ProofRite: A Paper-Augmented Word Processor

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ABSTRACT

Proofreading digital documents on paper is a common pattern of use among word processor users [7]. Yet, at present, there are no word processing programs that let users merge information gathered on a printout back into the digital version of the document.

In this paper we present ProofRite, an extended version of the AbiWord word processor [1], which lets users merge annotations and markings made on a printout with the original digital version of a document. Upon merging, marks are anchored in the document such that they can reflow with the text they are attached to. ProofRite showcases the first full implementation of the Paper Augmented Digital Document system [4] and shows how *cohabitation* between the digital and the paper world might simplify user workflow in many office-related tasks.

INTRODUCTION

For the majority of users, proofreading a document involves printing the document and making annotations or proofreading marks with a pen. By printing the document, users gain access to the many affordances of paper, including ease of annotation and navigation, concurrent access to many pages at once, and social acceptance during meetings. Yet, when it is time to bring the information gathered on paper back into the digital document, the shortcomings of this approach becomes obvious: users have to divide their attention between two documents to identify the locations of the corrections in the digital version of the document. This can be a time consuming and often frustrating experience.

To address this problem, we present ProofRite, a word processor designed to bridge the gap between editing a document on the computer and annotating it on paper. Using a Paper Augmented Digital Document (PADD) infrastructure [4] to record the correspondence between digital and printed versions of a document, ProofRite allows user to merge strokes made on paper using a digital pen such as the Logitech io pen [6] with their digital source. Annotations collected by the system are treated as an integral part of the digital document. In particular, strokes reflow with the text with which they have been associated (Figure 1). This flexibility allows users to address each annotation in the order that is most convenient for them without worrying about losing the context of their markings.

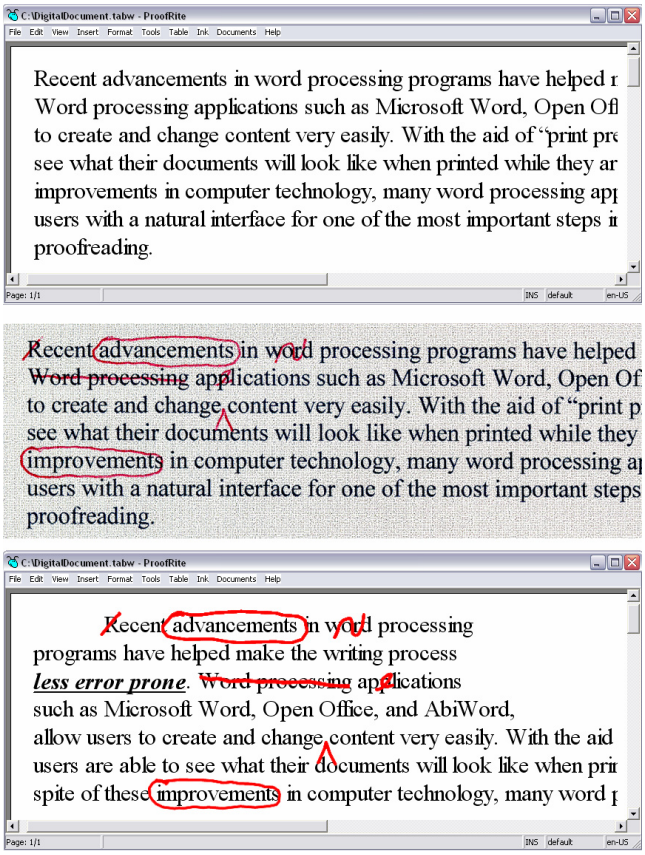

Figure 1: Top: ProofRite document. Middle: Same document printed and annotated on Anoto paper. Bottom: Strokes reflowed in ProofRite.

For convenience, our system also allows users to enter marks on the digital version using a Tablet PC. This flexibility lets users work with their documents in the format that best fits their needs – on their desktop computer, on paper, or on a Tablet PC – knowing that the information they are gathering will always be readily available within their word processor.

