Fostering Collaborative Information Gathering in Social Bookmarking Service

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Abstract The research aims at developing a Social Bookmarking Service to support information gathering in scientific research. The paper proposes a new mechanism for community building, which provides mutual awareness among the users based on their browsing behavior. The mutual awareness mechanism provides information about who browsed the user and whom the user browsed, which fosters collaborative information gathering. We have designed the mechanism and performed a preliminary evaluation of the usefulness using an experimental social bookmarking site.

1. Introduction

Collaborative information gathering is an approach to solve the problem of Internet Information Overload by organizing cooperation among users [31]. Collaborative information gathering can yield more undiscovered knowledge than single information searchers [6]. Members of a community may provide potential resources that can be utilized to achieve individual goals. A number of researches attempt to understand the effect of collaborative information gathering in online spaces [14, 15]. The result indicates that the potential resource can be provided through social interaction [22]. Another result shows that the information hints, which come from other search, can be used to guide the new searchers and increase individual searching performance [6]. In the context of bookmark service, it provides the place for users to conduct collaborative information gathering in online spaces [15].

Social Bookmarking Service (SBS) can be used as social software to foster collaborative information gathering and community building in scientific communities [16]. The growth of SBS does not only offer the possibilities of alternative search engines for online communities [3] but also contribute Research Collaboration Support System (RCSS) for research communities as a mean of collaborative information gathering [19]. Browsing others' shared bookmarks or tags can reduce searching effort and is an effective alternative to search engines and catalogue search [1]. An individual search using search engines may miss valuable information because the search algorithm returns too many results. Meanwhile, SBS is a type of finding information among like-minded communities [26]. In SBS for scientific communities

such as CiteULike [8], when people locate relevant articles, they can discover who else links to them, and that can ultimately lead to colleagues who share research interests and foster like-minded community building [4]. Although SBS present its benefit for social search, it still needs the mechanism for collaborative information gathering to increase the performance of collaborative search.

The paper describes the analysis and design of a new mechanism for fostering collaborative information gathering through community building in scientific communities. Since typical information search tools provide abundant retrieved information and may lack of most relevant information, an information gathering service that allows information sharing and acquisition among people needs to be developed. In order to foster collaborative information gathering, the new mechanism should provides awareness among the users based on their browsing behaviors. Studies of awareness highlighted the extent to which information sharing, presence of group and individual activity, and their interaction are the most important to successful collaboration [10].

The paper is organized as follows: Section 2 describes an analysis of collaborative information gathering in SBS. Section 3 presents a design of the mechanism to foster collaborative information gathering in SBS. Section 4 describes the related work and Section 5 describes conclusion and future work.

2. Collaborative Information Gathering

Information foraging theory [27] attempts to understand the effect of collaborative information gathering for individual and community. Cooperative information foraging models [5, 6]

show the effect of the diversity of information seekers and their footprints to each other and how this diversity directly affects the size of collaboration groups. It assumes that information hints, which come from other searchers, can be modeled as the number of search steps that are eliminated due to a distinct hint and increase individual searching performance. Cooperative information foraging encourages collaboration in the way of information sharing and gathering. People share information for some means such as mutual benefit or aware of others' presence [2]. Mutual information sharing can be explained as the situation that researchers both benefit from the results of each other's searches and have awareness of other's information.

Figure 1 shows the benefits of cooperative information foraging [27]. It describes that as long as the *diversity of hints* (*H*) increases with group size, then the size of a group increases the overall power of cooperative discovery in means of *rate of return to individual*. People can discover knowledge more quickly and thoroughly by foraging in groups. The benefits of cooperative information foraging contribute explanation of the successful of social software that allow groups of people to discuss problems and to discover knowledge at a faster speed than the individual information seeker.
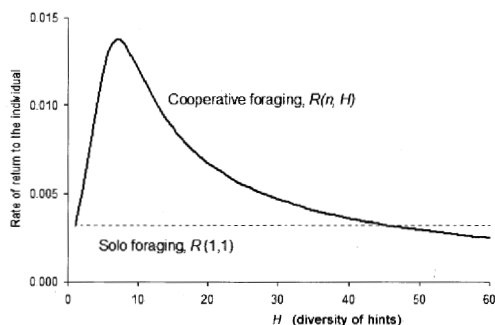

Figure 1. Benefits of cooperative information foraging [27]

Information seeking is the purposive behavior for seeking information as a consequence of a need to satisfy some goal [30]. Investigation into information seeking behavior concerns with how user navigates an information space and what he do with the available information provided by the system. The studies on information seeking behavior resulted the pattern of information behavior of scientific researchers in six generic characteristics as follows [9,18, 24, 30].

