

Going Beyond Text in Document Features on the Display of Search Results

Enas Gamra¹, Anwar Alhenshiri² and Hoda Badesh²

¹ Department of Computer Science, Faculty of Science, Almergeb University

² Faculty of Information Technology, Misurata University

enas.m.gamra@gmail.com, alhenshiri@it.misuratau.edu.ly, h.badesh@it.misuratau.edu.ly

Abstract:

With the large numbers of documents presented on the web and those accumulated on personal computers, finding a relevant one is becoming increasingly demanding. The only features displayed on the result set are mainly textual. To improve how users can detect relevant information, other features in the document should be exploited in the display of the results. To do so, the study presented in this paper took into consideration the direct display of search experience of all users while presenting search results. Moreover, the within view display of document content was also explored. The results of the study show that users while being able to see the content of documents on the search view and also the interest of other users in web documents resulted in more effective and efficient search.

Keywords: Human-computer interaction, information retrieval, information visualization, document feature, information seeking, web, desktop, collection, big data

INTRODUCTION

For nearly four decades, personal computers have used the desktop and folder system metaphors. When the size and number of personal documents on computers grows very rapidly, manual organization of those documents becomes very time consuming and ineffective. The difficulty increases when the user wants to find a specific document. The ability of users to browse and search through their files is limited by the conventional hierarchical structure and there are problems associated with the presentation of search result.

Nevertheless, there are many kinds of software that can be used to organize and search for desktop documents such as Windows desktop search and Google desktop. Users may end up reformulating multiple queries to find their intended results and complete their tasks. The presentation of documents using the current tools is linear and, hence, time consuming. Moreover, the features presented in the result hits in the conventional views may limit the user's ability to decide on which document to select for their task.

Several studies explored visualization as an alternative the use of conventional methods for the display of search results both on the web and desktop environments (Suvanaphen and Roberts, 2004; Kules et al., 2008). Visualization techniques can be powerful for performing various cognitive specific processes like descriptive, exploratory and analytical (Khan 2011). Visualization is used to explore, illustrate, and discover large data bulks and it helps with reducing the user's effort and provide better understanding of data (Sanobar Nishat 2013). Moreover, visualization techniques can be used to show documents of the same nature connected and under one category visually (Badesh & Blustein, 2011). It can also help with the presentation of multiple features of search results (Alhenshiri and Blustein, 2011). The use of visualization in



the presentation of search results can help users organize large collections of documents and find results more effectively and efficiently.

The current presentations of search results offered by tools such as Google Desktop and Google web search engine do not reflect the features of documents presented nor they convey much about the entire collection of results. The study presented in this paper aims to explore the benefit of three main features in the presentation of document result hits. The first feature is the use of visual objects (popularity stars) to reflect the frequency at which each document has been selected by previous users for the query being answered. The second feature is the use of font characteristics (size and color) to reflect the position of the query terms in the context of the document for which a summary is presented. Finally, the interface allows its users to swiftly view the document content while on the result hit view to explore possible results of interest. The effectiveness, efficiency, and enjoyment in using those features was measured. The results of the study showed promising effects.

The remainder of this paper is constructed as follows. Section 2 presents related research. Section 3 explains the methodology of the study. Section 4 explores the results of the study. Section 5 discusses the important results while the research limitations are illustrated in Section 6. The study is concluded in Section 7.

RELATED WORK

Dumais et al. (2003) developed a system called Stuff I've Seen (SIS) that makes it easy for people to find information that they have seen before. The system provides a unified index of information whether the information was received as an email, web page, document, or calendar appointment. The system helped users find their information easily and achieved more user satisfaction.

Elsweiler et al. (2007) designed a Personal Information Management (PIM) tool concerned with how users store, manage, and re-find information. They concentrated on the issues associated with performing PIM evaluations and exhibited a diary study of with information re-finding tasks. Significant contributions were recorded and encouraged further investigation.

Civan et al. (2008) investigated the difference between Gmail which uses labels for organizing documents and Hotmail which uses folders with respect to retrieval performance and limitations to completely express one's internal conceptualization. The results concluded that every model has its strengths and weaknesses. A combination of both models would increase efficiency.

