

Socs: Increasing Social and Group Awareness for Wikis by Example of Wikipedia

Claus Atzenbeck and David L. Hicks
Department of Software and Media Technology
Aalborg University Esbjerg
Niels Bohrs Vej 8, 6700 Esbjerg, Denmark
{atzenbeck, hicks}@cs.aau.dk

ABSTRACT

Many wikis provide good workspace awareness. Users see quickly what changes have been made or get notified about modifications on selected pages. However, they do not support a more sophisticated social or group awareness.

Being aware of social structures is important for collaborative work. Adequate tools permit team members to reflect upon their and others' roles, detect and solve related conflicts in good time, and provide a means to communicate team developments. This makes such applications an effective means for new collaborators (to understand the team), long term team members (to see what is going on), and team coordinators (to manage teams and identify potential problems). This becomes especially important for fragile, large, or ad hoc virtual teams as we find around many wikis, such as Wikipedia. Furthermore, we argue that social and group awareness increases the quality of articles indirectly and is beneficial for both experts and novice users.

We introduce Socs, a prototype that permits authoring social structures using spatial hypertext methods via a so-called "social space". It serves as a means to express, store, and communicate social information about people, such as wiki authors. Furthermore, Socs integrates a Web browser and the system-wide address book that act as sources for the social space and as a basis for sophisticated awareness services.

Socs provides awareness about the authors of a wiki page and which of them are part of the user's structure on the social space, those that are of special interest to the user. This creates implicitly recommendations about wiki pages (because users get notified when wiki pages are authored by known people), provides the basis of interpreting the authors' intentions (because users become aware of who wrote the articles), and foster communication (because users may want to discuss those article with whom they know).

Categories and Subject Descriptors

H.5.4 [Information Interfaces and Presentation]: Hy-

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

WikiSym '08, September 8–10, Porto, Portugal.

Copyright 2008 ACM 978-1-60558-128-3/08/09 ...\$5.00.

pertext/Hypermedia; H.1.2 [Models and Principles]: User/Machine Systems

General Terms

Human Factors, Design

Keywords

wiki, Wikipedia, social awareness, group awareness, collaboration, coordination, hypermedia, Web 2.0, Socs

1. INTRODUCTION

Since its early days hypertext has been perceived as a tool for thinking and communicating [13]. For example, Augment [16], a system developed in the 1960s by Doug Engelbart, permitted collaborative work on hypertexts by geographically dispersed people [17]. Decades later, the World Wide Web was invented [8] and quickly became the most successful (in terms of size and economy) information system so far. Its simplicity may have been a reason for its success, however, the early Web ignored many of the developments made in hypertext, such as collaboration support for shared documents, as Augment provided.

Another decade passed before the WWW began to move toward the massive use of collaboration services. This phenomenon has been described as "Web 2.0" by Tim O'Reilly [36]. It includes wikis, blogs, tagging, and social networking applications: the means to form communities or modify information collaboratively. There are also applications based on Web-technology that support collaboration, such as Google Documents¹. The Web 2.0 movement lets us witness an increasing importance of virtual communities which collaboratively produce and provide content to a vast number of recipients.

Wikis play a significant role in that. They permit simple editing of shared documents via a Web browser. The most prominent example is Wikipedia², a vast online encyclopedia that is produced by an open community. Wikipedia is currently available in 255 languages³. The largest set of articles can be found at the English Wikipedia, which currently counts at over 2.3 million. In the following we will discuss mainly Wikipedia, but assume that the discussion can be generalized to other wikis as well.

¹<http://docs.google.com>

²<http://wikipedia.org>

³http://meta.wikimedia.org/wiki/List_of_Wikipedias

Previous work has shown the importance of awareness for collaborative writing environments [15]. Thus, this becomes important to many services under the umbrella of Web 2.0 technologies (including wikis) and affects many other application domains, such as CSCW-based learning [34].

“[A]wareness is an *understanding of the activities of others*, which provides a *context for your own activity*. This context is used to ensure that individual contributions are relevant to the group’s activity as a whole, and to evaluate individual actions with respect to group goals and progress. The information, then, allows groups to manage the process of collaborative working.” [15]

Various awareness types have been developed [25]. Those include *workspace* (“What is happening?”), *personal* (“Who am I?”), *informal* (“Who is doing what?”), *social* (“Who communicates with me?”), and *group awareness* (“Who is in my group?”) [28, 21].

Many research projects focus on *workspace awareness* (e. g., [28, 19, 23]). It is probably the most prominent awareness type in wikis and refers to the information provided in time about activities of contributors on wiki pages. For example, Wikipedia’s *watch list* feature permits users to select articles they care about and get notified when those were modified. Also history pages increase workspace awareness: They exist for every article individually and list their previous changes. Furthermore, history pages “help editors quickly roll back objectionable changes” [37].

Watch and history lists are important features to help avoid vandalism. For instance, interviews with nine Wikipedia users have shown that all of them check their watch list frequently at log in [10]. Other means to see changes that happened on a Wikipedia workspace include an “IRC channel [that] show[s] every edit made to every article” [37] or Wikipedia’s *recent changes* pages⁴ [43]. Recent changes lists are customizable in their appearance for logged-in users and additionally available as RSS feeds.

