery charge. SoftBook does not require a computer because it uses a built-in modem to fetch text from SoftBook servers, which, according to the company, will offer both publicly available texts such as Westlaw legal publications and private libraries of specific corporate information, such as manuals or training materials. According to the company, SoftBook will cost $299 only if a buyer commits to spending $20 a month on electronic books. Otherwise, it will cost $599 to purchase outright.

electronic documents much as they would on paper, they provide an alternative to the standard "browse or search and then print" model of reading online. By integrating a wide variety of document activities, such as searching, organizing, and skimming, and by allowing fluid movement among documents, disruptive transitions between paper and digital media can be eliminated.

As XLibris demonstrates, the combination of paper-like qualities with digital capabilities allows us to augment these activities without redefining them or radically changing the way people work. The mobility of a reading appliance supports work away from the desk. With all these benefits, reading appliances can create a rich, universally accessible, online reading experience that improves the way we work. ❖

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