

Integrating Wikipedia, Facebook, and Other Personal Online Context into Collaborative E-Brainstorming

Mike Gartrell¹, Aaron Beach¹, Jai Ramanarayananankrishnaniyer¹, Xinyu Xing¹,
Qin Lv¹, Richard Han¹, Shivakant Mishra¹, Karim Seada²

¹ Department of Computer Science, University of Colorado at Boulder ² Nokia Research Palo Alto
Contact: mike.gartrell@colorado.edu

ABSTRACT

The position of this paper is that current electronic brainstorming applications need to be updated to more directly integrate online resources such as Google, Wikipedia, Facebook, etc. into the brainstorming process. The idea is to improve brainstorming by recommending ideas for brainstorming based on both the context of the brainstorming session, namely the ideas currently being discussed, as well as the personal context of the users, i.e. what technical expertise they contribute to the brainstorming session and what personal experiences/interests/preferences can be brought into the brainstorming process. We describe a preliminary application that implements a subset of these ideas.

1. INTRODUCTION

A variety of applications have been developed for collaborative brainstorming, including single display groupware and electronic whiteboards [11, 4, 10], brainstorming applications [8, 7], and proactive displays [9]. Most of these applications are not well integrated with the Internet. One new application, IdeaExpander [14], has sought to recommend new ideas (in the form of pictures) for brainstorming based on current keywords found in a text chat window of the brainstorming session, but the system is stand-alone and the pictures are taken from a small database not linked with the Internet. GroupMind allows users to drag and drop images from Web pages into a collaborative whiteboard application to manually generate and organize new ideas [13].

Other recent computer-mediated communication tools that support knowledge tasks, such as brainstorming and group conversation visualization, include Conversation Clusters [2] and Angler [1]. Conversation Clusters visualizes and summarizes conversations that occur during co-located meetings of groups using speech recognition, clustering, and semantic analysis to present an interactive display of automatically detected group conversation topics on a tabletop system. Angler is a Web-based application that helps knowledge professionals solve given problems; Angler facilitates each step of the problem solving process, including brainstorming. Like Conversation Clusters, our brainstorming application uses an interactive display to allow groups to visualize and manipulate artifacts that are created and discussed during a group meeting. Like Angler, our application facilitates group brainstorming and allows the group to visualize and track ideas contributed during the brainstorming session. However, unlike both of these systems, our application adapts to the unique composition of a particular brainstorming group using a number of online resources.

We believe it is important for next-generation electronic brainstorming applications to build upon this prior work and

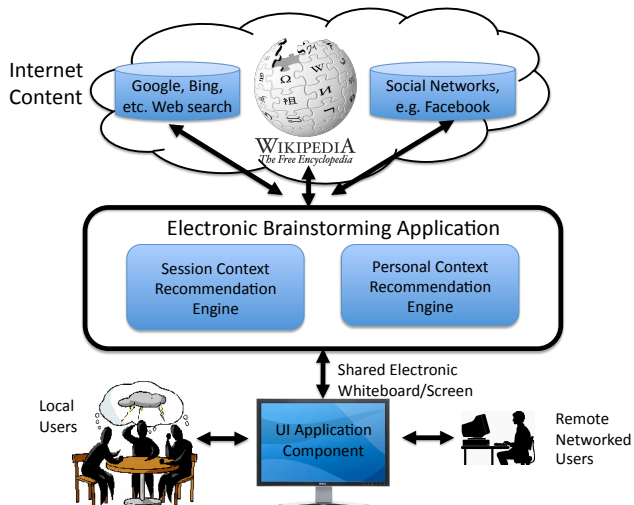


Figure 1: Architecture of next-generation e-brainstorming application integrated with online content.

evolve so that they can automatically generate new ideas to facilitate brainstorming by leveraging the vast riches of online resources. This new wave of e-brainstorming software will integrate elements of Web content, Google search, Wikipedia semantics, and online social network (OSN) personal content and relationship information to enable sophisticated assisted brainstorming. Online resources from the general Web and Wikipedia can be searched using Google to recommend more ideas for brainstorming that are related to current ideas being discussed on an electronic whiteboard. Further, online resources such as Facebook and Google Scholar can be mined to recommend ideas related to the personal preferences, social relationships, and technical expertise of the group of users participating in a brainstorming discussion.