Personal awareness is supported through Wikipedia’s user pages (i.e., user profiles). Each user can add information about himself/herself on a designated page, such as their biography or interests. This can be used to present themselves and their role within their groups or community.

Informal awareness describes information about the other users and what they are up to, that is “the kinds of things that people know when they work together in the same office” [21]. *Social awareness* indicates “the information that a person maintains about others in a social or conversational context” [28]. Finally, *group awareness* is about “other user’s roles, responsibilities, activities, movements and status in the process” [28]. The latter has been discussed also for other collaborative writing systems than wikis [33].

Wikipedia’s history lists, for example, provide information about *who* modified individual wiki pages. This increases awareness about who was actively working on these articles. This is especially important if author teams are fragile or change frequently during the writing process of an article.

Both workspace awareness and personal awareness are well supported by wikis like Wikipedia. However, often there

⁴For example, recent changes on the English Wikipedia are listed at <http://en.wikipedia.org/wiki/Special:RecentChanges>

is very limited support for informal, social, or group awareness. For instance, Wikipedia does not support representations of various roles in ad hoc teams. Or, in order to get information about social interactions or communication, users are forced to look them up explicitly by opening the appropriate *talk pages*. (Talk pages serve as means for user discussions about associated wiki pages.)

In this paper we aim at improving social and group awareness in Wikipedia and more generally in wikis. In the following we discuss the importance of communities for wikis with special focus on Wikipedia (Sect. 2) and refer to some use cases in order to make our approach more compelling (Sect. 3). Then we describe our prototype Socs and show its support for social and group awareness (Sect. 4). Finally, we refer to related application areas and future work (Sect. 5) and conclude the discussion of our research (Sect. 6).

2. COMMUNITY, COMMUNICATION, AND COORDINATION

2.1 Relevance of Community and Communication

In this section we discuss the relevance of community, communication, and coordination for wikis by example of Wikipedia. From this we draw our assumptions about how to improve social and group awareness for these applications.

Firstly, we point out that the Wikipedia community fosters user contributions. Secondly, the quality of articles stands in correlation to the number of editors and edits. Thirdly, discussions are not only an important means to deal with articles themselves, but also for solving problems within teams. Based on our observations, we conclude that improvements in team and collaboration support would lead to a higher quality of articles.

2.1.1 Community Fosters Contributions

Kuznetsov argues that the Wikipedia community defines itself among other characteristics by its users’ discussions about articles [27]. This makes the individual users feel needed by the community. That is to say, their subjective feeling of the importance of their role within the whole community of authors makes them feel as though a part of a community. The collaborative writing process requires from contributing authors “a sense of common purpose and belonging that unites them into one community. This community in turn fosters a motivation to contribute by sharing information and thus helping the collective to which one belongs” [27].

2.1.2 Quality of Articles in Correlation to Number of Editors and Edits

The motivation of community members to contribute to and discuss documents affects the quality of those documents. For Wikipedia there is “evidence of more cooperation in the development of the high-quality articles than other articles. This evidence includes a strong correlation between discussion (talkpage) activity and article quality, more edits per editor to high-quality articles, and a markedly different pattern of editors’ responses to other edits on these pages” [44].

2.1.3 Importance of Discussions

A survey of nine Wikipedia users showed that talk pages are their primary medium for wiki-related communication [10]. That means, communication takes place within the wiki itself. It becomes the production target and communication channel at the same time. Furthermore, talk pages are not only used for discussing articles, but also act as “low-cost arenas for resolving conflicts” [40]. This makes them a means to deal with a variety of problems that come up in team work, including conflicting points of views on articles or, potentially, interpersonal problems. This supports again the importance of discussions and communication in Wikipedia and wikis in general.

2.1.4 Conclusion: Improving Quality of Article

Considering the previous discussion, we can assume that *increasing social and group awareness will indirectly improve the quality of wiki documents* in various ways:

1. Both social and group awareness will foster communication due to users becoming aware of their communication partners and their discussions. Based on the evidence reported in [44] (see Sect. 2.1.2 above), this may result in an improved quality of the produced assets.
2. Group awareness will support community members in knowing who is collaborating with them. This increases the community’s self perception and understanding and fosters users’ motivation for contributing, as argued in [27] (see Sect. 2.1.1 above). More contributions may raise the documents’ quality.
3. Social awareness will also help to improve the community itself, because it provides means for resolving conflicts of various types. Thus, this may support collaboration as well as users’ motivation.

2.2 Roles and Coordination

2.2.1 Novices vs. Experts

Group awareness may also be beneficial for novice wiki users. A survey of novice Wikipedia users has shown that they have different perceptions of the wiki and its community compared to expert users [10]. The focus of novice users was on *gathering information* for articles: “It appears that, to novice participants, the Wikipedia seems more like a *collection of articles* with random people adding information here and there than like a *collection of people* talking about, editing, and protecting their efforts to author good work” [10]. In contrast, expert users had the *quality* of articles and improving the *community* as their main goals. They serve the community with group coordination [10]. This becomes emphasized by considering that “the fastest growing area of Wikipedia are devoted to coordination and organization” [40].

