Supporting Social Presence through Lightweight Photo Sharing On and Off the Desktop

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ABSTRACT

Lightweight photo sharing, particularly via mobile devices, is fast becoming a common communication medium used for maintaining a presence in the lives of friends and family. How should such systems be designed to maximize this social presence while maintaining simplicity? An experimental photo sharing system was developed and tested that, compared to current systems, offers highly simplified, group-centric sharing, automatic and persistent people-centric organization, and tightly integrated desktop and mobile sharing and viewing. In an experimental field study, the photo sharing behaviors of groups of family or friends were studied using their normal photo sharing methods and with the prototype sharing system. Results showed that users found photo sharing easier and more fun, shared more photos, and had an enhanced sense of social presence when sharing with the experimental system. Results are discussed in the context of design principles for the rapidly increasing number of lightweight photo sharing systems.

Categories and Subject Descriptors: H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems

General Terms: Human factors, experimentation, design.

Keywords: Digital photographs, photo sharing, mobile devices, social presence, social computing

INTRODUCTION

Digital photo sharing is a common mechanism for friends and family to keep current in one another's lives. Often this is done by posting and viewing photos on web sites and sharing photos over email. More recently, photo sharing systems are becoming lighter weight. The proliferation of camera cell phones has integrated digital photo sharing into people's highly used and mobile communication devices. Most camera cell phones can send images to other phones and email and

messaging accounts. Multimedia messaging service (MMS), available in many countries, provides a protocol for sharing digital media on mobile devices. Blogs and photoblogs are increasingly popular, lighter weight web based media for photo sharing.

Each of these photo sharing methods has strengths and weaknesses. Web-based photo sharing requires the most effort and works well for less frequent posting images of events such as holiday parties. The work of uploading and organizing photos becomes cumbersome for frequent posting. Sharing photos over mobile devices tends to be instance-based in that once a photo is sent and shared it is either deleted or lost in a long list of received messages. Cell phone based photo sharing lacks organization and does not provide the space for group sharing like the relatively heavier weight group photo web site.

Despite any shortcomings, cell phone based and other lightweight photo sharing is rapidly becoming an extremely heavily used communication medium that supports social presence, broadly thought of maintaining a presence in the lives of friends and family. As this medium flourishes, it is important to test for design themes that maximize the potential for these systems to support and enhance social presence.

Presented in this paper is an experimental photo sharing system that combines elements of the current systems and extends them in important ways. First, the usage barriers to sharing are minimized, even beyond today's camera phone sharing. Second, to support the social nature of sharing, it is group centric by default: photos are shared with a group of people as a unit rather than an individual as the unit. Third, shared photos are automatically organized by buddy and persisted for the user. Fourth, the system integrates desktop and mobile based sharing. In short, the system supports the simplicity and informality of mobile device-based photo sharing, while also providing persisted, automatic organization, and integration between desktop and mobile clients.

The goals for this work were to test the impact of the experimental photo sharing system on photo sharing behavior and on social presence, and importantly to evaluate the design

guidelines that motivated the system. Following is a detailed description of the photo sharing system, including design goals and some technical discussion. Also reported are results of an experimental field study of photo sharing, with and without the prototype system, of seven groups of four friends or family members.

Background

Photo Sharing and Social Presence

We used as a working definition of social presence the maintenance of a presence in the lives of friends and family. This includes connectedness and group cohesion, and is driven to a large extent through the sharing of life events with members of those groups.

Enhancing such social presence through storytelling with photos has a rich history [5], and much research has focused on the role of storytelling with digital photos in people's lives [1], and on hardware and software prototypes for shared viewing. [6] studied the photo sharing behavior of family members, including digital and print photos. Primary findings supported the importance of photo sharing as a medium for sharing life events. Digital photos often were e-mailed and viewed while talking on the phone. The Personal Digital Historian (PDH; [10]) project presents a digital photo organization system and prototype table-top digital photo viewer that supports conversational multi-person viewing with an emphasis on storytelling.

 [2] developed a prototype digital photo viewer called StoryTrack to support storytelling with digital photos in much the same manner people use print photos to tell stories: flipping though photos in order to tell the story of a past experience. Photos could be arranged into story tracks, including audio annotation, that could be viewed either locally or sent to a remote viewer.

