

To appear in *UBICOMP 2001*.

UniCast, OutCast & GroupCast: Three Steps Toward Ubiquitous, Peripheral Displays

Joseph F. McCarthy, Tony J. Costa and Edy S. Liongosari

Accenture Technology Labs¹
3773 Willow Road
Northbrook, IL 60062 USA

mccarthy@cstar.accenture.com, tony.j.costa@accenture.com,
edy@cstar.accenture.com

<http://www.accenture.com/cstar/>

Abstract. Artifacts and surfaces that can display digital content are proliferating at a steady rate. Many of these displays will be peripheral, i.e., used for content that is not directly related to one's primary activities. However, what kinds of content would people want to see on such peripheral displays? We have begun to investigate the use of peripheral displays in three workplace contexts: within an individual office (UniCast), outside an individual office (OutCast) and in a common area (GroupCast).

1 Introduction

We often hear predictions of a technology-rich future in which our environments will be filled with artifacts that can sense and respond to us in new ways – a world filled with a multitude of cameras, microphones, visual displays and audio speakers, to name but a few. Although such a world may seem threatening or menacing in some depictions, it is possible that such developments will lead to more accommodating environments that encourage more frequent and beneficial interactions and a greater sense of awareness among the inhabitants of such spaces.

We have begun to build an environment with *ubiquitous peripheral displays* – visual displays distributed throughout the physical space of our office that supplement those used for primary work activities. Since it is impractical to distribute such displays everywhere, we are approximating, or at least moving toward, ubiquity, by focusing on the use of such displays in three contexts: inside an individual office, out-

¹ Formerly, the Center for Strategic Technology Research (CSTaR) at Accenture.

side an office and in a shared space. We call the applications we have created to populate these displays with content UniCast, OutCast and GroupCast.²

The displays are *peripheral* in the sense that they are placed in physical locations that are outside the primary visual focus of people as they engage in their typical work activities throughout the day. UniCast displays are positioned on desktops in individual offices, to the side of the primary computer workstation; an OutCast display is embedded in a wall outside an individual office; a GroupCast display is situated off to the side in a public area with heavy traffic.

Our general goal in this work is to deploy the displays (and associated applications) as widely as possible within our group, and to investigate how – and indeed, whether – people would want to create, modify and access content on displays in a variety of contexts. We also seek to discover what kinds of differences exist in the types of content people are interested in seeing within their offices, projecting outside their offices, and encountering with other people present in public spaces.

In the sections that follow, we provide some details about the environmental context in which these applications are used, describe each of the applications in more detail, share some of our early experiences with the applications, and suggest some potential future directions for this work.

2 Environmental Context

The environmental context in which we have designed and built these applications is the physical space occupied by Accenture Technology Labs – Research, a 16,000 square foot section of the second floor of Accenture Technology Park, in Northbrook, IL, USA. There are approximately 30 members of the research group in Northbrook, including researchers, developers, technical writers and administrative staff. Over half of these people are currently using UniCast in their offices; in addition, there is currently one GroupCast display in a common area, and a single OutCast display outside of the third author’s office.

The research group area has a network of over 70 ceiling-mounted nodes each housing an infrared sensor, radio frequency receiver and audio speaker, and a set of infrared badges that transmit identification signals every two seconds. Badge location information is maintained in a Microsoft SQL Server 7.0 database, with a web browser interface for accessing and administering this information. Finally, we have a collection of eleven Axis 2100 Network Cameras installed in various hallways, meeting rooms and other common areas throughout this space.

² For notational convenience, we will often refer to the physical displays according to the applications running them, except where to do so would cause confusion.

3 UniCast

UniCast is an application that allows users to specify content they would like to see on peripheral displays located within their primary workspaces. In some respects, UniCast represents an extension of the functionality provided by the PointCast system [cf. Franklin & Zdonik, 1998], which allows people to specify news topics and stock symbols about which they would like to stay informed while their desktop computer is in screensaver mode. However, UniCast is different in several key aspects: it runs continuously on a dedicated, peripheral display; it allows for a broader selection of content; it reacts to the location of its “owner” via an infrared badge system; and it is tied into and makes use of content belonging to other UniCast user profiles. Figure 1 shows an example of UniCast in one office context: the rightmost monitor is used for UniCast content (the laptop in the middle is used as the primary workstation, and the monitor on the left is running ActiveMap [McCarthy & Meidel, 1999] and EventManager [McCarthy & Anagnost, 2000]).

