View & Share: Exploring Co-Present Viewing and Sharing of Pictures using Personal Projection

Andrew Greaves, Enrico Rukzio
Computing Department, Lancaster University, UK
{greaves, rukzio}@comp.lancs.ac.uk

ABSTRACT
Co-present viewing and sharing of images on mobile devices is a popular but very cumbersome activity. Firstly, is it difficult to show a picture to a group of friends due to the small mobile phone screen and secondly it is difficult to share media, e.g. when considering Bluetooth usage; technical limitations and repetitive user interactions. This paper introduces the View & Share system allowing mobile phone users to spontaneously form a group. A member of the group has a personal projector (e.g. projector phone) which is used to view pictures collaboratively. View & Share supports sharing with a single user, multiple users or all users, allows members to borrow the projected display and supports a private viewing mode. The paper reports the View & Share system and a explorative user study with 12 participants showing the advantages of our system and user feedback.

Categories and Subject Descriptors
H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – *Input devices and strategies; Prototyping.*

General Terms
Design, Experimentation, Human Factors.

Keywords
View & Share, projector phone, mobile interaction, personal projection, co-present.

1. INTRODUCTION
The purpose of viewing and sharing media is to communicate the experience with others. The co-present viewing and sharing of media provides communication of this experience between several people and often results in a collaborative task. Frohlich and several others suggest that sharing photos in this manner, face to face, is the most common and enjoyable [1]. The resulting collaboration between co-located people results in photo-talk. Here photos are used as triggers to facilitate storytelling, reminiscing and to raise discussion within the group. Although this is highly desirable, it is very cumbersome and problematic to achieve with a mobile device. Typically the experience is conveyed to everyone by either gathering around a single mobile device or passing the device around the group. Although this satisfies the requirement of sharing, one could argue that this experience is not exploited to its full potential. The experience is of a distributed nature and not consumed by all simultaneously.

Kun et al. presented a prototype application that supports the sharing of photos between multiple devices [2]. In this situation the devices were synchronized to support co-present sharing between users. Although this is a great step in alleviating the need to pass the device around, the sharing semantics used here and also described in similar work require that content is shared with everyone in the group. The small screen issue is also still present. Similarly, Clawson et al. presented Mobiphos, a mobile photo sharing application that allows a co-located group of users to capture and simultaneously share photos with all in real time [3].

Alternative solutions solving the inherent small screen issue are to use large screens in the environment. Unfortunately such displays are neither readily available nor accessible, and certainly destroy the degree of portability that the mobile phone provides. Tabletops are another solution which support viewing of pictures by multiple people and provision easy user interaction. However, like public displays they lack availability, constrain the user to a certain environment are costly and lack portability.

In this paper we describe View and Share [4] and report the findings of an explorative user study whereby 12 participants evaluated View and Share in supporting the co-present viewing and sharing of media. By combing a mobile phone with a personal projection device the small screen issues are solved. This combination provides great opportunities for the mobile phone to be the dominant device in supporting mobile co-located viewing and sharing of media when compared to alternative approaches.

2. VIEW & SHARE
The typical scenario which is addressed by the View & Share mobile application is supporting a group of friends who meet each other and want to view and share their pictures. View & Share supports quick and effective co-present viewing and sharing of media stored on the user's mobile devices. The combination of personal projectors and mobile phones allows several users to view pictures in a large format as opposed to the small limited mobile display.

The View & Share application encapsulates the sharing process and provides simple communication, co-ordination and media requests between single and multiple users. For this reason once a user is connected and thus a member of the group, media requests are handled automatically, transparent to the user and only require a single user interaction rather than multiple steps as is typically necessary. View & Share introduces two sharing interactions; *presenter oriented* and *viewer oriented.*

Within the group, users belong to one of two roles, either a *presenter* or a *viewer*. The *presenter* represents the user with the projector phone or a phone coupled with a personal projector who wishes to project their media for others to view and share. The presenter is the dominant role within the group. This principle is founded upon the *presenter* being the owner of the personal projection device and thus should always have full control. The *viewers* are the remaining users of the group. Their main role is to view the *presenter's* media and be recipients of the shared media.

