A Zero-input Interface for Leveraging Group Experience in Web Browsing

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ABSTRACT
The experience of a trusted group of colleagues can help users improve the quality and focus of their browsing and searching activities. How could a system provide such help, when and where the users need it, without disrupting their normal work activities? This paper describes Context-Aware Proxy based System (CAPS), an agent that recommends pages and annotates links to reveal their relative popularity among the user's colleagues, matched with their automatically computed interest profiles. A Web proxy tracks browsing habits, so CAPS requires no explicit input from the user. We review here CAPS design principles and implementation. We tested user satisfaction with the interface and the accuracy of the ranking algorithm. These experiments indicate that CAPS has high potential to support effective ranking for quality judgment - by users.

Categories and Subject Descriptors
H.3.3 [**Information Systems**]: Information Search and Retrieval – *Selection process*.

General Terms
Management, Design, Human Factors

Keywords
CSCW, Recommender system, Knowledge management, Social Networks, Collaborative filtering, User interface

1. INTRODUCTION
When browsing the Web, users have limited knowledge about the quality of the information and the links they see. In fact, the only existing hint behind links is that they change their color when visited. On the other hand, there is much relevant knowledge possessed by colleagues that does not get exploited. These colleagues can be peers or experts in the same organization; the knowledge is data files such as bookmarks, history and notes. In order to have access to this information, an active gathering of information, in the form of file uploading and page annotations, is usually required. Consequently, users are forced to change their work habits and contribute information. This, of course, is hard to achieve.

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One solution for this problem is to use a Recommender System [7]. We propose a recommender system for augmenting Web pages based on the collective experience of the community, i.e., members in the same organization. The system, CAPS (Context-Aware Proxy based System) [8], adds qualitative information to the Web page itself as viewed in the browser window.

The two main features of CAPS are page enhancement and search augmentation. Web pages are enhanced by annotation of their links with popularity symbols. Search queries get augmented by the addition of a relevant link. We identified two main usage scenarios of CAPS:

1. "Divide and conquer" -

   A group of users is trying to find something on the Web together. Using the system, they can tell which link has been already visited by a member of the group so as to avoid the reprocessing of the same information.

2. "Collaborate and obtain" -

   A user is trying to find information about a certain topic. The annotations and recommendations provided by the system help in locating the best path for this.

An important characteristic of CAPS is that it requires no explicit input from its users. CAPS gathers its data in the background by logging the users' browsing activity. Furthermore, it uses publicly available information, such as users' homepages, to improve the results.

CAPS provides several benefits. First, it serves as a useful utility for augmenting Web browsing and searching. Second, it can be used as a collaboration tool, since it provides users with a summary of peers' access statistics to pages. Lastly, it preserves organizational knowledge by keeping a repository of the acquired information over time.

2. DESIGN PRINCIPLES
We believe that designing a successful annotation system requires thorough planning. We have found four guiding principles for designing such a useful system:

1. Collaborative filtering
2. Zero-input interface
3. Context-aware interaction
4. Non-intrusive presentation

2.1 Collaborative Filtering

One of the most important channels of disseminating information and expertise within an organization is its social network. Collaborative filtering [4] allows us to take advantage of other people's experience. Indeed, users could find the broad point of view of Internet users and content providers in popularity search engines. However, the point of view received from these services might not be focused enough for a specific person. It does not take into account the relevant context of the user's profession, organization, location, etc. Hence, we believe that collaborative filtering that is based on peers and colleagues in the same organization has better potential to be meaningful.

A somewhat different aspect of collaborative browsing is that it can also deploy data collected from experts. Experts' opinions are very important. Thus, we want to identify and connect to the experts in the organization and use their knowledge, while also preserving it.

2.2 Zero-input interface

Annotating content is tedious work, and people often do not cooperate in this. Even a simple task, such as uploading bookmarks, requires repeated user attention for regular updates. Considering this, our goal is to provide a Zero-input interface - an interface that relies on implicit information rather than on explicit user input [5]. The information should be gathered as a side effect of the regular work of people, and not by any explicit action. Similarly, it is important to make sure that the consumers of this information receive it this way as well. Users do not need to change any of their work habits in order to benefit from such a system.

