Check for updates

ACM DIGITAL LIBRARY | Association for Computing Machinery | acm open

Latest updates: https://dl.acm.org/doi/10.1145/365024.365339

ARTICLE

The notification collage: posting information to public and personal displays

SAUL GREENBERG, University of Calgary, Calgary, AB, Canada

MICHAEL ROUNDING, University of Calgary, Calgary, AB, Canada

Open Access Support provided by:

University of Calgary

PDF Download
365024.365339.pdf
04 February 2026
Total Citations: 197
Total Downloads: 2733

Published: 01 March 2001

Citation in BibTeX format

CHI01: Human Factors in Computing Systems
Washington, Seattle, USA

Conference Sponsors:
SIGCHI

CHI '01: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (March 2001)
https://doi.org/10.1145/365024.365339
ISBN: 1581133278

.

The Notification Collage: Posting Information to Public and Personal Displays

Saul Greenberg and Michael Rounding
Department of Computer Science
University of Calgary
Calgary, Alberta, Canada T2N 1N4
{saul *or* rounding}@cpsc.ucalgary.ca

ABSTRACT
The Notification Collage (NC) is a groupware system where distributed and co-located colleagues comprising a small community post media elements onto a real-time collaborative surface that all members can see. Akin to collages of information found on public bulletin boards, NC randomly places incoming elements onto this surface. People can post assorted media: live video from desktop cameras; editable sticky notes; activity indicators; slide shows displaying a series of digital photos, snapshots of a person's digital desktop, and web page thumbnails. User experiences show that NC becomes a rich resource for awareness and collaboration. Community members indicate their presence to others by posting live video. They regularly act on this information by engaging in text and video conversations. Because all people can overhear conversations, these become active opportunities to join in. People also post items they believe will be interesting to others, such as desktop snapshots and vacation photos. Finally, people use NC somewhat differently when it is displayed on a large public screen than when it appears on a personal computer.

Keywords
Awareness, informal interaction, media spaces, messaging.

INTRODUCTION
Over last decade, we have seen mounting interest in how interpersonal awareness can be supported through an electronic medium. The general idea is that members of a distributed community somehow detect when others are on-line, and use that awareness to move into interaction with each other. On the popular side, we see this manifested by the explosion of text-based instant messaging services: a person sees friends and their on-line status in a personal buddy list, and can selectively enter into a chat dialog with one or more of them. Examples include MSN Messenger Service and ICQ. The Computer Supported Cooperative Work research community has also invested considerable effort in interpersonal awareness. There is now a body of literature on: understanding the critical role of awareness in informal interaction [12], how people track awareness information within their physical environment [7], social issues such as concerns about privacy and distraction [1,2], how it is used within virtual communities [15], and constructing and testing novel designs such as video-based media spaces [2,3], location trackers [8], and so on.

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, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.
SIGCHI'01, March 31-April 4, 2001, Seattle, WA, USA.
Copyright 2001 ACM 1-58113-327-8/01/0003…$5.00.

While current awareness systems are useful, they support only a handful of the attributes that comprises awareness information and how people in the every day world use it.

1. We are aware of many things: of people, of events occurring around us, and of things (artifacts) within the environment.
2. Our environment contains huge amounts of information that competes for our attention.
3. This information manifests many dynamic and static forms: movement, visual images of people and objects, text, sounds, and so on.
4. Information relevance may depend on time: if not seen almost immediately, it may lose its value. Some information may be ephemeral or long-lived.
5. How we notice some information and how deeply we attend to it is based on many factors. These include its *a priori* importance to a person, how noticeable that information is within our environment, and serendipity.
6. We selectively attend only a small portion of all information in our environment. While most is missed, this is not a problem in practice.
7. After becoming aware of this information, we sometimes act on it by: moving it to a handier place, altering it, or responding to people associated with it.

Other important points come from considering awareness as not only a personal phenomenon, but also as a social one.

8. Information is often a shared resource available to several people at the same time i.e., it occurs in public as well as personal spaces.
9. We manipulate information to increase the likelihood that others become aware of it e.g., by announcing it and by positioning it where others will see it.
10. We also notice information when someone else brings it to our attention, or when we see others acting upon it.

Meta Platforms, Inc. - Ex. 1024
Page 2

While these points have broad implications on how electronic systems should support awareness, our own research has a somewhat narrower focus. In particular, we are interested in how technology can support interpersonal awareness and interaction within small communities of colleagues, where members can 'announce' potentially interesting information to others (point 9), and where the system would display the information so that it would be a useful shared resource. Because groups may contain both co-located and distributed members, we wanted the system to be useful both to people who were alone in a personal space, and to people who were gathered in a common area (points 8–10). We also wanted to recognize some of the attributes of awareness information mentioned in points 1-7: that it comes in many shapes and forms, that it may be ephemeral, that there is a huge amount of it, and that people may selectively attend only some of it. Within this setting we wanted to evaluate the system as a socio-technical artifact, that is, to see how a group forms its social practice when using it over time.