Furthermore, novices seem not to be aware of their role within the community [10]. This, however, is a prerequisite for more intense collaboration and communication. Making them aware of the other group members to whom they are associated with and their respective roles would support their knowledge and understanding of the community. This may lead to higher motivation [27] and commitment to the project.

2.2.2 Users’ Presentations Within the Community

The importance of the community and the perception of its members is also indicated by the fact that many Wikipedia users publish their own user page with biographical information. Bryant et al. report eight of nine participants doing so [10]. In agreement with that, the same survey mentions that in Wikipedia “anonymous contributions are inherently suspect” and that this convention “is understood by Wikipedians [i. e., expert users] but not by novices” [10]. This indicates that (compared to novices) expert users have a more sophisticated understanding of the community. Thus, it seems to be important to them to stay aware of who is involved.

2.2.3 Conclusion: Different Needs, but Similar Requirements

Experts and novices have different perceptions and knowledge of the community. There are indications that most Wikipedia users want to present themselves as community members, however, a deeper understanding of the community itself seems to be a privilege of those who are experienced users [10]. In order to support the document creation process and quality, both experts and novices would gain from increased group awareness. This would help experts to improve their coordination tasks and support novices in understanding their role, the group, and their position among other group members.

3. PROBLEM SCENARIOS

In Sect. 2 we discussed some aspects of community, communication, and coordination and their relevance for experts and novices. We pointed out that social and group awareness are means to improve indirectly the quality of articles.

In the following we will discuss three sample scenarios that indicate other advantages of sophisticated social and group awareness. We show how this will provide implicit recommendations for articles, support interpretation of authors’ intentions, and finally, improve communication.

3.1 Implicit Recommendations

Sophisticated social and group awareness provides implicitly recommendations for reading articles or even getting involved with them. Imagine John, who frequently consults a corporate wiki similar to Wikipedia to get information about certain products of his company and its competitors. There are a large number of wiki pages available. Many of them include discussions about various technical issues. Because John is not a technician, it is hard for him to evaluate whether a certain wiki page is of good quality or not. He needs an expert who can recommend which ones are.

Over time John found out, however, which authors produced the most reliable and valuable content in the wiki. Thus, he spends more time for reading information written by those authors. When one of their names is associated with an article it is like a recommendation for John to read the text.

Similar to Wikipedia, John’s corporate wiki provides its users with a history list that shows all changes of each article, including references to those users who modified it. Thus, it is possible to get the information about the authors of an article. However, this is not practicable for John for several reasons:

1. John would have to switch to the history list for every article he is reading. This takes time and takes his concentration away from the actual content.
2. Assuming that John would check the history list for every article in order to get the authors' names, he would be confronted with a list of changes rather than authors. That means, some authors may appear multiple times, depending on how many changes they provided.
3. Furthermore, John is only interested in those authors who have "recommendation" status for him. This is only a small number of people. The history list, however, shows everyone who committed a change. For John this may be many irrelevant authors. He would need to parse all authors and recognize those who he trusts.

Now imagine a tool which would allow John to identify those colleagues or friends whom he trusts most in judging the quality of articles. Further imagine this tool would show a list of authors for every site and their involvement (i. e., number of changes), and identify those who he has marked as most reliable. This tool would make John aware if one of those persons was involved in authoring the wiki page he is reading without distracting his attention. It would not require further interaction beyond browsing wiki pages. Whenever the tool informs John about the co-authorship of one of his preferred authors, John takes this implicitly as a recommendation to further investigate this article.

3.2 Interpreting Authors' Intentions

Recommendation is one aspect of becoming aware of a text's authors. In this section we broaden this focus. John's experience of getting implicitly recommendations is based on his knowledge about the expertise of certain authors. More generally spoken, it is based on John's knowledge about people's backgrounds and their connection to the articles John reads. This, however, is also important for interpreting texts.

For instance, John may interpret a wiki page incorrectly, because he is not aware of who created it, the author's intentions, or background knowledge. These problems were confirmed in a real-world situation by a former employee of a large Danish telecommunication company: The company was using wikis extensively. However, due to lack of awareness about authorships, it became difficult to evaluate and judge documents in the context of their creators' intentions and reliability.⁵

Linguists put examples like the above mentioned one under the umbrella of *intentionality* and *acceptability*, two of seven textuality criteria. The first refers to the text *producer's* intentions for writing the text, the latter reflects the *recipient's* understanding in how relevant the text is for him/her [14].

Another more general real-world example is the work of lobbyists. Not knowing who the authors are may lead to a lack of understanding why they argue in a certain way. For instance, Volker Beck, a German politician, stated in an interview the problem that lobbyists are actively involved in formalizing law texts without being publicly recognized, not

even among members of the parliament.⁶ This may lead to serious problems, such as undiscovered conflicts of interests.

Imagine now that John's wiki could support awareness of authorships. This would enable John to evaluate the relevance and quality of the read articles not only by its content (which may be difficult if John is not an expert in the particular field), but also by knowing who created it. Due to more transparency he may be able to point out subjective points of view or intentionally misleading argumentations.

