Pour Images - An Interactive System for Sharing Images

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ABSTRACT
With the rise of mobile phones equipped with high resolution cameras the event of photo taking has expanded to take place in casual situations capturing ordinary objects. This has created a need for alternatives to todays browsing and sharing of photos. In this paper we present Pour Images, an interactive system for browsing and sharing digital images. Pour Images lets users transfer digital photos from their phones to an interactive table using pouring gestures. The photos can then be manipulated with and shared among multiple users. We evaluated our system by conducting a user study examining the ease-of-use and usefulness of the system. The study showed that people found that Pour Images was a useful and enjoyable way to share photos with friends and family.

Author Keywords
Interactive tables, mobile phones, gestures, photography, photo sharing

ACM Classification Keywords
H.5.2 Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Human Factors.

INTRODUCTION
With the emergence of higher resolution cameras in mobile phones it is now common to shoot pictures of ones' everyday surroundings and memorable things on a casual basis. As soon as people find things special, worth to remember or newsworthy, they point their camera phone and shoot a photo to share with friends and family. This could be a photo of a new haircut a girl wants to show to her boyfriend, or a boy wanting to show his friends his new cool shoes. The new tendency where people express themselves by showing everyday snapshots introduces a new kind of photos that does not necessarily make it all the way to the printed photo album. Instead these photos are viewed using Flickr, Facebook or other online photo sharing services if they are not viewed by handing over the phone that shot the photo. During informal observations we noticed that it has become common that people gather to view a couple of photos from each others' phones. This method however limits the number of people that can join the session, provides little-to-no interaction with the photos for viewers and limits the size of the photo to that of the phone. Sharing photos from a phone is usually done by uploading to online photo sharing services, by transferring between phones using Bluetooth, by e-mailing or instant messaging. However, none of these incorporate the aspect of collocated social interaction into the sharing process.

As an alternative to traditional ways of photo sharing we present Pour Images – an application that enables multiple collocated people to view photos on an interactive display. The interactive table is designed as a coffee table and allows everybody to be seated around it, having equal access to the images on the table. Pour Images allows multiple people to display images stored on their phones at the same time and provide a way for people to copy photos between phones. Around the table everybody can arrange, resize, rotate and play with the images. Finally users can wipe the images off the table when they leave, making sure that strangers cannot see the photos. Pour Images demonstrates a way for people to show, share, and play with images in a social and fun way.

Figure 1. Photo sharing using Pour Images

Pour Images was evaluated conducting a user study that examined how people use their phone camera, and their thoughts on using interactive tables and Pour Images for photo shar-

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ing. The study showed that people found that Pour Images was a useful and enjoyable way to share photos with friends and family.

This paper presents our approach of designing Pour Image by meeting the challenges of today's photo sharing. The remainder of this paper is structured as follows: First we identify related work in this field. We then describe a scenario supporting the system followed by an overview of Pour Images system design. We elaborate this in the Technical Overview with a detailed description of the system. Evaluation and results based on a conducted user study are then represented and discussed. Finally we sum up this study and suggest future work within the area.

RELATED WORK

Photo sharing

Anthropologist Richard Chalfen was one of the first to study conventional photo sharing with a focus on how families share their photos from e.g. birthday parties and holidays. He introduces the concept Kodak Culture as family and friends telling stories about their photos and sharing photos of people they all know [3]. With the rise of digital cameras, the majority of photographs are no longer processed and do no longer end up in the photo album. Instead these photos are viewed upon in front of a PC. Lindley and Monk investigates the challenges that families must overcome in order to share photos [10]. They argue that whereas storytelling with printed photos before were done in social rooms, e.g. the living room, it is now done in front of a workstation designed for one user only. Their proceeding study on the social influence of sharing images in front of a PC, conclude that the lack of physically being able to pass around digital photos, like it is done with printed photos, makes the sharing less socially enjoyable [11]. Specifically they suggest that enabling everybody to access the images as well as changing the seating from peeping over the storytellers shoulder, to be seated face to face, highly improves the experience.

Despite the emergence of digital photos, Frohlich et al. and Kirk et al. both agree that people prefer printed photos over viewing digital photos in front of computer screens [6, 8]. Frohlich et al. investigate practises in digital photo sharing in order to identify the requirements for past and future photo sharing technologies. From their user study the participants reported that looking at digital photos on a computer was a profound turn off and thought that the images seemed abstract and lacked manipulability. However when it comes to organising and browsing digital photo collections research by Rodden and Wood shows that people find it easier to organise their digital photo albums [16].

