Communications of the Association for Information Systems

Volume 27 Article 34

11-2010

Beyond Being Social: Prospects for Transformative Social Computing

John M. Carroll

College of Information Sciences and Technology, The Pennsylvania State University, jmcarroll@psu.edu

Communications of the Association for Information Systems

CAIS

Beyond Being Social: Prospects for Transformative Social Computing

John M. Carroll

College of Information Sciences and Technology, The Pennsylvania State University

jmcarroll@psu.edu

Abstract:

An important analytical lens for considering future trajectories and research issues for social computing is the perspective of *positive design*, that is, the perspective that asks how collaborative technologies like wikis, e-mail, instant messaging, blogging, microblogging, tagging, social bookmarking, collaborative filtering, social networking services, and online communities of various sorts could support social endeavor *in ways never before possible*, how they can strengthen the extant strengths of human social interaction. This perspective contrasts with the approach of investigating how inherent limitations of collaborative technology can be ameliorated. This article describes recent design work addressing the challenge of supporting activity awareness in new ways with social computing technologies.

Keywords: social computing, community informatics, activity awareness, positive design

Volume 27, Article 34, pp. 641-650, November 2010

The manuscript was received 4/2/2009 and was with the authors 1/2 month for 1 revision.

I. INTRODUCTION

Social computing refers to the new paradigm of human-computer interaction afforded by Web 2.0 technologies such as wikis, blogging (Blogger—blogger.com, Blogster—www.blogster.com), microblogging (Tumblr—www.tumblr.com, Twitter—twitter.com), tagging and social bookmarking (Citeulike—http://www.citeulike.org, Delicious—delicious.com, Digg—digg.com, Stumbleupon—www.stumbleupon.com) collaborative filtering and recommendation (as in Amazon and Firefly), public Web services (Flickr—www.flickr.com, LimeWire—www.limewire.com, YouTube—www.youtube.com), and social networking services (Facebook—www.facebook.com, MySpace—www.myspace.com, Bebo—www.bebo.com), which build on, and directly incorporate, earlier tools like e-mail, instant messaging, and virtual communities of various sorts. Social computing has *directly* transformed online collaborative interaction by affording richer and more varied discussion forums, for example, incorporating digital photographs and videos, voting, tagging, and recommending tools and visualizations to enhance collaborative awareness, etc. Social computing makes conversation a primary activity of human-computer interaction. And it expands conversation to include the whole world and allows it to persist forever in Internet archives.

Perhaps more significantly, social computing has *indirectly* transformed all practices and experiences of the World-Wide Web. As always, indirect impacts are more difficult to assess in the short term. But even paradigmatically solitary tasks, such as browsing/searching, sense making/decision making, and writing/editing documents, are often now collaborative tasks. Social computing fundamentally changes the Web from a comprehensive information repository to a set of collective projects, a worldwide community of communities. By facilitating and emphasizing content created by users, social computing blurs the boundaries between designers and users, between anointed experts and laypeople. Some of the most important "designs" in Web are community-based projects. For example, Wikipedia without its users is no more than a template.

Often the analytic discourse of social computing is compelled by the *problems* of social interaction with remote partners. For example, collaborating in the Internet often means working with partners in different time zones and cultures on work objects that are presented differently to different partners and updated asynchronously. Olson and Olson's [2000] classic analysis of remote collaboration concludes that it presents obstacles to social interaction that can never be overcome; in their words "distance matters." This could be true, but focusing so strongly on inherent deficits could also be self-fulfilling: If we seek merely to mitigate the intractable obstacles of mediated social interactions, we may indeed achieve no more than that.

In this article, it is suggested that an important complementary strategy is to develop, appropriate, and apply technological mediation so as to enhance interaction to levels not possible in a face-to-face world. One key to this is that people can now be aware of themselves and one another, and of their shared identities, commitments, and endeavors in ways not possible in a face-to-face world. I will refer to this as *activity awareness*, to emphasize that it is not merely a matter of status notifications [Carroll et al., 2003, 2006, 2009].

This analysis aligns with the positive design perspective [Avital, Boland and Cooperrider, 2008; Cooperrider and Avital, 2004]. Positive design argues that designs should strengthen the strengths of human systems, as opposed to merely mitigating deficits. For example, providing status updates to someone who cannot see his or her collaborators mitigates a deficit of remote collaboration [e.g., Olson and Olson, 2000], whereas helping groups perform more creatively by providing a persistent display of minority views creates a problem solving resource not typical of direct face-to-face group work, and could thereby help distributed groups to outperform face-to-face groups.