3.3 Foster Adequate Communication

Becoming aware of the authors of an article currently being read does not only provide implicit recommendations or required information for interpreting intentions. It also provides users with information for adequately communicating with them.

Again, imagine John using the corporate Wikipedia-like wiki. Because it is too cumbersome to look up authors for each article he reads and finds out which of those is among his close colleagues, he is not aware of who was involved in authoring. Because of that, John also does not realize that some of his close colleagues are authors. Thus, he does not start a conversation with them even when he meets them at lunch and misses potentially informative chats.

Further, imagining that John decides to comment on a wiki article, but he does not spend the time to check the involved authors explicitly, as described above. His feedback or criticism, however, turns out to be inappropriate or too general, that is, not tailored to the people's background knowledge or status. John lacks information about with whom he communicates that would let him adjust the style and content of his message or wiki page modifications. In return, this may lead to personal or social irritation or even frustration of team members, if they do not understand or misinterpret the way John articulates his feedback.

Now imagine the tool which makes John aware of the involved colleagues. This may have a variety of effects on John's actions:

1. John may start an instant conversation at the lunch table about a wiki article he read recently, because he recognizes one of his colleagues as an author. This conversation may produce additional knowledge and may help to raise the quality of the article.
2. John may actively contact a colleague, because some question about the article came up. He may do this, because he knows the colleague and thus his inhibition threshold for doing so is rather low. John also may have a stronger feeling of "caring about" the article, because it is not an anonymous person but someone who is close to him who is the author.
3. John may even start actively working on the article himself, because he realizes that he knows most of the co-authors personally and likes the way they discuss and collaborate. The awareness tool would provide all necessary information to John that would let him evaluate whether he fits well into the group of authors.
4. Whenever John sends feedback to a specific wiki page or commits changes, the awareness tool would inform

⁶The interview was broadcast on 2008-04-09 at the German radio station *Deutschlandradio Kultur*. Available as audio file at: <http://tinyurl.com/4bse52>

⁵Communication by e-mail on 2008-04-08.

him with whom he communicates. Thus, he can easily adjust his message or the wiki content modification and avoid irritation within the team. Furthermore, John may decide not to post strong criticism on the wiki if he knows an author personally, but rather attempt to talk to him directly. In some cases this may avoid denouncing the author publicly and thus potential anger, and may lead to higher satisfaction and more efficiency. This option would not be possible if John was not aware of who the authors are.

4. SOCS – A PROTOTYPE

4.1 Overview

Based on our literature survey and use case considerations, we designed and implemented our prototype Socs. It increases social and group awareness for Wikipedia users, but can be potentially extended for other wikis or services. The following system requirements are derived directly from the needs we have identified in the previous sections:

1. Increase the user's awareness for those people that are associated with the currently read wiki page (i. e., authors) and their activity level (i. e., how many modifications they committed).
2. Provide a means such that the user can create his personal structure of people that are most important or of relevance to him. The structure should be easy to create and to modify; its abstraction should permit representing subtle differences.
3. Support the user in notifying them about who of the authors of a currently displayed wiki page are within the user's selection of important or relevant people.
4. Integrating in the system-wide address book such that the user can mark relevant or important people conveniently from his contact pool. Furthermore, such an integration provides the ability to add wiki authors easily to the contact database to be synchronized to external devices, such as the user's cell phone or PDA.
5. Provide a means for coordinators or experts that allow them to represent and present teams in the context of the associated assets. The tool should support the analyzing process of social or group structures as well as the communication of those to colleagues (e. g., for the coordinators' strategic planning).
6. Support novice users with tools for easily expressing social or group structures in order to increase their awareness about contributors' roles, including their own. This aims at more communication or discussions for beginners.
7. Integrate Web browser technology such that the user may not have to change the application when browsing outside the scope of the wiki.

Figure 1 depicts a screenshot of Socs. It permits managing, organizing, structuring social relationships and fulfills all the above mentioned requirements. The main window features a space on which contacts can be arranged spatially. The "Actions" window provides some controls, such

as locking or deleting objects, color, and zooming. The "Address Book" window provides drag & drop within Socs for all address book entries. The window in the back shows the Web browser with a Wikipedia page open. Finally, the "Wiki Authors" window lists the corresponding authors of the open Web page.

Socs is written for Mac OS X and integrates two relevant frameworks provided by the operating system: the Address Book framework [2] and the Web Kit framework [1]. The address book integration enables Socs to use the system-wide address book database as a storage medium for contact information (requirement 4). This makes Socs an interface for managing contacts such that other applications integrating the Address Book framework can access those. Examples include Apple Address Book (e. g., displaying and modifying contact information), Apple Mail (e. g., finding and inserting e-mail addresses in new mail), iChat (instant messenger; e. g., retrieving contact information of chat buddies), Merlin (project management software; e. g., adding human resources from the contact database to a project), among many others. In return, Socs displays the latest contact information constantly, for example, after other applications have changed those.

Integration of the Web Kit framework provides a fully functional Web browser that can be used for browsing arbitrary Web pages (requirement 7). Thus, switching applications for browsing pages other than the wiki is not necessary.

4.2 The Space

4.2.1 Overview

Socs Social Space.