Social presence can help establish a common social milieu. Pix Pals [7] used photo sharing to allow children from radically different backgrounds to exchange glimpses of one another's lives and social environments. This was a tremendous project that involved exchanges of digital photos between children in London and in various parts of Africa. The exchanges consisted of digital photographs annotated with relatively short descriptions. The rich nature of the photographic media really helped the kids get a sense of the lives of children from different cultures.

One component to social presence is awareness of events in the lives of friends and family. This has been accomplished using photographs in interesting ways. For example, [9] developed the digital family portrait as an awareness system for maintaining awareness among family members, and particularly of the daily activities of seniors. In this system, the frame around a picture is used to provide awareness of happenings in the lives of the people in the picture.

Photo Sharing and Mobile Devices

[8] present an early study of digital photo sharing on mobile devices. Some results from their field study were that photos allowed family members to keep up on one another's life events and that system usage tended to be in the flow of everyday life rather than driven by specific occasions. Design recommendations included support for photo annotation and integration of mobile and fixed photo sharing applications.

In addition to sending photos to other people, mobile device based photo capture is starting to be used in other ways. [14] developed some creative social games, such as collaborative story creation, people can play using their camera phones while waiting at bus stops. In a more industrial application, [11] is developing a system for capturing case stories in the work place with mobile devices in which photos play a central role.

Of course commercial camera phone usage is growingly wildly (see below), and is being used in unexpected, yet meaningful ways, such as the "gift giving" practices documented in teen mobile phone use [13]. Undoubtedly this trend will continue, especially with wider adoption of MMS, and as interfaces for mobile devices grow more sophisticated in handling large amounts of data (e.g., [3]).

Commercial photo sharing systems

Many commercial products are photo web sites, used as much for archiving as for sharing. These sites, allow for storing, organizing, and viewing some number of photos, typically limited by an amount of storage space. In an early step toward integration of mobile and desktop photo sharing, several commercial systems such as Snapfish [12] support viewing web-based photo albums on specific mobile devices.

The number of mobile phones with cameras is growing rapidly, projected by one estimate to rise from 6.6 million in 2002 to 160 million in 2007 [4]. Again, the rapid increase in the use of these technologies underscores the need for study on how to design these systems to meet the goal of enhancing social presence.

FLIPPER PHOTO SHARING SYSTEM

In this section we describe our experimental photo sharing application. We start by defining our design themes, and then present an overview of the mobile version and then desktop version of the software. Because the user flips through photos as with a photo flip book, we took to calling the system Flipper, and will refer to it as such throughout.

Design Themes

The following design themes were stressed throughout development of our photo sharing system.

- Simplicity: Provide a minimal set of features, such as commenting on photos, but maintain focus on photo content.

- Group-centric Sharing: Photo sharing is a social exchange. Support sharing within buddy-list based groups.

- People-centric Organization: Use the people in the group as the natural organization for photos shared.

- Persistence: Persist/Save photos within the people-centric organization.

- Integration of desktop and mobile devices: Both are used for photo sharing; create a system that integrates the two.

- (Near) Automated Sharing: Photo sharing should be as easy as dragging and dropping on the desktop and simply taking a picture on a mobile device.

Mobile Flipper

The mobile version of the application (Figure 1) runs on any Pocket PC device. Pocket PCs were less desirable than mobile phones given their larger form factor, but were selected for feasibility of prototype development.

User Interface

Buddy tiles for people in the user's group are displayed around the perimeter of the screen. The images shared by the currently selected buddy are stacked in the center of the screen for viewing, and are sorted by recency, so the newest image for each buddy is displayed on top. The user simply hits the right and left buttons on the device to flip though photos. The user may navigate to a different buddy's photos by selecting different buddy tiles with the stylus or using the device's buttons. A user may toggle between the main view and full screen image viewing (Figure 2) by tapping the current image or hitting the OK button.