II. AWARE OF ACTIVITY

Groups engaged in collaborative activities of significant scope and duration must achieve and maintain *awareness* of diverse aspects of their shared activity in order to coordinate effectively. For example, they must verify mutual presence and attention, which is fairly straightforward in face-to-face interaction, but often subtle, difficult, and a continuing challenge in computer-mediated collaboration. Members need to know what tools and resources they have access to, but also what tools and resources their counterparts can access. The availability of tools and resources may change throughout the course of an activity. The group must have an understanding of who among them might know potentially relevant information or know how to do something that might be critical to the collective endeavor. Members need to know something of their partners' attitudes and goals and of what their partners expect

Communications of the Association for Information Systems

from them and of the activity. They need to know what criteria their partners will use to evaluate joint outcomes, the moment-to-moment focus of their attention and action during the collaborative work, and how the view of the shared plan and the work actually accomplished evolves over time. All of these intentional variables change constantly as the task context itself changes [see Schmidt, 2002].

We have been investigating how enhancing activity awareness in e-science contexts make distributed collaborative work more creative in ways not possible for face-to-face interaction. Establishing and sustaining a scientific collaboratory is far from a solved problem, even when members all belong to a single culture, and to a focused discipline, such as compact muon solenoids (http://scienceofcollaboratories.org). Indeed, more than 90 percent of collaboratories never even come to life, let alone die, and those that do become established, often quickly decline [Olson et al., 2008]. There is no single reason for the pervasive failure of collaboratory projects; often they are based on idealistic conceptions of what routine scientific work is like, on poor analyses of what the intended users specifically do or want to do, and on poor user interface designs. Solving apparent problems that are not problematic and failing to solve real problems are the two classical patterns for design failure. A complementary direction for theorizing and design investigation is to ask how collaboratory infrastructures could facilitate scientific work in ways no other kind of infrastructure has or perhaps can.

Our study of e-science collaboratories focuses on the worldwide community of CiteSeer users as a case study (http://citeseer.ist.psu.edu/). CiteSeer is a free online repository providing full-text access to 700,000 CISE research papers and over 10 million citations. CiteSeer receives over 1.5 million hits/day and is accessed from 150 countries by over a million unique machines monthly. Scientific communities have often formed around key resources, such as telescopes and particle accelerators. In the past, this meant relocating or regularly traveling to be near such resources. In the era of the Internet and collaboratories, it means having computational tools to facilitate and organize various sorts of interactions and activities. Our prior studies of the CiteSeer user community show that there is, in fact, a latent community and that its members are eager to have more direct support for collaboration [Farooq et al., 2009].

We have developed several relatively simple designs for enhancing mutual awareness of partners in shared activities of significant scope and duration beyond what it possible in face-to-face interaction. For example, supporting social bookmarking of objects in digital repositories allows users to organize a collection of resources with personal keywords—"tags"—and then share their classification system with others. This makes searching and browsing activity inherently collaborative, and instantly converts each individual's scholarly activity into a collective resource [cf., Farooq et al., 2007]. These benefits were never possible in traditional physical repositories or in traditional face-to-face collaborations. Thus, social bookmarking is an example of how mediated collaboration can enhance information interactions and collaborations in specific ways.