We begin with a description and design rationale of the system we built to support interpersonal awareness: the Notification Collage (NC for short). This is followed by a brief explanation of its underlying system architecture. We then describe our group's usage experiences with it, concentrating on how group members bootstrapped themselves, how NC was used in both public and personal spaces, and what people did on it. We close by relating our work to other research.

THE NOTIFICATION COLLAGE: DESIGN RATIONALE AND DESCRIPTION

The collage metaphor. The Notification Collage, illustrated in Figure 1 and the accompanying video figure, follows the metaphor of a bulletin board containing a collage of randomly positioned and possibly overlapping visual elements. Using various client programs, group members can post a variety of media elements to the NC (point 9). Upon receipt, NC reconstructs these as discrete visual entities and randomly places them onto the left side of the vertical bar that splits the board. Overlap is allowed, and new items are always positioned on top.

We chose this metaphor for several reasons. First, the overlap of items inherent in a large collage acknowledges that there may be a large number of information fragments, too many to fit neatly on the display (point 2). Second, collages are customarily used to present unstructured information comprising diverse media, conceding that awareness information comes in many forms (point 3).

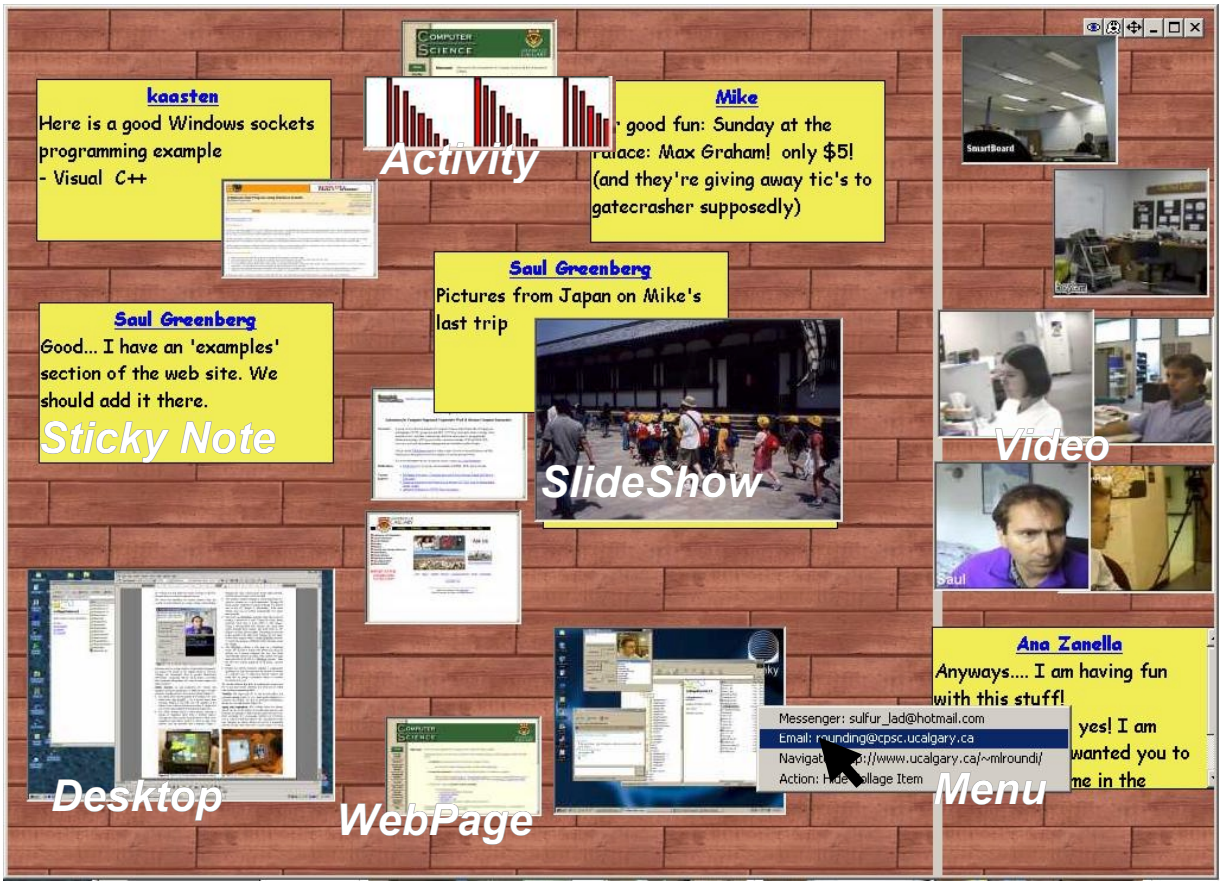

Figure 1. The Notification Collage. Media elements are annotated. New items are positioned only left of the vertical bar.