(1) *Starting*: comprise activities that form the initial search for information such as identifying reference that could serve as starting point of information seeking. These references may be any sources that are expected to provide relevant information.

(2) *Chaining*: follow citations of references. Chaining can be backward or forward. Backward chaining occurs when the original references are followed whereas forward chaining follow up on others sources that refer to an original source.

(3) *Browsing*: look for information in areas of potential search. The individual simplifies browsing by looking through tables of contents, citations, or abstract and summary of an interested publication.

(4) *Differentiating*: filter and select the potential references from the retrieved information by knowing difference between the quality of the information offered. The differentiating process depends on individual's knowledge.

(5) *Monitoring*: is the activity of keeping up to date of the new information or development in an interested area by following particular sources. The sources can be journal, newspaper, conferences, and so on.

(6) *Extracting*: is the activity that associated with going through a particular sources and selectively identifying relevant information from those sources. In the context of information seeking, extracting may be achieved by looking through bibliographies, indexed, abstracts, or online database.

An individual seeker can perform his information seeking behavior in SBS by using the fundamental function provided in existing SBS. Figure 2 shows the fundamental functions of SBS to facilitate information seeking behavior. A user can search for information in a SBS as the starting point by identifying his keyword that may suffice for searching the potential bookmarks [20]. By considering the bookmark collections in a search result, a user can navigate as chaining for the new bookmarks list by using related tags or related users functions provided in general SBS. In addition to the feature providing usernames or tags attached with a bookmark, this feature offers browsing function for users in the way of social navigation [11]. That allows a user to looking for information in potential area. Tagging system is one important function for differentiating the retrieved bookmarks. Tagging in a like-minded community provides the common knowledge to users in the community. Generic SBS provides recent activities to users in order to monitoring
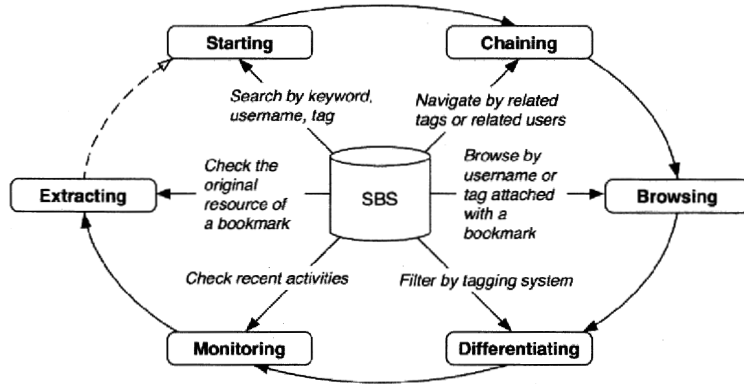
Figure 2. Encouraging scientific information behaviors in SBS

others' activities and allows an user to check the accuracy of the potential bookmarks by access to the original WWW through bookmark title. An user can check the original resource of an interested bookmark to verify whether that bookmark satisfies his need by clicking bookmark title. Although the generic SBS provides fundamental functions for information seeking, the mechanism for fostering collaborative information gathering such as the presence of users' activities still is needed.

Concerning to fostering collaborative information gathering, a literature [22] has presented four important elements that foster social interaction in online spaces: place-marking, common ground, awareness, and interaction mechanisms.

(1) *Place making* is the spatial metaphors to frame and interpret social information and exploit spatial properties to guide social interactions in the online space.

(2) *Common ground* refers to share understanding of participants in an online space.

(3) *Awareness* refers to the knowledge of the presence of other people including their interaction and activities.

(4) *Interaction mechanisms* enable participants to choose when and how to interact with others. In some case, the presence of other actions may provide some clues for knowing of others' actions and characteristics.

These four elements do not only support physical social interaction but also contribute distributed online work groups. Since collaborative information gathering can be identified in three main categories as *for identifying persons*, for *recommending, annotating and creating bibliographies, and for supporting collaboration* [13], awareness has been highlighted as the

importance for successful collaboration [10, 12]. The mechanisms to foster collaborative information gathering should facilitate awareness in social interaction.