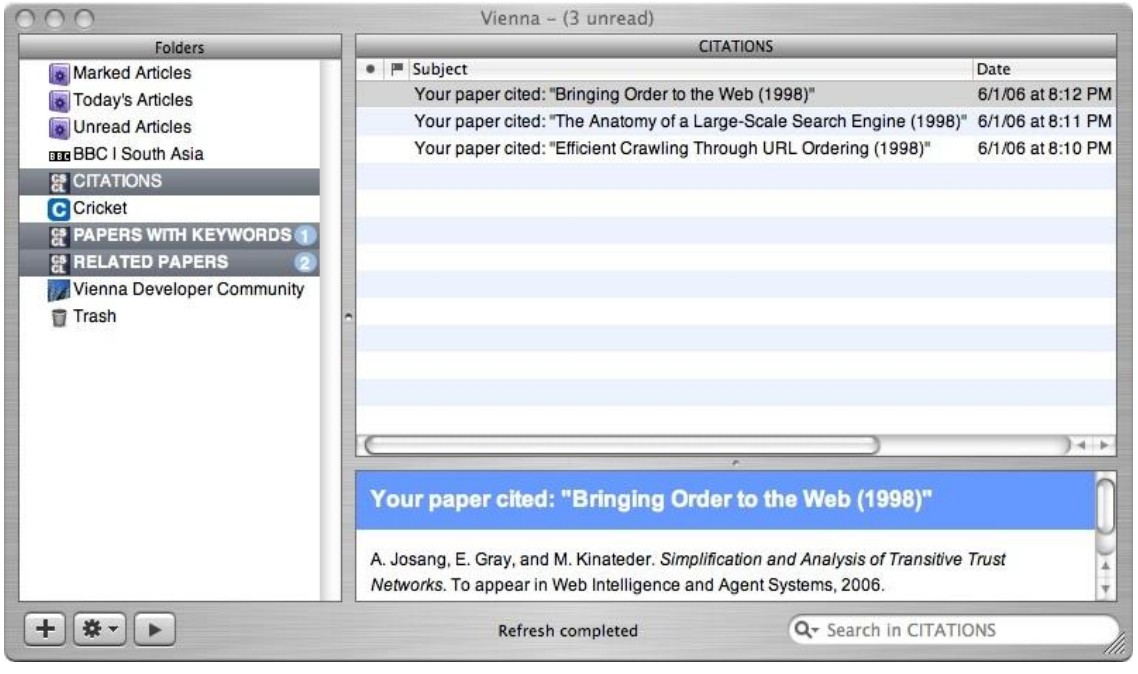

Figure 1. Prototype of RSS Feeds for Citeseer Aggregating Notifications for Key Publication Events

Communications of the Association for Information Systems

Social bookmarking services are an increasingly popular Web phenomenon, evidenced by the online explosion of websites like Delicious (http://del.icio.us). Recently, social bookmarking websites have started to emerge for academic communities as well (e.g., http://citeulike.org), but no empirical investigations have been carried out to determine how the visual analytics offered by social bookmarking can be useful to users of scholarly digital libraries. We speculate that users of scholarly digital libraries will find social bookmarking services useful for reflecting on their own intellectual practice ("how popular or stagnant is my current research focus") and analyzing trends over time ("a particular research area is ramping up in the field"). Social bookmarking has the potential to aid knowledge discovery of new and relevant online content and to support collaborative search and retrieval tasks [Millen, Feinberg, and Kerr, 2005].

Another relatively simple mechanism is pushed-updates informing scientists of publication activity related to their own knowledge work. In Figure 1, an RSS (really simple syndication) feed notifies CiteSeers users of new papers that cite their papers, papers with keywords they are monitoring, and papers related to papers they have published. Scientists need to be aware of one another's activities—who is doing what, when a digital resource of interest has been updated, when their own work has been cited by others, and so on. They do this by browsing new papers, going to conferences, and so on. The RSS mechanism cannot apply judgment and entails none of the social consequences of a conference, but it can comprehensively monitor the entire published literature—something humans are not good at. Social bookmarking and publication feeds are being incorporated in the new version of CiteSeer, CiteSeer^{x} (http://citeseerx.ist.psu.edu/).

We are also exploring mechnisms and designs to enhance scientists awareness of their collaborators' cognitive and affective states. Based on an empirical investigation of distributed teams collaboratively writing a research paper, we identified four types of creative breakdowns where enhanced activity awareness could support distributed teamwork [Farooq et al. 2009].

During cognitive conflict and dissent, one of the creative breakdowns we observed was the under-consideration of minority ideas. This was mainly due to normalization or majority influence in the group, resulting in the dismissal of dissenting ideas that may have been novel. Second, the novel ideas generated and narrowed down by group members in prior interactions did not fully carry over to subsequent interactions, were not readily available for review, and/or could not be easily integrated. As a result, novel ideas were easily lost, either for part of the group interaction or for the entire duration of the task. Third, groups made hasty decision in choosing which ideas to converge on. This resulted in a lack of critical evaluation of perspectives. Fourth, we noted that the groups exercised weak reflexivity during convergent thinking during which the members dissipated in their collective effort to develop a coherent product.

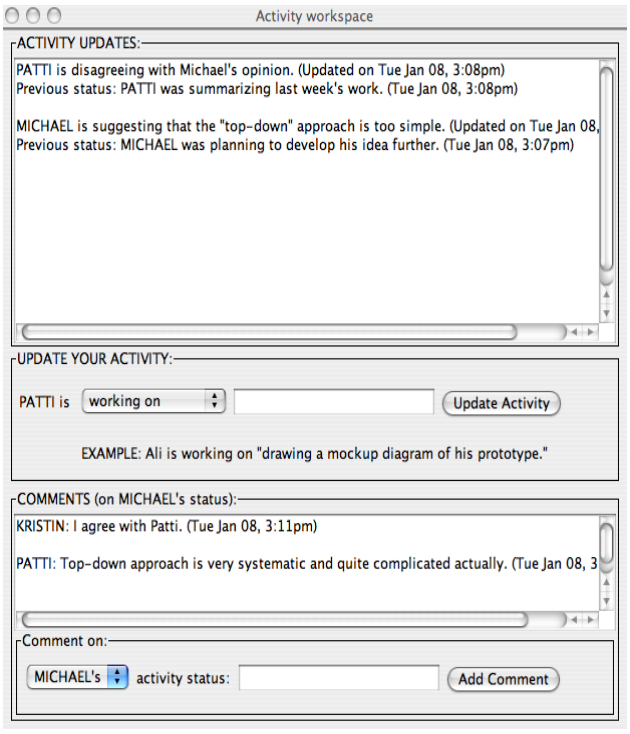

Figure 2. Structured Activity Updates Tool

The creative breakdowns we identified, in general, highlight the need for groups to have their own work represented to them through activity awareness mechanisms. For example, our second breakdown suggested that novel ideas got lost. If an idea has not been commented on and no one has ranked it based on some specified time threshold, the system can make the group aware that the idea has been dormant for some time and may prompt the group members to comment on it. In this way, the group is made cognizant of a possibly good idea that may otherwise get ignored. In general, recommendations to collaborators can serve as reminders to critically evaluate different perspectives in the idea workspace.