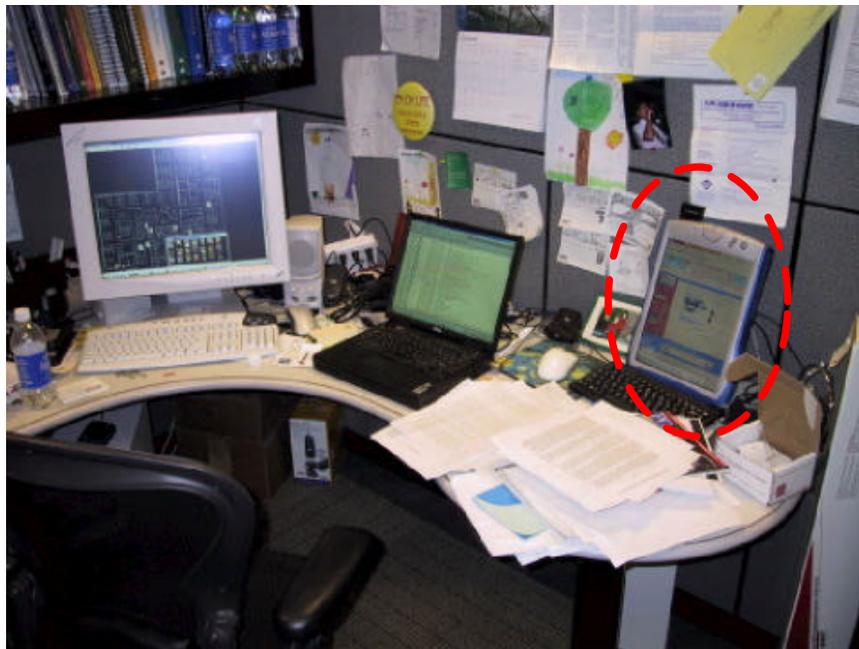


Figure 1: UniCast display within one office context.

Our model of interaction is primarily that of an ambient display [Weiser & Brown, 1997; Wisniewski, *et al.*, 1998; Redström, *et al.*, 2000] rather than the primary workstation display used for supporting a user’s primary work tasks. The hypothesis is that UniCast content should be interesting, but not terribly important or urgent, since im-

portant or urgent information is (or could be) sought out directly on the primary workstation. For example, the first author uses UniCast to cycle through his favorite on-line comics (among other types of content) which help to brighten his day, but are rather peripheral to his work, and which he therefore rarely seeks out on his primary workstation.

The content for UniCast includes the usual suspects – headlines and stock information – as well as many other types of content. The current implementation includes user-configurable modules of fifteen different classes:

- *Headlines*: The top 5 headlines from any of 273 channels in 16 categories from Moreover (<http://www.moreover.com/>).
- *Stocks*: Any stock symbol available from Yahoo! Finance (<http://finance.yahoo.com/>). At most 5 stocks can be displayed per page; for modules with more than this limit, UniCast randomly selects 5.
- *Weather*: Weather information for any US zip code available from Earthlink's weather portal (<http://www.earthlink.com/>).
- *Traffic*: Chicagoland Expressway Congestion map provided by the Departments of Transportation of Illinois, Indiana and Wisconsin – IDOT, INDOT, and WISDOT – in conjunction with the AI Lab at the University of Illinois, Chicago's Electrical Engineering & Computer Science Department (<http://www.ai.eecs.uic.edu/GCM/CongestionMap.html>)
- *Horoscopes*: Any of the 12 signs of the zodiac available from Yahoo! Astrology (<http://astrology.yahoo.com/>).
- *Web pages*: Any URL specified by the UniCast user.
- *InfoShare*: Any URL specified by *any* UniCast user; these URLs are organized by topic and/or people – either the person who posted the content or the person(s) for whom the content was posted (e.g., “I think Tony would be interested in this page”) – allowing access by any of three “channels” (this is essentially used as a local “What’s Cool?!” repository).
- *Announcements*: Text messages submitted through a special interface that includes a title, body and expiration date; this is mostly use for conference and workshop announcements. Subscription is “all or nothing.”
- *Reminders*: Visual and aural reminders of regularly scheduled events for the entire group. Events are individually selectable.
- *WebCams*: Live content from any of 11 Axis 2100 Network Cameras positioned in public spaces throughout the research group area (the video streams from these cameras can only be viewed behind the Accenture firewall, and the URLs are not circulated outside of our group).
- *In/Out List*: A list of who is in the office today (as well as when and where they were last seen) and who is away, based on information gathered through our infrared badge system. People to track are individually selectable. This module is labeled “ActiveMap” for historical reasons (see McCarthy & Meidel [1999] for more information).