This interface takes advantage of the relatively large screen size of the Pocket PC, and would be hard to fit on the screen of the more ubiquitous cell phone. We expect, however, that as resolution on cell phone screens increases, a reasonable approximation could be achieved.
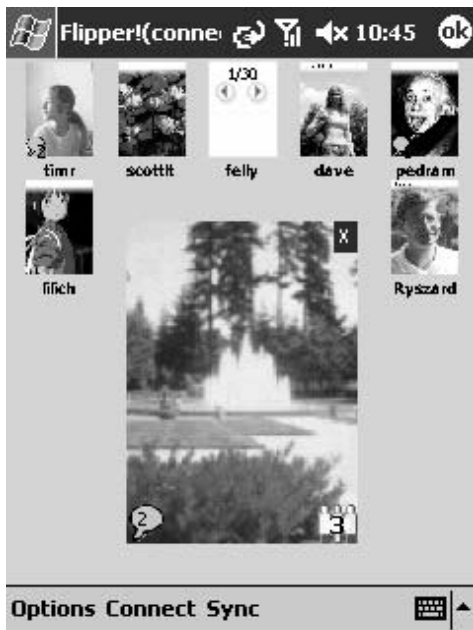
Image Sharing

Figure 1: Mobile Flipper, main screen. Expanded image in center, buddy tiles around perimeter.

Figure 2: Mobile Flipper, full-screen. Image expands to entire screen, maintaining aspect ratio.

Image sharing is made particularly easy on the mobile device. The user simply selects a folder from the Flipper options dialogue to synchronize to the camera's photo storage folder. Once this value has been set, the application periodically checks the files in the folder against images that have already been uploaded by the user. New images will upload in the background and all people with this person in their buddy list will see his or her new images. The result is that photos taken are automatically sent to the group of people with the user on their buddy list. As a check on automatic sharing, users can delete images they shared, removing the image from all buddies' clients.

Image Annotation and Hit Viewing

Additional features were kept to a minimum: commenting on photos and seeing who viewed photos (Figure 3). Users may view and add comments to any image, not just their own. A small comment window is opened by tapping the comment bubble at the lower left. The current system only supports text comments, but given that text input can be tricky with the stylus, alternative means of annotation, such as voice and "doodling" would clearly be valuable.

To support the sense of group interaction and activity, users can see who has viewed different photos by tapping the hits button in the bottom right of any image.
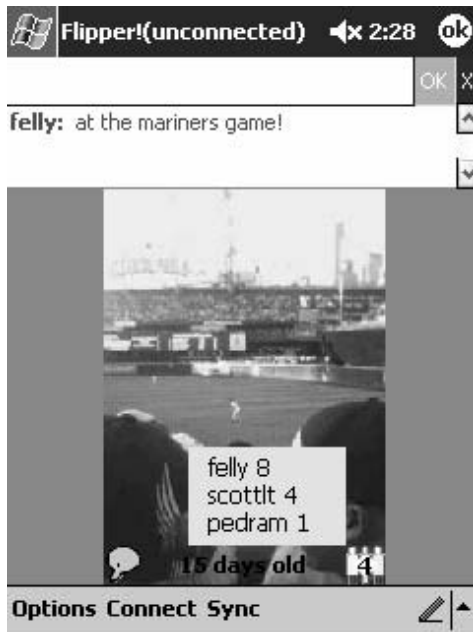
Figure 3: Mobile Flipper, features. Comment box is on top, and viewings are at the bottom.

Desktop Flipper

The desktop version (Figure 4) contains all of the same features as the mobile version. Additionally, both versions use the same back-end infrastructure (see below for a brief overview), and thus share the same content. The desktop version is designed more as a peripheral application, with buddy tiles arranged in a small strip that occupies little screen space. Photo sharing is slightly different in a more selective manner than with the mobile version. Rather than

Figure 4: Desktop Version, screen shot. The desktop version contains the same features and content as the mobile version.

specifying a folder to synchronize, the user simply drags and drops images from his computer into the application and the photo will be shared out with everyone who has that user on his buddy list.

Flipper Components

Back-End

The heart of the back-end lies in an Active Server Page on a server machine. This page acts as a middleware module that communicates with Flipper clients and with a SQL database. The client sends http post requests to the server with embedded xml text requests. The server, in turn, returns any new content and an xml response with information specifying content structure (which photos go with which buddies, etc.). The xml documents are cached on the local device, requiring only new or updated xml to be sent to the device.

Threading

Ensuring application responsiveness was extremely important for the mobile version. To handle the slow processor speed and intermittent internet connection, we implemented much of the back-end server communications in separate threads. We maintained the following actions in background threads: a) poll the server every eight minutes, and, if successful, parse the xml, b) image downloading and caching on the local device, c) image annotation, and d) usage instrumentation.

