Improving User Interaction in Digtial Books

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1 Introduction

With the introduction of the personal computer came predictions of the 'paperless office' [7] promising the redundancy of paper from everyday office related tasks. However, more than twenty years on from this original prediction [1] and despite the wide-spread availability of digital documents, consumer paper usage is in fact increasing. The main problem with the digital document paradigm is the differences they pose from their physical paper counterparts. The tangible properties of paper (e.g. that it's light, thin and flexible) afford many actions that are not possible on digital equivalents. Activities such as folding, ripping and flicking all contribute to the ease in which physical documents are manipulated and are difficult to replicate on the digital spectrum.

There is a substantial body of work [4,3] that has investigated the utility of digital documents. When comparisons have been made between digital and printed literature, the results have repeatedly demonstrated the inferiority of digital texts across a wide range of reading tasks. The cumulative evidence of this research strongly undermines the credibility of current digital document technology as a replacement of, or even in many cases as a supplement to, print. Our underlying motivation is, therefore, to improve the performance of digital technology for reading tasks.

Whilst the study of document use has demonstrated the weaknesses of digital document readers, technological responses have been rare. The main example to now being the work on the XLibris read appliance at PARC [6]. However, XLibris is now some ten years in the past, and substantial progress has been made in understanding the problems of digital document interaction in the meanwhile. The work presented in this paper is a continuation of the concepts developed in XLibris. We are not only updating the ideas from XLibris, but are also widening the scope of research beyond specialist reading appliances. For example, we also seek to address the reading of digital literature on standard PCs.

Despite the lack of technical work on developing reader interfaces, some key insights have been made that provide clear pointers for improving current designs. One powerful way of encapsulating some of the affordances that paper documents offer is Cathy Marshall's concept of 'lightweight navigation' [3]. Marshall defines the term 'lightweight' as navigation that occurs either when people move within an article in a way that is so unselfconscious that they aren't apt to remember it later. Our goal is to realise similar interactions in digital documents.

2 Improving Interaction

Our current work builds on a series of studies that have each focussed on specific areas in which digital document interaction can be improved. Throughout, we have incorporated the principle of lightweight interaction into our design, to better understand how this property can be systematically reified in software.

The first system [2] mimicked physical bookmarking methods by introducing coloured 'tabs' that subsequently act as digital placeholders. Bookmarking in physical documents requires a minimal amount of effort; placing and navigating to them are such simple tasks that users are likely to do it without thinking, making it a perfect example of 'lightweight' interaction. To imitate this behaviour on the digital level, we have opted for a visual approach which facilitates easy bookmark addition and removal as well as 'one click' navigation. A comparative user study confirmed a functional and perceived improvement over traditional digital bookmarking methods. For instance, average subjective scores of 6.0 (out of 10) for the traditional list and 8.1 for the new visual tabs. This provided an initial indication that the 'lightweight' approach did indeed substantially improve the usability of digital texts.

A second study of annotation methods on both paper and digital documents investigated *how* and *where* users mark up documents [5]. The results of that work concluded that margins are the most popular location for annotations as they a) are close enough to the text to make reference to it and b) provide a limited amount of additional space. More common methods of digital annotation which compel users to make notes *over* the original text can be seen as more 'heavyweight' than our solution as effort must be made not to obscure the original text. Separate mediums such as note books, Post-its etc, were also strong candidates for annotation on paper but did pose several potential problems (e.g. their ability to get lost and the difficulties that come with referencing the original text). These problems however, were easily remedied in a digital solution. By creating digital 'notes', users are able to create annotations with a potentially unlimited amount of space that can be linked to the original text and easily hidden from view. The easy to use toggle ability of this feature has been designed to act in the same way as lifting Post-its to see the original text beneath and further exemplifies the 'lightweight' properties of our solution.