The core part in Socs is the so-called *social space*. It is the 2D area within the main window on which people or groups can be represented. Socs features zooming for switching between focus and context [41]. It also implements "quickzoom" [3] which can be used to quickly zoom in or out and thus may serve as an alternative for navigating throughout the space.

Persons.

Icons on the social space represent persons. Their name as well as their Wikipedia login (if available) are displayed below them. Person icons can be put on the space via drag & drop from the "Address Book" window (or any application that permits dragging of person records, such as the Apple Address Book) or from the "Wiki Authors" window. Also dragging an entry from the Wikipedia authors list onto the space creates the wiki user as an icon there. Additionally an instance of this person is created in the system-wide address book, if it does not already exist (requirement 4).

Pictures for people icons are taken from the address book. A generic icon is used when no picture exists. Socs keeps a reference between the contact on the space and the address book entry. Double clicking an icon opens the corresponding entry in Apple Address Book where it can be further modified.

Drop Groups.

Dragging a group from Socs' "Address Book" window onto the social space creates a rectangular area with the group name at the same location. Such rectangles are called *drop*



Figure 1: Screenshot of Socs (social space, web browser, wiki authors list, address book)

groups, since they are meant to indicate groups of people who's representations (i. e., icons) were dropped onto them. Drop groups look similar to *adornments* in Tinderbox [9], however, they inherent narrower semantics, since they are used exclusively for grouping people. Socs holds references from drop groups to the corresponding group instances in the address book database. Double clicking a drop group opens it in the Apple Address Book.

When a group is dragged from the address book onto the space, all members of the group will appear on the left lower corner of the newly created drop group representation. Those contacts will remain a member of the group as long as they intersect with the drop group's rectangle. However, as soon as they are moved outside, they will disappear from the group in the address book database correspondingly.

Visual Cues.

Similar to spatial hypertext [30], Socs permits authoring social structures by spatial and visual cues, such as distance, alignment, color, or size (requirement 2). Using the space and Socs' structure abstractions, experienced Wikipedia users are able to represent social structures for coordinating groups or communicating them to others (requirement 5). Similarly novice users may benefit by representing the social structures they explore and associating them to themselves (requirement 6).

The following section will further discuss spatial hypertext, which became our design choice for Socs' social space.

4.2.2 Why a Space?

The Web approach is mostly about content delivery or, as Wendy Hall argues in a recent interview, "the Web does not really provide support for hypertext design or maintenance" [5]. This explains the lack of advanced structure mechanisms in Web 2.0 services, such as social networking applications [7] or wikis.

For instance, OpenSocial is an API that allows 3rd party software to connect to social networking applications. Several of them have been demonstrated at a Google event⁷ [20]. They all had their focus on *content*, that is, how content from other sites can be included in their own services using OpenSocial, but not on structuring as hypertext suggests.

In previous work we identified the abstractions used for representing social relationships, such as user profiles or virtual business cards, relationships (i. e., similar to links), or groups [7]. They permit priorly defined explicit structures. In an interview, Peter Nürnberg criticizes this approach by pointing to Vannevar Bush's original idea [12]: "Bush's association-based Memex is an attempt to break the tyranny of exclusive, a priori organization" [4]. This arguments gathers more weight if we keep in mind that certain communities are very emergent and dynamic. Among them those that are part of the Web 2.0 phenomenon [10].

The existence of emergent relationships in a world of mostly strictly explicit structures used for representing social contacts show the demand for something more appropriate. In fact, this discussion was lead over 16 years ago when Frank Halasz in his 1991 Hypertext Conference keynote demanded the "Ending the Tyranny of the Link" [24]. He proposed so-called "supra-network hypertexts", that are struc-

⁷The event can be watched at: <http://www.youtube.com/watch?v=9K0EbAZJTTk>

tures other than those based on networks. Spatial hypertext (e. g., Aquanet [29] at that time) is an example of those.

Spatial hypertext is made for dealing with emergent structures [31]. As Yamamoto et al. argue, it serves "like sketch representations [22] for hypertext authoring" [45]. Spatial hypertext is more than just another visualization technique; "it is also a way to take advantage of human perceptual abilities in hypertext navigation, and to provide users with a fairly intuitive medium through which they may express new structures and manipulate existing structures" [30].

Thus, spatial hypertext models appear to be appropriate for expressing social relationships. They provide a more sophisticated means to express emergent and fuzzy relationships, that is what we observe in virtual ad hoc teams, such as those related to many wikis. Furthermore, they permit intuitive creation and manipulation of structures. This makes spatial structures more appropriate for the type of task at hand than traditional node-link structures (i. e., the underlying paradigm of the WWW) would be.

The idea to use a space for contact management is not new. ContactMap [35] is a tool which provides a means for organizing contact information spatially, however, not as sophisticated as those we know from spatial hypertext applications like the Visual Knowledge Builder (VKB) [39] or Tinderbox [9]. Socs is with respect to it's spatial structure features closer to traditional spatial hypertext applications than ContactMap.

4.3 Awareness Features

Section 1, 2, and 3 discuss awareness as an important feature for collaborative environments. The space and visual cues can provide a helpful means to support that. For example, ContactMap supports awareness about recently arrived e-mails using visual cues. It aims at supporting individual users in *social reminding* (i. e., keeping track of relationships) and *social data mining* (i. e., finding a person even if the name and other attributes of that person are unknown) [42].

