Sharing Online Photos via Proactive Displays in the Physical Workplace

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ABSTRACT
Online social media services enable people to share many aspects of their personal interests and passions with friends, acquaintances and strangers. We are investigating how the display of social media in a workplace context can improve relationships among collocated colleagues. We have designed, developed and deployed the Context, Content and Community Collage, that runs on large LCD touchcomputers installed in eight locations throughout a research laboratory. This proactive display application senses nearby people via Bluetooth phones, and responds by incrementally adding Flickr photos associated with those people to an ambient collage shown on the screen. This paper will highlight the motivations, goals, design and early deployment experiences with this proactive display application.

Categories and Subject Descriptors
H.5.3 [**Information Interfaces and Presentation**]: Group and Organization Interfaces – *collaborative computing, computer supported cooperative work, synchronous interaction.*

General Terms
Design, Experimentation, Human Factors.

Keywords
Online social networking services, social media, physical spaces, proactive displays, mobile phones, ubiquitous computing.

1. INTRODUCTION
Online social media services enable people to share many aspects of their personal interests and passions with family, friends and strangers. Much of the attention on such services – in the traditional media as well as scientific literature – has focused on the use and impact of such services on interpersonal awareness, connections and relationships. Although there is a growing appreciation for the role of friendships and other informal relationships in work settings [Cohen & Prusak, 2001; Cross & Parker, 2004; Rath, 2006], and some research on the use of social media within the enterprise [Millen, *et al.*, 2006], relatively little attention has been devoted to how sharing personal media through online social networking services can help foster stronger relationships in the workplace.

We are investigating the use of *proactive displays* – large, public computer displays that can sense and respond to nearby people in contextually appropriate ways – in which we explore how a sociotechnical ecosystem consisting of people, offices, mobile phones and situated computer displays can promote greater awareness, interaction opportunities and relationships among collocated collaborators in a work setting. Online media streams flow among these elements of the ecosystem, providing the objects about which people can socialize [Knorr Cetina, 1997].

In this paper, we will describe the motivations, goals and design of a proactive display application, called the Context, Content and Community Collage (C4). The C4 system consists of a client application running on eight 46" LCD touchcomputers equipped with Bluetooth scanners deployed across our lab, a backend server to support the clients, and a collection of administrative tools to manage the system.

Figure 1: C4 display in an open area at the lab

Lab residents who register for the system specify one or more accounts and/or search terms on the Flickr photo sharing web service, and one or more Bluetooth phone names. Whenever those people are detected near one of the displays, photos associated with their Flickr accounts or search terms are arrayed in an ambient collage on the display.

As of this writing, the C4 system has been deployed for a little over a month, in a 25,000 square foot industry research lab with approximately 75 residents. In addition to describing the system, we will also report on some of the early usage and experiences people have had with the system. But first, we frame this system in the context of related work.

2. RELATED WORK

This work ties together at least two threads of research: the use of cameraphones for creating and sharing social media [Kindberg, *et al.*, 2005] and the use of large, interactive displays for showing community-oriented content in shared physical contexts [O'Hara, *et al*., 2003]. A full review of the related literature is not possible within the scope of this paper, and so we will select only a few examples to highlight here.

The growing ubiquity of cameraphones has changed the nature of personal photography. Kindberg, *et al.* [2005] provide an in-depth study of the use of cameraphones, including the use of the cameraphone *photos*. Of particular relevance to this work, they distinguish two dimensions of usage: personal vs. social, and affective vs. functional. We believe the usage we have observed lies primarily in the social/affective quadrant, with some examples of social/functional use. Ames & Naaman [2007] extend these categorizations of the use of cameraphones and cameraphone images to include the use of an online social media sharing system (ZoneTag). We have found similar social motivations behind the practices of tagging online photos in certain ways in our work.

The decreasing costs and increasing proliferation of large, interactive displays, is resulting in an ever-broadening array of physical contexts in which these displays can run applications that offer value to the people in, or passing through, such contexts. The research prototypes developed thus far differ primarily in the types of contexts, content and interaction models they have offered.