We developed a structured activity updates tool [Farooq, 2008]. Activity updates are displayed in the top pane of the tool (in Figure 2). Each user's previous activity update is also displayed. We thought that providing a user's previous activity would be useful in contextualizing the current activity. In the middle pane ("Update Your Activity"), users can choose from among the ten activity templates and fill in the blanks to share their activities. The lower pane of the tool provides a mechanism for users to comment on group members' activity updates. Our design rationale was that activity updates could

instigate and provoke users to reflect on and possibly respond to group members' activities. By commenting on others' activities, group members could provide feedback and possibly engage in a discourse. In the figure, Patti commented on Michael's activity update, which led Kristin to agree with Patti's comment.

This work is still in progress, but we have found that test participants can use this update tool, that they can appropriate it for further innovative uses of their own design, and that they find the updates and the updating to be useful. Intriguingly, the student project teams that used the activity updates tools produced more creative work that the teams that did not use it (creativity was operationalized as the proportion of relatively novel ideas).

One further direction we are pursuing to support awareness of activities in collaboratories is spatialization [Skupin and Fabrikant, 2007], that is, using spatial analysis and visualization techniques to enrich the representation of one's collaborators in a virtual organization. For example, we can depict where on earth a researcher or a research group is located (both typically and currently), where data was collected, where an event like a workshop or conference occurred, where an article was published, and so on. A simple prototype is Placeopedia (http://www.placeopedia.com/). Notifications of significant changes to the virtual communities, such as workshop "calls," various sorts of publication events, job postings and appointments, etc., can be subscribed to by users via an RSS feed. Within these virtual communities, members might be able to construct workspaces where they can link to existing document resources, construct new content to be shared as a resource, and discuss and socially tag existing resources [Ganoe et al., 2003].

III. AWARE OF COMMUNITY

Activities are embedded in larger social contexts. We have been investigating the achievement and consequences of heightened awareness of one's community through information systems and information spaces.

Community is a term and a concept under siege. Organizations and groups are often called communities just to suggest that they are non-coercive. More traditionally in sociology, community and society are differentiated as fundamental, and to some extent conflicting, *levels* of social organization. For example, Warren [1978] constructed the concept of community as the locality of linkages in interpersonal and inter-organizational networks for distributing resources, information, and support. This conception of community articulates key issues for contemporary studies of community: Is there a significant locality in the functional linkages, or is community declining [Warren, 1978]? And, to the extent that there is locality in the functional linkages, is it place-based [Wellman and Leighton, 1979]? These questions have occupied studies of community in North America for several decades [Bellah et al., 1986; Hester, 1993].

Every day people walk past buildings they have seen a thousand times, through familiar neighborhoods, in parks near where they live or work, along streets they know well. These places of routine conceal much. Each has a history. Each is the scene for encounters and conversations, finger wagging and handholding, thoughts and feelings. What would ordinary life be like if some of this place information could be retrieved, revisited, reconsidered, re-experienced?

In 1995, inspired by early experiments like Pavel Curtis's [1992] Lambda MOO, my students and I implemented a community MOO in Blacksburg, Virginia [Carroll and Rosson, 1996] We called it *MOOsburg.* At that time, our town was getting unbelievable attention as the site of the Blacksburg Electronic Village (BEV), one of the first Web-based community networks. The Web in 1995 was essentially ftp with a user interface. It did not support collaborative interaction in any sense. But our first attempt to do this with MOOsburg gave users the choice of a graphical user interface without collaborative interaction (BEV Web pages) or collaborative interaction without a graphical user interface (our text-only MOO with its classic teletype user interface).

Many colleagues advised us that people would not be attracted to teletype access to a text-only model of their town, but this was not what we found. Indeed, the MOO software infrastructure allowed people to build new places in the MOO, and they did so. One striking example was a community group that built a MOO model of their neighborhood and used it to carry out social events. Examples like this inspired us to wonder whether and how digital modeling of community places and support for collaborative activity might evoke or enhance communitarian behaviors, as well as identification and stewardship of the physical community.

