Design of an E-Book User Interface and Visualizations to Support Reading for Comprehension

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ABSTRACT
Current e-Book browsers provide minimal support for comprehending the organization, narrative structure, and themes, of large complex books. In order to build an understanding of such books, readers should be provided with user interfaces that present, and relate, the organizational, narrative and thematic structures. We propose adapting information retrieval techniques for the purpose of discovering these structures, and sketch three distinctive visualizations for presenting these structures to the e-Book reader. These visualizations are presented within an initial design for an e-Book browser.

Categories and Subject Descriptors
H.5.2 [Information Systems]: Information Interfaces and Presentation

General Terms
Design

Keywords

1 INTRODUCTION
When reading or studying a book, a reader needs to build an understanding upon the available textual materials, reflect on it given her own experiences and knowledge, and then rebuild the story in her mind. When an author is preparing a literature study or book review, she also needs help in exploring the themes and threads of the book and identifying cross references quickly. These scenarios could be applied to many kinds of books, including novels, textbooks, conference proceedings, digital journals, the Bible, etc. These demands are important particularly when the book is long and complex, but there is little software support available. Most of the e-Book software packages are simply a change of display from paper to screen, plus limited tools like keyword search, navigation, and personalized formatting. Little attention has been paid to assisting readers to read for comprehension.

Our research explores four major areas for supporting book reading tasks. First, how people read and what they need when reading an e-Book; secondly, how to (semi-) automatically generate the contextual information, the narrative structure and major themes of a complex book; thirdly, how to design a reading tool which integrates reading with assisting the user to understand a book using visualizations; and finally, how to conduct user experiments to evaluate the reading tool in ‘real world’ simulated tasks.

2 METHODOLOGY
In previous work, an interactive document reading tool ProfileSkim was developed following user centered system/UI design and evaluation principles: namely, user requirement analysis; technology development; system implementation; and user centered evaluation based on ‘real world’ simulated work tasks [1]. The research described here follows a similar methodological approach.

2.1 Research Project Architecture

We consider the user needs to be the most important part in a software design process, so they occupy the top position in the architecture (Figure 1). The user interface is the medium between the user and the software; users can communicate with the software through a well-designed user interface, which is supported by visualization techniques. The user interface and visualization are supported by information retrieval engines, including a topic detection and tracking engine, an ontology matching engine, and a text analysis engine. Each of these is built upon the e-Book corpus foundation.

From a preliminary study of relevant work, we found that current e-Book browsers provide little or no user interface support for “reading for comprehension”. The analysis and visualization of a book’s content, and the visualization of
narrative and thematic structures, are typically not supported.

2.2 Design Framework

An e-Book, especially a storybook, is constructed from the following constituent parts: language, story (events), organizational structure, themes, characters, and references. We can view the book as structured according to a three-dimensional space: a contextual structure which provides information about the organization of the book; a narrative-thread structure which provides information about the events and characters; and a thematic structure which provides information on the themes.

Information Retrieval techniques can support the book reading tasks as follows: using topic detection and tracking technique to find the basic narrative threads; using ontologies to identify and recognize themes; using textual analysis to derive the contextual information, and, using query based within-document retrieval technology to enhance the interactive reading and searching experience (Figure 2, A). Topic detection and tracking research has been investigated in the past to find new events and to track existing events in a stream of textual broadcast news stories. We propose adapting a novel technique that uses lexical chains [2] for discovering narrative threads based on chains of the characters in the book. In order to discover the thematic structure, or simply the major themes, of a book, we will employ ontologies. Initially, we propose deriving the ontology from the subject index of a book, and in the case of our experimental corpus (see below), the Bible, the associated intellectually derived concordances. For example, in the context of the Bible, the ontology of themes would include, "God", "man", "faith", and so on.

Three main visualization methods would be investigated and implemented, including a histogram or similar visualization for the contextual structure (Figure 2, B), a Hyperbolic Tree Map [3] or similar to visualize the thematic structure (Figure 2, C), and a lifeline [4] or similar visualization for the narrative-thread structure (Figure 2, D).

2.3 Corpus: The Online Bible

The experimental corpus has been chosen to meet the following requirements: it must be significant in size, structure, content, importance, and popularity; rich literature studies of it must be available to provide the necessary information for automatic or semi-automatic generalizations of themes and threads; it must provide a ground for reading and comprehension; its language must be easily understood by people from various backgrounds, to support user-centred system design and further evaluation; and its electronic resource and the relevant material must be easily accessible for research purposes. The Online Bible, its concordance and other Bible study materials, which are freely available from the Internet, have been chosen in accordance with the above criteria. For example, concordance Nave's Topical Bible is available from the StudyLight website [5].

![Figure 2 Bibliophile: The User Interface Design](image)

3 EVALUATION

User experiments will be conducted to evaluate the software using 'real world' simulated work tasks. The hypothesis of the research would be: visualization aided e-Book software will help the reader in reading and understanding the book contents. Each visualization feature in the user interface will be tested separately to see its effectiveness, as measured by the user's performance and satisfaction.

4 CONCLUSION

The goal of our research is to design e-Book browsers that aid users in perceiving, and understanding, the important conceptual structures of a book, and hence improve their comprehension of a book. We propose using IR techniques for discovering the contextual, narrative and thematic structures of a book, and have sketched possible visualizations for presenting this derived information. The next step in our research is to adapt existing IR techniques for the above purposes, and to develop and experiment with visualizations and an e-Book browser, in actual reading and comprehension tasks.

REFERENCES