On the web, Paulovich et al. (2008) designed a search interface called PEx-Web that supported interpretation of collections of web results. It allowed users to avoid visiting unwanted web pages and to discover relevant patterns based on visual representations through visual clustering. PEx-Web helped users to find their intended document amongst the results effectively which was proven and shown in the comparison study.

Moreover, Badesh & Blustein (2011) proposed a Data Mountain Search Results Presentation Interface (DMSRPI) for improving the presentation of how users recog-

nize web search results using clustering and visualization. The interface was intended to improve the effectiveness and efficiency of users search of the Web.

Alhenshiri and Blustein (2011) indicated that in order "to enhance the user's ability to identify relevant documents among large sets of results, visualization techniques can be utilized". They presented a research survey concerned with visualizing the processes of query reformulation and result presentation in web information retrieval. They concluded on the using aspects of visualization in web information retrieval to achieve successful search more effectively, efficiently and users are satisfied.

Grierson et al. (2015) introduced a 2.5D graphical interface called SIZL (Searching for Information in a Zoom Landscape). The interface showed the combined results of multiple search systems using 3D elements in a 2D perspective which permitted its users for more effective identification of relationships among documents.

Previous works regarding the use of visualization to organize and manage collections of documents show the significance of investigating retrieval in large collections of documents. Those works have focused on the use of shapes and colors in most cases in either 2D or 3D settings. In the case of organizing collections of documents for retrieval purposes, the research in this paper will focus on visualizing certain elements in the presentation of search results. The aim is to enhance the efficiency and effectiveness of the process of finding relevant documents in large collections of result hits.

RESEARCH METHODOLOGY

The research is mainly a study in which two main features in human-computer interaction in the case of document retrieval were investigated. The study compared two search interfaces. The first was a baseline interface similar to the conventional text-based search tools used on the web such as Google's (See Figure 1). The second interface implemented the features in investigation (Figure 2).

The baseline interface contains the conventional search box, a search button, and a list of result hits. Each hit consists of the title of the document with a brief summary underneath. The title appears in blue text while the summary in black. Since the interface is designed for both the web and the desktop search purposes, the title works as a link to the entire document.

In Figure 2, the new features intended to be investigated in the study were added to the interface. The first feature is the use of the rating stars to reflect the popularity of the result hit. The second is using larger bold texts for the query terms in the context of the summary. The final feature is allowing the user to see a quick view of the document within the results view as shown in Figure 2 without having to leave the current screen.

Thirty-two participants took part in the study. They were university students—both graduates and undergraduates—aging between 18 and 40 years old. They had good understanding and use of English while Arabic was their native language. Partici-



pants with low English skills were eliminated. Moreover, the study used two tasks designed to cover different search topics as follows.

Task1:

"Use the given search system to find documents that have information about healthcare in terms of diseases, treatments, discoveries, news, and the like".

Task2:

"Use the given search system to gather news that include information about science and technology".

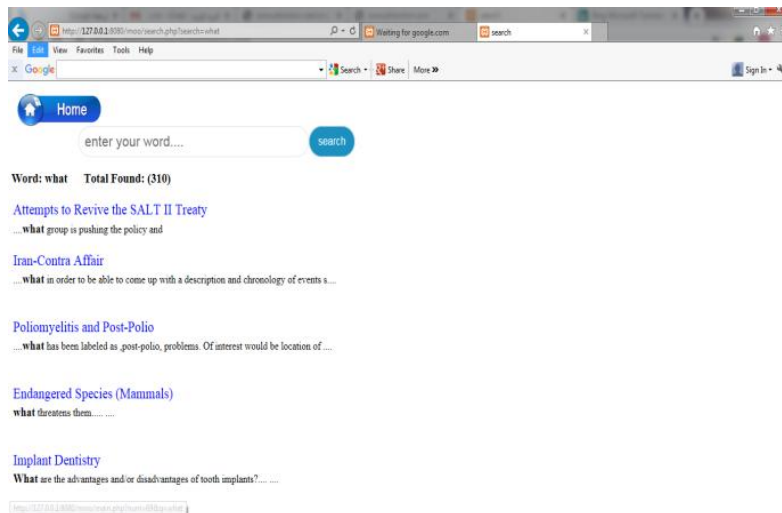


Figure (1) Baseline Interface

The tasks chosen for the study had to cover broad topics to allow the user to look further into the dataset and find more and more relevant documents. Otherwise, and since the documents are all in English, users would be restricted to stop searching at the very first encounter of a relevant hit. That was shown in the preliminary testing of the interface. The broader topic tasks were more suitable for this situation.

