Tabbed Browsing Behavior as a Source for User Modeling

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Abstract. In our research, we focus on improving the user model by using novel sources of user feedback – tabbed browsing behavior of the users (also called parallel browsing). The tabbing is nowadays established as the more accurate description of browsing activities than the previous linear representation. Users take advantage of multiple tabs in various scenarios, by which they express different relations and preferences to hypermedia being visited in such tabs. The aimed contribution is to include this behavior into the user model, so improving accuracy of modeled user's characteristics and thus improving personalization.

Keywords: user modeling, tabbed browsing, adaptive web-based systems

1 Motivation

Nowadays, all major web browsers support visiting multiple pages at once using the mechanism of multiple tabs contained within one browser window. This behavior is called parallel browsing and in general, for the purposes of web usage mining, it is not discerned whether multiple tabs or browser windows are being used. For the purposes of this paper, we refer to such behavior simply as tabbing.

The tabbing has nowadays become accepted as a more accurate description of browsing activities than the previous linear models, in which a visit to one page was perceived as leaving the previous page. The acknowledgment of emergence of this behavior is found even in web standards, as the W3C specification of Page Visibility API (www.w3.org/TR/page-visibility/) was proposed in 2011 in order to enable web developers to determine visibility of pages and allow them to save on device and browser resources when the user is browsing in different tabs. The specification has only recently (Feb. 2013) entered the pre-final "Proposed Recommendation" stage. The fact that such measures are created for something as ample as processing power of current devices is a strong hint that the tabbing behavior is current issue.

Meanwhile, in the field of Adaptive Web-Based Systems, user model is the essential feature to facilitate the adaptation. It covers and represents user's interests, knowledge, goals, etc. Sourcing the indicators for such user features is the ongoing research issue. Our hypothesis is that using data on the tabbed browsing, observing which tabs the user is keeping opened, which tabs he opens and when, and how he opens the sites in existing or new tabs, has a potential to improve user models.

2 Related work

Previous research has already shown that the tabbed browsing (also called tabbing or parallel browsing) is common amongst most users. This model better lines up with the real user behavior than earlier linear model where each visit to a web page replaces the previous page [1]. A study [2] was performed logging and then interviewing the users for *reasons* why they use tabs. The situations cited by users were: *reminders* (keeping opened tabs with things to do later), *opening links in background* (opening multiple links in multiple background tabs), *multitasking* (switching to a tab to perform a new task), *going "back and forth"* (switching between two or more pages), *frequently used pages* (keeping pages opened for later use), *short-term bookmarks*.

It was proposed that differences in tabbed browsing can indicate the type of search query [3], or differentiate sessions to improve recommendation algorithms [4]. When trying to observe the tabbed browsing, typical problems arise from its invisibility in the server logs (only pageloads). When basing the observation only on the server logs, the tabbing is only estimated within a large space of possibilities [1] or observed indirectly and partially, e.g. through the order of clicks and visits to a search results page [3]. When basing the observation on an augmented browser (plug-in or extension), the users and tabbing are observed precisely and sometimes at the scale [5], but we are then limited to participants with such modified browser.

It is worth noting that some approaches overlap with the notion of tabbed browsing even when they do not refer to tabbing explicitly. One example is the analysis of click streams. When the user follows a link from one page to another and then, later, from the same source page into different one, it can be inferred that the source page was still opened [3], representing branching in the tabbed model. Another example is the evaluation of time spent on a web page. When this measure is tracked in fragments (not only as a difference between two subsequent pageloads) and only time in focus is considered, this indicator partly represents switching between tabs in the tabbed model. However, neither current approach covers all aspects of tabbing from tab creation, through tab switching, to closing and a deeper exploitation of possible scenarios in which users browse in this way has not been researched.

3 Tabbed browsing as a source for user modeling

Our aim is to propose a method for user modeling based on tabbed browsing. We create an overlay user model on top of open-corpus domain model, modeling *user interests*, *goals and tasks*, and *context of work* (device-centered, including user task), with possible inclusion of *individual traits*, specifically browsing style. Our proposed approach to user modeling consists of three steps: (i) Acquisition and modeling of the tabbed browsing actions, (ii) Recognizing the *scenarios of tab usage* being performed, (iii) Building or augmenting existing user model. Fig. 1 depicts an overview of our approach – user activities can be sourced either (i) from browsing agent (extension), covering only specific users, but all their activity, or (ii) from in-page scripts, covering all users, but only within given systems.

*R*easons *for using tabs* [2] line up into the three categories of implicit feedback:

- *Examination behavior* (selection, duration, repetition, etc.). The multiple tabs can be used to examine multiple objects and selection and repetition are important aspects, as the user can revisit any opened page in a tab without loading it again.
- *Retention behavior* (save a reference, save an object, deletion, etc.). The user can keep important or interesting pages opened in the background tabs and retain them as a reminder or bookmark, closing them only when they are no longer needed.
- *Reference behavior* (object-object reference, object-portion reference, etc.). The user can open multiple links from a list of results, switch back and forth, etc.

These cited *reasons for using tabs* are however users' view – what should the user do in a given situation. For the reverse view, i.e. situation where we have observed an activity and we are interested in what could be the user trying to do, we propose the following *scenarios of tab usage*: *Retention of a tab* (*single future use*, *recurrent future use*), *Opening links in background and exploring them*, *Changing context* (switching to different task), *Comparing content*.