The rise of digital cameras has changed the values of photos today. In a study by Okabe and Ito on how camera phones are being used in everyday life in Tokyo, they find that people shoot pictures of everyday moments. They describe it as "The mundane is elevated to a photographic object" [15] implying that ordinary objects or events now occur as photo worthy and is shared between friends and family. Research by Mäkelä et al. conclude that digital photos are used to tell stories *with* instead of telling stories *about* a particular photo [12]. Lindley and Monk categorise this further as the images are used to either reminisce about past shared events or for assist a storytelling [11].

Privacy Issues

Sharing digital images is usually done using online photo sharing services like Flickr and Facebook. These services do not alone rely on available WiFi or other mobile network but also raise privacy issues. Miller and Edwards [14] investigate the privacy perspective on the online photo sharing service Flickr and conclude that since the Kodak Culture primarily communicate within their existing social groups of friends and family, there are limits to what they want share online, excluding online services as being a useful photo sharing service. The online sharing services are rather suitable for people who primarily share with strangers. Sharing images by handing the phone over to another person, requires a trust in the other person. The study of Stelmaszewska et al. [18] concludes that people tend less to hand over a phone to work associates than with family. Overall the behaviour of sharing images varies depends on who we share with and where we are.

Interactive tables and Mobile phones

When people share printed photos they are often gathered around the coffee table in the living room. Therefore an obvious alternative to sharing digital photos in front of a PC and photo sharing online, is an interactive table. The interactive coffee table allows collocated people to be seated facing each other, offers equal access to photos, and invites social interaction [17]. Sharing information located on physical objects like mobile phones and interactive tables and possibilities for integration of these have been researched by several. A method for detecting and tracking mobile phones is suggested by Echtler and Klinker using a *always-on-table* approach where the phone is placed on the interactive table in order to establish a connection between the two [5]. Also using *always-on-table* Wilson and Sarin created the system Bluetable, a Bluetooth based interactive system for transferring photos between devices [19]. The Photohelix system [7] by Hilliges et al. is an interactive table application that enables user to visualise and organise photo collections. It is also based on a *always-on-table* placement where controlling and navigating the photo collections is done by placing a physical control object on the table.

As an alternative to traditional interaction forms such as using keyboards and touchpads we suggest using gestures. A user study by Kray et al. [9] investigates the use of gestures on mobile devices, especially focusing on dual-device scenarios. The feedback showed in general that users liked using gestures because of its ease of use and they evaluated it as being "fun" and "quick". Furthermore the participants pointed out that gesturing is most suitable for sending information to other devices. In a proceeding development of the mobile interaction system Cocktail [20] the use of gestures is explored by translating a bartender's gestures of pouring and mixing into transferring and mixing media files. Recently Throw Your Photos was presented at Ubicomp 2010.

The system allows users to have the phone in their hands while engaged in a photo sharing session on an interactive table [4]. In order to display images on the interactive table, they throw the photos off the phone, using thumb gestures.

POUR IMAGES

Based on previous research our focus is to provide an alternative to traditional photo sharing solutions with inspiration from from other systems such as Throw Your Photos [4]. We present Pour Images based on the idea of making multiple users simultaneously share photo shot by phone cameras in a fun and social way. The phones are connected to an interactive coffee table that serves as a display for showing photos.

Scenario

The usage of Pour Images can be explained by following scenario.

> Peter, Karen and Lisa are friends and work together in the same company. Last Saturday all of them were at the company Christmas dinner party. This Monday is like any other Monday and as the clock strikes 11 they go for a cup of coffee. As they brew the coffee they talk about the party and all the fun they had. Karen suddenly remembers Peter performing some fun dance moves while wearing Ann the secretary's shoes. As they are about to get seated by the coffee table Karen grabs her phone and starts pouring images from the party on to the table. They all play around with the images and have a great laugh looking at Peter acting silly. Peter is relieved that these are only showed between the three of them and not shared with hundreds of friends on Facebook. However Peter would still like to have a copy of one of the photos so he takes his phone and tabs the image indicating that it should be transferred to his phone. When it is time to go back to work Karen cleans the images off the table exiting the application, hence leaving the table the same as when they arrived.