The architecture for such an e-brainstorming system is shown in Figure 1. Users sitting/standing in front of an electronic display can either have their presence detected automatically, e.g. by detecting their mobile phone's location, or by manually logging into the application, via the local keyboard/mouse or other UI mechanism. The login process enables the application to become aware of each user's personal contextual information, such as their public OSN handle, e.g. Facebook, or a link to their research home page describing their technical papers and expertise. As the group of users begin brainstorming, ideas are recommended based *both* on the session context and personal context, where new

ideas related to session context may be suggested based on a Google search of the terms found on the screen, while personal context from an OSN profile brings in users' interests, experiences, and expertise to inform the brainstorming session. The design should be flexible enough to accommodate both in-person brainstorming as well as remote brainstorming with online networked participants.

2. THE BRAINSTORMING SYSTEM

This section describes the proposed system. Our brainstorming application consists of three major components:

1. Session Context Manager, which manages information related to the current session in the brainstorming application.
2. Personal Context Manager, which mines users' personal information from a variety of data sources, including Google, Google Scholar, Facebook, and other online sources and builds user profiles that contain each user's content interests and social connections.
3. User Interface, which allows the user to submit ideas as text, pin ideas of interest, link ideas to Wikipedia articles and other Web content, and request idea recommendations.

The first two components support the Idea Recommendation Engine, which integrates information from the current brainstorming session, Facebook user profiles, Google, Google Scholar, Wikipedia's link structure, and other online sources to provide idea recommendations to the brainstorming session. The Idea Recommendation Engine sends recommended ideas to the User Interface, which in turn allows users to interact through their mobile and stationary devices. The general interaction between these system components is depicted in Figure 1. The related functions of each component are described in greater detail in this section.

2.1 Idea Recommendation Engine

The goal of the Idea Recommendation Engine is to recommend ideas to the participants for brainstorming. These recommended ideas are displayed on the shared electronic board and can be manipulated by the participants. The Idea Recommendation Engine obtains these ideas from the Session Context Manager and the Personal Context Manager. Below we discuss these components in more detail.

2.1.1 Session Context Manager

The Session Context Manager records the history and state of the current brainstorming session. By recording what ideas users have requested, expressed interest in, expressed disinterest in, and opened for viewing in more detail, we can track the progress of the brainstorming session and learn more about the interests of users regarding the current brainstorming topic. As the system learns more about users' interests from the Session Context Manager, it is able to recommend ideas that are semantically similar to these interests.

One way of enabling users to express interest or disinterest in an idea is through pinning and unpinning functionality. By pinning an idea, the user expresses interest in an idea and indicates that this idea should remain on screen through one or more refresh iterations of the brainstorming session. By unpinning an idea, the user expresses disinterest in an idea

and indicates that this idea should be removed during the next iteration of the brainstorming session.

An alternative to the binary method of expressing interest or disinterest in an idea by pinning or unpinning is to ask users to rate each idea on a scale, such as a scale from zero (no interest) to five (most interested). We plan to evaluate both alternatives in future prototypes of our brainstorming application.

2.1.2 Personal Context Manager

The Personal Context Manager consists of two subcomponents: the Personal Content Miner and the Social Connection Manager. Using these two subcomponents, the Personal Context Manager builds a profile for each user that contains the user's content interests and social connections. These user profiles are critical to the implementation of the Idea Recommendation Engine.

The Personal Content Miner processes information from each user's Facebook profile, personal Web site and curriculum vitae, and Google search history. Additionally, content from each user's publications, as accessible through Google Scholar, can be mined for content interests. Important concepts from these data sources can be extracted using standard text mining statistical measures, such as tf-idf [12].

The Social Connection Manager examines each user's Facebook profile, personal Web site and CV, and publication information from Google Scholar to obtain information about the user's social connections. Information from these data sources allows us to estimate the strength of the social connections between each user in the group participating in the brainstorming session.