Figure 3 summarizes four important elements for social interaction in online spaces. Each element is used to foster social interaction independently from another. In this context, SBS can provide fundamental functions for place making, common ground, awareness, and interaction mechanisms for fostering collaborative information gathering and community building. Researchers use SBS to exchange information with the purpose to achieve each own individual goal in means of gather information for their research and aware of others' information. Although the generic SBS functions provide information for others' activities as recent activities feature, awareness element should be considered in order to improve for the new benefit.
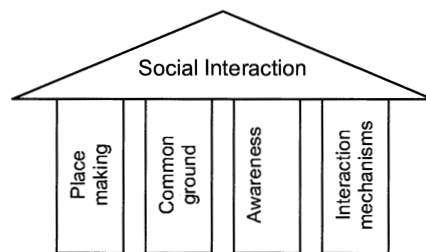

Figure 3. Four elements for fostering social interaction in online spaces

3. Fostering Mechanism

Based on the four elements for fostering social interaction in online spaces, we can identify these elements in SBS as shared bookmark, tagging system, others' activities, and social navigation.
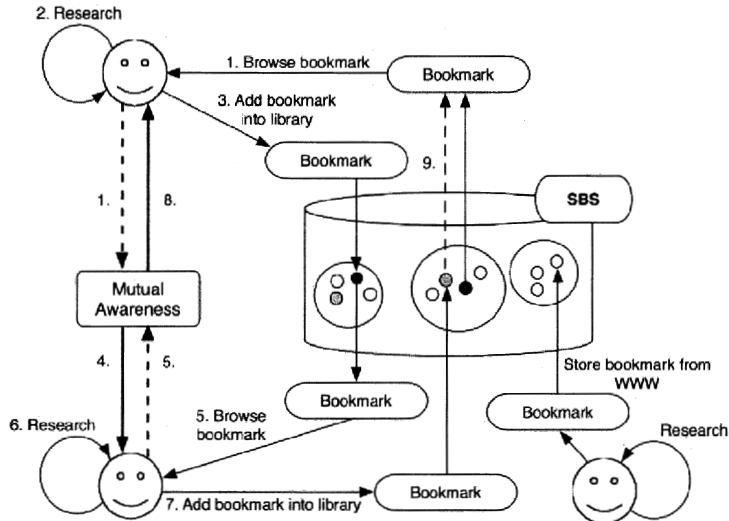
Figure 4. Fostering Collaborative Information Gathering in SBS

(1) Shared bookmarks as place making

SBS offers a shared bookmark as the metaphor to frame social information to foster information gathering and discovering to users [21, 23]. Shared bookmark can be used to organize and present information for users in online spaces. For instance, an experimental SBS *ReMarkables* [17] provides presence of users by their name, their own tags, and their own bookmarks libraries as usual SBS.

(2) Tagging system as common ground

Tagging system can be used to provide shared understanding for users in SBS and is a convenient way of navigating one's own collection and determining his characteristic [23, 25]. It can function as common ground in SBS. Newcomers in a like-minded community can understand the special keywords provided as tags and sense about the topic of that community. Tagging system can foster collaborative activities such information gathering in like-minded communities [13].

(3) Others' activities as awareness

Typical SBS provides a number of users' activities such as recent activities [16] for user to aware of others' information. Providing recent activities is one kind of awareness element in SBS to contribute collaborative information gathering [14]. In another way, mutual awareness in SBS can be provided by a browsing users list in order to present users' browsing behaviors. Mutual awareness in this context is the information of browsing behavior informing to each other user. Individual user can know who browsed into his library whereas whom was browsed by the user.

(4) Social navigation as interaction mechanism

Social navigation is one of the efficient ways to enhance information discovery in SBS [25]. Since bookmarks can be valuable information for other, individual seekers tend to navigate through others' libraries in order to find the new useful bookmarks. Clicking a tag or a username shows a new potential result to a user. In addition to the sake of social navigation, it can be used to contribute interaction mechanism element in SBS. Since browsing behavior leaves footprint to a user whom is browsed, it can increase the way of using social navigation, not only from related tags or users in generic SBS but also from a browsed user list provided by mutual awareness mechanism.

