Co-Located Photo Sharing on Mobile Devices

DANE DOUBELL
Department of Computer Science
University of Cape Town
Cape Town
South Africa
DDoubell@cs.uct.ac.za

PHILIP ARKCOLL
Department of Computer Science
University of Cape Town
Cape Town
South Africa
PArkcoll@cs.uct.ac.za

SUPERVISOR: GARY MARSDEN
Department of Computer Science
University of Cape Town
Cape Town
South Africa
Gaz@cs.uct.ac.za

CO-SUPERVISOR: DYNAL PATEL
Department of Computer Science
University of Cape Town
Cape Town
South Africa
DPatel@cs.uct.ac.za

ABSTRACT

Recent years have seen great advances in the field of mobile device technology and digital photography. These advances have resulted in a significant increase in popularity of such devices. Despite this rise in popularity, technology aimed at facilitating the sharing of the digital photographs using mobile devices is still limited.

This paper aims to further the research into such technology, by detailing the creation of an application, for use in co-located sharing of digital photographs, on mobile devices. The application, nicknamed FunkyShare, will allow users to share photographs in a group setting. Our application proposes to take advantage of the digital photographs format and mobile devices technology, to enhance the sharing experience and promote photo-based storytelling.

A user centred design process is used in the iterative development and evaluation of two software prototypes. Prototype evaluations, in the form of user experiments, yielded several results, from which new requirements for future prototype iterations are elicited. These requirements form a concrete basis for any future work on an application of this nature.

GENERAL TERMS
Design, Experimentation, Human Factors

KEYWORDS
PDA, Education, Usability,
Naturalistic Observation, Smart Phone, Prototyping

1. INTRODUCTION

Recent years have seen a great increase in popularity, as well as functionality, of mobile devices such as cell phones and Personal Digital Assistants (PDAs). Coupled with this, there has also been an increase in the availability of devices with the ability to capture and store digital photographs. These two factors have led to an increasing trend in sharing and viewing of digital photographs on mobile devices.

FunkyShare has been developed as a tool to enhance the co-located photo-sharing experience as well as the involved social interactions around this experience. The tool allows users to use PDAs to share photographs in a co-located group setting.

The FunkyShare application consists of two parts. These are the graphical user interface and the backend networking functions of the application.

2. BACKGROUND

2.1. User-Interface

There is a substantial body of literature [17,16,6,1] on the taking and sharing of digital photos and the rich social experiences involved with these acts.

Two papers, one by [16] T. Kindberg et al. and the other by [6] D. Frohlich et al., discuss several different scenarios in which people share images on their mobile devices.

- People who co-experienced and event and took photographs shared them later.
- People who took photos with the intention of sharing them with other people who were not co-present at the time.
- Photos taken for individual use. Although, often shared
- People taking photos then immediately sending to other people do describe an event.

R. Sarvas et al. [22] discus the social discourse observed around the sharing of mobile photographs. The paper details experiments with a program called MobShare which allows users to share and comment on digital photographs amongst each other in a non-co-located context. MobShare lets users upload sets of images to onto a central image gallery on the internet, from their mobile phones.

Another paper [24] published findings on "Digital Group Histories" where subjects each had photos which they collaboratively placed onto a timeline of related other photographs and stories. The paper discusses the implementation of a Personal Digital Historian (PDH). The PDH is a single display piece of furniture which allows groups of users to sit together and order their photos in a timeline based story.

In [4] a report on the use of mobile devices for the purpose of storytelling using digital photographs is given. The project involved the development of software which supported storytelling through digital images over a network. The paper goes on to discuss several key design themes involved in developing such an application. These include simplicity, group-centric sharing, people-centric organisation of images and fast automated sharing.

This project developed an application for users and therefore it was vital that it be designed with them in mind. Several papers discuss the advantages of User-Centred Design (UCD) or Interaction Design (ID) in the development of user-based applications [14, 13, 20]. UCD is a design methodology which pays great attention to users during all stages of development. In [11], UCD is discussed as a vital design methodology, specifically for the design of applications aimed at mobile devices. In [20] three key points are described as a vital part of the UCD process. These are, firstly, the focus on users from an early stage in the design and evaluation, of artefacts. Secondly, identifying, focusing and agreeing upon specific usability and user experience goals and lastly, accepting that multiple prototype iterations are inevitable. These key points formed the basis for the design and implementation process in this project.