Figure 1 illustrates the presenter oriented sharing technique. Here the *presenter* browses through their pictures which are then displayed to the group via the projection. The *presenter* can send a

particular picture to all *viewers* through selecting the *send to all* function on the mobile device. The picture is then copied, displayed and stored on the *viewer's* mobile phones.

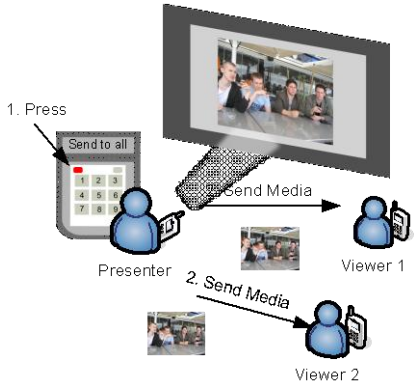

Figure 1. Presenter oriented sharing.

Figure 2 illustrates the viewer oriented sharing technique. Here the role of sharing is shifted and undertaken by the recipient of the media, the *viewer*. The *viewer* submits a request for the currently projected image. When received by the *presenter* the image is automatically sent to the *viewer*. Because the sharing originates from each *viewer*, sharing with a single *viewer* or multiple *viewers* is both possible and easily achieved.

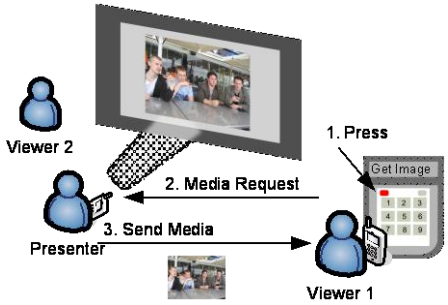

Figure 2. Viewer oriented sharing.

The *presenter* can switch to *private mode* in which the projection is not used. This mode can be used when viewing and sharing private pictures in a public setting. Using this mode, the *presenter* browses through their photos using their device and opts to share private photo(s). The photo is then displayed on all the *viewer's* devices. Here sharing is achieved by each user through viewing their private mobile screen but without users having to gather around a single screen as is currently required.

Viewers within the group can also temporarily borrow the projected display to allow them to view and share their media with others using the *presenter's* projector.

2.1 Implementation

Java ME (CLDC 1.1 / MIDP 2.0) was used to implement the View & Share application and was tested using three Nokia N95's. A battery powered mobile pocket projector (Samsung SP-P310ME) was used as the personal projector. We envision using projector phones in the future once they provide the necessary APIs and independent display support.

Figure 3 illustrates the system architecture. The resulting setup is similar to our previous work and allows independent control of the mobile screen and projection, this is not possible with the currently available projector phone [5]. The laptop is only used as a server allowing projection of content, which differs from the content displayed on the mobile phone screen. The server is not seen or used by View & Share users.

Our approach allows the presenter to browse images on the mobile phone as a grid of thumbnails and at the same time allow others to view the current image but enlarged on the projection. Temporarily disabling the projection is also possible for the case of private viewing, here the projection is obscured.

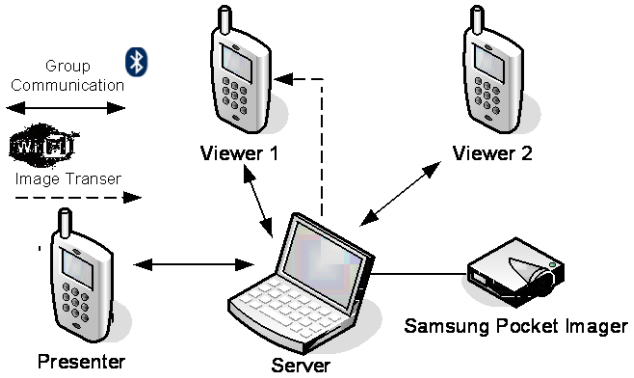

Figure 3. View & Share Architecture

Formation of the group and communication within (co-ordination and media requests) is achieved using Bluetooth and uses a lightweight message protocol. Members of the group must first connect to the presenter. This is achieved by performing a Bluetooth Device and Service Discovery operation. Message requests describe the origin of the message, the operating mode (presenter or viewer), the message function and current privacy setting (public or private). The Java APIs for Bluetooth (JSR 82) were used to facilitate communication within the group and the File Connection API (JSR 75) was used to access media content on the mobile phone. Pictures are transparently shared between devices using WiFi.

