Social Aspects of Using Large Public Interactive Displays for Collaboration

Daniel M. Russell, Clemens Drews, and Alison Sue

IBM Almaden Research Center, 650 Harry Rd., San José, CA 95120 USA
{Daniel2, CDrews, AliSue}@us.IBM.com

Abstract. Large displays have several natural affordances that can simplify small group collaborative work. They are large enough to hold multiple work areas, they are easy to see and can be manipulated directly via touch. When placed into group and public spaces, such displays create pervasively available working surfaces for lightweight, temporary walkup use. The *BlueBoard* is a large plasma display with touch sensing and a badge reader to identify individuals using the board. The onboard software acts as a thin client giving access to each participant's web-based content (e.g., home pages, project pages). The client also has a set of tools and mechanisms that support rapid exchange of content between those present. The overall design of the BlueBoard is one that is easily learnable (under 5 minutes), very simple to use, and permits novel uses for collaboration. Our initial field study revealed a number of social issues about the use of a large pervasively available display surface, yet indicates that a shared public display space truly has distinct properties that lend themselves to sharing content. Extreme learnability & overall simplicity of design makes BlueBoard a tool for collaboration that supports intermittent, but effective use for side-by-side collaboration between colleagues.

1 Introduction

Large displays are rapidly growing more affordable and offer new opportunities for ubiquitous placement in work environments. [1,3,6,7,8,9,10, 12] As any walk through a current airport shows, large displays are commonly scattered throughout the concourses as information displays.

In our work with large interactive display surfaces, we have come to realize that these are distinctive devices -- a kiosk with an integrated personal identification device becomes a new kind of work tool for groups of people who have to collaborate. It is qualitatively different than a personal computer with a big display.

That is, work practices are especially subject to social effects when the devices are large and communal. In our initial tests, we have found a number of somewhat unanticipated interactions between the device as a thing to use, and the device as a place where work occurs. These effects derive from the changes in the way this system is naturally used, and seem to be inherent in larger display surfaces.

G. Borriello and L.E. Holmquist (Eds.): UbiComp 2002, LNCS 2498, pp. 229-236, 2002.

2 BlueBoard Overview

The BlueBoard is a large device based on a 1.3 meter plasma display (XGA) with a resistive touch screen (from SMART Technologies [8]) and a badge reader for personal identification (an HID brand RFID reader connected to the serial port [5]), with a laptop PC secured in a lockbox bolted to the rear of the display, running the BlueBoard thin client software. (Please see [13] for a complete description of the BlueBoard.)

In common use patterns, the BlueBoard is intended for both very fast personal use (walk up, check your calendar, walk away – all within 5 seconds), and for small group collaborative use (a small number of people stand around the BlueBoard to sketch ideas, pull up information from their personal space, compare notes, share content, create something new).

It is this second aspect of BlueBoards that is the focus of this paper. Large interactive displays are a relatively new and unusual phenomena – they are not yet a commonplace part of our electronic information landscape.

In the BlueBoard, the badge's unique identifier is sent to a Badge Server database that authenticates the user, handing back a URL to that person's personal content.

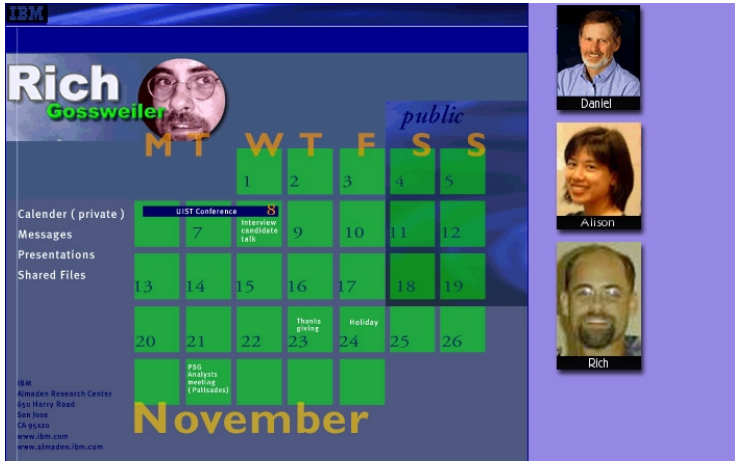

Fig. 1. A typical BlueBoard personal display. This kind of content is set up by each user as their "home content." Content displayed on the BlueBoard can be shared with another person by dragging the content (window, image, URL) to their p-con. Here, Rich is showing his home page calendar to Daniel and Alison.