System Design

Pour Images consists of two applications; a mobile application and a table application. The mobile application enables the user to share images located on a phone by sending them to a table by performing a gesture with the phone. The table application is directed at multiple users receiving, sending, and displaying images simultaneous as well as letting users interact with the images.

Pouring Gesture

When people shoot pictures using their phone camera and download images from their mobile web browser, they might eventually want to share them with co-workers and friends. Instead of the thumb actions used in Throw Your Photos [4] we suggest the metaphor of pouring images. Here the phone acts as a jug of images that can be poured onto the table. This type of gesture was inspired by the pointing gesture by Kray et al. [9]. After pouring images onto the table the user can simply put the phone back into his pocket or use it for other purposes. As opposed to the *always-on-table* placement method used in e.g Photohelix[7] and Bluetable[19] where you have to leave the phone on the table during the interaction. As with Throw Your Photos we wanted to exclude the privacy issues connected to the *always-on-table* placement by letting the user keep full control of private photos and public photos.

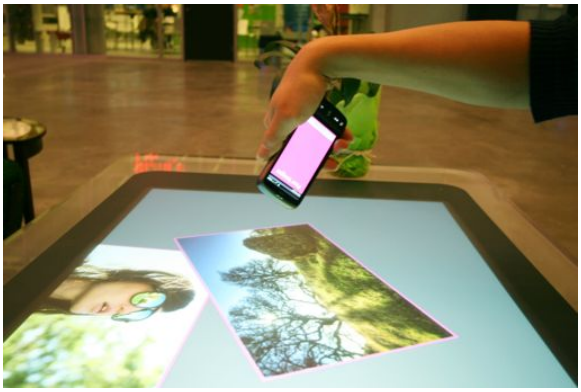

Figure 2. User performing a pour gesture.

Image Visualisation and Manipulation

Showing photos on the table should reflect and bring together the old fashioned way of sharing printed photos placed on the coffee table. After pouring images from a phone, they appear randomly as if someone dropped a batch of printed images on the table. When people gather to share stories or reminisce about events, the printed photos are passed around between people, some are used for telling stories and some photos are pointed at. With simple digital manipulation, people can still pass images around by moving and rotating them for a another person to view it from his particular position at the table. Rearrangement can be made by piling them into stacks and the users can manually sort them. Furthermore people can focus particular images by resizing. Say for instance one is telling a story using three of the images, an upscale of these would then put the images in focus and provide a better view for the people at the table.

Ownership Identification

When a group of people are sharing their images on the same table, there might be times where they want to know who has the ownership of the different images. By ownership we mean who originally poured the photo and to whom the photo was later copied. It might not always be essential to know the ownership so we aimed for a subtle way to illustrate it. Instead of using text we decided to indicate the ownership by colours as done in Throw Your Photos [4]. A set of predefined different colours enables us to distinguish between different people, and their owned images on the table, by assigning each person a colour when establishing connection between phone and table. When a shared image appear on the tabletop its frame will be coloured according to the colour assigned to the owner. If a photo has been copied to multiple phones the frame will then appear colour graded showing all the colours of matching ownerships. By looking at the frame the user can easily determine if he already

copied a particular photo to his phone.

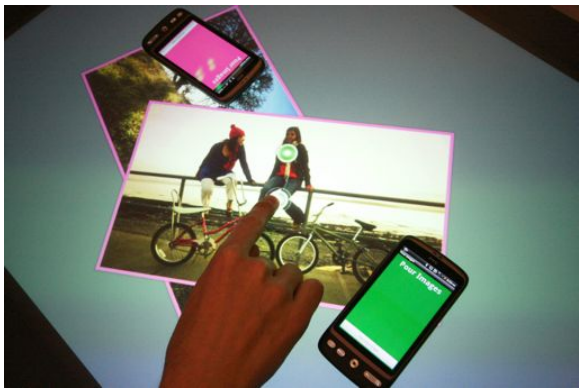

Figure 3. User transferring an image from the table to his phone.