Meta Platforms, Inc. - Ex. 1024
Page 3

Media elements. NC collects awareness information posted to it by clients (e.g., Figure 2 shows a client) and displays it as different types of media elements. Figure 1 includes examples of media elements and identifying annotations.

a. The *Sticky Note* element follows the metaphor of a real sticky note (*aka* Postit™). As a person types their message (Figure 2, top left), the NC displays it within the note for others to see: edits are shown in real time.
b. The *Video* element shows a live video stream captured from a desktop camera. Through the client, people can specify a refresh rate on their image ranging from 'near-live' to 'once per minute'. They can also manually take a snapshot (Figure 2, video mirrored on the upper right).
c. The *Desktop* element displays a visual thumbnail of a person's desktop. With the client (Figure 2, middle), people post their desktops at a desired size to the NC.
d. The *SlideShow* element extends the notion of tacking a picture to a bulletin board. Using the client (Figure 2 bottom), a person selects one or more photos to post to the NC, and specifies whether the photos will cycle within a single *SlideShow* element on the NC, or as multiple *SlideShow* elements (each containing a single photo) across the collage.
e. The *WebPage* portrays a web page as a thumbnail. We provide a custom web browser for this (not shown): as a person navigates the web, the client automatically captures a web page thumbnail and posts this to the NC as a *WebPage* element. Thus the NC can display thumbnails of all pages a person visits.
f. Finally, the *Activity Indicator* displays a continuously updating bar chart reflecting the amount of activity at a person's site. A client (not shown) collects this by using a proximity sensor to monitor movement in a room.

We should mention that there is nothing that restricts the NC to just these media elements: new ones can be added with modest programming effort.

Display. We expect the NC to run on both large public displays in a common area (Figure 3a), and on personal workstations—ideally on a second monitor [6] (Figure 3b) (points 8–10).

Figure 2. One of several clients used to post information.

Aging and competition. New collage items are always placed on top. As the number of posted items increases, new elements cover old ones. More unusually, old items occasionally 'bubble up' towards the surface. The result is that new elements are almost always visible for a reasonable amount of time, giving them a good chance of being noticed. The appearance, eventual visual decay and occasional reappearance of items reflect that some (but not all) information is timely yet ephemeral (point 4), that some information may be missed (point 6), and that people's awareness of information fragments is sometimes accidental and serendipitous (point 5).

Adjusting item visibility and salience. NC users can select elements to bring them to the surface, drag elements to reposition them, or hide elements from view via a menu option. They can also drag items over to the right side of the vertical bar (Figure 1). NC treats this as a special area: it does not place new items on this side of the bar. Consequently, those items will not be covered up unless the person does this explicitly. People can shift this bar horizontally, thus allocating more or less space for the respective sides (item placement is automatically adjusted to spread across the area). We should note that all these

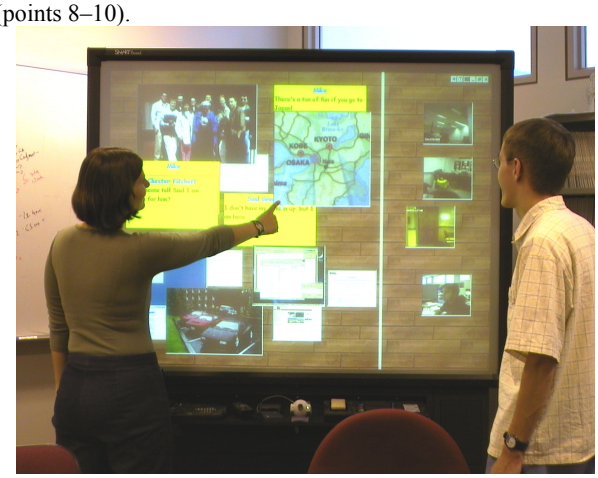

Figure 3a. The NC on a large display in a public setting.

3b. The NC on a 2nd monitor in a personal setting.