This work touched on several of the aspects described in the literature mentioned above. Below is a list of the areas which were covered during its development:

- Co-located sharing of photographs taken during a co-experienced event
- Co-located sharing of photographs taken during non co-experienced event
- Use of lighter and more compact mobile devices (PDAs)
- Combining of sets of photographs taken during non co-experienced event
- Co-located photo based storytelling
- Group centric photo-sharing and design

2.2. NETWORKING

While there is a growing number of standard communication mediums, there are only two main types of networks: FIXED and AD-HOC. Fixed networks gets its name from the type of network where computers are statically plugged into a fixed network (e.g. via a wall jack) while ad-hoc networks are dynamically changing networks usually determined by proximity to other networkable devices.

This communication of mobile networks is becoming more ad-hoc to suit the style of devices. Along with this trend of mobile ad-hoc networks, a new trend of ad-hoc applications is starting. In a paper describing a definition of an ad-hoc application [7], it can be seen that the desired final artefact of this project should meet that definition, which hinges on three basic requirements:

- Mobility
- Peer-to-Peer
- Co-location

The majority of programs that are created as ad-hoc applications are done for functionality in collaborative software. Collaborative applications are primarily designed for aiding a user to communicate and work with another user for a given task or objective.

When dealing with collaboration, there are four categories into which interaction falls. Below is a table of these categories with examples of each.

Table 1: Collaboration categorised by Time and Location

	Co-located	Non-co-located
Synchronous	Same Place – Same Time (e.g. Meeting support)	Different Place – Same Time (e.g. Video conferencing)
Asynchronous	Same Place – Different Time (e.g. Shift work support)	Different Place – Different Time (e.g. Email)

Various research has been done in each of these areas. A thesis done by Naustaedter [19] is one such investigation into non-co-located synchronous collaboration through webcams and the privacy implications thereof.

Studies have also been conducted into non-co-located asynchronous collaboration. An example is the notification collage of [9] where users can post messages and pictures on the public space for other users to view at any time. This can be used as a synchronous platform when combined with real-time activities, such as has been the case in [10] where an instant messaging service has been built into a public shared space for real-time collaboration.

Although a few papers deal with collaboration in a synchronous, co-located fashion such as [23], it is not in the area of Photo browsing and sharing in a group setting. It is thus in this area of research that this project will focus as it has no published work on the topic.

Keeping in mind that the target area of research is Co-located synchronous photo sharing, a suitable communication medium needed to be decided upon.

The flavours of communication with mobile devices include infrared, Bluetooth, Wi-Fi, GPRS and 3G. Infrared communication is becoming a legacy medium and will not provide the speed needed for real-time collaboration with most of the current applications.

Papers such as [2] have investigated ad-hoc networking using Bluetooth technology and have claimed current Bluetooth communications are too simplistic in design. When looking at the drawbacks of Bluetooth in the same paper, we see that Wi-Fi is superior in ad-hoc networks. When creating an ad-hoc network, it would be prudent to have another communication medium as the primary platform and have Bluetooth devices to connect via a network hop in a Personal Area Network (PAN) as described in an Ericsson Review Paper [12]

Even though 3G and GPRS technology is becoming more affordable to the general public, the 3G speeds of 384 kilobits per second are severely less than the substantial 11 Megabits per second offered by Wi-Fi. GPRS throughput is slower than 3G. Another discrediting factor is that both will incur high costs to use as more photos are shared using either medium.

With regards to Wi-Fi, much work has been done in the area of ad-hoc [5, 11] networks in terms of dynamic message routing and API architecture design [15, 3] as well as of security concerns with quality of service in mind [18]. For all the reasons stated, Wi-Fi had been selected as the chosen medium for the initial implementation.