Transferring a Shared Image

People use image sharing for two main purposes; visual support for storytelling or reminiscing about a shared event [6]. In the latter case it is given that the people that were present at the event want their own copy of e.g. a group photo. In Throw Your Photos [4] the user has to drag the image into his proxy zone, changing the position of the image and interrupting the conversation. In our solution the user can tab the image he wants to copy and from an appearing menu start the image transfer. This means that the user can get a copy of the image without moving it or interrupting the ongoing arrangement or conversation of the image.

Leave the Sharing Activity

After using Pour Images, eventually people want to remove the images they have poured on to the table. This might be due to strangers getting seated at the table or simply because one has to leave. However in other situations users might want to shortly leave the table or use the phone for other purposes still leaving the images on the table. The applications allows users to be able to tell when they want to leave thereby removing the photos they own from the table. At the same time we want the users to be able to use their phones for other purposes while the application is still running so they can easily resume the sharing activity.

TECHNICAL OVERVIEW

In this section we present our implementation of the Pour Images system. Pour Images consists of two applications; a mobile application and a table application. The mobile application runs on an Android [1] phone and enables the users to share images located on it by presenting a gallery of all images. As the user browses through the images s/he selects the ones s/he wants to share and performs a pour gesture, which will transfer the images to the table. The table application runs on a Microsoft Surface [13] interactive table and allows multiple users to share their images. Connection between table and phone is established using Bluetooth [2].

Figure 5 shows an overview of the system. Phones and table are connected via Bluetooth (1). Transferring images from a phone to table is done by performing a pouring gesture (2).

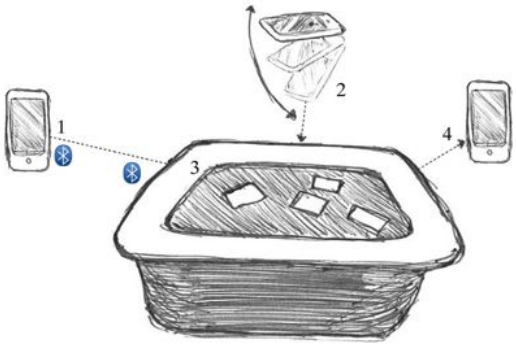

Figure 4. Overview of the Pour Images system. Phones are connected to the table using Bluetooth. Images can be transferred from a phone to the table by performing a pour gesture and back to a phone by using the image menu.

Images transferred are shown on the table and can be moved, scaled and resized using touch (3). Users can then transfer images from the table to their phones (4).

Connection

All communication between phones and table is done using Bluetooth. The table application holds one connection for each phone.

The connection between phone and table is initiated when the android application is started. If started for the first time the application will scan for nearby visible Bluetooth devices and present these as a list to the user as shown in figure 5 (1). The list is filtered to initially show only devices with names containing the word ‘surface’ and an option to show all devices. If no devices with the name ‘surface’ is detected, the list will contain all visible devices. The user can then select the device to connect to by tapping it on the list.

When receiving the connection attempt, the table application will spawn a new thread that handles all communication from and to that phone and start listening for messages from the phone. The phone will confirm the connection by sending a ‘1’. Receiving the message, the table will select a colour for the phone and send this back. The phone changes the background colour of the application to the received colour as shown in figure 5 (2) and saves the table’s Bluetooth MAC address in the local application settings. When the application is started again it will automatically connect to the table without the need of scanning or user-selection, significantly speeding up the process of connection.

The connection is kept open until the user explicitly kills it by using the exit-button or force-closes the application. Leaving the connection open even when the application is not running in the foreground leaves the user free to do other things on the phone while still being able to transfer images from the table to the phone. Furthermore the user can enter the application again without having to reconnect to the table

Figure 5. Mobile application UI screenshots: Start screen of the phone application, display available Bluetooth devices (1). The phone is assigned a colour after the connecting to a table (2). Images are shown in a grid (3). After receiving an image from the table a Pour Images notification appear in the notification bar(4)

Selecting and Transferring images

Selecting images is done from a gallery displaying images stored on the phone. The gallery is implemented using an Android GridView showing images in a grid structure as shown in figure 5 (3). Images are loaded using the Android MediaStore database. The images can be selected by tapping them.