During the next four years, we enhanced MOOsburg to integrate with Web pages, taking advantage of innovations in Java object serialization [Isenhour, Rosson, and Carroll, 2001]. We modeled parts of Blacksburg and developed an interactive map display/control to navigate this geo-spatial database [Carroll et al., 2001]. This version of MOOsburg was quite advanced for its time and afforded a variety of novel applications: The local Save-our-Streams group used

MOOsburg to organize water quality tracking; results and discussions could be posted “at” map locations in a stream.

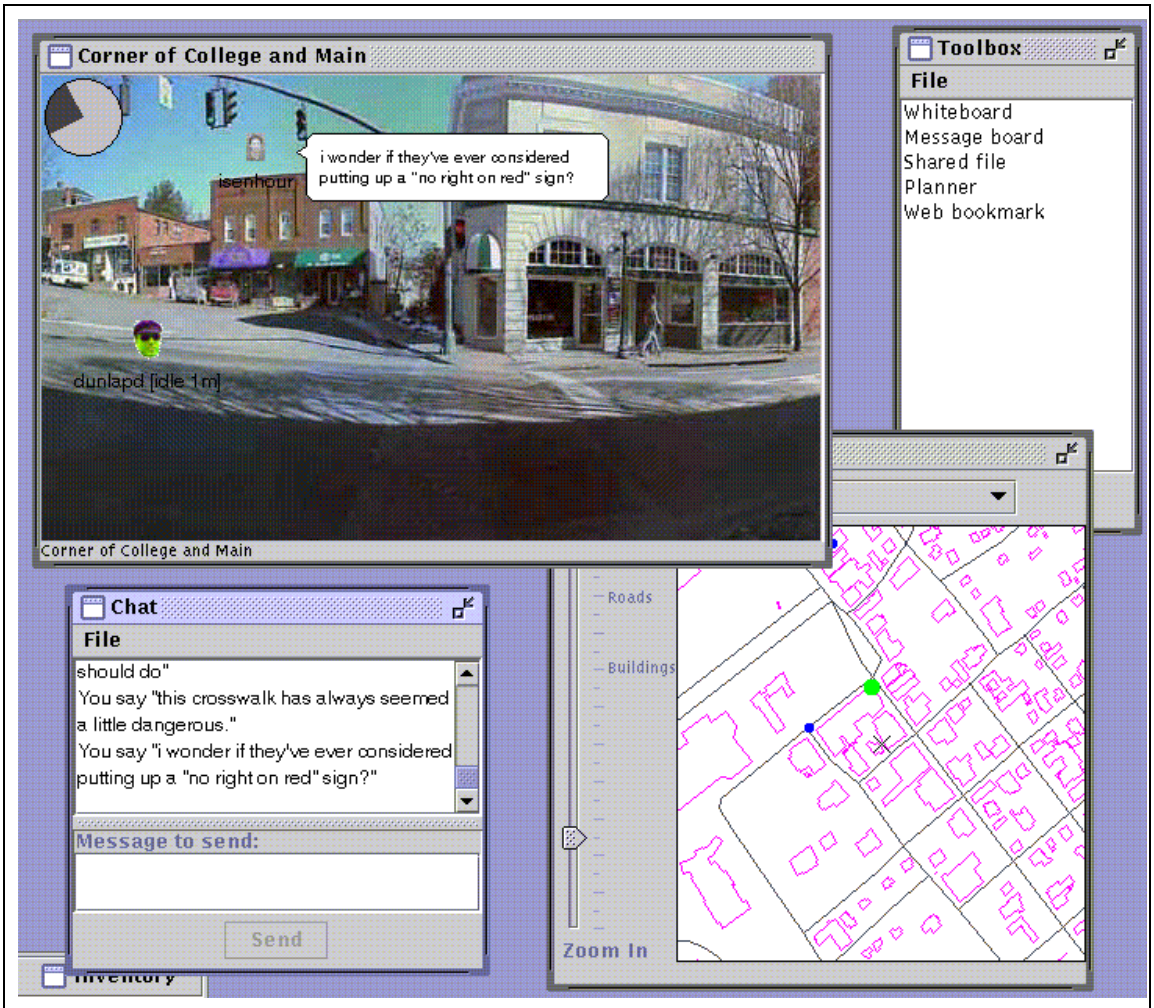

Figure 3. MOOsburg Organized Community Locations in a Coordinate Space That Was Navigated by Pointing in an Interactive Map

Many aspects of MOOsburg were quite cumbersome. Because the collaborative services we provided were so far beyond what typical browsers could support, we had to create our own client to support MOOsburg collaborations. This, combined with the fact that many people in the late 1990s were still connecting to the Internet via fairly slow modems, led to tedious interaction rhythms. By 2002, Java technology, and what has become known as Web 2.0, caught up to us and permitted MOOsburg to be assimilated into a generally toolkit for collaborative Web-based services, BRIDGE (Basic Resources for Integrated Distributed Group Environments, http://bridgetools.sourceforge.net/).