In our prior work [6], we developed three measures that capture the social connections and content interests of a group, called group descriptors. These group descriptors are the social descriptor, expertise descriptor, and dissimilarity descriptor. Our work shows that these factors have significant impact on group decisions, and we plan to explore the use of these descriptors in the Idea Recommendation Engine. The social descriptor measures the social relationship strength of the group, and will be computed by the Social Connection Manager. The expertise and dissimilarity descriptors are measures related to the content interests of the group, and will be computed by the Personal Content Miner. The content-based group descriptors in our prior work were developed in the context of item ratings (e.g., movie ratings); the implementation of these descriptors in the Personal Content Miner will need to be altered to account for subject matter expertise and semantic similarity of concepts. Regarding semantic similarity, we will investigate the use of existing techniques for computing semantic relatedness, such as latent semantic analysis [3].

3. THE BRAINSTORMING APPLICATION

The brainstorming application's UI application component provides control over items that appear on the shared electronic screen and governs how users interact with those items. A mockup of our proposed UI is shown in Figure 2. This UI mockup is based on our prior work on the brainstorming application described in [5]. We used VNC in our prior work to support remote users. The application UI provides functionality for displaying ideas, pinning and unpinning ideas, adding ideas via the search bar, setting the number of new ideas to display, and setting the degree of focus and personalization. The idea refresh, search, focus control, and idea quantity control function as described in [5]. Each

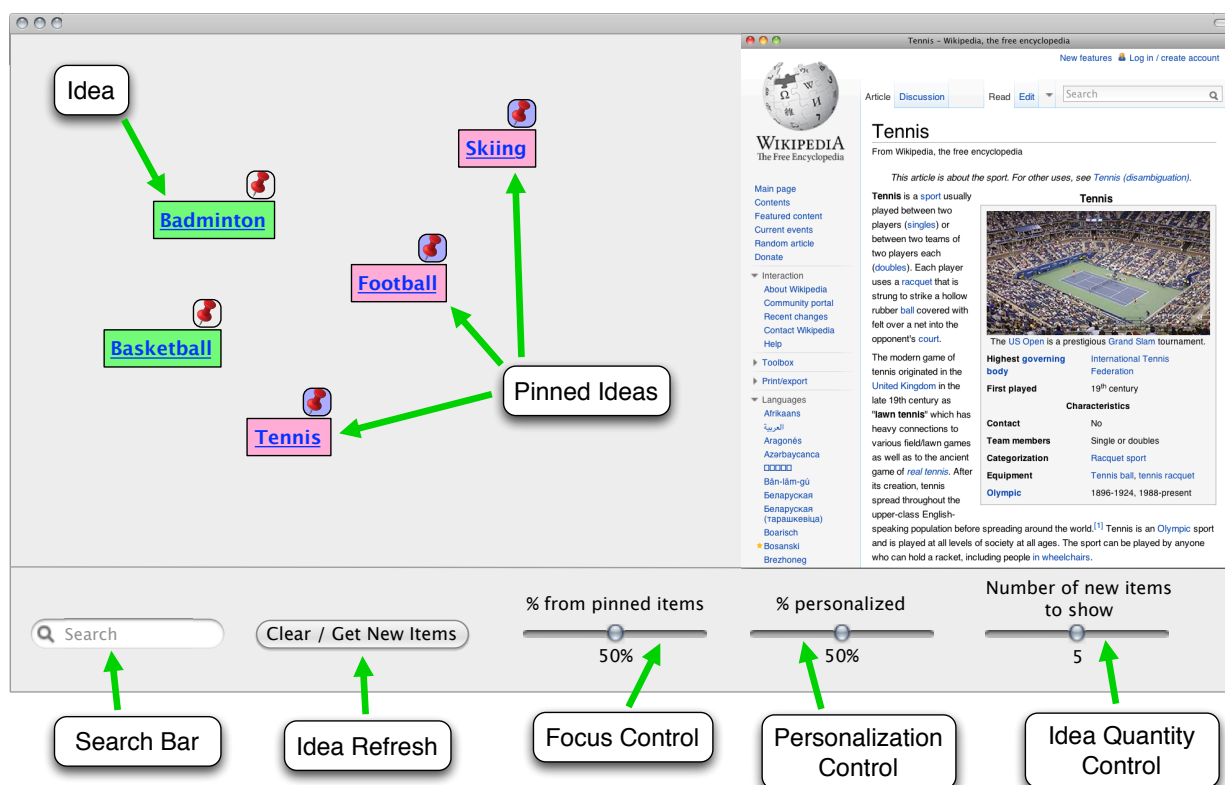


Figure 2: UI mockup of our proposed brainstorming application, where ideas recommended from session context are based on the pinned and unpinned items as well as the focus control, and ideas recommended from personal context are controlled by a personalization sidebar. A subset of these concepts have been implemented.