EXPERIMENTAL FIELD STUDY

We conducted an experimental field study in which we studied the photo sharing behaviors of groups of four people, friends or family, for two weeks each. The goal for the study was to assess the degree to which our system increased photo sharing and social presence.

Methods

Participants

Participants were seven groups of four people, friends or family members, drawn from the Microsoft usability subject pool. Minimal selection criteria were imposed to assess the impact of photo sharing among more "everyday" users. Participants were not required to be heavy photo sharers, but had to own or have easy access to a digital camera and had to currently have a nominal number of digital photos on their computers. Participants ranged in age from 19 to 51. Groups were defined by a range of relationships, including some groups who were very close (22 year old college buddies, mother and daughter) and some who were less close (co-workers).

Procedures

During one week, participants shared photos using the Flipper photo sharing system. Within each group of four, two participants were given Pocket PCs with integrated phones and cameras (Samsung i700 Pocket PC Phones), so that two people in each group were able to use the mobile version of Flipper. During the other week, participants were instructed to share photos as they normally do. During this standard photo sharing week the Pocket PCs were used to take and share photos with other group members via the devices' off-the-

shelf sharing capabilities (email). The arrangement of two participants with the mobile devices and two without was chosen to replicate the likely naturally occurring arrangement, some people with and some without such mobile devices. This also captured all the photo sharing combinations between mobile and desktop users. During both weeks participants were instructed to share photos "as they naturally would" in the hopes of avoiding inflated sharing. The order for using Flipper or standard methods first was counterbalanced across groups.

The experimenter met with participants at the start and end of the experiment. At the initial visit, participants completed a background questionnaire assessing their current photo sharing behavior and relationship to other group members. At the end of the first week, participants were sent an email with instructions to switch photo sharing conditions and to complete a short questionnaire that assessed the impact of photo sharing over the previous week on their relationship with other group members. At the end of the second week, the experimenter conducted a wrap-up session that included completion of the same photo sharing assessment questionnaire, and a roundtable discussion on the Flipper photo sharing system.

Measures
Measures were of three forms. First, behavioral measures were collected to compare the number of photos participants shared with one another using their standard methods versus using Flipper. System usage was instrumented so that for each participant the number of photos shared and viewed, and number of comments on photos in Flipper could be calculated. Tabulation of the number of photos shared using standard procedures relied on self-report as there was no way to record photos sent using various means.

Second, subjective impressions of how photo sharing impacted social presence among group members were collected through questionnaire items, primarily 7-point Likert scales. For example, participants rated how connected they felt to other group members after each week of photo sharing. Participants also rated how easy and fun was sharing and viewing photos using the standard and Flipper methods. Participants using mobile devices completed similar measures specifically referencing their experience with the mobile devices.

Finally, qualitative measures were collected through open-ended response items and through the post-experiment roundtable discussion sessions.

Hypotheses
We predicted that groups overall would share more photos with the Flipper system than with their normal methods and that they would report enhanced social presence as measured by subjective group cohesion, connectedness, and so on. We also predicted that photo sharing would be easier and more fun using Flipper.

Results

Usage: Sharing
Given that the photo sharing behaviors of group members were not independent (e.g., heavy sharing by one person may induce another person to share more photos), analyses were performed at the level of the group. This left a small N of only 7, but was considered a more sound approach statistically. Groups shared more than twice as many photos using the Flipper system ($M_{FL} = 13.69$) than they did with their normal photo sharing methods ($M_{STD} = 6.23$; $t(6) = 2.47$, $p < .05$, Figure 5).

This increase in sharing may be due in part to the automatic nature of sharing with Flipper. To account for this as best possible, reported are the net number of photos shared after deletion. On average 22% of desktop and 0% of mobile photos were deleted. Given that one data source was self reported while the other was objectively measured, it is worth noting that comparisons of self report only data yielded more dramatic differences, with self-reported number of photos shared using Flipper of 16.9 per person on average. Longer term studies are needed to address the possibility that the novelty of Flipper generated increased usage.