Today we are in a new place technologically and socio-technologically. Geospatial services such as Google Maps have made routine and lightweight what was formerly idiosyncratic and cumbersome. Mobile and location-sensing devices make it possible to use places themselves as indices for community-based information and activity. And the Internet is no longer a frontier for everyday experience, but thoroughly integrated into everyday experience. Conditions are perfect for a better MOOsburg.

We are working with the nonprofit community of State College, Pennsylvania, with Intel Corporation, and with the Knight Foundation to design community information and interaction within the Wireless State College infrastructure. Technologically, this means that a set of IP addresses can be accessed within the State College Wireless network without an account. With our community partners, we are developing a family of application concepts, many of which can be seen as extension of MOOsburg.

Lost State College [see Carroll and Rosson, 2008; Carroll and Ganoe, 2008] embeds information displays about the history of places in State College in interactive maps accessible at those physical places through the wireless

network. Thus, people can access the history of a place as they stand in it, and be able to move around to adjacent places and browse their histories.

Figure 4. Mobile Client View of Place-Indexed Community Events

The places that are part of Lost State College can also be annotated, creating a place-based blog. Community members might subscribe to the blog in various ways, including being notified when they are near the corresponding physical location, being notified of zoning discussions regarding that location, etc. The places of Lost State College will also be accessible through the desktop Web, through a sort of neo-MOOsburg, now easily mashed up with Google Maps push pins. Our design hypothesis is that accessing and reconstructing the histories of our everyday places will help the people living in those places to more fully identify and engage with the places for which they are the contemporary stewards.

An interesting aspect of this kind of information infrastructure is that it is easy to repurpose in many ways. For example, the same interactive map and database system that embodies Lost State College can also provide a community calendar, spatially indexing and displaying events of the current day (as shown in Figure 4).

The community awareness and interactions afforded MOOsburg and its mobile-wireless descendent are not mitigating deficits of distance. Rather, they recruit place as a resource to index and enrich information spaces. Humans are already masters of apprehending and leveraging space in their perception and cognition, our community systems are an example of strengthening this strength through positive design.

Communications of the Association for Information Systems

IV. DISCUSSION

Social computing is disrupting contemporary work activity, leisure, and education. A signature challenge for social computing is to confront and address aspects of remote collaborative interactions that undermine communication and human performance, the development of common ground and social capital, and the formation of trusting human communities. This will remain a concern for the foreseeable future. However, it is *equally important* for us not to overlook possibilities to create remote collaborative interactions that are better than being there, that do not merely mitigate the costs of distant interaction, but introduce new sorts of benefits.

In this article, I described research investigating ways to enhance activity awareness in ways not possible in traditional face-to-face interactions. Thus, I argued that e-science collaboratories are not just awkward infrastructures we put up with in order to work with partners who are located far from us; they are environments that allow us to be aware of what our partners and other colleagues are doing and to be collaboratively creative *in ways never before possible*. Further, I argued that neighborhood infrastructures can enhance our awareness of things going on around us in the physical world beyond what it would be if we merely engaged our neighbors and our local activities face to face.

As is so typically the case in information technology, we can make some of these same points looking outside the research lab at the creative appropriations of information technology that have already been made by ordinary people coping with a complex and dynamic world. Of course, an obvious place to look for such innovations is in games, where social computing services like Second Life and Twitter are being integrated in mashups with collaborative games like World of Warcraft to create a wide variety of new game experiences [Moscato and Moscato, 2009].

However, these technologies have also been remarkably appropriated for very serious purposes. For example, communication and logistics infrastructures failed during the 2005 Katrina emergency in New Orleans. But a loose Internet community appropriated Google maps with pushpin annotations to create an innovative emergency response application: Users could access the interactive map through a Web browser, and annotate their current location and condition directly in the map. The information was instantly shared with the world. This was by no means a comprehensive solution; it was a finger in the dike. But at least in some cases, friends and family were able to exchange critical and timely information in circumstances where other infrastructure had failed. It is notable that the U.S. Department of Homeland Security is currently supporting research in social computing platforms for community-based approaches to emergency management. And many other work activity contexts are appropriating social computing for addressing critical problems, including telemedicine, knowledge management, global writing projects (like Wikipedia and the Global Textbook Project), community networks/living labs, and open source software development projects.

More recent examples involved Twitter and YouTube as tools for citizen journalists. For example, the Iranian regime's bogus landslide in June 2010, the ensuing and continuing riots throughout Iran, and the violent repression by the regime all were exposed to the world nearly in real time. Brief tweets project a sense of being part of an unfolding event. People around the world identified with the Iranian dissidents and vicariously experienced the violence as it occurred. Months later, updates are still being posted minute by minute; for example, reports of torture in Iranian prisons. Somewhat more asynchrously, YouTube presented continuing and distrubing images of the violence. There simply could not be a worse state of affairs for totalitarian regimes. Such regimes have always relied on lack of awareness, on being able to carry out violence in private or at least to delay the flow of embarrassing information. Because of effective remote collaborations, this is no longer an option.