The proposed scenarios relate to both current and future activities and allow inference of several features of a user model, e.g. interest in pages in tabs kept for future use. Each tab can belong to multiple scenarios for various (possibly overlapping) time periods. Detected scenarios should be tracked for each tab together with information about group of other tabs in which was the scenario performed. This is the basis for user interests represented as weighted relations to domain terms of visited pages.

4 Current work and conclusions

We already proposed a model for user actions during tabbed browsing together with an algorithm for tabbed browsing reconstruction from events observed by script included in a page [6]. We evaluate our approach within an adaptive educational system ALEF [7]. We observed that the users (specifically students during a learning session) not only use tabbed browsing extensively, but relations which were not expressed explicitly in the domain model in ALEF were found, e.g. the students were commonly switching in tabs between given explanation-type learning objects. Browsing explanations concurrently with exercises was also common behavior. This suggests that even a relatively simple reasoning made directly from the tabbing model (the first phase of the proposed approach, see Fig. 1) can help also in domain modeling. Our experiments showed that tabbed browsing is valuable source for discovery of relations between objects being presented (e.g. learning objects in ALEF), which can serve for further improving of personalization.

Along with this line we explore the possibility of sourcing the user model from tabbed browsing more generally, i.e. considering browsing on the open Web. We have realized the tracking and tabbing modeling within BrUMo browser extension (brumo. fiit.stuba.sk). We currently collect dataset of user behavior.

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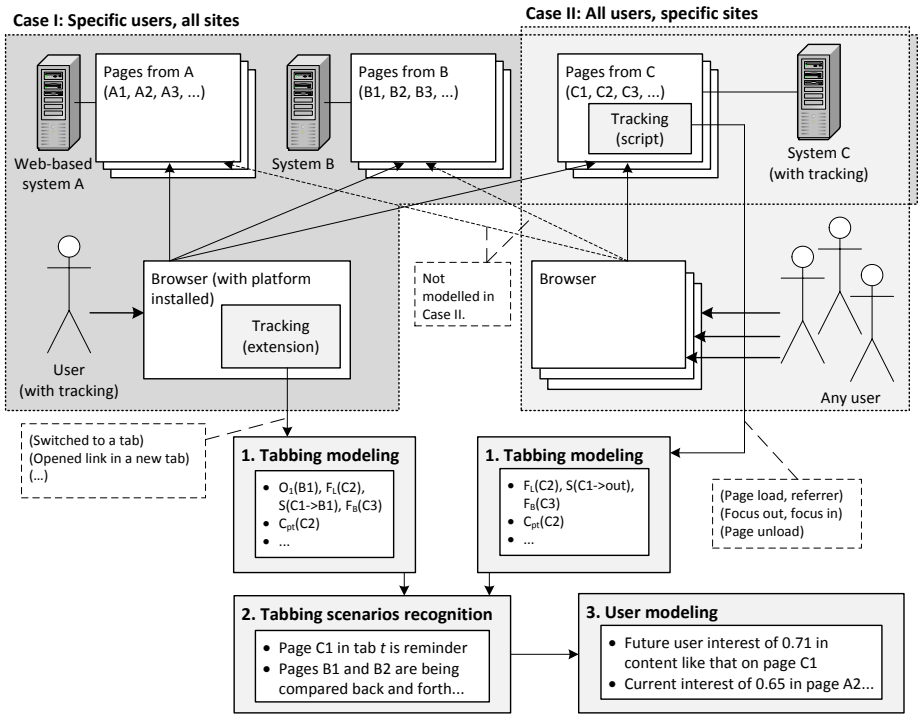

Fig. 1. Overview of our user modeling approach based on tabbed browsing.

References

1. Viermetz, M., Stolz, C., Gedov, V., Skubacz, M.: Relevance and Impact of Tabbed Browsing Behavior on Web Usage Mining. 2006 IEEE/WIC/ACM Int. Conf. on Web Intelligence - WI'06. pp. 262–269. IEEE (2006).
2. Dubroy, P., Balakrishnan, R.: A Study of Tabbed Browsing Among Mozilla Firefox Users. Proc. of the 28th int. conf. on Human factors in computing systems - CHI'10. pp. 673–682. ACM Press, New York, USA (2010).
3. Huang, J., Lin, T., White, R.W.: No Search Result Left Behind: Branching Behavior with Browser Tabs. Proc. of the 5th ACM int. conf. on Web search and data mining - WSDM'12. pp. 203–212. ACM Press, New York, USA (2012).
4. Bonnin, G., Brun, A., Boyer, A.: Towards Tabbing Aware Recommendations. Proceedings of the 1st Int. Conf. on Intelligent Interactive Technologies and Multimedia - IITM'10. pp. 316–323. ACM Press, New York, USA (2010).
5. Huang, J., White, R.W.: Parallel browsing behavior on the web. Proc. of the 21st conf. on Hypertext and hypermedia - HT'10. pp. 13-17. ACM Press, New York, USA (2010).
6. Labaj, M., Bieliková, M.: Modeling parallel web browsing behavior for web-based educational systems. Proc . of the 10th int. conf. on Emerging eLearning Technologies and Applications - ICETA'12. pp. 229–234. IEEE (2012).
7. Šimko, M., Barla, M., Bieliková, M.: ALEF: A Framework for Adaptive Web-Based Learning 2.0. Proc. of IFIP Advances in Information and Communication Technology, 2010, Vol. 324, pp. 367-378, Springer,(2010).