The increase in photo sharing with Flipper was reflected in participants' subjective experience of photo sharing. During the Flipper week, participants reported, using 7-point scales from 1 = Not at all to 7 = Very Much, that they were more likely to share photos ($M_{FL} = 5.75$, $M_{STD} = 3.75$, $t(6) = 2.82$, $p < .05$), that photo sharing was easier ($M_{FL} = 5.07$, $M_{STD} = 3.15$, $t(6) = 6.89$, $p < .05$), and that sharing and viewing photos was more fun ($M_{FL} = 5.46$, $M_{STD} = 3.51$, $t(6) = 3.77$, $p < .05$; Figure 6).
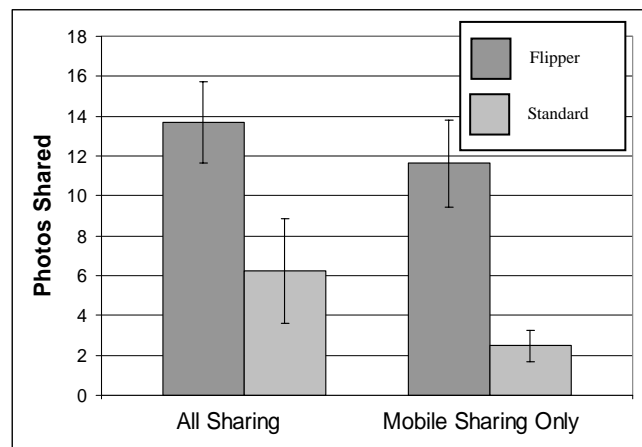

Figure 5: Photo sharing using the experimental Flipper system and using standard methods overall and just with the mobile devices.

Looking just at mobile device users, they overwhelmingly shared photos from the mobile devices, as opposed to the desktop ($M_M = 11.64$, $M_D = 3.2$, $t(6) = 2.98$, $p < .05$). Several participants never posted a single photo using the desktop version. The number of photos shared using mobile Flipper was also significantly more than the number reported sent

from the devices over email (M_{email} = 2.50, t(6) = 4.69, p < .05; Figure 5). Again this difference was supported in the subjective impressions of the users who reported mobile sharing more fun (M_{FL} = 4.86, M_{EM} = 2.21 t(6) = 2.65, p < 0.5) and easier (M_{FL} = 5.36, M_{EM} = 2.50, t(6) = 3.07, p < .05) with mobile Flipper than with email (Figure 7).
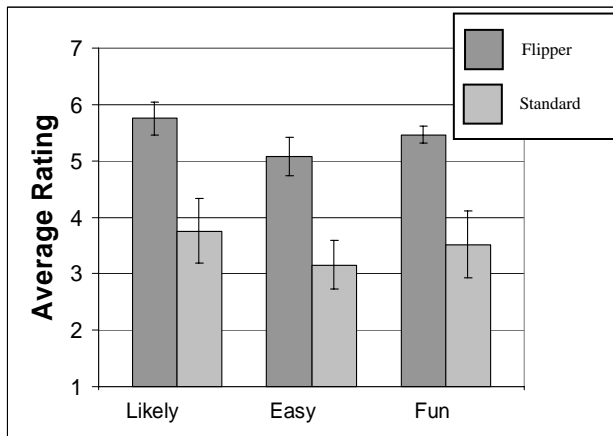

Figure 6: Ratings on 7-point scale from 1 = Not at all to 7 = Very Much So for likelihood of sharing photos, and that sharing photos was fun and easy.
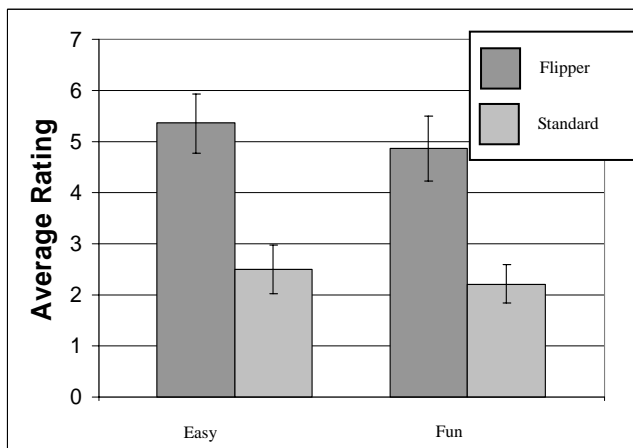

Figure 7: Subjective experience ratings for how easy and fun photo sharing was from the mobile device using the Flipper system and the standard sharing method (email).