Meta Platforms, Inc. - Ex. 1024
Page 4

actions affect only the local NC: it is *not* a strict 'what you see is what I see' system. Through these mechanisms, the idea is that people can adjust an item's salience to themselves (and to others if that NC is in a public area) by: making it fully visible if it is partially obscured; hiding it; moving it next to another item that is related to it; adjusting how visible it is to themselves; and guaranteeing it will not be supplanted by new items (points 5, 9 and 10). As well, people will likely attend this area because of its importance; this will increase the likelihood of them noticing new or changed elements on the left side of the collage.

Acting on information. A person can act on any media element by raising a context menu (Figure 1, bottom right). Through this menu, people can *respond* to whoever posted the item by emailing or instant messaging them, or they can visit the home page of the poster (point 7). Particular media elements may have their own custom interactions (point 7). For example, a person can select a menu item on the *WebPage* element to display the actual page in a browser.

UNDERLYING ARCHITECTURE

The Notification Collage is built atop a client / server architecture as illustrated in Figure 4. At its heart is a Shared Dictionary server that maintains a string-based key/value pair, a client-side library (DLL) that handles all communication with the server, and a simple API for programming clients. A typical sequence illustrates how this architecture works (letters match those in Figure 4).

A. Through the API, clients announce (or publish) new or altered key/value pairs, or requests to remove a key.
B. The client-side DLL marshals this announcement as a string containing the command, the key and the value
C. The DLL sends it to the server via a socket connection.
D. The server updates the shared dictionary as directed.
E. The server then broadcasts the same sequence to all connected clients.
F. Upon receipt of this message, each client-side dll updates its own local cache of the shared dictionary.
G. The dll generates an event that signals via the API that a particular key has been created, modified, or destroyed.

This architecture is similar to a notification server [14,4], which also rebroadcasts incoming messages. There are several differences. The maintenance of all key/value pairs within the shared dictionary means that new clients arriving after some activity has already occurred can request the current status of the dictionary (this happens automatically upon connection), which means that the client can update the display as needed. That is, it serves as a model-view-controller. In contrast, clients of a pure notification server must use some other mechanism to get the current state e.g., by requesting it from another client [5]. We use a cache so that client requests for a key's value do not require another trip to the server, thus speeding updates.

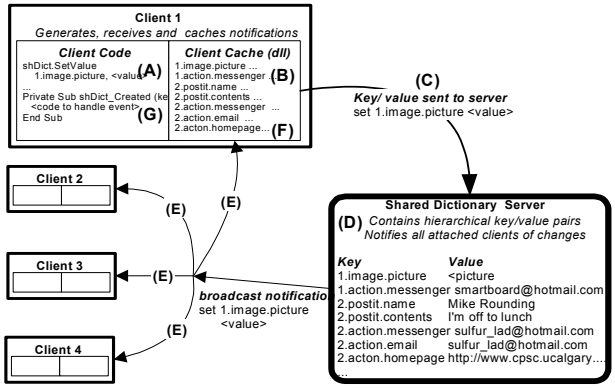

Figure 4. System Architecture.

Keys are hierarchical, which means that clients can structure information they are sending out, and can selectively pattern-match incoming events [5]. NC exploits this by setting the following convention for naming keys. Each media element is identified by a unique id (a number) followed by a set of words that indicate what information the value will contain. For example, a *Sticky Note* element uses 5 keys: <id>.sticky.name indicates the name of the note's creator, and <id>.sticky.contents holds the note's contents. <id>.action.messenger, <id>.action.email, and <id>.action.homepage hold information that is inserted in the *Sticky Note's* context menu i.e., the messenger and email address of the person and the URL of their home page. Any change to a note just requires a change of the value of key <id>.sticky.contents; the other information does not have to be retransmitted. Other media elements work in a similar fashion. All images, for example, use the key <id>.image.picture to hold a marshaled version of the image. Finally, reusing media elements is easy because individual elements are associated with a key's id. Changing <id>.sticky.contents tells the receiver to change the contents of a particular *Sticky Note* element. Similarly, changing <id>.image.picture will create an image stream within a single element (this is how the *SlideShow*, the *Desktop*, and the *Video* elements are implemented). When keys are received that contain new id's, the NC creates new media elements matching the key's type.

In summary, NC works by having all clients simply publish key/value pairs indicating a media element (by the key names), its information (by its values), and how someone can respond to it (by the keys containing the sub-key 'action'). When NC receives these as events, it simply reads the keys and associated information to construct or modify the media element on the board. Creating new media elements is easy: a particular key name convention is agreed upon, a client is programmed to generate this information, and code is added to the NC for displaying it.

USER EXPERIENCES

The first version of the Notification Collage was created in May 2000. Because it was new software still under active development, we initially deployed it only to our own research group. We summarize our experiences here.