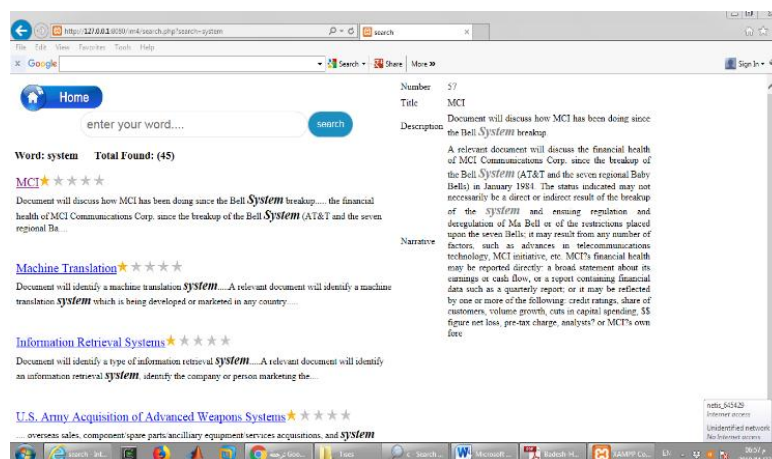


Figure (2) The interface with added features

The design of the study was complete factorial in which all combinations of the tasks and the two interfaces were used. The study design was within-subjects and counter-balanced so that each participant experienced all conditions in different random orders. This design minimizes the need for a large pool of participants and limits the number of errors associated with individual differences. A counterbalanced design limits the effect of order.

STUDY RESULTS

The data collected in the study concerned the effectiveness of the tool (interface) used in addition to the time spent (efficiency), and the enjoyment of the interface. The effectiveness factors included: the links the participant recorded, the links they opened, and the links they viewed, the number of errors, the number of mouse clicks. The efficiency was measured through the time the participant spent on each task. The enjoyment was measured using the questionnaire answered by the participants.

1. Effectiveness Factors

The first effectiveness factor the study took into consideration was the number of documents recorded by the participants. Those are the documents of interest located for the tasks. The total number of hits recorded for the base interface was 155 documents compared to 232 documents found on the improved interface. The Anova test results ($F=1.86$, $p = 0.177$) indicate no significant difference even though the difference on average is important.

Second, the study recorded the number of errors on both interfaces. The total number of errors on the baseline interface was 58 while only 29 errors were recorded for the improved interface. The Anova test results ($F=4.74$, $p<0.03$) indicated a significant difference. The number of errors was recorded because it provided a valid indication of the effectiveness of the interface in finding relevant documents.

Finally, the study recorded the number of mouse clicks made on both interfaces. The numbers were similar with 380 clicks on the baseline interface and 349 clicks on the improved version. Moreover, the Anova test results ($F= 0.86$, $p =0.35$) showed no significant difference. The reason for recording the number of clicks on each interface is to measure the user's navigation ability on the way to finding relevant documents.

2. Efficiency Factors

To measure the efficiency while using the interfaces, the time each participant spent to complete the tasks was recorded. The average amount of time spent on the baseline interface was 3.0 minutes. The improved interface had 3.1 minutes on average. There was almost no difference in time for completing the tasks on the two interfaces ($F= 0.100$, $p=0.752$). The indications of those results are discussed in the following section.

3. Enjoyment Factors

The user enjoyment of the interface was recorded using a post-task survey and also in the debriefing that followed completing the study. The study took several measures into account including the ease of use, the confidence in completing the task, the user



assurance in finding relevant documents, and the user willingness to use the interface in the future.

Most users (29 out of 32) found the improved interface easier to use compared to 25 participants on the baseline interface. Although the difference was not significant ($z = 0.99$, $p = 0.161$), used indicated in the debriefing that the difficulty was due to the use of English in the data set as well as the need for more time to familiarize themselves with the interfaces.