Transferring images is initiated when the application recognises a pour gesture. The integrated accelerometer of the Android phone provides information about the movement and orientation of the phone. The accelerometer measures the position of the phone in space by placing it in a 3-dimensional coordinate system. The mobile application recognises the pour gesture by enabling a service that monitors the accelerometer. We implemented a `SensorEventListener` that uses the `getOrientation` method to get the orientation of the phone. The method returns the X,Y and Z coordinates of the phone's position in space measured in radians. We monitor the Y coordinate and disregard the X and Z coordinates since we want to recognise a pour gesture when the user holds the phone in a downward position no matter how the phone is orientated around other axises. We decide that a pour gesture has occurred when the phone is tilted more that 45 degrees downwards. Translated to the sensor output of $\frac{-\pi}{2}$ to $\frac{\pi}{2}$ radians the angle corresponds to a sensor output on the Y axis of more than 0.78.

The mobile application notifies the table of an image transfer by sending a *2* followed by the number of images the user has selected for transfer. For each image the size of the image is sent then the image data. The table application receives, saves and shows each image as they are downloaded.

Displaying images

The user interface of the table application is implemented using a ScatterView – a WPF component for .NET. Images can be added to the ScatterView and the ScatterView handles all transformation of these images. We have added a menu to images that can be toggled by performing a tap-and-hold gesture on the images as is illustrated in figure 3. The menu is another WPF component; ElementMenu. This menu is designed for touch-application use and we use it by assigning elements in the menu to the colours matching the different phones. When the menu emerges it shows the colour of the users that do not own the particular image. The identification through colours makes it easier for the user to identify his phone in a multi-user environment. When selecting a colour from the menu, the table will send the image to the phone identified with the colour and the frame colour of the image is updated accordingly.

Receiving images

While running the mobile application we will listen for messages from the table signalling that a user has requested an image to be sent to the phone. The mobile application will accept images from the table and save it in a folder on the phone's local storage. Having received and saved an image, the mobile application will store information about the image in Androids MediaStore database allowing the images to be shown in other applications. When the process of saving an image and storing information in the MediaStore is finished the user is notified about the transfer by a notification in the Android notification bar as shown in figure 5 (4). Images transferred to the phone while the application is running in the background will still trigger a notification and hereby always inform the user of successful transfers.

EVALUATION AND RESULTS

An essential part of collocated photo sharing is the social and enjoyable aspects. We therefore first wanted to investigate how people use their phone camera both regarding shooting and sharing photos. Secondly we wanted to investigate how

the participants reacted to sharing phone camera photos using Pour Images. This was investigated by questioning the participants on how useful and enjoyable Pour Images were to them. Our concern was if the participants would find Pour Images suitable for everyday photo sharing and if the participants would enjoy sharing photos on a table.

To answer these questions we wanted our participants to be experienced phone camera users, with a prerequisite that they used their phone camera more than once a week.

Methods

In the first part of the questionnaire the goal was to provide objective measurements on what kind of images people had on their phone and in what context they were shot.

In the second part the goal was to provide objective measurements of Pour Images. We investigated the user reaction to Pour Images by asking them to perform a range of tasks and afterwards answering both quantitative and qualitative questions in order to investigate the usefulness and enjoyment.

Experimental Setup

We recruited a total of 13 participants (11 men, 2 women) among students at the IT University of Copenhagen. 8 of these tried Pour Images while the remaining 5 answered questions not related to Pour Images. The mean age was 30 years. The participants were divided into groups, with people they already knew. The groups were tested separately with each test lasting about 20 minutes. All participants were power users and worked on a PC for four hours or more daily. In contrast 9 participants had no exposure to larger interactive tables like the Microsoft Surface, with 3 having some exposure and one reported professional experience. Moreover the participants found the activity of digital photo sharing using phones, computer screens or social network sites natural among friends.

We conducted the test in a large room in a public building, with people passing constantly. Simulating a living room atmosphere we furnished the test area with a sofa and an armchair and with a Microsoft Surface being the coffee table. On the coffee table we put a small plant, we placed a plant on the floor and added a small side table with a small lamp on it. In each group the participants were seated around the coffee table.

Tasks

We had a scenario on photo sharing with three tasks.

- Show 1-2 photos to your friends from your phone on the table.
- Play around with the images.
- Transfer a photo from one group member phone to your phone.

Procedure

The groups were explained which tasks to go through and while performing the tasks we observed the participants. Upon completing the tasks each participant was given a questionnaire. The questionnaire was split into three parts;

Figure 6. One group filling out the questionnaire after testing Pour Images at the test site.