The group and its setting. Our group comprised mostly research assistants, graduates and faculty: only two were directly involved in the NC project. Much of the group inhabited a research laboratory whose floor plan is shown in Figure 5. The left side of the laboratory comprised workstations and workbenches for graduates and research assistants. Computers were typically equipped with a camera and two monitors (Figure 3b). The right side was a small, public meeting area containing a 72" rear-projected Smart Board, also equipped with its own camera (Figure 3a). Partitions are short, so people anywhere in the laboratory had some peripheral awareness of activity elsewhere in the room, including what was on the Smart Board. The Smart Board (which had its own 'user identity') always ran NC and a client that would post the video from its camera (a panorama of the room).

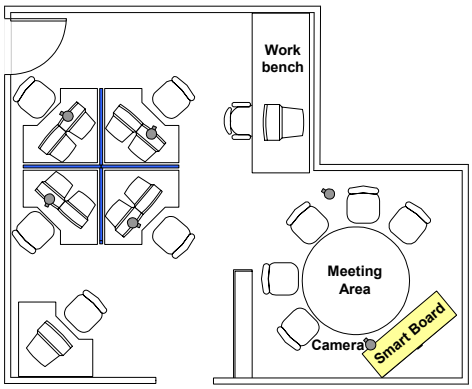

Figure 5. Floor plan of the laboratory.

While some group members regularly worked in the laboratory, others did not. Faculty had separate offices. Other members were telecommuters: one regularly worked at his home office 110 km away, coming into the laboratory only occasionally. Another group member was on a work internship 1000 km away for part of the evaluation period. A few others alternated between work and home offices.

Bootstrapping. Our first version of the Notification Collage was accessible only by co-located group members. Not surprisingly, we saw very little activity on it since these people could see each other directly. A dramatic change happened as soon as people could easily access NC across the Internet. There was a noticeable buzz of excitement: people wanted to join in, and those connected became evangelists for getting other team members to join. People saw and used NC as a way for dispersed group members to reconnect with each other and to those in the laboratory.

A sense of presence. People's first instinct was to post their visible presence to the NC via the *Video* element. This mimicked what is usually seen in most media spaces and instant messengers: all could sense who was around. Typically, people would move video images to the right side of their NC so they would not be covered up. As telecommuters became visible and reachable, the people inside the laboratory also became highly interested in the NC i.e., they would connect to it and stay connected to it.

The role of the personal display. Our expectation of NC was that people would run it only on the single large public display in the research laboratory, and that those outside the laboratory would connect to it every now and then from their personal machines. In practice, the NC quickly found its way to almost permanent display on everyone's desktop, even if those people were in the same room as the public display. We saw that people with multiple monitors did their main work on one monitor and had their view of the Notification Collage running on the other display: this accords with Grudin's findings that second displays are often used to hold peripheral information [6]. While those in the laboratory could glance around to the Smart Board, it was not in their direct line of sight. They felt that having an instance of NC on their own machine made them more aware of changes, and they were better able to respond to particular events.

Those with only a single monitor were concerned about the screen space required by NC. Consequently, we added a transparency feature where people could see through any overlapping windows onto the NC underneath (Figure 6). People could solidify the NC for greater clarity at will. This was positively received, as people could now work in their full environment without sacrificing their knowledge of 'what was going on' in the NC community. Even people with dual monitors sometimes used transparency, at times overlaying other windows holding peripheral information they wanted to track [6].

The role of the public display. When the NC appeared on the public display, people used it somewhat differently than when it appeared on their personal computers.

First people not at their workstations used the public display as another means of tracking and posting information to the NC. This depended on several things: whether they were logged onto a workstation in the room, whether they were closer to the public display than to their workstation, and so on. As expected, people would also bring other people's attention to items on the public display and would converse around them [4].

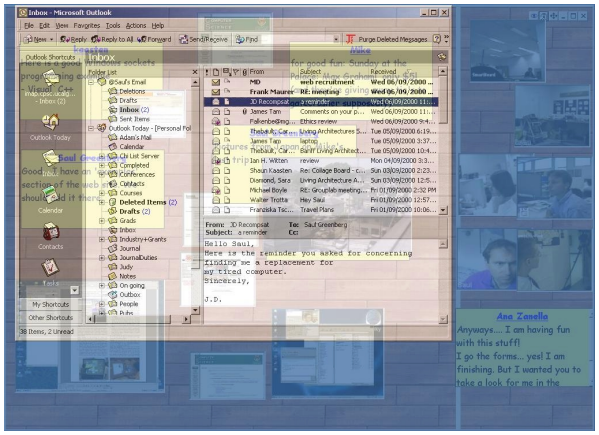

Figure 6. The transparent NC. This person has a conventional email window positioned on top of the NC.