2.1 Current Design

Our new implementation combines our previous tools to create a system that facilitates bookmarking and annotation in one unified tool. The Notes system (see Fig 1) creates a virtual space that allows users the freedom to make use of the space surrounding the PDF much like a physical book sitting on a desk. On one side of the 'desk' sits the PDF while the on other are "piles" of Post-it notes. These inexhaustible piles of Post-its can be dragged on to the PDF, the desk itself and even partially on the document to create a make-shift bookmark. When the PDF page is changed, all bookmark Post-its that are not on the current page are moved behind the PDF area leaving them partially obscured

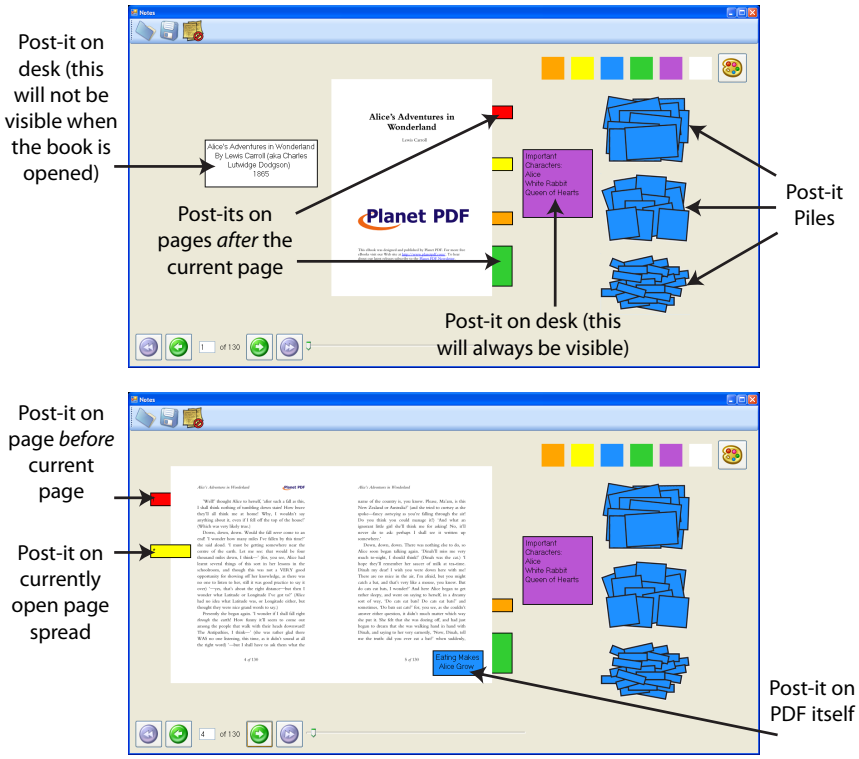

Fig. 1: The Notes System

but still visible as bookmark 'tabs'. When clicked these tabs will automatically change the current page to the page in which the Post-it sits. Each Post-it can be tailored to the user's needs by modifying its size, colour and text and can be removed by dragging it back onto the Post-it pile.

Another intuitive function of the program is its ability to behave like a real book. As mentioned above, the 2 page spread has been modelled to appear as if it is sitting on a virtual desk and 'opens' and 'closes' in the same way physical books do. Further to this however, we have also incorporated a feature that 'flips' bookmark Post-its from one side of the book to another depending upon which pages are open on the screen. This example of 'lightweight interaction' mimics the way sticky tabs behave in physical books; i.e. tabs that are stuck to pages that appear *before* the open page appear on the *left* whereas tabs that are stuck to pages that appear *after* the open page appear on the *right*.

This functionality essentially allows one simple tool to be used in a manner of different ways; i.e. as a note taking facility on the PDF and/or the desk and a bookmarking tool. This intuitive interaction exhibits the lightweight characteristics defined by Marshall and keeps user cognitive load to a minimum by providing a minimal set of tools to provide a large amount of functionality.

2.2 Future Work

The ultimate goal of this research is to prove by example that incorporating 'lightweight' properties into digital document reader design will substantially improve their interaction. In doing so we hope to identify a solid definition for the term in order to better facilitate their incorporation into digital software systems. To accomplish this, we will implement several more innovative document reader solutions that utilise the 'lightweight' techniques suggested by Marshall and test them by means of subjective user review.

3 Conclusion

The usability of digital documents is a critical element of a healthy digital reading environment. Marshall [3] has demonstrated the very poor user experience of digital books, and Sellen and Harper [1] highlight the low usage in digital documents of features that are commonplace in printed texts. Annotation and placeholding are reported by Marshall, Sellen and others as particularly valuable and common user actions. Supporting effective interaction will increase user engagement and interaction with digital text that can subsequently be exploited by software to provide better feedback and support of user activity.

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