The first part was a qualitative study of the participant's use of their phone, with questions like: "What was on the last image you shot with your phone?", "What kind of images do you have on your phone?", "How would you usually show your friends photos from your phone?", "If one of your friends has a photo on his phone that you want, how would you get it?" and "Do you see any problems with sharing like that?". A total of 13 answered this questionnaire.

The second part examined the potential of Pour Images on a 5-point scale and the possibility of answering "not sure". 8 participants of the total 13 answered these questions after testing the application. The participants were asked whether they found the application *useful* and *enjoyable*. Furthermore they were asked whether they liked the *gesture for sending (pouring) images* onto the table and whether they liked the *colour identification* on the image frame and the menu. Finally we were interested in knowing if the participants found it easy to use by asking them about the possibility of remembering how to use Pour Images again (*ease of remembering*).

The third part was a qualitative study of 7 participants' opinions on using Pour Images and interactive tables, with questions like: "Do you like sharing photos using a coffee table? Why?", "What are the advantages of sharing images on a coffee table, than say in front of a PC?", "Do you see any problems with using a coffee table for sharing?", "If this application and tabletop were in e.g. cafs and bars – would you then use it? Why?" and "Do you see any problems with letting other people control (e.g. resize and rotate) your photos?".

Results

The results from the second part of the questionnaire are shown in table 1 with the average score and standard deviation. The results are rated on which level the participants agree on a scale from 1 to 5. The lowest score 1 denotes "extremely disagree", the mean score 3 denotes "neutral", and the highest score is 5 being "extremely agree". The first

question showed that in average the participants agreed on the application being useful with none of the answers being "not sure". The second question about whether they enjoyed using Pour Images received a high score (4.42, st.dev. 0.53) with one participant answering "not sure". The question regarding whether the participants liked the gesture for pouring had two participants answering "not sure". Furthermore this question scored the lowest point in the questionnaire with the highest standard deviation which indicates that there were least consensus among the participants on their opinion of the gesture. The respond to whether the participants liked the colour identification 3.71 with one answering "not sure". Finally the question concerning if the participants thought they would be able to remember how to use Pour Images scored the highest point in the questionnaire with none answering "not sure". In general none of the evaluated questions in table 1 showed answers towards disagreement from the participants. The standard deviation were in most cases below 1 indicating that the answers were rather consistent.

	Avg.	*sdt.dev*
Useful	3.75	0.46
Enjoyable	4.42	0.53
Gesture for sending (pouring) images	3.33	1.21
Colour identification	3.71	0.95
Ease of remembering	4.57	0.51

Table 1. Results from the questionnaire.

Discussion

Use of phone cameras

The study by Okabe and Ito [15] on how people in Tokyo use their phone camera, showed that people shoot photos of everyday moments and casual ordinary objects. People use these photos for telling stories or telling news to friends and families. When the participants were asked what kind of images they had on their phone it was these photos of everyday moments. Some of the answers to the question on what images they had on their phones and how they took them were:

> *Pictures of randoms things I see around for uploading in social networks like twitter and also pictures of friends at parties.*
>
> *[A]nything that I find useful and interesting I just take them.*
>
> *Mostly things I need to remember, or of events or happenings. When I don't have my regular camera on me.*

Also it was photos of extraordinary events e.g. a friend doing a trick and especially parties. One answered that the last photo he shot was "'showing off my new shoes", another his lego prototype for an exam project, and a third had just taken a photo as he saw the interactive table. As to how the photos where taken the repsonses were "on the go", "unplanned", "spontaneous" and "point and shoot".

The participants were asked to report in what ways they usually would use for photo sharing. 8 out of 13 reported sharing photos using e-mail, 4 out of 13 reported use of online service like Facebook, Flickr and Picasa, 5 out of 13 reported that they use Bluetooth between phones and 1 out 13 reported use of instant messaging. However on using online services one reported a privacy issue regarding "handling more private photos". Only 4 out of 13 did not see any problems regarding the present ways of sharing photos. On sharing photos with friends they said

> *[I share] through mobile, screen and sometimes through internet like Picasa, Flickr, Facebook [...] Through mails people may forget to send. I'm not sure if I can send to many friends at a time.*
>
> *I usually hand them over the phone to see them or if I have my laptop close at hand I upload them there first to see them on a bigger screen.*
>
> *On the phone or post them on Facebook.*
>
> *Ask [my friend] to e-mail it to me or send it over MSN, I presume he can transfer it onto his PC/Mac.*

It seemed that the participants would find some way to share photos, but not agreeing on how. Our approach was to develop a system that could offer an alternative to the present ways of sharing photos. In the third part of the test we investigated the participants thoughts on using an interactive table and Pour Images for photo sharing.