Usage: Viewing and Commenting
Our system logged the number of times users viewed and commented on photos. Distinguishing between a viewing and a simple mouse-over en route to viewing a different picture is difficult and our detection of viewings was overly sensitive. For example, the mean number of desktop viewings as logged by our system was 808. For one week's worth of photo viewing, this undoubtedly is an overestimate. However, mousing over more than 800 photographs on average during one week indicates that people clearly were using the system to view and review photos. The range of views shows considerable variability with a minimum of 163 desktop viewings to just over 2300. This means that the most active viewer moused over about 14 times as many photos as the least active viewer.

Viewings on the mobile device are more reliable, since the user had to actually tap with the stylus or navigate to a photo with the navigation buttons. On average, participants viewed 70.65 photos on the mobile devices over a one week period, with a range of 25.5 viewings on the low end to 108.33 viewings on the high end.

Given that text input on a mobile device is difficult, we suspected that people would overwhelmingly use the desktop application to comment. Overall, few comments were entered, with an average total number of comments of 3.92. The bulk of those were indeed entered from the desktop (M_D = 2.69) versus the mobile (M_M = 1.24) version of the application.

Social Presence Subjectives
Participants completed a number of 7-point Likert scale items that assessed the impact of photo sharing on social presence. Items measured were: connectedness to group members, feeling up to date on the lives of group members, extent to which one felt social, level of group cohesion, and extent to which one's experiences were shared with group members. As predicted, many of these (Table 1) showed significant gains in elements of social presence when using the Flipper photo sharing system. For example, significant differences were found for feeling up to date on the lives of group members and that the group was cohesive.

Item	Flipper	Standard	Sig. (2-tail)
Connected	4.92	3.11	p < .05
Up to date	4.43	3.36	p < .05
Social	4.93	4.25	p = .30
Cohesive	4.54	3.00	p < .05
Share experiences	4.50	3.10	p < .05

Table 1: Average social presence responses while sharing photos using Flipper versus standard methods. 1 = Not at all, 7 = Very much.

People reinforced the improved social presence in their verbal feedback. One person said, "The first week I knew what was going on with everybody, but the second I didn't at all." An interesting case is when two people in the same group knew a third person in common, but did not know each other well. The system seemed to help them learn about one another. "I don't really know Michelle, and the first week I knew her a little more, but that second week I went back to not really knowing her."

Qualitative Feedback
As mentioned, at the end of each two week period, participants gave qualitative feedback in a roundtable discussion. Following are some of the highlights of these conversations, particularly as they relate to the photo sharing design goals.

Minimal Features/Simplicity The system was designed to be as simple as possible, with no menus and virtually no options, other than buddy selection and the option to be notified of

new content. People's comments echoed their written feedback that sharing with this system was much easier than with conventional methods. "I really like sharing photos without menus. It was just really easy to share."

A handful of features were nominated as possible additions, although people made it clear they should not interfere with the simplicity of the primary interface. Generally, additional features were directed at organization of photos received. In the current system, photos pile up, ordered chronologically with the newest photos on top. This will have trouble scaling beyond even several weeks worth of photos. A minority of people suggested categorical organization ("holidays", "parties"). Most people, however, preferred the people-centric organization augmented with time-based organization, such that the most recent two weeks or so of photos are visible in the application, and viewing earlier photos requires navigation through a calendar interface. Several people indicated a value in searching through comment text.

Automatic Sharing Given the premise that increasing photo sharing increases social presence, one of the guiding design principles was to reduce the number of steps required to share photos. This notion was taken to the extreme with the mobile version, which automatically shares photos with buddies. Nearly everyone commented that this was a big plus. One person remarked, "It was just done. It was great. It was really great." Many people shared similar sentiments that sharing photos was "just a lot easier." With standard photo sharing people often share only a select few photos, a practice that eliminates the whimsical sharing just to have a fun contact with someone. In contrast, reducing the barriers to sharing allowed people to "share WAY more" photos and to "share photos we never would have shared."

The automatic sharing from the mobile device does, of course, have the drawback that all photos taken will be shared out with other members of the group. This was somewhat eradicated by being able to delete photos shared unintentionally or that a person just didn't like. A more important limitation brought up by every group was that while the automatic sharing was convenient, they wanted more control over who they shared the photos with. For example, the 23 year olds just out of college do not want every photo they take to be shared with their parents, yet they do want their parents on their photo sharing buddy list. To handle this, almost universally, people reported that they would like to single-click select from a list of pre-defined groups that pops up after taking each photo. Participants felt they would have no more than 6 or 7 groups with which they shared photos.