When asked about their confidence in the results they found for the task, 24 out of 32 participants were very confident in the case of the improved version of the interface. Only 17 participants out of 32 were confident in the case of the baseline interface. The difference according to the z-test for measuring the difference between two proportions was significant ($z = 1.82$, $p = 0.034$).

Participants who confirmed finding relevant information on the new interface were 30 out of 32. On the baseline version, the number of participants who were certain about finding relevant information was only 22. The results of the z-test for measuring the difference between two proportions indicate that the difference was significant in this case ($z = 2.56$, $p = 0.005$).

When asked about their intention to use the interfaces on the web in the future, users had similar answers for both interfaces. There was no difference between the two cases. They indicated in the debriefing that they would use the baseline interface due to its familiarity to the user. Those who wanted to use the improved version stated that they need more time to familiarize themselves with the new features.

DISCUSSION

With respect to the effectiveness of the interfaces in comparison, users needed more mouse clicks on the baseline interface than those required to complete the tasks on the improved interface. This can be attributed to the fact that users needed to go back and forth on the baseline interface to see the content of documents and the list of result hits. Participants stated that explicitly to confirm the value of presenting the content of documents on the same page where the search result hits appear.

Moreover, the difference between the number of errors users made on the two interfaces was significant. This result can be attributed to the ease of use provided in the new interface. That is the ease in finding relevant results, searching and viewing the content, and understanding the view of results and document content. In the debriefing, participants indicated that the improved interface caused no confusion while looking for relevant documents and lead to fewer errors.

When asked, participants indicated that the new interface had helped them with determining accurate results faster due to the use of rating stars. The stars reflected the popularity of a page with respect to the frequency of selecting that page by users searching using similar query terms. Users focused on those pages with high visit rates. Users indicated that they liked the stars feature since it reduced the need for performing more search by submitting more queries.

Participants stated that the improved interface was more effective because they were able to notice the query terms among the rest of the document summary more clearly. That was due to the use of different font sizes and colors for query terms in both the title and summary of the document in the result hits. The significant difference between those who found the new interface more helpful and those who did not can be attributed to the features embedded in the new interface.

With respect to the efficiency factor measured in this study, the difference in time spent on the interfaces to achieve the tasks was not significant. Even though the design of the new interface was intended to encourage users to find relevant results faster, they took similar times to those taken on the baseline interface. The new interface gave users the chance to see the content of documents on the same view alongside the list of result hits. The user did not need to go to a different view to see the entire document. Moreover, the interface gave the user the chance to see in clear rating stars the popularity of pages. However, the time difference was not significant.

In those cases, the similar times can be due to different causes. First users did not have enough time to familiarize themselves with the new interface. That would have minimized the time they needed to complete the tasks. Second, the limited number of documents used in the study could have also affected the results. Users would have been able to test the value of the new interface with more documents. In that case, the difference in time needed to complete a task would have been more significant. Finally, some participants did not get used to recognizing the stars embedded in the interface which made it similar to the baseline one for them.

All in all, the features embedded in the improved interface which include the popularity stars, the different font characteristics used for query terms in the result hits, and the view of documents within the larger view of search results were shown to be effective and enjoyable in many ways as discussed above. The efficiency, though, did not achieve a noticeable advancement and that can be due to time restrictions. Users did not have enough time to familiarize themselves with the Interface and its new features. They neither had time to recognize all the benefits of the new features and how they can be used to fasten the process of searching.

RESEARCH LIMITATIONS

Among the most important limitations of the research was the shortage of documents in the native language of the participants. Even though the participants indicated that their understanding of English was good and sometimes excellent, the nonnative language of the collection must have affected the understanding of the text. In addition, it was very hard to find participants with different backgrounds and education levels who know English very well. Therefore, only university students took part in the study.

CONCLUSION

The research discussed in this paper is an attempt to improve the effectiveness of the display of result hits in the case of any collection of documents. That may involve web result hits as well as personal collections of documents. The interface considered in the design took abstract documents and measured how fast, effective, and enjoyable the interface with its new features was by comparing it to a baseline case. The



results show some improvements as discussed above. Even though the differences were not significant in many cases, users showed great interest in the features added in the new interface. Further experimentation would reveal more significant features in both the document and the display method that could lead to more significant improvements.

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