3 Representing a Person: P-Cons for Fast Access

A BlueBoard is handy for fast access to personal information, but unlike other information appliances, it also supports both single users and multiple users. That is, it

needs to work for a single person walking up to the BlueBoard to check their calendar, and it needs to work for small groups of people working together.

In earlier work [13], we addressed the problem of how to represent an individual and a group. Swiping your badge by the reader brings up a representation of the badge owner in a column on the right hand side of the large display (see Figure 1). A "personal icon," or ***p-con***, is created on the BlueBoard display off on the side in the tools area. Note that a person's "home page" is not immediately displayed, but becomes available only by explicitly touching one's p-con.

As multiple people each swipe their badge, their p-cons stack up on the right hand side of the screen. They initially appear somewhat large, but scale down as more people badge in (up to a maximum number of 20 people, after which point the p-cons become unidentifiable blobs).

The p-con becomes the rapid access point for personal content. A user sets up their content ahead of time, linking items such as calendars, presentations, continually updated information (stock quotes, project status, etc.) to the home page. Then, once badged-in to the BlueBoard, a finger touch on the p-con brings up the first page of their content.

The p-con is also the way to share information between simultaneous users. If one user is showing a slide from their content or an especially interesting web page, a drag-and-drop movement from the page to a p-con will deposit a copy of that content in the p-con.

4 Social Effects of Shared Interactive Displays: A Field Study

In normal use, the BlueBoard is a place where a small number of people can quickly and easily work together. A major question is what would actually happen in small group use.

We ran a field study of the BlueBoard in use by small groups at a workshop held at the IBM Almaden site. Badges were given to 163 participants, 90% from outside of IBM or Almaden, and with no advance knowledge of the test. The database was initialized with their email addresses and pointers to their home pages.

At the beginning of the workshop, a brief 4 minute demonstration of the BlueBoard was given to all participants simultaneously, and the BlueBoard was made available in the hallway immediately outside the auditorium for non-directed use during the breaks and an extended lunch. (The BlueBoard was one of many demonstrations in the hallway.) The instruction covered badging-in, access to one's home page through the p-con, exchanging URLs, use of the whiteboard tool, sharing whiteboard content between badged-in people, and badging-out to cause shared content to be automatically emailed away.

Users of the BlueBoard were videotaped in use, and six were given a post-use informal interview that asked questions about their goal in using the board, particular problems they had, and possible future extensions.

During the 110 minutes of BlueBoard availability, it was nearly constantly in use as participants would walk up, badge-in and begin exploring its capabilities. Although

no task was set, we saw several apparently authentic work uses of the board during the time we observed. These included demonstrations of participant website development ("let me show you this great thing I did..."), explicit sharing of web pages, and uses of the whiteboard for non-trivial diagrams.

After the workshop, we collected our field notes and analyzed the video.

As would be expected, we learned a number of pragmatic user interface lessons from our observations: inconsistencies in the UI widgets and idioms, the particular difficulty of using a touch screen with long fingernails (they generate an uncertain touchdown point on the resistive touch sensor), how high we can place elements on the screen to be used by short people, and so on.

4.1 Observations on Group Use

Although we were initially simply looking for instances of authentic work-like uses of the BlueBoard, and the degree to which all the BlueBoard features could be used after such short instruction, we were struck by the number (and importance) of social interaction effects that took place. Here are the six most evident effects we noted in our analysis:

1. Social learning through exposed interaction: The interface style of the BlueBoard is evident – a user can only touch parts of the display to make things happen. Consequently, the entire interaction process is visible to everyone, there are no hidden keystrokes or sudden mouse movements that are difficult to understand. Participants who are unsure of how to use a particular function of the BlueBoard were able to very easily see how someone else could do the thing they wanted. In the course of study, we saw many examples of someone picking up a behavior by seeing someone else use it in the course of their interaction.

2. Etiquette of multiple person use is unclear: When a group was using the BlueBoard, other participants were often uncertain about what kind of behaviors would be acceptable. Should one badge-out while another person was engaged in making a point? Was it permissible to badge-in without making any kind of verbal comment? Time and again we saw hesitations as new BlueBoard users struggled with these momentary crises. Similar issues arise in any kind of workgroup that is focused on a shared information resource (including non-electronic) – what are appropriate behaviors for engaging and disengaging? [11] We believe these questions will subside over time as board use becomes more commonplace and practices evolve. (See Figure 2.)