Meta Platforms, Inc. - Ex. 1024
Page 6

Second, telecommuters used the video generated by the camera attached to the Smart Board as a means to monitor and communicate with people seated at the meeting table or workbench, and with people wandering about the laboratory (see Figure 5). This was a particularly important way for telecommuters to contact laboratory inhabitants when they were *not* at their workstations, as well as laboratory visitors and associates who did not have a personal NC. For example, we saw telecommuters notice and contact part-time members of the group who appeared occasionally in the laboratory.

One-to-one, overheard, and broadcast communication. People often took advantage of the presence information by using the NC as an instant messenger. We saw people directly message each other by raising the context menu on a media element and invoking Microsoft Messenger on them (giving one-to-one communication with the person who posted the element). More often, we saw people communicate within the NC through *Sticky Notes*. These typically began with the other person's name e.g., 'Hey Mike…'. While not designed as a chat tool, people would frequently communicate to each other in real time by modifying their own note and by monitoring changes to others.

Conversations over *Sticky Notes* differed from those over Microsoft Messenger. Since all could see the *Sticky Note* contents, the conversation could be overheard. This became an opportunity for casual interaction [12] where others would join the conversation. These others would sometimes just say hello, or would join in any bantering, or would contribute to the conversation when they felt they had something to add.

Seeing incoming *Sticky Notes* also meant that people in the laboratory could tell others about messages directed to them. This happened when the addressee did not notice the note, or when he/she was a room visitor.

We also saw *Sticky Notes* used for purely broadcast communication. People used them to inform the group about current or upcoming events, to annotate other media elements, or to elicit group comments. *Stickies* also served as a way to make general queries or requests which could be answered by anyone e.g., 'Does anyone know…'.

Video as conversation and opportunity. We saw people use *Sticky Notes* and *Video* elements in tandem. They would sometimes wave to re-enforce a greeting, and would accentuate a note's message by exaggerating their body language (laughter, thumbs up, looks of shock, making faces at one-another). They also used the video to show others physical things being talked about. One person, for example, used the video to display the covers of a large number of boxes of software he had just purchased.

Aside from knowing that a person was around, the group used other things they saw on the video as opportunities for conversation. For example, one conversation stemmed from seeing a particularly ugly hat a person was wearing, with quite a few people eventually joining into the teasing. Seeing 'visitors' in the video also led to many conversations. One telecommuter introduced his children (who were visible on the video) to other group members. In another case, a person working at home recognized a visitor to another person's office that he had not seen for years. They began to chat. Since the telecommuter's wife had also met this person several years back, she too came up and joined the conversation.

Video also provided situational feedback. In one case, a telecommuter asked a person in the laboratory to get something from elsewhere in the building. He saw her get up and leave, thus affirming that she was doing what was requested.

Artifact display. People used the NC for displaying other artifacts to the group as different media elements. We saw one popular example where people would post digital photos to the NC via the *SlideShow* element for others to see. These included photos of personal vacations, families and friends, and group outings. Other examples included postings of large desktop thumbnails and individual photos. People sometimes included *Sticky Notes* to explain the slide show. Most importantly (and unlike instant messaging and media space system use) conversations would sometimes arise as a consequence of people seeing these artifacts.

Privacy issues. We saw several privacy issues accompany NC use. First, NC does not guarantee reciprocity. One can use it without signaling their presence through video. Alternatively, a person can have the video capture client running without having the NC displayed. While people did usually enforce reciprocity through social habit, we saw inadvertent reciprocity breakdowns. One example stemmed from the power-save facility that turned off the Smart Board projector. We noticed telecommuters sending a message to a person captured by the Smart Board camera. Of course, that person did not see the message as the display was dark.

We sometimes saw people on the *Video* element having no idea that their image was being broadcast. For example, one telecommuter reported seeing the lights come on after hours in the laboratory, and watching a cleaning person (unaware that she was being monitored) going about her duties.

Telecommuters who used NC video from home reported other privacy concerns. One telecommuter's home office doubled as a guest bedroom. While he felt video was essential (and had it always on), his wife (who was not part of this NC community) did not like the idea: she received no benefit from having the video on and saw it as a possible intrusion. He was also more aware of his appearance: while he previously worked with his shirt off on warm days, he no longer did so. He was also concerned about inadvertently broadcasting situations visible within the room e.g., family members wandering by in various states of undress, or who used the room for other purposes. As a partial solution, he

Meta Platforms, Inc. - Ex. 1024
Page 7

habitually rotated the camera to face out the window when leaving the room. Another telecommuter commented and apologized for the 'mess' visible in his room.