- *Factoids*: 363 different “factoids” manually collected from various sources on the web, organized into 8 categories (Culture, History, Human Body, Nature, Recycling, Science, Space and General). Subscription is by category.
- *Flashcards*: Short questions and answers; a default set of US State Capitols augmented by whatever flashcards people add.
- *Artwork*: 1000 images, organized into 10 categories, from Corel’s Super Ten Royalty-Free Art Photo Pack. Subscription is by category.
- *Pictures*: Digital images uploaded to a shared directory. Images are individually selectable.

Users first select a module class to install and then add personalized selections or preferences to that instance of the module. For example: for the web page module, any number of URLs can be specified (and different instances of the web page module can have different sets of URLs); for headlines, there is a form with checkboxes for listing news categories; and for weather, the user enters one or more U.S. zip codes. Every instance of a module has a range of times for each day of the week (including an easy way to specify all day and/or every day), and a priority level from 1 (lowest) to 5 (highest).



Figure 2: UniCast profile maintenance interface.

and, although it is intended to mostly be used as a passive display, each unit includes a touch-screen and/or keyboard and mouse. We found that users wanted to be able to pause and occasionally go back to a page displayed on UniCast (especially pages that had a high density of text). The Java-based interface provides the user with minimal control of the display using a set of finger-sized button controls to *pause* or *resume* the cycling, to go *back* to the most recently displayed page. An additional *send* button to allow users to transfer content from their peripheral displays to a browser on their primary workstations for further exploration is currently under development.

The behavior of UniCast is tied into the infrared badge infrastructure in our office environment. By sensing the owner's location, the UniCast display toggles between two modes: home and away. When the user is in his or her office (*home* mode), UniCast displays content as described above. When the user leaves his or her office, the UniCast display switches to an *away* mode that either displays the user's current location in the office (using the infrared badge system) or a message predetermined by the user.



Figure 4: OutCast display outside an office.

4 OutCast

OutCast is a variation on the peripheral display theme. Whereas UniCast is directed toward a user within his or her own office space, OutCast is directed toward co-workers near the user's office (see Figure 4). Rather than display information that is only of interest to the owner, OutCast displays information about the owner that is intended for others to view. In many ways, OutCast reflects a behavior that is pervasive throughout the office environment – the posting of articles, cartoons, photographs, and other paraphernalia on office doors. OutCast picks up on this behavior and moves it into the electronic realm, enhancing it where possible.