Two decades ago, Hollan and Stornetta [1990] suggested that researchers should more deliberately exploit the ways that computer-mediated interactions afford better collaborative outcomes, instead of only focusing on how computer-mediated collaboration raises new difficulties for interlocutors. For the most part, their examples emphasize asynchronous forums: When collaborators are not constrained by real time, when they can "post" their contributions instead of merely speaking them, they and their partners can consider and reflect on contributions more fully and more deeply. Diverse perspectives can be shared and preserved instead of being lost through production blocking, conformity, and other downsides of face-to-face interaction.

Hollan and Stornetta were writing at a time when text-based discussion forums were the state of the art for asynchronous collaboration. Much has changed in the past two decades. For example, posting a podcast of one's views might be even more effective than the posting a textual contribution to a forum. A podcast allows the author to provide speech inflections and other audio and illustrative graphics and other imagery. In our ongoing work, we are investigating design strategies to take activity awareness not only as a challenge and a problem for collaborative systems, but also as an opportunity to enhance activity awareness in ways beyond what is possible in the physical world of face-to-face interaction.

In conceiving of future trajectories for social computing, it is important to focus on new possible upsides, on how to enhance human activity in unprecedented ways, rather than to merely anticipate and defend against possible downsides. Innovative designs often entail challenges and discombobulation for people with respect to established practices and assumptions. For example, in almost any social computing application, there are challenges with respect to personal privacy. Such worries have motivated views of collective activity that anonymize individual contribution. This design concept could support brainstorming, but it obstructs articulate deliberation and debate. An interesting counterpoint is work aimed at making it easier to identify authors of Wikipedia articles.

Addressing challenges and discombobulations is part of innovation, part of design, part of technology development. But it is not the primary driver for innovation, design, technology development. In the terms used by David Cooperrider, social computing should seek to "magnifies strengths" of human organizations. Because every social computing application must depend on the creative engagement of its users; anything less than that is not enough.

ACKNOWLEDGMENTS

This work was supported by the John S. and James L. Knight Foundation, by Intel Corporation, by the US National Science Foundation (0113264, 0454052), by the US Office of Naval Research (N000140510549), and by the Frymoyer Chair Endowment at Penn State. This paper was prepared for and originally presented at the *NSF Workshop on Digital Transformation of Urban Experiences*, held atTemple University, November 1-3, 2007.

REFERENCES

Avital, M., R.J. Boland, and D. Cooperrider (eds.) (2008) *Designing Information and Organizations with a Positive Lens, Advances in Appreciative Inquiry, Volume 2,* Oxford, England: Elsevier Science.

Bellah, R. et al. (1986) *Habits of the Heart: Individualism and Commitment in American Life,* Berkeley, CA: University of California Press.

Carroll, J.M. and C.H. Ganoe (2008) "Supporting Community with Location-Sensitive Mobile Applications" in Foth, M. (ed.) *Handbook of Research on Urban Informatics: The Practice and Promise of the Real-Time City,* Hershey, PA: IGI Global, pp. 339–352.

Carroll, J.M. and M.B. Rosson (1996) "Developing the Blacksburg Electronic Village", *Communications of the ACM* (39)1, pp. 69–74.

Carroll, J.M. and M.B. Rosson (2003) "A Trajectory for Community Networks", *The Information Society* (19)5, pp. 381–393.

Carroll, J.M. and M.B. Rosson (2007) "Participatory Design in Community Informatics", *Design Studies* (28), Special Issue on Participatory Design, pp. 243–261.

Carroll, J.M. and M.B. Rosson (2008) "Theorizing Mobility in Community Networks", *International Journal of Human-Computer Studies* (66), Special Issue on Mobility, pp. 944–962.

Carroll, J.M. et al. (2001) "Designing Our Town: MOOsburg", *International Journal of Human-Computer Studies* (54), pp. 725–751.

Carroll, J.M. et al. (2003) "Notification and Awareness: Synchronizing Task-Oriented Collaborative Activity", *International Journal of Human-Computer Systems* (58), pp. 605–632.

Carroll, J.M. et al. (2006) "Awareness and Teamwork in Computer-Supported Collaborations", *Interacting with Computers* (18), pp. 21–46.

Carroll, J.M. et al. (2009a) "Community Collective Efficacy" in Whitworth, B. (ed.) *Handbook of Research on Socio-Technical Design and Social Networking Systems*, Hershey, PA: IGI Global, pp. 608–619.