Privacy issues

Our first main concern regarding Pour Images was privacy issues. Earlier studies by Stelmaszewska et. al.[18] show that people are not comfortable showing their photos to strangers. The questionnaire showed that the participants were comfortable with sharing photos with friends, but using an interactive table in public places like a bar and a cafe raised privacy issues. 3 out of 7 reported privacy concerns regarding sharing in public places, with one reporting that he would not be sure if "my photos were kept when I leave".

> *[I will use it] if it is a place I trust with people around that I know. I wouldn't want strangers to look at my pictures!*
>
> *[I will use it] maybe with a close group of friends.*
>
> *I would not find it comfortable that other people, that i don't know, can look at my pictures.*

We were also concerned that letting other people have control of your photos on the table would be a problem. The questionnaire showed however that as longs as it was not strangers playing with the photos, the playing was "a fun battle" of controlling the photos.

The Gesture

The quantitative score of the gesture was 3.33 on average and only 1 of 7 participants mentioned the gesture in the questionnaire describing it as "cool". When participants used the gesture, most of them did not know when to stop pouring

because it took some time for images to appear on the table. The slow transferring from phone to table created some confusion, which might have influenced the score.

Enjoyment

Using Pour Images and interactive tables was described as "natural", "fun and intuitive", and "awesome". The question on whether they agreed on Pour Images to be useful had an average score of 3.75 and the participants reported that they would use it for showing pictures from shared events. One participant was more specific on what kind of images he would share on an interactive table:

> *[I] would use it for showing pictures from vacation and parties. Not for funny pictures - I would just show the phone. I imagine that in a family where everybody has phones and could like that show images from a shared trip.*

Finally the investigation of Pour Images and using interactive tables for photo sharing had an average score of 4.42 on the question on whether the participants agreed on Pour Images to be enjoyable.

> *Yes, because they are large and can se details and can also compare two images [...] You can discuss the pictures and if you are more than two people together you don't leave the others out of your sharing – others don't feel left out and can easily join in the activity.*
>
> *The touch feeling, having something more similar to a physical photo, makes it feel very natural.*
>
> *It's more interactive and easier to see what you're showing.*
>
> *All friends can see them at a time and can discuss, make fun.*

The overall the evaluation shows that Pour Images can be a social and fun alternative to the present ways of sharing photos among friends and family. The table is suitable for sharing images in homes and private places, in order to avoid the risk of strangers intruding. There are still privacy issues regarding sharing image in the public.

CONCLUSION

In this paper we presented Pour Images, an application for sharing, transferring and interacting with photos. The system design originated from a need of systems that would support the emerge of short-lived photos taken with mobile-phone cameras.

We presented the design and technical specification of Pour Images. The system consists of two applications; a mobile application and an interactive table application. The applications communicate using Bluetooth and allow users to transfer image back and forth between multiple phones and a table. Photos from a phone can be transferred to a table by performing pour gesture with the phone and photos can be transferred back to a phone by selecting it when displayed on the table. Furthermore photos on the table can be played with by moving, rotating and resizing them.

Finally we evaluated Pour Image by conducting a user study that examined how people use their phone camera, and their thoughts on using interactive tables and Pour Images for photo sharing. The study showed that people found that Pour Images was a useful and enjoyable way to share photos with friends and family. However people expressed concerns regarding their privacy and the participants would not feel comfortable photo sharing on interactive displays in public places.

In continuation of our work we suggest a study on how interactive tables can be integrated in public, without violating the personal life of people. Furthermore we imagine that sharing on interactive tables is not limited to images, but is well suited for any other file types like e.g. text documents, video and music files.