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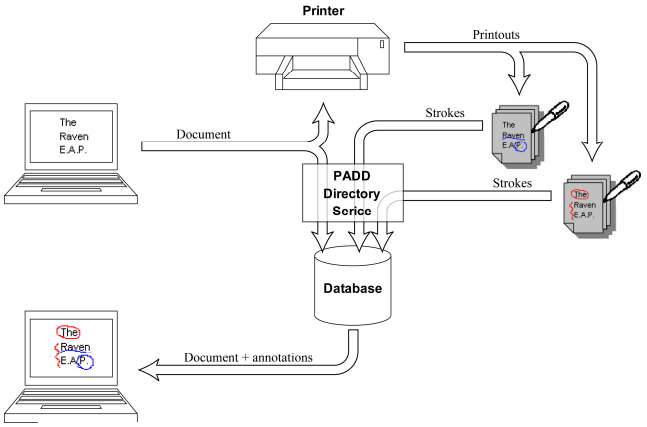

Figure 2: System architecture of ProofRite.

IMPLEMENTATION

The ProofRite system is divided into two major components (Figure 2). The first component is the Paper Augmented Digital Document infrastructure which establishes and maintains the link between digital documents and their printouts. Our system is the first full implementation of the PADD infrastructure [4]. While the original PADD system uses each document at its own "database", our fully distributed infrastructure offers a greater level of flexibility for users. For example our system allows for several independent printouts of the same document, and will let the author merge and identify annotations made on each of the individual printouts. The infrastructure and its corresponding API also make it very easy for new applications to connect to and offer PADD services.

This infrastructure also offers a unique bridge between the physical and digital world, allowing access to the digital version of a document by simply tapping the physical version with a digital pen. Upon synchronization, the PADD infrastructure will automatically download the documents to the computer on which the pen was synchronized. Using this feature, printed documents become a proxy of their digital counterparts [5], and a user's file cabinet (or paper-laden desk) can act as their file system, independent of where they are or of who printed the document.

The second component of the ProofRite system is an extension of AbiWord [1] that interacts with the PADD infrastructure to establish the relationship between a given page in a document and a given piece of paper. It can fetch the strokes made on paper and then merge them into the digital document. Upon merging, the strokes become part of the document's structure and can reflow with the text as the user addresses each proofreading mark in turn. Our system extends previous moving mark-up systems [2, 3] by providing support for non-static text (Figure 1), and by using an improved heuristics to identify the anchoring point most likely to reflect the mark semantics (Figure 3). This is particularly important in proofreading applications as many proofreading marks span several lines and using the

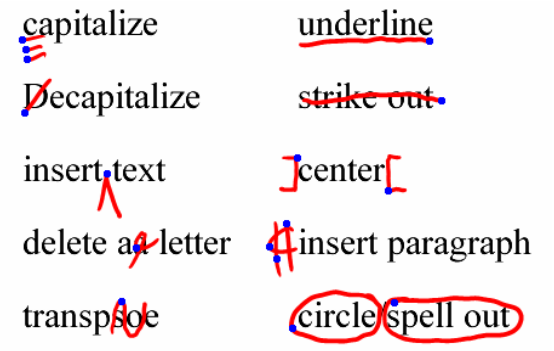

Figure 3: Common proofreading marks and their corresponding anchor points (blue dots).

bounding box of a mark will often create awkward anchorings.

FUTURE WORK AND CONCLUSION

While we have not conducted formal user evaluations of the prototype presented here, we have received positive user responses during public demonstrations of the system. User's comments also identified several areas for improvement. For one, users requested automatic processing of simple proofreading marks such as "delete". Another concern is the handling of notes made in the margin of the document. We are currently exploring ways to better cluster the different elements of such notes and provide efficient ways to display them on the screen. We would also like to improve the PADD infrastructure by introducing support for distributed, shared access to printers, improving the transparency of the system in general, and including security features such as access rights for documents and annotations.

By bridging the gap between paper and digital documents, the ProofRite system streamlines the editing cycle and illustrates the advantages of the cohabitation approach for this task [4]. We believe that similar benefits can be achieved in other application domains which rely heavily on paper such as music, architecture, and engineering.

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