Figure 4 describes a new mechanism in SBS for fostering collaborative information gathering as providing mutual awareness information. The sequences of using the mechanism are the following.

(1) A user *browses bookmarks* in other's library to find useful bookmarks. His browsing behavior is recorded into mutual awareness information.

(2) The first user performs *research* by reading the publication linked from the found bookmark.

(3) As the result of research, the first user *adds a bookmark into library* by assigning his own tags.

(4) The information about browsing behavior of the first user is *informed* to the second user in order to acknowledge another' behavior.

(5) By awareness information about who browsed, the second user may *browse* bookmark of the first user by clicking his name appeared in

browsed users list. This behavior will be recorded into mutual awareness information.

(6) The second user performs *research* by reading the publication linked from the found bookmark.

(7) As a result of research, the second user *adds bookmark into library* by assigning his tags.

(8) The information about browsing behaviors of the second user is *informed* to the first user in order to acknowledge behavior of the second user.

(9) By aware of the second user's behavior, the first user may *browse* into the second user's library once more to monitor whether the new bookmarks are added into the second user's library.

The function of SBS for providing mutual awareness information can be implemented as a Browsed users list as shown in Figure 5. The direction of an arrow for each user name presents user's browsing behavior. In case of forward direction (➡), it means user has browsed another library. Backward direction (⬅) means another user has browsed into user's library. Mutual direction (⬌) is the information about both users has browsed mutually into each other's library.
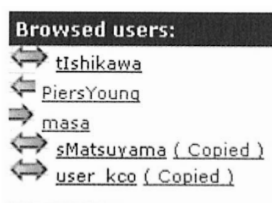

Figure 5. User interface for mutual awareness

A preliminary experiment to evaluate the usefulness of the proposed user interface has been conducted using an experimental social bookmarking site [28]. The participants of the experiment were asked to judge whether the presence of awareness information is useful or not for collaborative information gathering. Some comments from the participants can be summarized as:

"Mutual awareness information may be useful for searching other researchers who share same interests in the early stage of research process. But it is hard to evaluate the mutual awareness information displayed in SBS within short term use."

"Social bookmarking service is not convenient in the situation without internet connection. I need a tool that can be used in both local and network such as Google gear."

We will evaluate the effectiveness of the proposed mechanism by analyzing users' browsing behavior. The results of evaluation will be verified and interpreted with statistical test. Users will be asked for their satisfaction about the new mechanisms and its information.

4. Related Work

There are some studies on social interaction and how to provide the presence of activities of user in SBS. Two literatures are selected here as related work because of its similar idea to provide awareness to users in SBS.

TopicMark [15] is a topic focused bookmark service for professional groups, which presents the specific topic generation process and the autonomous aggregation of information resources. The purpose of TopicMark is to provide an approach to information that utilizes the contextual knowledge of user's interests, activities and collaboration with others. The system harvested regarding people's shared information needs and constructed collected resources as topics. The similarity among users' interests documents' content and groups' topics are explored to support information discovery process. While TopicMark harvests knowledge of users, the mutual awareness information provides further the presence of users' activities by their browsing behavior. This information eases to interpret whether others browse into the library and foster collaborative information gathering in like-mined communities.

CiteSeer collaboratory [12] facilitates community building and collaboration for the users of CiteSeer [7]. CiteSeer is a search engine and digital library of literature in the computer and information science. Supporting collaborative activities in the early, upstream stages of scientific discovery are a first approximation to enable collaboration currently between users. CiteSeer collaboratory provides awareness about potential collaborators to users in order to construct collaboratory. The system uses notification systems to convey activity awareness whereas the mutual awareness information provides presence of others' browsing behavior to users.

5. Conclusions and Future Work

The paper proposed a mechanism of fostering collaborative information gathering in SBS for scientific research communities. The design of new mechanism is based on the important elements for fostering social interaction as place making, common ground, awareness and interaction mechanisms. The mechanism provides

the mutual awareness information about browsing behaviors of others, which will foster the community building in information gathering. The preliminary evaluation of the effectiveness using an experimental social bookmarking service is presented.

Although we have performed preliminary evaluation for the usefulness of the proposed user interface, the new mechanism for fostering collaborative information gathering in SBS as providing mutual awareness information needs to be validated for the effectiveness of the mechanism. We will continue evaluation for the proposed mechanism and optimize it for the most benefit for users.

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