

An Overview of Web-Based Monitoring: Future Directions and Challenges

Melanie Kellar

Google

1600 Amphitheatre Pkwy,
Mountain View, CA 94043 USA
kellar@google.com

ABSTRACT

Monitoring is a web-based activity that is characterized by multiple visits to a web page in order to view new or updated information. This workshop paper provides an overview of a recent research project examining web-based monitoring and discusses future directions and challenges in supporting monitoring on the Web.

Author Keywords

Monitoring, WWW, revisitation, user behaviour, task.

ACM Classification Keywords

H.5.4 [Hypertext/Hypermedia]: Theory, User Issues.

INTRODUCTION

Previous research examining revisitation patterns [2; 7] and refinding strategies [1; 3] suggests that revisitation is an important and sometimes challenging web activity. One less commonly studied aspect of revisitation is monitoring, which occurs when users revisit web pages in order to view new or updated information. The increasing availability of web-based services and content allows users to monitor a variety of information online, ranging from news and blogs to sporting scores, bank balances, and online communications. Monitoring is becoming a dominant web activity [4] and a large number of web browser monitoring tools are available that allow users to refind and monitor information online.

One goal of a recent research project [5] was to better understand web-based monitoring. In particular, we were interested in determining the role of monitoring in the context of task and also how to better support monitoring activities. This workshop paper provides a summary of this research as well as future directions and challenges for studying monitoring on the Web.

MONITORING AND THE ROLE OF TASK

In order to better understand web-based monitoring activities, we conducted a series of semi-structured interviews with 40 participants [4]. During the interviews, participants were asked to describe several aspects of their monitoring activities, such as the goal of the monitoring activity; the type of information being monitored; the duration and frequency of the activity; the use of user logins and search queries; follow-up activities; and the nature of the activity (e.g., work, school, or personal).

The results of the study suggested that monitoring is not an independent information seeking task and instead an activity that occurs across all web task types, which include Browsing, Fact Finding, Information Gathering, Communications, Transactions, and Maintenance. This finding implies people use different strategies when refinding and monitoring information on the Web. Therefore, information monitoring activities may require different types of web browser support depending on the underlying task. Table 1 provides a characterization of all six monitoring activities.

Table 1. A characterization of web-based monitoring activities.

Task Type	Characterized by the Monitoring of:
Browsing	web pages in order to see “what is new”
Fact Finding	specific information (e.g., sports score)
Information Gathering	new content to support an ongoing research-based task
Communications	new and updated communications (e.g., email)
Transactions	web pages either in anticipation of, or following, an online transaction.
Maintenance	web page changes with the intent of maintaining information on the page



Figure 1. The Text Clip tool alerts users when a selected piece of information changes on a web page. In this example, a user is monitoring the CHI submission deadline and is being notified that the date has changed.

TASK-SPECIFIC MONITORING TOOLS

Based on the findings and recommendations of the semi-structured interviews, we developed three prototype task-specific monitoring tools. The first tool, Text Clip, supports Fact Finding monitoring by allowing users to select particular clips of text within a web page. When the web browser detects that the information of interest has changed, a small notification appears in the bottom right hand corner of the web browser. Clicking on the notification displays the updated information (see fig. 1). The second tool, the Page Updated tool, supports Maintenance monitoring by notifying users when any information on a Web page changed. The third tool, Enhanced Bookmarks, supports Browsing monitoring by providing a visual representation of how much a page has changed since the user's last visit (see fig 2).

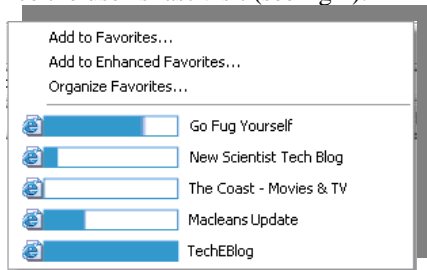


Figure 2. The Browsing monitoring tool, Enhanced Bookmarks, provides a visual representation of how much a page has changed since the user's last visit. In this example, almost all of the content on the "TechEBlog" web page has changed since the user's last visit.

A laboratory experiment was conducted with 20 participants to evaluate the appropriateness of task-specific monitoring tools. Participant evaluations of the three tools determined that the use of task-specific monitoring tools was appropriate. In particular, participants were very positively disposed towards the Text Clip tool, which supports Fact Finding monitoring activities and the Enhanced Bookmarks, which support Browsing monitoring activities.

FUTURE CHALLENGES

While the nature of monitoring activities on the Web is now better understood, there are several challenges ahead for the design and development of tools to support web-based

monitoring. This includes developing integrated monitoring tools, facilitating monitoring information in non-traditional environments, and supporting more efficient web use.