3. Who drives? Groups using the BlueBoard often tended to have one person dominating the interaction. Usually, this was the person doing work at any one moment, either by showing group members their content, navigating to a web page to show a result, or working on the whiteboard. Less frequently, but encouragingly, we also saw several instances of small groups (2 – 4 people) where there was NOT an obvious group leader. These more cooperative discussions were almost exclusively whiteboard drawing sessions where turntaking was rapid and fluid.

Fig. 2. BlueBoard setup in the field study. The whiteboard tool is always one touch away from instant use. The image can be dragged onto the artist's p-con or onto another p-con to be emailed when that person badges-out. In this video sequence, the user controls the use of the board while three other users watch, waiting their turn.

4. *Learning to work together – evolution of turn-taking:* It happens that the BlueBoard touchscreen cannot handle more than one touch point at a moment. If two people touch the screen simultaneously, the cursor jumps to the midpoint between them. When two people are using the whiteboard tool together, it is immediately obvious to the drawers that this is true, and a turn-taking practice rapidly comes into place. We note with some satisfaction that complex floor controls were never asked for nor needed. Instead, because the people drawing could immediately see the consequences of their actions, and because they were physically adjacent, they could easily tell when their partner was about to draw and coordinate their joint actions.

5. *Reaching across*: The size of the BlueBoard is an important determiner in the way groups of people work with it. In the small dynamic workgroups, 2, 3 or 4 people would stand effectively shoulder-to-shoulder, each person reaching in to touch and operate the BlueBoard. By contrast, when a single person was leading the discussion, they would tend to stand in front of the board with other members (from 1 to 5 others) making an arc in front of the board. We noticed many instances of hesitation when controlling the board required reaching across another person standing in a controlling position. That is, like reaching for a plate at the dinner table, participants considered the reaching maneuver to be perhaps slightly rude – and an assertion of control over the proceedings.

6. *Group sharing of information*: As others have pointed out, shared information artifacts need not be electronically based, but simply available to many people simultaneously. [11] When such shared displays are being created and edited in real-time, there is a distinctly opportunistic use of the information being used in the meeting. Even when a single person is controlling the flow of events, being able to share the

experience of editing *in situ* provides additional important side-channels of information exchange. In our study we noted several instances of side-comments being incorporated into the flow of the discussion; comments that might have never been a part of a virtual discussion.

4.2 Observations on Individual Use

In addition, we had several observations about individual uses of the BlueBoard.

1. *Text input:* Although participant home pages were not optimized (or even minimally set up to take advantage of the BlueBoard), it didn't seem to matter except in cases when text input was required for search or login. Since search strings tend to be short, a virtual keyboard of some kind will suffice. But login authentication requires typing in a password, and as noted above, a BlueBoard class device is particularly accessible for co-participants in a group setting. In the field study, no keyboard was available, so participants simply did without, but it is a problem that will have to be resolved.
2. *Drawing is important:* The whiteboard tool was put into the BlueBoard initially as a small drawing capture area. Over time, though, we have been consistently surprised at the utility of the whiteboard tool and the novel uses people have found for it. While the whiteboard tool is currently very simple (simple vectors drawn point-to-point by finger-dragging), the simplicity of the tool, its attractive similarity to fingerpainting, and most importantly, its automatic capture via being emailed as an attachment, all led to a wide number of uses. One of the unexpected uses noted during the field study was the number of times people would write their email address and drag it to an acquaintance's p-con. This would effectively send the recipient an image with an email address in it – quickly and simply, all without typing. (Similar instances of people scheduling appointments by writing times, dates and places were also seen.)

Similarly, we were struck by the quality of the relatively low-quality drawing tool that we used. Although many participants did not seem to notice, users who were graphically-attuned noted the relatively crude drawing (point-to-point vectors with jaggies). A few months after this field study, we rewrote the drawing tool to use antialiased ink in a painting style, and received very high praise from subjects in a follow-on study.

3. *Easy to use*: Of the six behaviors shown in the introductory four minute demonstration, we saw all of them in competent use by first-time users. Some of the skill users demonstrated was clearly due to social learning through observation, but we were pleased to find that the affordances of the interface were fairly apparent.
4. *Few badge-outs*: On the other hand, the one behavior that was problematic was badging-out when leaving the BlueBoard area. Nearly everyone who had do some work (e.g., created a whiteboard image or saved a URL to their p-con) successfully badged-out. But around 50% of those that did not capture an image or other content failed to badge themselves out of the BlueBoard. (The number is approximate, plus-or-minus 10%, because we did not accurately track badge-out events.)

5 Other Work

There are many large display projects in the research world, but few that combine personalization with simple shoulder-to-shoulder collaboration tools. Nevertheless, several projects are sufficiently similar to merit attention.