The Notification Collage [Greenberg & Rounding, 2001] is an application running both on personal computers and a public display that enabled members of a small work group to share a variety of content – e.g., photos, slideshows, video, web pages, notes – with both collocated and remote members of the group. Although we have adopted the collage metaphor in our C4 application, we have restricted the range content sources – to simplify the use for as broad a population as possible -- and focused solely on public displays, as one of our goals is to increase interactions among people in the physical workplace.

The Plasma Poster Network [Churchill, *et al.*, 2003] consists of three large, interactive displays deployed in a kitchen, hallway and foyer of an industry research lab. Content producers could post text, web pages, images and short video clips; content consumers could read content, navigate different content frames and send messages to content producers. We have drawn heavily upon the insights and design principles articulated in this work, and differentiate it in a few respects: rather than require people to explicitly post individual content items to the displays, we tap into existing social media streams (photos on Flickr); the content shared on C4 displays was more personal, whereas the content shared on Plasma Posters tended to be more professional (though the relatively few examples of personal content were enjoyed by the Plasma Poster content consumers); and the content shown on the Plasma Posters, like that in the Notification Collage, was not related in any specific way to the people who happened to be in front of the displays at any given time.

There are relatively fewer examples of large displays that show content relating to the people who are in their vicinity. IBM's BlueBoard [Russell, *et al.*, 2002] was an example of a large display whose content and applications were affected by people nearby. Users could swipe their employee badges at the badge reader in order to bring up a whiteboard, presentation, calendar or other tools to engage with others on focused collaboration tasks. The C4 system, by contrast, is intended for less focused, more ambient types of awareness and interactions, and so identifies people nearby automatically via their Bluetooth phone names, without requiring a badge swipe.

Another related example of large, situated displays that respond to people nearby is the proactive display applications deployed at UbiComp 2003 [McCarthy, *et al.*, 2004]. This suite of three applications – AutoSpeakerID, Ticket2Talk and Neighborhood Window – required conference attendees to create an explicit web-based profile, associate the profile with an radio frequency identification (RFID) tag, and then showed elements of those profile when the associated tags – usually inserted into conference name badge sleeves – were detected nearby. Although our primary goal is similar – increasing the sense of community among collocated people – the C4 system differs in at least four key aspects: we use a Bluetooth phone rather than an RFID tag to identify people; our profiles do not contain the content to be displayed so much as they are simply pointers to [potentially] continuously updatable streams of content; our deployment is in a workplace setting rather than in an academic conference; and the displays have been in use for a longer duration than a 3-day event.

3. SYSTEM DESCRIPTION

The C4 system consists of a JavaScript user interface that runs in Firefox using kiosk mode, and series of Ruby application servers that allow users to register for the system, detect users near C4 displays, and determine the content be shown on the displays. For the sake of brevity we will focus on the components of the system that help users register, contribute, and interact with the C4 system, and thus, the high-level components that facilitate interactions between users at our research lab.

3.1 Registration

We developed a simple 3 step registration process for users of the C4 system: create a username and password (the username is shown on the C4 display when the user is nearby); select a Bluetooth device from a list of detected Bluetooth devices; and specify and configure one or more content modules from which social media will be selected to show on the display when you are detected nearby. For our initial deployment, users were able to build content feeds using a series of searches on Flickr, a popular photo sharing website.

3.2 Content Module: Flickr

The Flickr content module allows users to create a content pool of publicly shared Flickr photos by specifying personal and/or other people's Flickr accounts from which to select photos. We recognized that some members of the lab do not have Flickr accounts (or use any web-based photo sharing service), and given our goal to make participation as broad as possible, we wanted to enable people to at least have photos representing their interests appear when they were near the displays, even if they were not their own photos. Thus people could either specify others' Flickr account names, or simply leave the account name field blank (a null account name), and specify more general Flickr search terms.

To accommodate general Flickr searches, as well as specific Flickr users who may have photos in their collections that our C4 users would not consider "safe for work" (at least not to be shown

on a public display in the workplace), we offered users two ways of restricting their photo streams. For each Flickr account specified (including the null account), C4 users can specify *include terms* that must appear in a photo's meta data (title, caption or tags) in order to be displayed, and/or *exclude terms* that must not appear in a photo's meta data in order to be displayed.