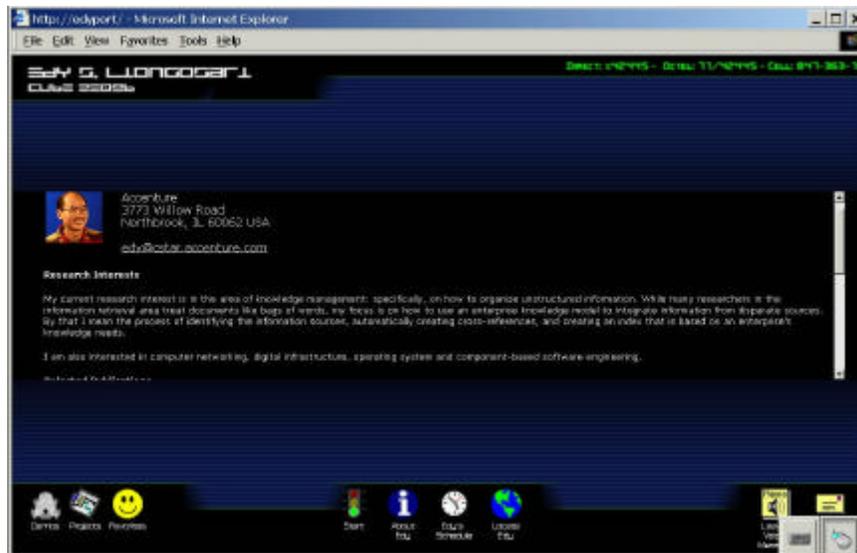


Figure 5: OutCast displaying Biography content.

OutCast runs in a web browser, and is displayed on an NEC 2010 flat-panel monitor augmented by a MicroTouch touch-screen, embedded in a cubicle wall and connected to a Pentium II computer. Visitors to this office can access any of the following types of content (note: “owner” will refer to the occupant of the office):

- *Biography*: Information about the owner from his or her personal web page (see Figure 5).
- *Calendar*: Any entries in the owner's Microsoft Outlook Calendar that are not marked private.
- *Location Information*: Based on the owner's infrared badge.
- *Project Information*: Brief descriptions of each of the owner's projects.
- *Demonstrations*: Online demonstrations of projects (where applicable).

- *Favorites*: A list of URLs to be shared with passersby.
- *Text Message*: The ability to leave the owner a message using a touch-screen virtual keypad.

One capability in OutCast that is not yet incorporated into UniCast is the ability to tie into existing enterprise applications and database resources. For example, calendar information can be pulled from the centralized calendaring system for the office, and project and biography information can be pulled from their corresponding web pages or databases.

Although we consider OutCast to be an example of a peripheral display, in that it is not used as a primary workstation, OutCast employs a distinctly different interaction paradigm from UniCast. Whereas UniCast is largely passive, offering minimal interaction, OutCast has the ability to toggle between a passive mode, where content randomly cycles much as UniCast content does, and an active mode, where a user can interact with the display to navigate through and explore each module's content or leave a text message for the OutCast display owner. We are exploring ways add a video capture capability to the display – or, rather, the wall – which would enable video messages to be left, and to adapt the displayed content to different visitors or classes of visitors, where visitors are identified via their infrared badges.

5 GroupCast

A physical space that can sense people in the vicinity, and has knowledge of their interests, can use this information to create new informal interaction opportunities for these people. For example, a shared public display in a workplace, combined with a tracking system, can display information of mutual interest to the people passing by the display. People may choose to take advantage of this information to initiate a conversation with someone about whom they may know very little, leading to an increased sense of community in the workplace [Deutsch, 1995; Naylor, et al., 1996; Putnam, 2000].

Other researchers have investigated how to create greater awareness among people who are electronically connected but not physically collocated [Zhao & Stasko, 2000; Sawhney, *et al.*, 2001; Greenberg & Rounding; 2001]. Our focus has been how to create greater awareness of each other when people are gathered together – or passing each other – in the same physical space. We also want to distinguish our work from other work using large public displays in the foreground to support the performance of primary work activities (e.g., Streitz, *et al.*, [1999]); although GroupCast uses a large public display, it is intended to be more of a background or peripheral display, and we believe that the content is more likely to spark informal conversations if it is not directly related to work activities.

As an example scenario of GroupCast in action, suppose Joe and Teresa pass each other in the hallway fairly regularly and yet know very little about each other. However, the “Wine of the Day” web site pops up as they both pass by a GroupCast display, leading to a spontaneous and serendipitous discussion about the merits of old-vine zinfandels (see Figure 6). After the discussion ends, they both go away, knowing a little more about each other, and, assuming the discussion did not deteriorate into a vicious argument, they are more likely to have conversations (on wine and other topics) in the future.



Figure 6: GroupCast in context of use.

One of the stumbling blocks we encountered in the initial design of GroupCast was how to acquire content that would be of mutual interest to people. We first considered using a large web-based form displaying content areas that people could rate with respect to their interest level (this was the approach we took with MusicFX [McCarthy & Anagnost, 1998, 2000], which adapted aural aspects of the workout place rather than visual aspects of the workplace). When people passed each other in front of the GroupCast display, content in the intersection of their interests would be displayed.