Socs is similar to ContactMap in providing social reminding and social data mining. Furthermore, both applications provide social-related awareness. They differ, however, in their prior problem domains. ContactMap targets mainly personal information exchange via e-mail, whereas Socs is a tool specific for wikis or Web-based documents.

Awareness support in Socs is made possible, because it holds references to various data sources, including the social space, system-wide address book database, and Wikipedia authors associated with the currently viewed article. While the user browses Web pages, Socs evaluates whether the current site is part of a supported service, such as Wikipedia. If this is true, Socs fetches the authors of the article and displays them as list within the "Wiki Authors" window.

At the same time, Socs compares this list to the content of the social space. Persons who appear in both locations are marked: Their names appear highlighted on the social space. Additionally, the column "Location" at the "Wiki Authors" window indicates where Wikipedia authors can be found within Socs. An "S" shows that there is a correspondent instance of that person already on the social space (and thus also in the address book), "AB" indicates its existence only in the address book, but not on the social space.

Without additional user interaction, Socs makes users aware about who the authors are of the currently open Wikipedia

page. Furthermore, it provides information about how active they were, that is how often they modified the page. This fulfills requirement 1 that we defined for our system.

Socs also informs the user about who in his/her personal social structure is involved in writing the currently displayed Wikipedia article (requirement 3). This lets the user ignore unknown or irrelevant people who are not part of the personal social space and focus on the implicit connection between the open article to the user's social structure.

5. RELATED APPLICATION AREAS AND FUTURE WORK

Socs is not only relevant for wikis in collaborative working environments. Furthermore it is of potential benefit for all application domains that deal with documents and social relationships or networks.

We have discussed the benefits of Socs for wikis. Broadening the topic would let Socs appear as a generic CSCW application, as they exist today, for example, in corporate environments. We expect to see similar benefits there as we have them identified for wikis, including increased communication due to higher awareness or higher efficiency due to implicit recommendations. Furthermore, Socs would provide a sophisticated means for structuring social relationships that go beyond what we know from most existing applications in that domain. Examples include Web 2.0 social networking applications or personal information management [7].

Another area that would benefit from Socs is information analysis in the domain of intelligence service and counterterrorism or police investigations (e.g., offender profiling [11]). Professionals in both areas deal with social relationships at two different levels. Firstly, they deal with terrorist or criminal networks. Secondly, they need to organize themselves in teams and coordinate their work. The latter is similar to what we discuss in this paper about Socs and its benefits for wikis and applies also for intelligence and police work.

Beyond using Socs for representing, communicating, and managing teams, it could be used to analyze and evaluate terrorists and criminals. As we argue in [6], intelligence analysts are confronted with various sources that are associated with certain cases or people. Also tools for analyzing social networks (e.g., [32]) provide another source that needs to be further analyzed by humans.

Intelligence or police agents need to structure all that information in order to realize certain connections that will help solving the task at hand. Socs already integrates some sources which can be further extended. Its awareness features could notify analysts whenever they came across a document that is associated to a suspect person (i.e., terrorist or criminal) that is part of the current investigation (i.e., appears on Socs' social space). This fosters quick action response times and enables analysts to get in contact with appropriate experts.

It has been shown that spatial hypertext is an appropriate tool for communicating [38]. Socs makes use of this structural model and applies it on social structures. Thus, it becomes a tool not only for structuring, but also for communicating structures with others. This targets a problem that has been identified in conjunction with the tragic events of 9/11, where a lack of communication among U.S. government agencies indirectly enabled the attack [26].

We have shown the relevance of our research for the in-

telligence and police domain. Besides continuing work on Socs for Web 2.0 (such as wikis) and business applications, we will extend it to match the special requirements of those two areas.

Furthermore, we will investigate improving Socs as a CSCW application. This will include the design and evaluation of Socs' social space as a shared space that can be used by a number of collaborators versus the ability to connect individual social spaces and structure them at a meta level.

It would be helpful in many ways if Socs itself could increase its awareness of spatial structures. This can be done by implementing a spatial parser [18]. This requires further investigation, for example, on the requirements and structure types that are related to social structures.

6. SUMMARY AND CONCLUSION

Socs combines multiple sources used for representing social relationships or personal social networks. Those include the local system-wide address book, authors lists of currently open wiki pages (currently Wikipedia), and the social space, which is the most central part of the system. It aims at increasing social and group awareness.

The social space is based on a spatial hypertext paradigm and provides spatial and visual cues to represent relationships. This makes use of the user's visual intelligence and provides a means to support emergent and fuzzy structures, as we find them in social relationships. This paradigm differs from what most applications are based on: node-link structures (e.g., friend relationships in social networking applications) or other explicit relation types, such as groups (e.g., grouping in contact management applications).

Socs provides a means to make the user aware of implicit relationships between persons on the social space and the currently read wiki page by highlighting those that authored the wiki page and appear on the social space. This draws several advantages, as we described in Sect. 3. First, users can use this information as implicit *recommendations*, assuming that people that are on the social space are of importance and thus the article they co-authored may be as well. Secondly, users are able to see selected authors in their context on the social space. This enables them to *interpret* what those authors may intend by the current article. Thirdly, users are made aware of *implicit connections* and may use this for further communication, for example, contacting the author.