Figure 4 illustrates the *presenter oriented* (Figure 4 left) and *viewer oriented* (Figure 4 middle) sharing interactions. The received image, as a result of either interaction, is displayed on the *viewer's* mobile screen (Figure 4 right) and automatically saved.

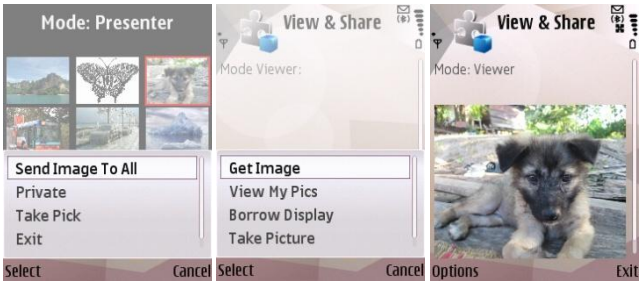

Figure 4. Sharing Interactions.

3. USER STUDY

An explorative user study was conducted observing four groups of three friends using View & Share. The 12 participants were mainly students, all had prior computer experience to a high degree and owned a mobile phone, 11 of which had a camera. 9 of the participants were familiar with photo browsing software on mobile phones and 8 had prior knowledge of sharing photos using Bluetooth. Participants were aged between 23 and 38 with a mean of 27 and consisted of 9 males and 3 females.

Members of each group were all friends and regularly participated together in social events and activities. Each member was asked to provide 30 to 50 photos to be used in the experiment. Backup photos were provided for members who failed to bring photos, this was applicable for two groups. For those who brought photo's it was mandated that at least some of the photo's included all members of the group.

By using groups of friends and familiar photo's we hoped to observe and capture realistic user behavior when using View & Share. We believed that the group experience would lead to collaborative "photo talk" as described by Frohlich [1]. Unlike previous research, we also wanted to observe users social behavior when browsing images in a group using a large projected mobile display, the impact this had on sharing (for example the effect the social setting has) and the benefits of sharing in this way. Usage behavior was also automatically recorded, this included the total number of sharing interactions and type (presenter or viewer oriented), the number of borrow requests, whether these were successful or not and the number of private viewing occurrences.

The experiment was conducted in two different social settings and locations. Group 1 was observed using the system in their own home during the evening. Here the social setting was more relaxed and members of the group indulged in snacks and a glass of wine during the experiment. The remaining groups performed the experiment in the Computing Department at Lancaster University during their working day.

Each group completed a short training phase whereby the functionality of View & Share was demonstrated and explained; participants were encouraged to ask questions. Following this the experiment began and participants were observed, for this purpose audio and video was recorded. The experiment was split into two halves. Firstly, participants were simply observed using View & Share for circa 15 minutes and were left to their own devices. The investigator stayed in the room to answer any questions or resolve any technical difficulties. The second half of the experiment was very similar, however members of the group were explicitly asked to complete certain tasks using View & Share with the intention of allowing every member to portray each of the two roles (viewer and presenter) and evaluate all functionality.

After completing both parts of the experiments each member of the group was asked to complete a short questionnaire containing selected questions from the IBM Computer Usability Satisfaction Questionnaire and the NASA Task Load Index. There were several questions regarding viewing and sharing habits and both their viewing and sharing preferences. Following this a group interview was conducted to elicit feedback, comments and suggestions.