However, we soon discovered we had conflicting goals: having a profile that would be broad enough to include content of potential interest to a large number of people, and yet still be small enough so that we could reasonably expect people to specify that

content, e.g., by filling out a form. By the time we had amassed enough potential content in our profile form, we were fairly confident that no one (besides those working on the project) would take the time to fill it out.

After we launched UniCast, we had an insight: instead of using the intersection of known interests of both (or all) people near the display, just display content that one of the people had already specified in their UniCast profile. Although that content might not match the profile of the other people, it is still of interest to at least one person passing by, and may still generate the desired conversation [opportunity] between the passersby. Using the UniCast profile, we can rely on people's own self-interest in customizing content that they will see regularly (in their office), rather than struggling with the somewhat less rewarding task of specifying content that only is available when they are in a public area.

6 User Experience

UniCast, GroupCast and OutCast have been in use – though also under continuous development – for several months. We have collected qualitative and quantitative data about the use of UniCast from a variety of users; however, due to the small number of installations of OutCast and GroupCast (one each), we are not yet in a position to provide much data on our other applications. The qualitative data presented in this section is based on interviews conducted with four UniCast users; the quantitative data is based on analysis of the profiles of all eighteen users.

All UniCast users run the application on a display that is peripheral to their primary workstation display. Most users have a separate computer to run the application, however one runs it on a second monitor attached to a workstation, though that workstation itself is not this user's primary workstation, providing this user with two peripheral displays (the other display is used for two purposes -- a browser window which has the MyYahoo portal and an instance of AOL's Instant Messenger).³

Of the fifteen classes of content modules available in UniCast, the most popular modules among the users we interviewed were the Web Pages modules, allowing people to add any arbitrary web site to the stream of content that cycles through their UniCast display. Other popular modules cited include Weather, Factoids, WebCams and the infrared badge-based In/Out List ("ActiveMap"). These last two are particularly interesting, since they raise a number of privacy issues among some people. Our group appears to have a high tolerance for [perceived] privacy intrusion, since more than 90% of the group wears their badges regularly, and only one person has com-

³ See Grudin [2001] for a more extensive study on the use of multiple monitor ("multimon") usage. We concur with his assertion that there is generally poor software support of such use, particularly among laptop computers. Since most of our colleagues use laptops as their primary workstations, we provide [older] desktop computers & laptops to power the UniCast displays.

plained about the web cameras (and even that person appears to have grown used to them).

The least popular modules that were cited by interviewees are those for Traffic and Reminders. In the case of the former, we believe that this is due to the fact that several people have commuting patterns not covered by the Chicagoland Expressway Congestion Map. In the case of the latter, we believe this may be due to an ineffective design on the reminders (particularly with respect to the audio component of reminders, which some people find annoying).

We also have some information as to how people are customizing their UniCast profiles (see Table 1). The first column lists the module class name. The second column shows the average number of selections per module class, e.g., the average number of stocks or average number of headline channels a person is monitoring through UniCast. The third column shows the minimum number of selections per module class and the fourth column shows the maximum number of selections per module class. Note that there may be more than one module instance per class (which is why one person has 13 webcam selections when there are only 11 webcams).

Table 1: Numbers of instances and selections of UniCast modules.

Module Name	# of Users who created a module instance	Average Selections / Module	Minimum Selections / Module	Maximum Selections / Module
<i>Internal Webcams</i>	18	9.1	1	13
<i>Weather</i>	17	2.4	1	4
<i>Headlines</i>	16	22.2	4	58
<i>Stocks</i>	15	16.4	4	74
<i>Web Pages</i>	13	12.5	2	42
<i>Factoids</i>	12	5.8	4	8
<i>Artwork</i>	12	6.0	2	10
<i>ActiveMap</i>	11	13.7	12	16
<i>Announcements</i>	10	3.0	3	3
<i>Horoscopes</i>	8	1.4	1	2
<i>Pictures</i>	8	9.0	3	39
<i>Reminders</i>	8	3.8	2	6
<i>Flashcards</i>	6	25.5	1	50
<i>Traffic</i>	6	1.0	1	1
<i>InfoShare</i>	5	4.4	1	9

We have also collected some informal feedback from OutCast users. Users typically use OutCast when the owner (office occupant) is away. The features that people reported liking and using most were the Location Information (to hunt down the owner in real-time, if he is in the office) and Calendar (to identify the next available opening in the owner's schedule). The least liked and used was the Text Message feature, since people were uncertain about the reliability of this function; users still tend to leave text messages using atoms – Post-It® notes – rather than bits.