Carroll, J.M. et al. (2009b) "Beyond Being Aware", *Information and Organizations* (19)3, pp. 162–185.

Cooperrider, D. and M. Avital (eds.) (2004) *Advances in Appreciative Inquiry: Constructive Discourse and Human Organization*, New York, NY: Elsevier Publishing.

Curtis, P. (1992) "Mudding: Social Phenomena in Text-Based Virtual Realities", *Proceedings of the 1992 Conference on the Directions and Implications of Advanced Computing,* Berkeley, CA.

Dourish, P. and V. Bellotti (1992) "Awareness and Coordination in Shared Workspaces", *Proceedings of CSCW 1992: ACM Conference on Computer-Supported Cooperative Work* (Toronto, Ontario, Canada), New York, NY: ACM, pp. 107–114.

Farooq, U. (2008) *Supporting Creativity: Investigating the Role of Awareness in Distributed Collaboration,* (unpublished dissertation), Pennsylvania State University, University Park, PA.

Farooq, U. et al. (2007) "Social Bookmarking for Scholarly Digital Libraries", *IEEE Internet Computing* (11)6, pp. 29–35.

Farooq, U. et al. (2009) "Designing for e-Science: Requirements Gathering for Collaboration in CiteSeer", *International Journal of Human Computer Studies,* Special Issue on e-Science Usability (67)4, pp. 297–312.

Ganoe, C.H. et al. (2003) "Classroom BRIDGE: Using Collaborative Public and Desktop Timelines to Support Activity Awareness", *ACM UIST 2003: Conference on User Interface Software and Tools,* New York, NY: ACM, pp. 21–30.

Hester, R.T. (1993) "Sacred Structures and Everyday Life: A Return to Manteo, NC" in D. Seamon (ed.) *Dwelling, Seeing, and Designing: Toward a Phenomenological Ecology,* Albany, NY: State University of New York Press, pp. 271–297.

Hollan, J. and S. Stornetta (1992) "Beyond Being There", *Proceedings of CHI 1992: ACM Conference on Human Factors of Computing Systems* (Monterrey, CA), New York, NY: ACM, pp. 119–125.

Isenhour, P., M.B. Rosson, and J.M. Carroll (2001) "Supporting Interactive Collaboration on the Web with CORK", *Interacting with Computers* (13), pp. 655–676.

Moscato, D.R. and E.D. Moscato (2009) "A Critical Analysis of Using 3-D Virtual World Environments in e-Commerce Strategy", *Issues in Information Systems* (X)2, pp. 267–274.

Olson, G.M. and J.S. Olson (2000) "Distance Matters", *Human-Computer Interaction* (15), pp. 139–178.

Olson, G., A. Zimmerman, and N. Bos (2008) *Science on the Internet,* Cambridge, MA: MIT Press.

Putnam, R. (2000) *Bowling Alone: The Collapse and Revival of American Community,* New York, NY: Simon & Schuster.

Skupin, A. and S.I. Fabrikant (2007) "Spatialization" in Wilson, J. and A. Stewart Fotheringham (eds.) *Blackwell Companions to Geography, Volume 7: The Handbook of Geographic Information Science,* Malden, MA: Blackwell, pp. 61–79.

Schmidt, K. (2002) "The Problem with 'Awareness'", *Computer Supported Cooperative Work* (11), pp. 285–298.

Warren, R. (1978) *The Community in America*, Chicago, IL: Rand McNally and Company.

Wellman, B. and B. Leighton (1979) "Networks, Neighborhoods, and Communities: Approaches to the Study of the Community Question", *Urban Affairs Quarterly* (14)3, pp. 363–390.

ABOUT THE AUTHOR

John M. Carroll is Edward Frymoyer Professor of Information Sciences and Technology at the Pennsylvania State University. Research interests include methods and theory in human-computer interaction, particularly as applied to networking tools for collaborative learning and problem solving, and design of interactive information systems. Books include *Making Use* [MIT, 2000], *HCI in the New Millennium* [Addison-Wesley, 2001], *Usability Engineering* [Morgan-Kaufmann, 2002, with M.B. Rosson] and *HCI Models, Theories, and Frameworks* [Morgan-Kaufmann, 2003], *Rationale-Based Software Engineering* [Springer, 2008, with J. Burge, R. McCall and I. Mistrik], and *Learning in Communities* [Springer, 2009]. Carroll serves on several editorial boards for journals, handbooks, and series. He is Editor of the *Synthesis Lectures on Human-Centered Informatics*. He received the Rigo Award and the CHI Lifetime Achievement Award from Association for Computing Machinery (ACM), and the Goldsmith Award from the Institute of Electrical and Electronics Engineers (IEEE). He is a fellow of ACM, IEEE, and the Human Factors and Ergonomics Society.

Communications of the Association for Information Systems

ISSN: 1529-3181