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REFERENCES

1. Android. `http://www.android.com/`.
2. Bluetooth. `http://www.bluetooth.com/`.
3. Chalfen, Richard (1987). *Snapshot Versions of Life*. Bowling Green, Ohio: Bowling Green State University Popular Press, Bloomington, IN, USA, 1987.
4. F. Chehimi and E. Rukzio. Throw your photos: an intuitive approach for sharing between mobile phones and interactive tables. In *Proceedings of the 12th ACM international conference adjunct papers on Ubiquitous computing*, Ubicomp '10, pages 443–444, New York, NY, USA, 2010. ACM.
5. F. Echtler and G. Klinker. Tracking Mobile Phones on Interactive Tabletops. In *2nd Workshop on Mobile and Embedded Interactive Systems (MEIS'08)*, September 2008.
6. D. Frohlich, A. Kuchinsky, C. Pering, A. Don, and S. Ariss. Requirements for photoware. In *Proceedings of the 2002 ACM conference on Computer supported cooperative work*, CSCW '02, pages 166–175, New York, NY, USA, 2002. ACM.
7. O. Hilliges, D. Baur, and A. Butz. A.: Photohelix: browsing, sorting and sharing digital photo collections. In *In: TABLETOP 2007: Second Annual IEEE International Workshop on Horizontal Interactive Human-Computer Systems*, pages 87–94, 2007.
8. D. Kirk, A. Sellen, C. Rother, and K. Wood. Understanding photowork. In *Proceedings of the*

SIGCHI conference on Human Factors in computing systems, CHI '06, pages 761–770, New York, NY, USA, 2006. ACM.

9. C. Kray, D. Nesbitt, J. Dawson, and M. Rohs. User-defined gestures for connecting mobile phones, public displays, and tabletops. In *Proceedings of the 12th international conference on Human computer interaction with mobile devices and services*, MobileHCI '10, pages 239–248, New York, NY, USA, 2010. ACM.

10. S. Lindley and A. Monk. Designing appropriate affordances for electronic photo sharing media. In *CHI '06 extended abstracts on Human factors in computing systems*, CHI '06, pages 1031–1036, New York, NY, USA, 2006. ACM.

11. S. E. Lindley and A. F. Monk. Social enjoyment with electronic photograph displays: Awareness and control. *Int. J. Hum.-Comput. Stud.*, 66:587–604, August 2008.

12. A. Mäkelä, V. Giller, M. Tscheligi, and R. Sefelin. Joking, storytelling, artsharing, expressing affection: a field trial of how children and their social network communicate with digital images in leisure time. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '00, pages 548–555, New York, NY, USA, 2000. ACM.

13. Microsoft Surface. `http://www.microsoft.com/surface/`, 2008.

14. A. D. Miller and W. K. Edwards. Give and take: a study of consumer photo-sharing culture and practice. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '07, pages 347–356, New York, NY, USA, 2007. ACM.

15. D. Okabe and M. . Ito. Camera phones changing the definition of picture-worthy. Japan Media Review, August 29, 2003.

16. K. Rodden and K. R. Wood. How do people manage their digital photographs? In *Proceedings of the SIGCHI conference on Human factors in computing systems*, CHI '03, pages 409–416, New York, NY, USA, 2003. ACM.

17. C. Shen. From clicks to touches: enabling face-to-face shared social interface on multi-touch tabletops. In *Proceedings of the 2nd international conference on Online communities and social computing*, OCSC'07, pages 169–175, Berlin, Heidelberg, 2007. Springer-Verlag.

18. H. Stelmaszewska, B. Fields, and A. Blandford. The roles of ti place, value and relationships in collocated photo sharing with camera phones. In *Proceedings of the 22nd British HCI Group Annual Conference on People and Computers: Culture, Creativity, Interaction - Volume 1*, BCS-HCI '08, pages 141–150, Swinton, UK, UK, 2008. British Computer Society.

19. A. D. Wilson and R. Sarin. Bluetable: connecting wireless mobile devices on interactive surfaces using vision-based handshaking. In *Proceedings of Graphics Interface 2007*, GI '07, pages 119–125, New York, NY, USA, 2007. ACM.

20. J.-W. Yoo, W. Choi, K.-W. Park, and K. H. Park. An intuitive data transfer technique using bartender's gestures. In *Proceedings of the seventeen ACM international conference on Multimedia*, MM '09, pages 991–992, New York, NY, USA, 2009. ACM.