7 Future Work

These three applications originated as three separate projects, but as work progresses, it is becoming increasingly apparent that there are many opportunities for sharing content and infrastructure among them. One of our near-term future goals is to come up with a common profile structure for all three applications, with an interface that allows users to easily specify which content is intended for which application (and physical setting).

In UniCast, we want to continue work on our InfoShare module; it was only recently made available, and we don't have many users who have created instances of the module. We think that increased use of this module can help create a greater sense of community among people in the group (another mechanism for learning about each other's interests, without being physically co-present). We also need to be more diligent about keeping our Announcement information fresh (and well populated – several people have commented that modules with few items get boring quickly).

With GroupCast, we'd eventually like to investigate other ways of using the profiles, such as using an intersection of the profiles (returning to the original design) or the set difference between profiles (since that would ensure novelty on at least one person's part). We also want to create multiple installations of GroupCast, and have at least one be in a space where there is something that helps attract people and keep them lingering for at least a few seconds (the badges fire every two seconds, and it sometimes takes a few seconds for new content to be displayed). Our current plan is to place a water cooler or coffee maker near one installation. We also want to design an evaluation that would help us assess whether – or how well – GroupCast is accomplishing its goal of increasing social capital in the workplace.

OutCast is truly an outcast with respect to the other two applications. At present, it shares no content or infrastructure with the other two. In addition to including UniCast and GroupCast content on OutCast displays – e.g., to provide content for the screensaver, or list of Favorites – we'd like to be able to incorporate some of the infrastructure from OutCast in the others. For example, with access to an enterprise-wide calendar system, we might identify commonalities with respect to locations people have traveled, or will be traveling, to, and use that to bring up travel-related pages

when people pass by a GroupCast display ... for example, showing a map of Napa Valley vineyards when Joe and Teresa next pass each other.

8 Conclusion

We have created three applications that allow us to explore peripheral displays in three contexts: within a collection of individual offices, outside an individual office and in a group setting. Early feedback on one of the applications – UniCast – has been very positive (in fact, demand is outpacing our supply of additional monitors). We are eager to expand this application and its user base, as well as conduct further development and deployment of our other applications, GroupCast and OutCast. Although we are still far from a truly ubiquitous deployment of peripheral displays, we hope that others can learn from our experience and be more inclined to experiment with their own peripheral displays in these, and other, contexts.

Acknowledgements

The authors wish to thank Jeremy Goecks, who helped build an early version of GroupCast, Mitu Singh, who built some of the components used in OutCast, and all the members of our research group who have used these applications and provided valuable feedback on how they use – and would like to use – peripheral displays in a variety of contexts.

References

1. Deutsch, Claudia H. 1995. Commercial Property; Communication in the Workplace; Companies Using Coffee Bars to Get Ideas Brewing. *The New York Times*, 5 November 1995.
2. Franklin, Michael, and Stan Zdonik. 1998. Data in your Face: Push Technology in Perspective. In *Proceedings of the 1998 ACM Conference on Management of Data (SIGMOD '98)*, Seattle, pp. 516-519.
3. Greenberg, Saul, and Michael Rounding. 2001. The Notification Collage: Posting Information to Public and Personal Displays. In *Proceedings of the 2001 ACM Conference on Human Factors in Computer Systems (CHI 2001)*, Seattle, pp. 514-521.
4. Grudin, Jonathan. 2001. Partitioning Digital Worlds: Focal and Peripheral Awareness in Multiple Monitor Use. In *Proceedings of the 2001 ACM Conference on Human Factors in Computer Systems (CHI 2001)*, Seattle, pp. 458-465.
5. Harper, Richard H. R. 1992. Looking at Ourselves: An Examination of the Social Organisation of Two Research Laboratories. In *Proceedings of the ACM 1992 Conference on Computer Supported Cooperative Work (CSCW '92)*, pp. 330-337.
6. McCarthy, Joseph F., and Theodore D. Anagnost. 1998. MusicFX: An Arbiter of Group Preferences for Computer Supported Collaborative Workouts. In *Proceedings of the ACM*