2.3 Context-aware Interaction

The system should be aware of the context of the user task. It should identify different user tasks and adapt correspondingly. We relate here to two user tasks: browse and search. When the user task is browsing, the system should enhance links. When the task is searching, it should provide additional links.

2.4 Non-intrusive presentation

The enhancements should be made on the same page that the user watches, and not in any different/separate interface. In addition, when using the same browser content-window, the enhancement should be aesthetic though non-intrusive, providing small symbolic information while expanding it, based on mouse-moves.

3. IMPLEMENTATION

We propose a Context-aware Annotation Proxy based System (CAPS). CAPS acquires its information via a Zero-input Interface through using a proxy. Then, it annotates Web pages according to the user task. Behaving like a proxy but enhanced by some changes, CAPS is a mediator that is based on IBM WBI intermediary [1] as a programming platform. These changes include:

- logging user requests, and building a repository of access statistics and page metadata;
- keeping user profiles based on their homepages for users registered as experts;
- ranking pages based on these access statistics and a matching with the expert profiles.

CAPS uses the above information to augment browsing via a unique user interface that is described no.

User interface

A user sets up CAPS by defining it as a proxy in the browser. A user who wishes to be considered as an expert by the system (which is optional) needs to register by providing CAPS with his or her homepage URL. This registration is actually the only explicit interaction with CAPS required of the (expert) user.

When a user browses the Web, CAPS slightly modifies the pages to reveal the popularity of the links. Each link recognized by CAPS is annotated with a small image next to it. The image reveals the score of the link and is presented in one of three levels: "known" (yellow), "popular" (yellow-red) and "hit" (red). Hovering above these images with the mouse will broaden the information presented, in a ToolTip style.

Whenever the user invokes one of the popular search engines, CAPS adds a highlighted link at the top of the page and ranks it. This link is a recommendation of the system and is relevant to the query terms as given by the user to the search engine. Furthermore, this recommendation changes every time the user accesses a page, even with the same search query, so as to reveal new information to the user.

Figure 1 presents an example of CAPS user interface. In this example, the user searched for "context aware". At the top, a highlighted recommended link, rated "hit", which did not appear in Google's hit list. Two other links are known and annotated "popular" and "known". The Tootip style information appears because the user has hovered the "popular" link with the mouse.

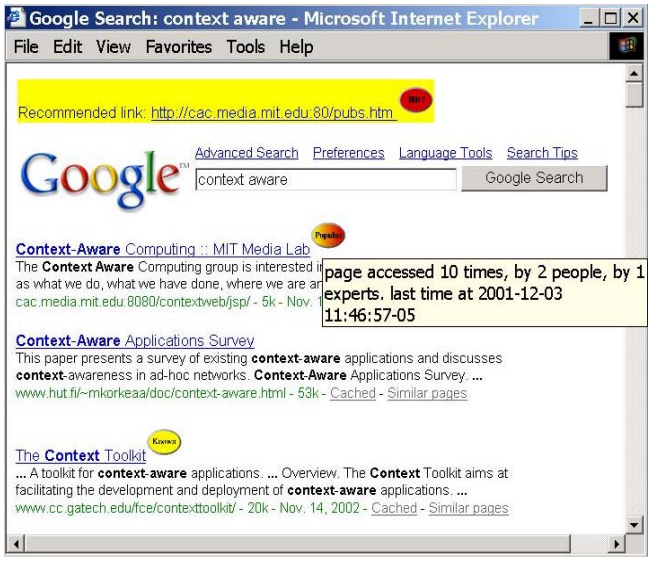

Figure 1: CAPS user interface

Ranking algorithm

The CAPS ranking algorithm is comprised of three normalized measures that receive equal weights, based on:

1. The number of people that have requested and accessed the page for a minimal dwell time.
2. The total number of times that it has been accessed.
3. The number of experts that accessed it.