3.3 Proximity Sensing

The C4 system uses Bluetooth to detect users who are within range the C4 displays. Each display is equipped with two Linksys DBT-120 USB Bluetooth adapters. These adapters constantly scan for nearby Bluetooth devices, each time a Bluetooth device is detected the received signal strength indicator (RSSI) and Media Address Control (MAC) address for the detected device are relayed to a central Location Server. The Location Server interpolates the RSSI values for each Bluetooth device and determines whether a user is *near* the display (standing in front of it) or *far* from the display (across the room, or perhaps in another room, from the display, but still detected by the Bluetooth scanner). The Bluetooth MAC address is then checked against the list of registered Bluetooth devices to generate a list of users who are near or far from the display.

3.4 Displaying Social Media

Each C4 display shows a continuously modified collage built by randomly selecting photos from nearby users' photo streams. The determination of which users' content is shown next is done using a three-tiered system. First, priority is given to new users who have been recently detected by the display (either near or far), but have not had their content displayed. If no recent arrivals are detected, the system uses a semi-random process to select content associated with a user who is near the display (60% probability) or far from the display (40% probability). Once a user is selected, the system randomly selects a photo from that user's content module. If no registered users are near a display it randomly selects a photo contributed by any registered user of the system.

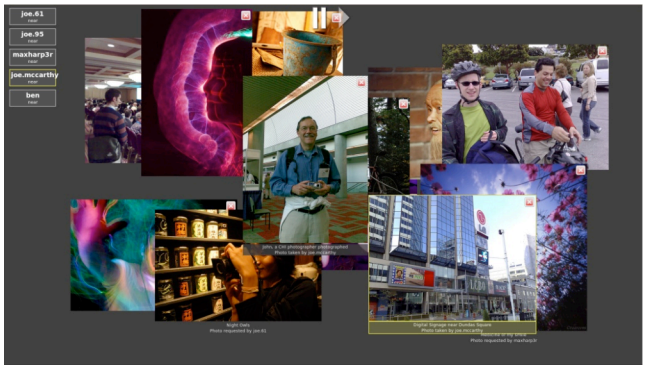


Figure 2: Screenshot of C4 display

The display is virtually partitioned into 5 overlapping regions – upper left, upper right, lower left, lower right and center. A new photo is added to a partition in a pre-specified order (e.g., the first photo is added to the upper left, next photo is added to upper right, etc.), but randomly positioned within each partition. This semi-random rendering of the collage was designed to allow each photo to have as much "face time" as possible while still giving the appearance of a random distribution (and in fact, all users interviewed believed the positioning of photos was completely random).

A new photo is added to the collage every 7 seconds, and the maximum number of photos shown on the collage at any given time is 25 (5 per partition). Photos are removed in first-displayed, first-deleted order, so as to minimize the possibility that users will see any particular photo being deleted (they are deleted "from the back"). In addition to the photos, the usernames of each person currently detected (near or far) are shown in a vertically oriented queue on the left side of the display.

3.5 Interacting with Social Media

The C4 display application runs on a 46" LCD touchcomputer, and we have added a few basic methods for interacting with the application and the photos shown on the collage. Near the top of the display are iconic pause and play buttons, to enable people to temporarily pause the display – in case they want to engage in an extended discussion about a particular photo – and to restart the incremental collage construction afterward (if no button presses are detected in 60 seconds, a warning message is displayed, and if the pause is not explicitly continued in response to the warning, the collage construction continues on).

The photos themselves are framed within panels that show metadata about each photo (i.e. "requested by", "taken by", "date taken", "search query used to find") and can be easily moved around the display. On each photo panel we added an iconic close window button (an "X" in the upper right corner) and a "report as inappropriate" button (iconified as a caution symbol next to the close window button).

3.6 Administrative Controls

To facilitate ease of administration we provide C4 administrators with tools to approve/deny moderations suggested using the display's "report as inappropriate" button. A series of shell scripts was developed to simplify the remote restarting, updating, and monitoring the 8 LCD touch-computers.