Integrated Monitoring Tools

One implication of this research is that different functionality is required to support different information monitoring activities. However, we need to be cautious that we are not simply building a series of "one off" web browser tools. The development of three separate tools was appropriate for the purpose of our preliminary evaluation but a more integrated solution is needed. For example, a Swiss Army Knife approach may be more useful, where several task-specific tools are integrated into a single system. Users could then choose the monitoring tool that best supports the information they would like to monitor. Scope [8] is an example of monitoring system integrates and displays notifications from multiple sources. Future work should investigate how we can support web monitoring activities not only across multiple tasks, but also across multiple devices (including both desktop and mobile computers).

Monitoring Information in Non-traditional Environments

As the availability of dynamic information increases on the Web and as users move away from traditional desktop environments, it is important that we continue to study how to effectively support information monitoring context. This research examined monitoring in a traditional display environment (e.g., single/dual monitor). One of the challenges of information monitoring is the fact that display space in traditional environments is at a premium; users cannot always afford to monitor information on a continual basis. Instead, monitored information is often retrieved as needed, meaning users may interrupt their task at hand in order to complete a monitor activity. This leads to distractions and provides an entry point for serendipitous web browsing.

Augmented surfaces [6] offer novel opportunities for information monitoring by allowing users to extend their display space onto other surfaces in the environment such as tables and walls. However, it is first important to evaluate how the introduction of an awareness monitoring tool impact users' web monitoring activities, particularly in augmented display environments. It is expected that the introduction of augmented displays for information monitoring could allows users to be more efficient in their monitoring activities, particularly in workplace settings.

Supporting Efficient Web Use

During the semi-structured interviews, a small number of participants (12.5%) reported that monitoring was a compulsive or obsessive activity. We hypothesize that effective monitoring tools may be useful in mitigating this compulsive behaviour. In particular, tools that are accurate and reliable could reduce the amount of time users spend monitoring information on the Web. In addition, tools that

deliver updated information to users without requiring them to navigate the Web may also reduce the amount of serendipitous browsing, leading to more efficient web usage.

Finally, before we can study the impact of monitoring tools on the efficiency of web users, we must first develop metrics with which to measure this impact. For example, we hypothesize that the effectiveness of a monitoring tool can be measured in part, by the reduction in the number and length of web page visits to frequently monitored web pages. In order to fully understand the impact of these tools, stronger and more reliable metrics are needed.

Monitoring is an important and sometimes complex web-based activity. This paper provides an overview of a recent research project exploring the nature of web-based monitoring through semi-structured interviews and a laboratory study. Based on these studies, we have presented challenges and future directions that should be considered when designing and developing the next generation web-based monitoring tools

ACKNOWLEDGEMENTS

This research was conducted as a Ph.D. student in the Faculty of Computer Science at Dalhousie University. Thanks to Dr. Carolyn Watters, Dr. Kori M. Inkpen, and Dr. Michael Shepherd. This research was supported by the Natural Sciences and Engineering Research Council of Canada.

REFERENCES

1. Teevan, J., Adar, E., Jones, R., and Potts, M. (2007). Information Re-Retrieval: Repeat Queries in Yahoo's Logs. In *Proceedings of SIGIR 2007*, Amsterdam, The Netherlands.
2. Cockburn, A. and McKenzie, B. (2001). What Do Web Users Do? An Empirical Analysis of Web Use. *International Journal of Human-Computer Studies*, 54(6): 903-922.
3. Jones, W., Dumais, S. and Bruce, H. (2002). Once Found, What Then?: A Study Of "Keeping" Behaviors in the Personal Use of Web Information. In *Proceedings of ASIS&T 2002*, Philadelphia, PA, 391-402.
4. Kellar, M., Watters, C. and Inkpen, K. M. (2007). An Exploration of Web-Based Monitoring: Implications for Design. In *Proceedings of CHI 2007*, San Jose, CA, 377 – 386.
5. Kellar, M. (2007). An Examination of User Behaviour during Web Information Tasks. Ph.D. Dissertation, Faculty of Computer Science, Dalhousie University, Halifax, Canada.
6. Rekimoto, J. and Saitoh, M. (1999). Augmented Surfaces: A Spatially Continuous Work Space for Hybrid Computing Environments. In *Proceedings CHI '99*, Pittsburgh, PA, 378 - 385.
7. Tauscher, L. and Greenberg, S. (1997). How People Revisit Web Pages: Empirical Findings and Implications for the Design of History Systems. *International Journal of Human-Computer Studies*, 47(1): 97-137.
8. van Dantzich, M., Robbins, D., Horvitz, E. and Czerwinski, M. (2002). Scope: Providing Awareness of Multiple Notifications at a Glance. In *Proceedings of AVI 2002*, Trento, Italy.