
LiquidText: Active Reading through Multitouch Document Manipulation

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Abstract

Active reading, involving acts such as highlighting, writing notes, etc., is an important part of knowledge workers' activities. Most computer based active reading support has sought to better replicate the affordances of paper. Instead, this dissertation seeks to go past paper by proposing a more flexible, fluid document representation, controlled through gesture and multitouch input. Formative evaluations revealed details about modern active reading behavior and early reactions to the prototype system. I discuss how these will inform the next design iteration, and current plans for a comparative study against other media.

Keywords

Active reading, multitouch input, visualization

ACM Classification Keywords

H5.2 Information Interfaces and Presentation: User Interfaces – Interaction Styles. H5.2 Information Interfaces and Presentation: Miscellaneous

General Terms

Design, Human Factors

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Introduction

Reading is not passive. For many knowledge workers, reading often entails annotation, information extraction, outlining, and complex navigation tasks [2, 5]. This type of reading is known as ‘active reading,’ and is a frequent occurrence for a wide range of knowledge workers [1].

Given the prominence of active reading, there has long been an interest in providing computational support for the process. Sellen et al., however, found that computers were not well suited to the task [6]: the flexibility paper could provide for annotating, visualizing, navigating, etc. could not be matched by computers in 1997. Widespread recognition of these deficiencies, coupled with technological improvements, led to computers that better replicate the affordances of paper [4, 8]. A ten-year follow-up to the 1997 study found that modern pen-based tablet computers were sufficiently paper-like as to roughly match it as an active reading medium [4], even supporting simple bimanual interaction.

But paper is not a panacea. It offers little support for important parts of the active reading process, such as overviews, or cross-page comparisons or synthesis [5]. Annotations associated with large spans of text, or to content on multiple pages, are similarly infeasible.

With these and other shortcomings, we might ask whether paper really is the ideal model to replicate. While paper has typically been better than the digital alternatives of the day, I offer that its representational inflexibility makes it a poor active reading medium.

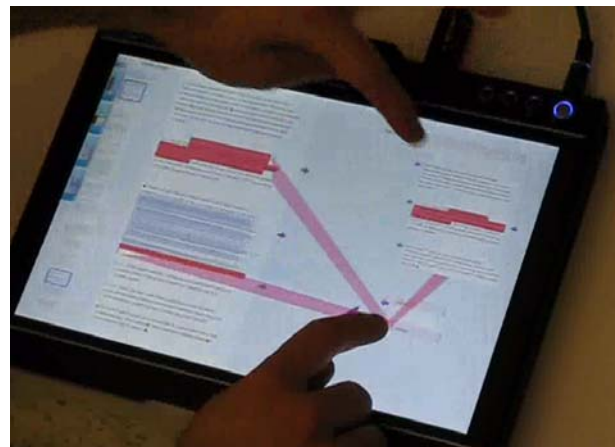


Figure 1. User interacting with several text objects in LiquidText

LiquidText

Most active reading support systems seek to provide various digital functions sitting atop a fundamentally paper-like experience [2-4, 8]. This makes sense, as paper is familiar, and relatively good for active reading. But this also tends to lead to systems inheriting paper's shortcomings. With LiquidText, I am exploring an alternate approach: building a high degree-of-freedom document representation which the user can richly manipulate throughout the active reading process (Figure 1). The system is decidedly unlike paper, allowing the user to collapse parts of the text, pull pieces of the text apart and rearrange them, create links throughout the text, and the like.

But *efficiently* selecting among these functions, as well as controlling their parameters, requires more bandwidth than the single point of a mouse. LiquidText therefore uses multitouch input along with a rich set of

gesture-based interaction techniques for controlling the representation. Multitouch is especially appropriate here given the natural mapping it has to the spatial degrees-of-freedom of the representation, as well as the importance and expectation of bimanual interaction in reading [6].

Research Agenda

My larger goal for this dissertation is to move toward an improved active reading experience by offering people a more flexible reading medium. As part of this, I seek to understand LiquidText's impact on active reading through five research questions: **1)** How is active reading performed today, and **2)** what problems do people experience with it? **3)** What is the impact of a flexible, high degree-of-freedom representation on the subjective experience of, **4)** the processes involved in, and **5)** the outputs resulting from, active reading.

One way I expect these questions to contribute to the general discipline of HCI is by elucidating the active reading process. Answering the first two questions will reveal details of current active reading practice and help to support past studies, which often investigated only small subsets of active reading (e.g., [7]). Much of the prior research also tended to study behavior [5], or to compare active reading between two media [6]; but few have sought to understand the problems people face in the current state of affairs. Answering the latter three research questions will help shed light on the adaptability of active reading—how people can appropriate new types of affordances into the process.

Second, LiquidText's highly flexible document representation is atypical, and helps contribute to the breadth of UI designs. And as it lends itself especially

to touch technology, it also helps in establishing representational approaches and interaction techniques for this relatively new type of platform.

Work Completed

To answer the first two questions I ran a formative study, including a diary task and interviews, to investigate people's current opinions and behavior with respect to active reading. The results of the study revealed a great deal about specific processes and motivations involved in reading, and the ways in which these processes vary. Readers also identified a variety of problems in areas such as extracting and aggregating content, visualizing texts, etc.

The first step toward answering the latter three research questions is to complete the iterative design of the LiquidText prototype. For this, I conducted a formative evaluation of the current prototype, teaching participants to use the LiquidText prototype, and asking them to perform a 25 minute active reading task before interviewing them for reactions. The study concluded with two design workshops where these participants collaborated with us to devise ideal future active reading environments. Participants proposed a variety of design refinements, such as the use of pen + multitouch interaction, novel content visualizations, and more immersive workspaces. Presently, I am analyzing the results of the interviews and workshops to figure out what functional requirements they imply, as well as which user suggestions to include in the revised design.

Next Steps

Once the results from the interviews and design workshops have been incorporated into the revised

version of LiquidText, the final component of this dissertation will be a controlled study.

Subject to the results of forthcoming pilot studies, I expect this summative evaluation will be a within-subjects comparison, evaluating participants' active reading under two conditions. For the control condition, participants will perform an active reading task (such as summarization) using the medium of their choice (PC, tablet PC, or paper). For the experimental, they will first be trained to use LiquidText. The training will be followed by extensive practice using LiquidText, spread over several days, in order to give participants an opportunity to appropriate LiquidText's atypical functionality. Finally, participants will perform an active reading task in LiquidText, followed by interviews and a general reading assessment test. The experimental and control conditions will be counterbalanced

This study thus gives us the opportunity to observe how active reading practice varies between traditional media and LiquidText, as well as to solicit subjective opinions about our high degree-of-freedom representation, and our use of touch and gesture input. By also comparing outputs, such as summaries written, from the active reading tasks, I expect to be able to provide useful answers to the last three research questions.

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