Distraction issues. When many items were on the NC, people found it more difficult to find information they felt important. While people could post many elements to the collage—slide shows, photos, videos—most felt video to be the most essential element. Although *Video* elements always rose to the surface of the collage on every update, it was still effortful to find them in a busy collage. Related to this, people sometimes wanted a way to 'filter' items from the display, especially if the NC was on their personal computer. For example, one person commented that he wanted to remove a *SlideShow* element from the NC because he found the current set of photos uninteresting and the cycling of images distracting. As a consequence, we added the option for people to 'hide' elements. We also saw people regularly move elements they felt important—particularly videos—to the right side of the NC so they would not be covered up.

DISCUSSION

We can distill several general points of NC use from these experiences.

1. NC became interesting only when the communication circle widened to people outside the immediate physical room. We initially thought that NC would have been useful for even co-located people, as items could be left on it for others to see at a later time. This was not a strong enough impetus to warrant its use.
2. People's first instinct was to create a visible presence for themselves: they wanted to see others, and others to see them.
3. People wanted direct as well as peripheral access to the NC. Having it on their personal workstation made it more accessible than just using the public display.
4. People running NC on their personal computer were concerned about the tradeoff between screen space *vs* the value of the information on the NC. Multiple monitors and transparency help.
5. Visitors and people not seated at their workstation used the public display as a convenient way to monitor and post information to the NC.
6. The public display acted as a way for telecommuters to reach people (including room visitors) visible from the its attached camera, and for those people to respond.
7. Making directed conversations visible to the group meant that anyone could monitor and join in, and that those inhabiting a public space could tell a person about a note addressed to them.
8. People exploited media elements for tandem communication (especially video), using each channel to augment the other.
9. People also exploited media elements for asynchronous interaction i.e., to leave messages and artifacts for others to see whenever they wandered by.
10. There remain outstanding privacy concerns that must be dealt with, particularly on how video is captured and displayed and how reciprocity is managed.
11. People would adjust the visibility of items to make them more salient i.e., by moving chosen elements to the right side of the NC so they would not be covered up.
12. The collage metaphor represents all media elements equally, yet some people felt some media elements (e.g., video) to be more important than others. The NC interface should be tuned to recognize this.
13. Unlike instant messaging and media spaces, conversations sometimes began from people seeing interesting artifacts within the space and wanting to talk about them (e.g., photos or desktop snapshots).

In essence, we saw that people treated the NC as a virtual room/bulletin board encouraging interaction. One person would post a media element, and others would (eventually) become aware of it and selectively react to it. What typically ensued was a sometimes brief, sometimes lengthy, sometimes parallel interaction between many people on the board. People made faces at each other, chatted through the *Sticky Notes*, and often posted other media elements onto the NC that were relevant to the conversation. These experiences suggest that NC affords uses spanning several types of collaborative tools: awareness notifiers, instant messengers, media spaces, asynchronous bulletin boards, and MOOs.

RELATED WORK

A rich CHI and CSCW literature forms the intellectual foundations of our work: e.g., awareness [4,6,7], casual interaction [12], instant messaging [13], virtual communities [15], privacy [1,2,8], video media spaces [3], community bulletin boards [9], and system architectures [4,5,14]. Rather than review this well-known literature, we recount two quite different systems that heavily influenced our design of the NC: the CollageMachine and Tickertape.

Andruid Kerne's *CollageMachine* inspired our idea of presenting notifications in a collage. As explained on his website (http://mrl.nyu.edu/ecology/collageMachine/):

CollageMachine builds collages. It deconstructs web sites and re-presents them in collage form. The program crawls the web. It breaks pages down into media elements–images and texts. Over time, these elements stream into a collage.

Collage users prime the collage by feeding it several search terms or URLs that they are interested in. They then influence what new items appear and where they are placed in the collage by selecting items for which they feel an affinity, and by removing undesired items (which weights those types of pages less).

Kerne explains that the CollageMachine is a form of Dada art, as it uses structured chance procedures to generate aesthetic assemblages [11]; thus no two collages will produce identical results. It creates new meaning by recontextualizing found objects i.e., by placing web

Meta Platforms, Inc. - Ex. 1024
Page 8

elements from different sources near each other in the collage. He connects this Dada-inspired collage with *emergence* in cognitive science; researchers have demonstrated that seeing unexpected combinations stimulates people to detect new patterns and form new ideas. CollageMachine exemplifies Kerne's design philosophy of *interface ecology*: an open set of relations which situate the interface and which balances deduction and induction, seat-of-the-pants problem solving, and artistic methods of personal expression [10]. Of course, NC differs substantially from CollageMachine: NC was built for collaborative information rather than web visualization.