4. FINDINGS & DISCUSSION

The total number of sharing interactions across all four groups was 129, 87 were *viewer* oriented and 42 *presenter* oriented. Between groups those who brought their own photos yielded the greater number of sharing interactions. Private viewing resulted in 25 occurrences and 22 cases of borrowing requests with 15 granted. The lowest mean score (1 = strongly disagree, 5 = strongly agree) for the IBM Computer Usability Satisfaction Questionnaire was 3.58 and the highest was 4.42. For the NASA Task Load Index the mean values were as follows: mental demand = 2.41, frustration level = 2, effort = 2.75 and performance = 4.25. For the latter the higher score closer to 5 represents the best case, for the first three the closer to 1 signifies the better the result.

Viewing media: All participants agreed that viewing photos using the projection when compared to the mobile phone was better. Participants commented that the big screen allowed simultaneous viewing experiences between all group members. One participant raised an issue that occurs when several people view a picture on a single mobile phone, which requires passing the device around. He commented that users have to typically wait whilst others are making comments, they are yet to see the picture and the excitement / suspense builds up as users wait while others make comments. However, when it is their turn to view they are often disappointed. A further participant commented, "The projection facilitates spontaneous interaction, everyone sees it without delay". Benefits with regards to the increased size and resolution of the image were expressed but potential issues with ambient light and finding a suitable projection surface were also highlighted. Further comments included "Easier to view as a group, prefer the projection as it is a natural response rather than a gradual one", "Fun times, fun to comment on together" and "Enables more interaction between the audience".

Sharing Media: Participants raised the following issues when using MMS and Bluetooth to send pictures to friends. MMS is expensive, but for some users MMS are free. One user commented that although she prefers our approach, MMS allows her to send to people far away. Several also commented that they have experienced problems when using Bluetooth, "it is error prone and can only send to a single recipient". All 12 participants agreed that they preferred using View & Share to support the sharing of media between friends when compared to the above methods. The following comments were made: "Very convenient to use", "never have used photo sharing software because it's a pain to setup" and "This method is more intuitive and direct, fulfilling the purpose very well".

Participants quickly grasped the concepts of the two sharing interactions, "The methods here are more straight forward". Although the *presenter oriented* interaction accounted for the lowest number of sharing interactions several commented, "Sending to all in the group is handy". This was also evident when viewing media privately. Further comments included "Methods used here are much more rapid in response and receiving and can upload numerous images at once in a very quick succession" and "Allows participants to get the images they wanted".

One participant in group 2 (the least number of sharing interactions) commented that he wouldn't really share images and was more likely to share videos in pubs, "YouTube videos are pretty funny". This participant also commented that he used Facebook to share images with others.

In both cases when viewing and sharing photos, several referred to Facebook as a means to achieve this and made suggestions to the presenter to add the photos to Facebook. In one instance the response to viewing a picture was, "Amazing, I think I might get that image, are you gonna put them on Facebook" and in another instance and by the same participant "That's cool, that's a well good photo, get that on Facebook".

It is unclear why the participant mentioned this, perhaps it was to bridge the gap between images on a mobile phone and those on the computer, which are uploaded to Facebook. However it is possible to upload pictures to both Facebook and Flickr via the mobile phone. From my personal experience I continually see albums on Facebook with the title "phone pics" and typically these photos captured represent 'in the moment' experiences.

Communicating Experience: By using the projection to view images a high degree of sharing through viewing was achieved by all users simultaneously. Participants engaged in what Frohlich and many others describe as photo-talk; the reminiscing and storytelling of past events as a result of seeing a photo [1]. Participants enjoyed viewing media together, one user commented "Nicer with a group of people, provides spontaneous interaction, prefer to view in a group as people can discuss the photo and make comments", another commented "It's kind of like a movie". For the groups where all members provided photos a greater amount of, and more active communication occurred. In several occurrences discussion of a certain picture led to further discussion of another picture with participants actively engaged in describing and making comments about photos. Some of the members in group 1 had photos which were several years old. This resulted in reminiscing and comments which specifically mocked or embarrassed the individual(s) in the photo, some comments were even abusive but with no intent to offend. Group 1 appeared to be the most active group and were continually laughing, joking and having fun browsing the images. We believe the reason behind this was the social setting in which the experiment took place. Here it was about 8pm, participants were in their own home, appeared more relaxed and participated whist enjoying snacks and a glass of wine. This is representative of an idealistic setting at home. Here they were more actively involved when compared to the other groups who participated at work.