Group-centric Sharing All photos shared were shared with everyone in the group. Although a few people inquired whether they could specify a subset of group members to share specific photos, by and large the advantages of increasing social presence by connecting with all group members quickly and easily seemed to far outweigh the disadvantage of less control over who received what photos. "I liked the way it was set up for a number of people,"

commented one person. Only one person indicated that he changed the nature of the photos he shared because he knew all group members would see them, although this was likely due to the members of this group being less familiar with one another than were people in other groups.

Social Presence and Persistence In many ways the application was designed around a more ephemeral photo sharing: sharing photos with buddies that are fun and keep people posted on your life, but not necessarily photos you would archive. As seen in the questionnaire results above, most people felt they "knew a little more of what was going on in people's lives." Yet, as one person put it, "I like the disposability of it. Normally it's so permanent and heavy: you have to compose an email and then they get it and feel it's this big thing they have to save. With this, it's just this little picture and you drag in your photos and it's easy and they can view it or delete it or whatever." Similarly, people commented that they "found [themselves] always checking to see if anyone posted anything", but also that "it was fun to see people's pictures, but I don't need to keep them around forever." In conjunction with the calendar functionality for older photos, several people suggested simply tagging photos that stay in the archive, with the rest of the photos deleted automatically after some amount of time.

Mobile-Desktop Integration Another design goal was seamless integration of desktop and mobile usage. Aside from occasional internet connection and device issues with the Pocket PCs, generally the integration was quite advantageous. In one group, this was particularly helpful, as the two mobile users never used the desktop version, but still were able to share their photos. As one desktop-only user remarked in reference to photos from a mobile user, "We saw pictures you just normally wouldn't have sent." On the receiving end people were able to show pictures to friends that they received from people sharing from the desktop client.

GENERAL DISCUSSION AND CONCLUSIONS

Our experimental photo sharing system was successful in increasing the number of photos shared and in enhancing people's sense of social presence. Drawing on results from the field study we now revisit our initial design goals, with an eye to revision and improvement.

Simplicity: By definition a lightweight photo sharing system should be simple, and often the photo itself is enough communication. Despite the fact that comments in our system were used only lightly, participants in the field study almost unanimously supported additional commenting features, especially audio commenting.

Persistence versus ephemeral nature of sharing: With storage capabilities rising over time, storage of all photos shared and received is possible. For lightweight sharing systems, however, many photos can be discarded. From our field study, solutions that warrant consideration involve a calendar interface for photos older than about a couple of weeks. Users may then want the option of moving all older photos to the archive or letting them die out unless tagged for saving.

Group centric sharing: Group centric sharing is somewhat radical in that it likely leads to scenarios in which photos are shared with friends or family more peripheral to the photo content. The upside is that group centric sharing increases the sociability of the process, erring on the side of inclusion and widening one's social presence. This was well received in the field study, as seen in people's comments that they started to learn about group members they did not know as well, but our test groups were small. Clearly people will want to have multiple groups with whom they share photos. This warrants further study with groups large enough to include subgroups, but group based sharing could be a default, and individualized sharing a secondary option.

Automated sharing: Automated sharing means a person decides which photos not to share, rather than the other way around. Results show that this made photo sharing significantly easier. However, greater control over which photos are shared with whom should be supported. Based on our field study results, inserting a single intermediate step of selecting a group with which to share should be adequate.

Integrated desktops and mobile devices: Aside from the camera itself, the desktop and the mobile device currently are the primary tools for storing, taking, and sending photos. Such integration of course is not a requirement, and indeed several mobile device users in our field study never even used the desktop client. However, bringing the two together will expanded the sphere of people that can share photos, subsequently increasing social presence. This also supports the somewhat overlooked sharing from desktops to mobile devices.

SUMMARY
Lightweight photo sharing is fast becoming a heavily used medium for sharing life events. An experimental system was build around design themes for such systems with regard to their enhancement of social presence. Results from an experimental field study showed that people shared twice as many photos and had an increased sense of social presence when using the experimental system. Results shed light on possible design guidelines, such as group-centric and automatic sharing, for lightweight photo sharing systems.

ACKNOWLEDGMENTS

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