An API that could handle ad-hoc network communication over mobile devices using Wi-Fi was needed and the most suitable API was one named OpenTrek [21]. The features of OpenTrek are summarised below:

1. High level class hierarchy. OpenTrek uses a high level C++ class hierarchy to interface with the device hardware (where stationary middleware tools often use C (SDL), COM (DirectX) or other proprietary interface mechanisms).

2. OpenTrek Launcher. All applications have to provide a main interface to start and manage sessions. The OpenTrek Launcher provides this, and also enables the developer to customize its appearance using Lobby modules.

3. Automatic network session management. Collaborative Software needs a way for devices in ad-hoc peer to peer networks to physically find each other. The applications also need a way to manage users joining and leaving the different sessions. OpenTrek provides awareness support as well as a session initiation protocol optimised for handheld devices.

3. APPROACH

3.1. APIs

The FunkyShare application GUI was developed using an API called GAPI Draw. GAPI Draw was designed specifically for the creation of graphical applications for mobile devices. The networking backend was developed using OpenTrek, a API which plugs into GAPI Draw and adds wireless networking capabilities.

3.2. User Experiments

The development of FunkyShare involved two user experiments. The user experiments took the form of user focus-groups. The focus groups were also considered as ethnographical studies of how the users interact with a photo-sharing program of this type. As the application designed is the first of its kind it was difficult to make assumption on how users would react to it. It was important that information of this sort be collected and used to shape future iterations of the application. By using these design and implementation techniques, we ensured that users had as much influence as possible on the final application..

The first was an evaluation of an initial software prototype. The purpose of the experiment was to perform a formative evaluation of the application's design. Users were asked to describe using FunkyShare, six personal photographs. This allowed for the study of how users shared photographs which were not taken at a co-experienced event. The data collected from this experiment was then used to form the design of the second prototype.

The second experiment was another formative evaluation. Users were taken on a photograph capturing outing then were asked to share the photographs taken using the FunkyShare prototype. This allowed for the study of how users shared photographs which were taken at a co-experienced event. Results from this experiment were used to design new requirements for any future work on an application of this form.

Both the experiments yielded good results which were subsequently used for improving the FunkyShare application.

3.3. Final prototype

The second and final prototype of FunkyShare was based on the design of an application detailed in [10]. It used a metaphor based on public and private spaces on a screen. Part of the display consists of a private area showcasing all a users private photographs. The other half of the display is a public, shared area. Users can then move a private photograph into the public area by dragging it. The photograph is then shown in the public space of all the other PDA's in the session. *Figure 1* is a screenshot taken of the final prototype.

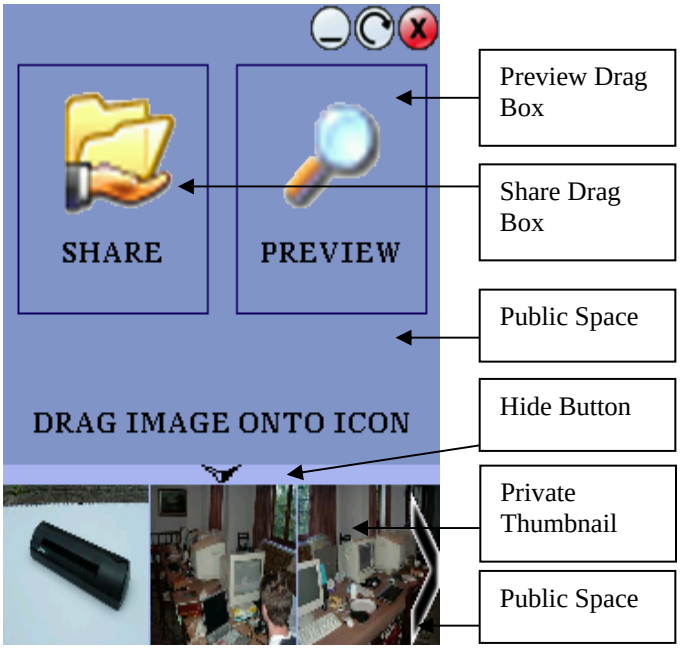

Figure 1: Software Prototype two. Photograph sharing screen.