idea contains a hyperlink to the Web page for that idea. The mockup shown here adds new functionality for setting the degree of personalization and for populating the brainstorming application screen with new ideas by dragging and dropping links from the Web view. The personalization control sets the percentage of new ideas that are generated from the users' personal interests and social connections as obtained by the Personal Context Manager component of the Idea Recommendation Engine. The Web view window shows the Web page content for an idea. While viewing Web content, a user can drag a link found in this window to the brainstorming application window, resulting in the creation of a new on-screen idea. For example, in Figure 2, a user could drag the "sport" link in the Web view window containing the Wikipedia article to the brainstorming application window, resulting in the creation of a new "Sport" idea. The link for this Sport idea points to the "Sport" article on Wikipedia.

Our prior work focused solely on Wikipedia as the source for obtaining new ideas during the brainstorming session. Since Wikipedia may not contain relevant content for some brainstorming topics, we would like to expand the scope of the Idea Recommendation Engine in our brainstorming application by considering the entire Web. We plan to investigate ways to use Google Search to enable this functionality.

In future iterations of our brainstorming application, we plan to investigate linking between ideas. Since each idea in our system is associated with a Web page for that idea, we can exploit the link structure of the Web to automatically discover semantic connections or links between ideas that are currently displayed on screen. These automatically discovered links would be displayed graphically according to the

semantic distance or affinity between ideas. For example, links for closely related items could be displayed with thick, red lines, while links for more distantly related items could be displayed with thin, blue lines. In addition to automatic discovery and display of links between ideas, we will also permit users to manually create links between ideas. These manually-created links will allow users to explicitly specify the affinity between ideas, and will be used as feedback to the Session Context Manager. As the Session Context Manager learns about idea affinity from these links, this affinity information will influence the recommendation of new ideas.

We will also investigate aggregation or grouping of ideas in our application. This functionality would allow users to treat a group of ideas as a single, aggregate unit for the purposes of pinning, unpinning, rating, and linking. Aggregation allows users to more easily manipulate and process larger amounts of ideas generated by our application, such as during brainstorming sessions that involve large groups or that happen to generate a significant volume of ideas.

4. IMPLICATIONS FOR COLLECTIVE INTELLIGENCE IN ORGANIZATIONS

Our brainstorming application has a number of implications for Collective Intelligence (CI) in organizations. The Personal Context Manager in our application leverages users' content interests and social connections in recommending brainstorming ideas. This functionality allows the application to automatically adapt to the unique characteristics of each individual participating in the brainstorming session, as well the social connections within the brainstorming

group. We believe that such behavior enhances the feeding of CI through the creation and capture of new ideas during the brainstorming session. Furthermore, through leveraging users' content interests, as available through mining personal Web sites, CVs, Google search history, and other personal artifacts on the Web, our brainstorming application facilitates knowledge reuse within the brainstorming group.

In future iterations of our brainstorming application, we will investigate ways to support collaboration units larger than the small teams that typically participate in brainstorming sessions. One possibility is the implementation of full support for recording, saving, and playback of a brainstorming session in the Session Context Manager. This would allow users to create brainstorming session artifacts, enabling sharing and reuse of brainstorming sessions across different teams within a larger collaboration unit. During playback of a session, we envision that the application would enable users to resume the brainstorming session at any time. From this point of resumption, the session could be modified by pinning/unpinning ideas, requesting idea recommendations, etc. Such functionality enables reuse and evolution of existing brainstorming sessions by different groups of users, further facilitating reuse and refinement of knowledge within the organization.

5. CONCLUSIONS

This paper has presented our position that online resources such as Google, Wikipedia, Facebook, and other sites should be integrated into electronic brainstorming applications. We have presented our vision for a brainstorming application that uses session context and personal context to facilitate the brainstorming process by recommending new ideas to users. We have discussed the challenges in recommending ideas based on these sources of context, and presented our initial plans for addressing these challenges. The position presented in this paper opens the door to a new generation of collaborative brainstorming applications that leverage the vast amount of online content and social context available on the Web today.

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