Borrowing: The majority of participants saw benefits in the ability to physically borrow the projected display. Comments included "That's cool" and "I LOVE to borrow". One participant, who happened to be the eldest, made the following interesting comment that no one else raised, "Projector allows retention of personal property, no invasion of personal space or risk of personal data been seen". This applies both to borrowing the projection and also to viewing media via the projection. There were however, some reservations with the process of borrowing the projected display. These included acts which could potentially occur when borrowing and what happens to the media content once the display is relinquished. Users debated whether the submission of a request to first borrow the display was necessary. The idea of being able to push content to the display automatically "why would you ask, we are all friends", or having a reserved area of the projection for each viewer whilst simultaneously supporting the viewing of multiple media sources, seemed appealing. Here the following scenario could then be satisfied, "I've got something to show you, look at this". Further research into social protocols would be necessary to find a true answer to this question in this context of use. Two further issues arose concerning the validity of the borrowed content on the *presenters* phone and situations in which the borrower projects unsuitable or embarrassing photos using the *presenters* mobile phone. In the latter case participants did not assume that just because they were friends they wouldn't project inappropriate content, it may seem appealing to do so.

Privacy: When viewing media privately two cases emerged; Firstly participants would change to *private mode*, locate the image on the mobile phone and then use the *presenter oriented* technique to send the photo to the mobile device of each user. Here the photo remains private to passersby's. In the second case the *presenter* entered *private mode*, located the image and then made the display public allowing everyone to view the large image. This allowed the *presenter* to find the correct image without publicly browsing through their images, which they would not wish to do. The reason for this (also mentioned by several participants) is the typical flat file approach and a lack of a storage hierarchy for media content on mobile devices.

5. CONCLUSION

This paper evaluated View & Share in supporting the co-present viewing and sharing of pictures. All 12 participants preferred our approach to view and share media co-presently. The large projected mobile display facilitated simultaneous group viewing of pictures by all group members, which is currently not possible using a single mobile device. Furthermore, face-to-face in the moment experiences occurred and were shared amongst the group through viewing, resulting in active discussion and further enhanced the viewing experience. Support for sharing with a single member, multiple members or all members is easily achieved requiring only a single user interaction. Observations led us to believe that the social setting and relevance of the projected content specific to the users within the group, impacts users viewing and sharing behavior. In a more relaxed setting for example the users home, an increased amount of photo-talk occurred and comments were of various natures: embarrassing, mocking, descriptive and in general participants seemed to have more fun in physically sharing the experience with others.

Future work shall explore supporting other forms of media, how we can better provision for multiple users, supporting further interactions and continuing to enhance the viewing experience.

6. ACKNOWLEDGEMENT

This work is supported by the NoE Intermedia, funded by the European Commission (NoE 038419).

7. REFERENCES

[1] Frohlich, D., Kuchinsky, A., Pering, C., Don, A., and Ariss, S. Requirements for photoware. CSCW '02. ACM. New Orleans, Louisiana, USA

[2] Ah Kun, L. M. and Marsden, G. Co-Present Photo Sharing on Mobile Devices. Mobile HCI 2007. ACM. Singapore.

[3] Clawson, J., Voida, A., Patel, N. and Lyons K. Mobiphos: A Collocated-Synchronous Mobile Photo Sharing Application. Mobile HCI 2008. ACM. Amsterdam, Netherlands.

[4] Greaves, A. and Rukzio, E. View & Share: A Collaborative Media Viewing and Sharing Framework for Projector Phones. *In:* MIRW 2008. Amsterdam, Netherlands.

[5] Gadget Graver. World's First Video Projector Mobile Phone Epoq EGP-PP01. http://www.gadgetcraver.com/ videoprojectormobilephone-p-198.htm