This is the initial screen seen by the user when the application is launched. The final prototype also included functions which allowed for joint zooming, rotating and moving of images by users. If any user in a session performs any of these functions on the public image the operation is sent to all other PDAs in a session. Users can thus draw special attention to an object in a photograph by zooming in on it and moving it to the center of the screen. *Figure 2* and *3* show a user zooming in on a person in a photograph.

Figure 2: User viewing a shared photograph.

Figure 3: User using the zoom and move function to highlight a particular object in the shared photograph.

4. RESULTS

4.1. Future Requirements

The most important requirement taken from the second experiment was the need for some sort of locking mechanism on the sharing and interaction with photos. It was assumed that some sort of social locking would take pace. However, this was not the case. The user experiment, which involved eight users sharing photographs, began in complete chaos. Users did not take turns and the sharing system broke down. Later it was found that in smaller groups where communication is easier there is more organization in sharing and social locking is sufficient.

A locking mechanism for larger groups, could allow a period of time in which a user can talk about his/her photograph before someone else shows their own photo. It could also allow other users enough time to ask the photograph's owner a question about the photo without anyone else manipulating or changing the photo. A system which allows for control to be passed between users must be developed. However, when we developed this program we did not consider the difference that group size would have on the sharing experience. The more realistic photo-sharing experience would most likely involve smaller groups where the lack if locking mechanism is not such a big problem. Perhaps a compromise could be reached between a system which caters for large groups and one for smaller groups.

Another significant requirement identified was for a session history which would allow users to look at photos shared earlier on in a session. However, without implementing a list of this sort and putting it through user-testing, one cannot ascertain whether users would really find it useful or not.

4.2. Networking Benchmarks

The artefact employs a technique that broadcasts packets to all devices simultaneously. Any unacknowledged packet is sent again, but apart from these intermittent losses, the time taken to send data to one device over OpenTrek is the same for multiple PDAs.

Table 2 contains benchmarked times for sending a photo from one client to another using FunkyShare.

Table 2: Network benchmark results

7680 byte packets

	x PDAs
10k	immediate
20k	immediate
50k	0.5 seconds
100k	1 second
200k	2 seconds
500k	4 seconds
1mb	12 seconds

5. CONCLUSIONS

Based on the iterative development of the artefact, the following requirements have been drawn up for the construction of an application that allows co-located photo sharing over mobile devices.

1. The program must make use of an ad-hoc network
2. The program must implement a private space for each user as well as a shared public space for all users
3. It must be simple for a user to publicly share photos in a private collection or private space
4. Any user should be allowed to share a photo in the public space
5. In a synchronous sharing session, only the owner of the currently displayed image should have control to manipulate that image, unless released to other users.
6. The image file sizes should be adjusted to ensure network transfer times for replicating the image to other clients does not exceed 2 seconds for viewing.

6. FUTURE WORK

Digital Rights Management (DRM) is a topic that receives the spotlight at many conferences and should by no account be left out of this application. While many users enjoy sharing and distributing photos freely, other users keep photos private for personal use only. They exists a market that lies in between when dealing with co-located photo browsing. They are the users who wish to show others photos they have, but do not wish for others to copy them. An analogy can be drawn from a tradable sports card. If someone has a unique card, they are eager to show every friend and family member. If asked to copy the card, they are more reluctant. This is because the more people who possess this card, the less importance placed on it and less popular or valuable it is.

A group such as that could be accommodated by having a menu option where the user can decided whether to copy-protect his/her content and after displaying to others, is deleted off their PDAs.

There is also further study that can be conducted in the field of Large display groupware. With multiple members at a meeting and only a few possessing PDAs, a single large display (such as a 42” plasma screen) can be connected to a computer version of the artefact and members can take turns to use it to aid their talk. This will have implications on advertising to mass audience or the general public shared space where users can update the public photo. Wiki’s can be investigated to see how cooperation would work in this setting.

An OpenTrek licence can be purchased for the use in commercial products. If the OpenTrek launcher can be expanded to include other network mediums such as Bluetooth and re-written to be able to run on non-win16 devices (as most phones are), then the FunkyShare artefact can be ported easily to a cellular phone and used in mainstream photo sharing.

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