4. EARLY USE OF THE DISPLAYS

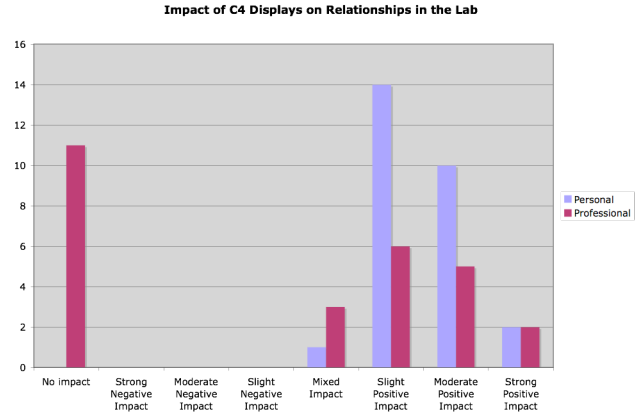
We have been collecting statistics about the use of the C4 displays, and have conducted an initial survey to assess how well the displays are helping to improve interactions and relationships among people in the lab, four weeks after the initial deployment.

At the end of the first four weeks of use, of a total lab population of 75 people – including permanent and temporary (intern) employees as well as external contractors, a total of 51 people created C4 accounts. Of these, 18 did not specify a Bluetooth name and/or a Flickr account, and so the system was unable to effectively sense and respond to them. Of the 33 who did specify both a Bluetooth name and one or more Flickr accounts, 17 specified only their own Flickr accounts, 9 specified null accounts with generic Flickr search and 7 specified both. During this period, we logged 36,983 touch interactions on the C4 displays, of which 34,621 were select or move events, 2,101 were close events, and 261 touch events were associated with the "report as inappropriate" feature (180 events were the initial touches of the caution icon, 49 events were cancellations via a "no" touch, and 32 were confirmations via a "yes" touch). The vast proportion of interactions took place on three displays – the ones in the kitchen, the main open area, and next to one of the rows of cubicles occupied primarily by interns.

During this same period, we logged 37,761 "near" events (i.e., a registered C4 user's Bluetooth phone was within approximately 1

meter of one of the displays) and 3,106,991 "far" events (i.e., a registered C4 user's Bluetooth phone was within approximately 10 meters of one of the displays). Corresponding to the distribution of interaction events, more "near" traffic was detected near the kitchen, main open area and main intern area; "far" traffic followed a similar pattern, but was more evenly distributed.

Four weeks after our initial deployment, we sent around an email link to a web-based survey to 75 people, including permanent and temporary members of the lab, and external contractors. The survey was open for one week, during which time 31 people responded. One of the questions was "On balance, how would you rate the overall impact of the proactive displays on your ***personal*** and ***professional*** relationships with others at the lab?" The results are summarized in Table 1.



On a 7 point scale, where 4 is a neutral rating, the average rating of the impact of proactive displays on personal relationships among people in the lab was 5.63. While one respondent indicated a "mixed impact", all the other respondents indicated at least a slight positive impact. Unfortunately, the impact on professional relationships was not as strong, with 11 respondents reporting "no impact", two reporting "mixed impact" and 13 reporting at least a slight positive impact. This discrepancy between the impact on personal and professional relationships is not surprising, given that the photos shown on the displays were nearly all of a personal nature. However, given the recent research demonstrating the importance – and productivity gains – from personal friendships in workplaces, even increases in personal relationships can have an indirect impact on professional aspects of work [Rath, 2006].

5. DISCUSSION

Our initial analysis of the C4 display deployment indicates that we are achieving positive results toward our goal of improving relationships among the people in the lab. Thus far, the improvement has been primarily in the personal dimension; although we believe there is some indirect benefit to professional relationships, we also plan to introduce new content modules that will enable people to more easily share aspects of their professional lives on the C4 displays.

Other future features we are considering include adding the capability for users to interact with the displays via their mobile phones in more interesting ways (beyond simply having the displays sense the Bluetooth names of the phones), adding more content modules, adding a capability for users to create (not just configure) their own content modules – allowing for user-generated code, in addition to user-generated content – and to add a mode to support more focused collaboration tasks. We also plan to conduct more extensive evaluations of the user experiences with and around the displays.

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