The DynaWall from GMD is a very large wall display with a touch surface [10] that supports people working together on a merged set of SoftBoard displays [9]. Similarly, the Interactive Workspaces Project at Stanford [3,9] also emphasizes large, sophisticated display areas for information rich display manipulations. For light-weight information access, there are many professional providers of kiosk systems, relatively few of which offer network service access for general information (as opposed to specialized networks, such as banking networks for ATMs). Other kiosk systems [2,4] provide web services or vision-based person-tracking schemes, but none seem to actually know what users are present, or what their personal information content might be.

Some systems, such as the Accenture peripheral displays [14, 15], function primarily as output devices – and not especially as fully interactive working surfaces. Like televisions in working environments, they have their own effect on the social dynamic of a working place, but distinctly *not* the same as an interactive display surface.

6 Summary

Few display devices have tried to be functional for an individual and a small group at once – these dual goals create an inherent design tension between solving the problems of the few, yet serving the many.

The social effects of a communal working space are subtle and varied: people have distinct styles when working in public, yet the value of a shared work surface seems unquestionable. From our initial studies, it is obvious that patterns of group interactions are profoundly altered in the presence of any social communication device – and that large displays will be an important factor in the technology trends to come.

We expect that not only will we continue to discover basic social effects (e.g., the grouping patterns that emerge) from the interaction of social groups with technological affordances, but we will also see a co-evolution of social use patterns and technologies as similar devices become more common in the workplace.

References

1. Buxton, W., Fitzmaurice, G. Balakrishnan, R. & Kurtenbach, G. Large Displays in Automotive Design. IEEE Computer Graphics and applications, 20(4), (2000), 68-75
2. Christian, A. D., Avery, B. Digital Smart Kiosk Project: About Faces. *ACM Proceedings of CHI '98.* v. 1 (1998) 155-162

3. Fox A., Johanson B., Hanrahan P., and Winograd T., Integrating Information Appliances into an Interactive Workspace, *IEEE Computer Graphics and Applications*, 20, 3 (June, 2000), 54-65
4. Grize, F., Aminian, M. Cybcerone: A Kiosk System Based on the WWW and Java. *Interactions*, 4(6), (1997) 62-69
5. HID Corporation, http://www.HIDCorp.com
6. Houde, S., Bellamy, R., Leahy, L. In Search of Design Principles for Tools and Practices to Support Communication within a Learning Community. ACM SIGCHI Bulletin, 30(2) (1998) 113-118
7. Pedersen, E. McCall, K., Moran, T., Halasz, F., Tivoli: An Electronic Whiteboard for Informal Workgroup Meetings, *ACM Proceedings of InterCHI '93* (1993), 391-398
8. SmartBoard. http://www.SMARTTech.com
9. Stanford Interactive Workspaces Project http://graphics.stanford.edu/projects/iwork/
10. Streitz, N., J. Geißler, T. Holmer, S. Konomi, C. Müller-Tomfelde, W. Reischl, P. Rexroth, P. Seitz, R. Steinmetz i-LAND: An interactive Landscape for Creativity and Innovation. In: ACM Conference on Human Factors in Computing Systems (CHI'99), Pittsburgh, Pennsylvania, USA, (1999), 120-127
11. Bellotti, V., Rogers, Y. From Web press to Web pressure: multimedia representations and multimedia publishing; CHI'97 conference proceedings on Human factors in computing systems (March, 1997) Atlanta, GA USA, p 279-286
12. Elrod, S., Bruce, R., Gold, R., Goldberg, D., Halasz, F., Janssen, W., Lee, D., McCall, K., Pedersen, E., Pier, K., Tang, J., Welch, B. Liveboard: A Large Interactive Display Supporting Group Meetings, Presentations and Remote Collaboration Desks, Video, and Screens. Proceedings of ACM CHI'92 Conference on Human Factors in Computing Systems (1992) p.599-607
13. Russell, D. M. & Gossweiler, R. On the design of personal & communal large information scale appliances. *Proceedings of UbiComp 2002* (Atlanta, GA, USA).
14. Huang, E., Tullio, J., Costa, T. J., McCarthy, J. Promoting awareness of work activities through peripheral displays. *Proccedings of CHI-2002*, (Minneapolis, MN, USA).
15. McCarthy, J.F., Costa, T.J., and Liongosari, E.S. UniCast, OutCast & GroupCast: Three Steps Toward Ubiquitous Peripheral Displays. *UbiComp 2001 Proceedings*, 332-345, (Atlanta, GA, USA).