The integration of wikis and contact information (such as drag & drop from the list of authors or the local address book) provide a tool for representing social relationships among and to collaborators. This helps novices to *explore the community* and experts to *coordinate teams or communicate* social aspects to colleagues.

Socs is a project that can be associated with or applied to various domains. The heart of the system is the ability to author social relationships and get notified about related issues. Socs' social space is based on a spatial hypertext paradigm. This makes it the first application of its kind in the discussed application domains.

7. REFERENCES

- [1] Apple Computer. *Web Kit Objective-C Framework Reference*, 5 2006. Visited on 2008-04-22.
- [2] Apple Computer. *Address Book Objective-C Framework Reference*, 7 2007. Visited on 2008-04-22.

- [3] C. Atzenbeck. *WildDocs – Investigating Construction of Metaphors in Office Work*. PhD thesis, Aalborg University, Denmark, 7 2006.
- [4] C. Atzenbeck. Interview with Peter J. Nürnberg. *SIGWEB Newsletter*, 2007(Fall):3, 2007.
- [5] C. Atzenbeck. Interview with Wendy Hall. *SIGWEB Newsletter*, 2007(Spring):1–4, 2008.
- [6] C. Atzenbeck, D. L. Hicks, and N. Memon. Emergent structure and awareness support for intelligence analysis. In E. Banissi, L. Stuart, M. Jern, G. Andrienko, F. T. Marchese, N. Memon, R. Alhajj, T. G. Wyeld, R. A. Burkhard, G. Grinstein, D. Groth, A. Ursyn, C. Maple, A. Faiola, and B. Craft, editors, *Proceedings of the 12th International Conference on Information Visualization (IV'08)*, pages 326–332. IEEE Computer Society, 2008.
- [7] C. Atzenbeck and M. Tzagarakis. Criteria for social applications. In V. Dimitrova, M. Tzagarakis, and J. Vassileva, editors, *SociUM: Adaptation and personalization in social systems: groups, teams, communities. Workshop proceedings in conjunction with the 11th international conference on User Modeling*, pages 45–49, 2007.
- [8] T. Berners-Lee and R. Cailliau. World-Wide Web. In *Computing in High Energy Physics*, 9 1992.
- [9] M. Bernstein. *The Tinderbox Way*. Eastgate Systems, 2006.
- [10] S. L. Bryant, A. Forte, and A. Bruckman. Becoming Wikipedian: transformation of participation in a collaborative online encyclopedia. In *GROUP '05: Proceedings of the 2005 international ACM SIGGROUP conference on Supporting group work*, pages 1–10. ACM Press, 2005.
- [11] Bundeskriminalamt. Operative Fallanalyse (OFA). WWW, 2008. Visited on 2008-04-05.
- [12] V. Bush. As we may think. *The Atlantic Monthly*, 176(1):101–108, 7 1945.
- [13] J. Conklin. Hypertext: an introduction and survey. *Computer*, 20(9):17–41, 1987.
- [14] R.-A. de Beaugrande and W. Dressler. *Introduction to Text Linguistics*. Addison-Wesley, 1981.
- [15] P. Dourish and V. Bellotti. Awareness and coordination in shared workspaces. In *CSCW '92: Proceedings of the 1992 ACM conference on Computer-supported cooperative work*, pages 107–114. ACM Press, 1992.
- [16] D. C. Engelbart. Augmenting human intellect: A conceptual framework. Summary Report AFOSR-3233, Stanford Research Institute, 10 1962.
- [17] D. C. Engelbart. Collaboration support provisions in AUGMENT. In *Proceedings of the AFIPS Office Automation Conference (OAC '84)*, pages 51–58, 1984.
- [18] L. Francisco-Revilla and F. Shipman. Parsing and interpreting ambiguous structures in spatial hypermedia. In *Proceedings of the 16th ACM Conference on Hypertext and Hypermedia*, pages 107–116. ACM Press, 2005.
- [19] C. H. Ganoe, G. Convertino, and J. M. Carroll. The BRIDGE awareness workspace: tools supporting activity awareness for collaborative project work. In *NordiCHI '04: Proceedings of the third Nordic conference on Human-computer interaction*, pages 453–454. ACM Press, 2004.
- [20] Google. Campfire one: Introducing OpenSocial. YouTube Video, 2007.
- [21] S. Greenberg, C. Gutwin, and A. Cockburn. Awareness through fisheye views in relaxed-WYSIWIS groupware. In *GI '96: Proceedings of the conference on Graphics interface '96*, pages 28–38. Canadian Information Processing Society, 1996.
- [22] M. D. Gross and E. Y.-L. Do. Ambiguous intentions: a paper-like interface for creative design. In *UIST '96: Proceedings of the 9th annual ACM symposium on User interface software and technology*, pages 183–192. ACM Press, 1996.
- [23] C. Gutwin, G. Stark, and S. Greenberg. Support for workspace awareness in educational groupware. In *CSCL '95: The first international conference on Computer support for collaborative learning*, pages 147–156. Lawrence Erlbaum Associates, Inc., 1995.
- [24] F. G. Halasz. “Seven Issues” revisited. Keynote address, Hypertext '91 conference, San Antonio, Texas. WWW, 12 1991.
- [25] C. Y. Jang, C. Steinfield, and B. Pfaff. Supporting awareness among virtual teams in a web-based collaborative system: the teamscope system. *SIGGROUP Bulletin*, 21(3):28–34, 2000.
- [26] T. H. Kean, L. H. Hamilton, R. Ben-Veniste, B. Kerrey, F. F. Fielding, J. F. Lehman, J. S. Gorelick, T. J. Roemer, S. Gorton, and J. R. Thompson, editors. *The 9/11 Commission Report. Executive Summary*. Norton, 2004.
- [27] S. Kuznetsov. Motivations of contributors to Wikipedia. *SIGCAS Comput. Soc.*, 36(2):1, 2006.
- [28] I. Liccardi, H. C. Davis, and S. White. CAWS: a wiki system to improve workspace awareness to advance effectiveness of co-authoring activities. In *CHI '07 extended abstracts on Human factors in computing systems*, pages 2555–2560. ACM Press, 2007.
- [29] C. C. Marshall, F. G. Halasz, R. A. Rogers, and W. C. Janssen. Aquanet: a hypertext tool to hold your knowledge in place. In *Proceedings of the 3rd ACM Conference on Hypertext*, pages 261–275. ACM Press, 1991.
- [30] C. C. Marshall and F. M. Shipman. Spatial hypertext: designing for change. *Communications of the ACM*, 38(8):88–97, 8 1995.
- [31] C. C. Marshall, F. M. Shipman, and J. H. Coombs. VIKI: Spatial hypertext supporting emergent structure. In *Proceedings of the 1994 ACM European Conference on Hypermedia Technology*, pages 13–23. ACM Press, 1994.
- [32] N. Memon and H. L. Larsen. Structural analysis and destabilizing terrorist networks. In *Proceedings of the 2006 International Conference on Data Mining DMIN'06*, pages 296–302, 2006.
- [33] S. Mendoza-Chapa, M. Romero-Salcedo, and H. Oktaba. Group awareness support in collaborative writing systems. In *Proceedings of the 6th international workshop on groupware (CRIWG)*, pages 112–118. IEEE Computer Society, 2000.
- [34] A. Mitchell, I. Posner, and R. Baecker. Learning to write together using groupware. In *CHI '95:*

- Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 288–295. ACM Press, Addison-Wesley, 1995.
- [35] B. A. Nardi, S. Whittaker, E. Isaacs, M. Creech, J. Johnson, and J. Hainsworth. Integrating communication and information through ContactMap. *Communcation of the ACM*, 45(4):89–95, 2002.
- [36] T. O'Reilly. What is Web 2.0? Design patterns and business models for the next generation of software. WWW, 9 2005.
- [37] R. Friedhorsky, J. Chen, S. T. K. Lam, K. Panciera, L. Terveen, and J. Riedl. Creating, destroying, and restoring value in Wikipedia. In *GROUP '07: Proceedings of the 2007 international ACM conference on Supporting group work*, pages 259–268. ACM Press, 2007.
- [38] F. Shipman, R. Airhart, H. Hsieh, P. Maloor, J. M. Moore, and D. Shah. Visual and spatial communication and task organization using the Visual Knowledge Builder. In *Proceedings of the 2001 International ACM SIGGROUP Conference on Supporting Group Work*, pages 260–269. ACM Press, 2001.
- [39] F. M. Shipman, H. Hsieh, P. Maloor, and J. M. Moore. The Visual Knowledge Builder: a second generation spatial hypertext. In *Proceedings of the 12th ACM Conference on Hypertext and Hypermedia*, pages 113–122. ACM Press, 2001.
- [40] F. B. Viégas, M. Wattenberg, J. Kriss, and F. van Ham. Talk before you type: Coordination in Wikipedia. In *HICSS '07: Proceedings of the 40th Annual Hawaii International Conference on System Sciences*, page 78. IEEE Computer Society, 2007.
- [41] C. Ware. *Information Visualization*. Morgan Kaufmann, 2 edition, 2004.
- [42] S. Whittaker, Q. Jones, B. Nardi, M. Creech, L. Terveen, E. Isaacs, and J. Hainsworth. ContactMap: Organizing communication in a social desktop. *ACM Transactions on Computer-Human Interaction (TOCHI)*, 11(4):445–471, 2004.
- [43] Wikipedia. Help: Recent changes. WWW, 7 2008. Visited on 2008-07-14.
- [44] D. M. Wilkinson and B. A. Huberman. Cooperation and quality in Wikipedia. In *WikiSym '07: Proceedings of the 2007 international symposium on Wikis*, pages 157–164. ACM Press, 2007.
- [45] Y. Yamamoto, K. Nakakoji, and A. Aoki. Spatial hypertext for linear-information authoring: Interaction design and system development based on the art design principle. In *Proceedings of the 13th ACM Conference on Hypertext and Hypermedia*, pages 35–44. ACM Press, 2002.