The idea of broadcasting notifications to a group was inspired by Tickertape and its Elvin Notification Server architecture [4]. Tickertape is a one-line display: text messages appear in a horizontally scrolling window. Tickertape messages are *published* to one or more named groups. People *subscribe* to particular groups and see only those groups' messages. Messages come from different sources. A person can post a message explicitly, and others can reply by posting to the same group. As with NC, bi-directional posting causes tickertape to double as a chat system. Also, messages can be automatically generated as a side effect of people's activity e.g., calendar scheduling or software repository use. Autonomous clients can collect and repost headlines from information sources such as Usenet news or from on-line news feeds.

While there are many similar attributes between NC, Tickertape and how both are used [4], there are also significant differences. NC visualizes a broad set of multimedia elements, while Tickertape is essentially a one-line text display. NC directly supports interpersonal awareness (through *Video* and *Activity Indicator* elements); Tickertape does not. Because postings are saved in the NC shared dictionary, late joiners can see previously posted elements. In contrast, Tickertape users can only see information posted after they had joined. Consequently, NC acts more like a media space or MOO, while Tickertape is more of a broadcast chat system or MUD.

SUMMARY

We described the motivation, design, and user experiences the Notification Collage. We did not dictate to this group how they should use NC; rather, we saw them rapidly evolve their use of NC as a collaborative environment. We saw NC heavily used by co-located and distributed members.

Of course, there are several problems and issues in the NC. Some are mundane and easy to fix, others (such as privacy and distraction concerns) are more serious and have no obvious solution. We plan to modify and further study NC to address some of these issues. Expected changes include: how items are displayed in the collage (to minimize distraction); creating a richer set of media elements and how people can act on them (e.g., clicking a video could raise a full audio/video channel, while clicking a desktop image would raise a screen-sharing tool); and introducing techniques to mitigate privacy concerns over video [2]. Of course, we plan to deploy NC to other groups and monitor how they use it within their own settings.

In summary, NC affords uses only partially supported by other collaboration tools. It acts as an awareness tool, an instant messenger, a media space, a MOO, an asynchronous bulletin board, and as a public community board.

Acknowledgements. Ideas emerged from chats with Univ. Queensland staff (Geraldine Fitzpatrick, Simon Kaplan, Bill Segall), Microsoft Research Collaboration Group staff (Anoop Gupta and Jonathan Grudin), and Andruid Kerne. Microsoft Research and NSERC funded this work.

REFERENCES

1. Bellotti, V. What you don't know can hurt you: Privacy in collaborative computing. *Proc HCI'96 Conference on People and Computers XI*, 241-261, Springer, 1996.
2. Boyle, M., Edwards, C. and Greenberg, S. The effects of filtered video on awareness and privacy. *Proc ACM CSCW,* 2000.
3. Finn, K., Sellen, A. and Wilbur, S. (eds) *Video Mediated Communication*, Hillsdale, NJ.
4. Fitzpatrick, G. and Kaplan, S. Supporting public availability and accessibility with Elvin. *J CSCW*, Kluwer, In Press.
5. Greenberg, S. and Roseman, M. Groupware toolkits for synchronous work. In M. Beaudouin-Lafon (Ed.) *Computer-Supported Cooperative Work*: *Trends in Software 7*, John Wiley & Sons, 1999.
6. Grudin, J. Partitioning Digital Worlds: Focal and Peripheral Awareness in Multiple Monitor Use. *Proc ACM CHI, 2001*.
7. Gutwin, C., and Greenberg, S. A framework of awareness for small groups in shared-workspace groupware. *J CSCW*, Kluwer, In Press.
8. Harper, R. Why people do and don't wear active badges. *J CSCW* 4(4), Kluwer, 1995.
9. Houde, S., Bellamy, R. and Leahy, L. In Search of Design Principles for Tools and Practices to Support Communication within a Learning Community. *ACM SIGCHI Bulletin* 30(2) 113-118, 1998.
10. Kerne, A. Interface ecology. *interactions* 5(1), 1998.
11. Kerne, A. CollageMachine: Temporality and indeterminacy in media browsing via interface ecology. *Proc CHI'97 Extended Abstracts (vol 2),* 1997.
12. Kraut, R., Egido, C. and Galegher, J. Patterns of contact and communication in scientific collaboration. *Proc ACM CSCW*, 1988.
13. Nardi, B., Whittaker, S. and Bradner, E. Interaction and outeraction: Instant messaging in action. *Proc ACM CSCW*, 2000.
14. Patterson, J., Day, M. and Kucan, J. Notification servers for synchronous groupware. *Proc ACM CSCW,* 1996.
15. Turkle, S. *Life on the Screen: Identity in the Age of the Internet*. Simon and Schuster, 1995.