It is important to note that we require minimal dwell-time to log a page access, and also take into account the date the page has been accessed.

In general, a page gets a ranking in one of the three measures above relatively to the most visited page. As for counting the number of experts that have accessed a page, an expert is considered to be recommending a page if a match between the expert's profile and the page being scored is discovered. This matching is actually between one of the pages in the expert's homepage and the scored page. Again, the Editor uses a standard vector model similarity algorithm to find such a match.

4. EVALUATION

We tested CAPS by using three different user studies. The first two studies explored the two user scenarios in aspects of productivity and user satisfaction. The third study tested the CAPS ranking algorithm.

Evaluating the two scenarios

We asked two groups to use CAPS in the two scenarios. The first group tried the "divide and conquer" scenario, and the second one tried the "collaborate and obtain".

The first group used it in pairs, searching for cheap airfares during periods of 10 minutes, while sitting in separate offices. CAPS dramatically changed the behavior of users when they knew what their colleagues were doing. The pair using CAPS barely needed to coordinate during the task, nor did they process the same travel site twice.

The second group tried the system to search for information about "context-aware computing". In the search, MIT Media lab's Context-aware computing group's publication page was recommended by the system – even higher than the main page of the group. Users outside our group, and new users in the group found it very useful for obtaining knowledge about the field. Whereas, users within the group gradually found different pages as they kept using CAPS. That is because CAPS presents different recommendations each time the user access it.

Evaluating CAPS ranking

A core group of 4 users, from one research group was asked to report their Web surfing during one day. The data collected was processed using CAPS's algorithm, and a ranked list of sites was produced. Then, 10 users were asked to give feedback on the ranked sites. They included the original core group, 2 additional users from the same research group, and 4 users from outside the group.

In this experiment, 123 URLs were collected and ranked according to the CAPS ranking algorithm. From the 123 URLs, 17 were ranked "hit" and "popular". Of the highly ranked sites, an average of 3% were marked as not good enough. Not all the members in the group know all the highly ranked sites. Of the known sites in the list, an average of 7% were reported as under-ranked. An average of 6% were found to be new and interesting to the users. It was interesting to observe how almost all the users that answered the questionnaire ended up exploring interesting sites that they found in the list. This result implies that a user's browsing habits can be helpful for other users

General observations

Most CAPS users liked both the Zero-input and the non-intrusive user interface, and the link annotations. They thought CAPS is useful and has potential for improving the search and browse activities. They perceived it as a worthy supplement to the current Web environment. However, they wished for an additional interface to query the system for even more results.

5. RELATED WORK

Several previous works listed in [6] have used history and proxy data to avoid explicit gathering of data. They were aimed towards building a document repository or computing page rankings. A system [2] based on proxy architecture, has aimed to support cooperative browsing. It provided awareness to other group members logged into the proxy by listing the links they visited. Yet, this architecture did not facilitate automatic quality assessment of the links.

A different aspect of CAPS that was addressed in other systems is the Zero-input interface. Surflen [3] implemented a Zero-input interface to recommend pages based on clusterization of users and their browsing history. Letizia [5] implemented a Zero-input interface for recommending relevant pages, based on the user's browsing profile. Its role was to assist one user, based on her behavior, rather than based on other people's opinions. Both used a separate monitor to present the recommendations, while CAPS provides links ranking and recommendations on the same page.

In addition, CAPS's algorithm is different from the above systems. CAPS makes use of the users' history to provide rankings of the sites, rather than on document and users similarity. Furthermore, the use of a statistical combination of the numbers of access times, users, and experts, makes its ranking algorithm unique.

6. FUTURE DIRECTIONS

Future work should concentrate on testing the system more thoroughly and on tuning the algorithm parameters.

7. CONCLUSIONS

To summarize, we found that implicit collective group experience can be effectively used to enhance and focus browsing and searching activities. That is, why not browse with a little help from your friends?!

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