- 1998 Conference on Computer Supported Cooperative Work (CSCW '98), Seattle, pp. 363-372.
7. McCarthy, Joseph F., and Theodore D. Anagnost. 2000. MusicFX: An Arbiter of Group Preferences for Computer Supported Collaborative Workouts. In *Proceedings of the ACM 2000 Conference on Computer Supported Cooperative Work (CSCW 2000) Video Program*, Philadelphia, PA, p. 348.
 8. McCarthy, Joseph F., and Theodore D. Anagnost. 2000. EventManager: Support for the Peripheral Awareness of Events. In Peter Thomas, Hans W. Gellersen (Eds.) *Handheld and Ubiquitous Computing*. Proceedings of the Second International Symposium (HUC 2000), Bristol, UK, September 2000. Lecture Notes in Computer Science, Vol. 1927, Springer – Verlag, Heidelberg, pp.227-235.
 9. McCarthy, Joseph F., and Eric S. Meidel. 1999. ActiveMap: A Visualization Tool for Location Awareness to Support Informal Interactions. In Hans W. Gellersen (Ed.) *Handheld and Ubiquitous Computing*. Proceedings of the First International Symposium (HUC '99), Karlsruhe, Germany, September 1999. Lecture Notes in Computer Science, Vol. 1707, Springer – Verlag, Heidelberg, pp. 158-170.
 10. Naylor, Thomas H., William H. Willimon and Rolf Österberg. 1996. The Search for Community in the Workplace. *Business and Society Review*, 97:42-47.
 11. Putnam, Robert. 2000. Bowling Alone: The Collapse and Revival of American Community. Simon & Schuster.
 12. Redström, Johan, Peter Ljungstrand and Patricija Jaksetic. 2000. The ChatterBox: Using Text Manipulation in an Entertaining Information Display. In *Proceedings of Graphics Interface 2000*, Montréal, Canada.
 13. Sawhney, Nitin, Sean Wheeler and Chris Schmandt. 2001. Aware Community Portals: Shared Information Appliances for Transitional Spaces. In *Journal of Personal and Ubiquitous Computing*, 5(1):66-70.
 14. Streitz, Norbert A., Jörg Geißler, Torsten Holmer, Shin'ichi Konomi, Christian Müller-Tomfelde, Wolfgang Reischl, Petra Rexroth, Peter Seitz and Ralf Steinmetz. 1999. i-LAND: An Interactive Landscape for Creativity and Innovation . In *Proceedings of the 1999 ACM Conference on Human Factors in Computing Systems (CHI '99)*, Pittsburgh, PA, pp. 120-127.
 15. Weiser, Mark, and John Seely Brown. 1997. The Coming Age of Calm Technology. In Peter J. Denning & Robert M. Metcalfe (Eds), *Beyond Calculation: The Next Fifty Years of Computing*. Springer – Verlag, pp. 75-85.
 16. Wisneski, Craig, Hiroshi Ishii, Andrew Dahley, Matt Gorbet, Scott Brave, Brygg Ulmer and Paul Yarin. 1998. Ambient Displays: Turning Architectural Space into an Interface between People and Information. In Norbert A. Streitz, Shin'ichi Konomi and Heinz-Jurgen Burkhardt (Eds.) *Cooperative Buildings - Integrating Information, Organization and Architecture*. Proceedings of the First International Workshop on Cooperative Buildings (CoBuild '98), Darmstadt, Germany. Lecture Notes in Computer Science, Vol. 1370. Springer - Verlag, Heidelberg, pp. 22-32.
 17. Zhao, Qiang Alex, and John T. Stasko. 2000. What's Happening? The Community Awareness Application. In *2000 ACM Conference on Human Factors in Computer Systems (CHI 2000) Extended Abstracts*, The Hague, pp. 253-254.