Throw Your Photos: An Intuitive Approach for Sharing between Mobile Phones and Interactive Tables

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ABSTRACT
Many approaches have been proposed to connect mobile phones with interactive tables. Most rely on having the phone placed on table all times, which may hinder the overall user experience with applications on phones in general and with photo sharing ones in particular: privacy, intuitiveness of use, and technology limits are on stake. We introduce in this paper an approach which allows users to have the phone in hand when interacting with photo manipulation applications on tables, supported with natural gestures of throwing photos off the phone onto the table and dragging them into it to enhance the connected relationship between the two physical entities even when placed apart.

Author Keywords Interactive tables, mobile phones, sharing, gestures.

ACM Classification Keywords H5.m. Information interfaces and presentation.

General Terms Design, Human Factors.

INTRODUCTION
Many industrial and research institutions have been looking at the possibilities of integrating mobile phones and interactive tables. Their aim is to bring the physical world, represented by the phone and the table, and the virtual one, depicted by the digital content that resides on both, into a meeting point where information would flow intuitively between the two worlds, and the interactions in the two physical modalities would become mutually unified.

To achieve this integration many have looked at how phones and tables can be paired and connected [1]. Others have prototyped different interaction paradigms between both physical spaces to create intuitive user experiences [2]. This paper tackles the second direction where it introduces an interaction concept based on the phone communicating with the table whilst held in hand, unlike known implementations that require the phone to be placed on table at all times. This requirement can incur some limitations. Privacy and control over content on phone is one such issue. It can be experienced for instance when a user places a phone on the table surface and tries to scroll throw come content. Its display would inherently be visible to others around the table and thus whatever on screen, even if personal, is exposed to all.

Another issue involves the usability of interactions on the phone. Users will have to lean over it and return to their normal standing posture every time their attention switches between the table and the phone display to initiate an action on it. This could be irritating especially when there are many people around and when performed repetitively.

Also some technical limitations may incur as of this always-on-table placement. The phone needs some features to be augmented on it such as QR codes [3] or LED lights [2] to allow the table to track it. Attaching markers to a phone however is not a tolerated fashion and phones with infrared LEDs are not common anymore. An alternative to this could be that the table use shape tracking techniques to distinguish phones on its surface [1]. This however is not always efficient as most phones have the same form factor.

The solution we are proposing does not require any phone augmentations and allows the user to fully manage private and public content, in this case photos. The user holds the phone in hand and throws/picks desired photos through simple gestures on the phone and interactive table.

PHONE IDENTIFICATION
A user has a set of photos on his mobile phone and wants to share some on an interactive table with others who can then manipulate or take copies of. They connect vie Bluetooth their phones to the table which pops up a circular shape proxy, or user zone, on its surface for each to identify them. In this case the user does not need to place the phone on the table any more for it to locate him. The proxy acts as the place holder and thus sets the phone free.

Each connected user, or phone, has a different color for his zone as Figure 1 shows. It is initially located at the centre of the table and its owner moves it later to his side to tell the table where he is standing. The only requirement here is that whenever the user changes location around the table that proxy must follow.

With the introduction of this proxy concept we have eliminated the limitation enforced by the need of having the phone always placed on table in order to interact with it.

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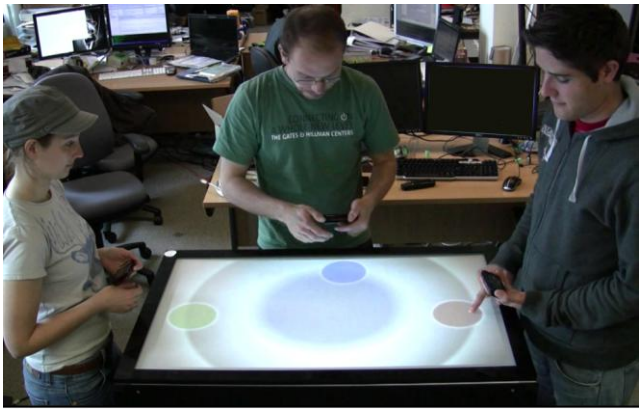
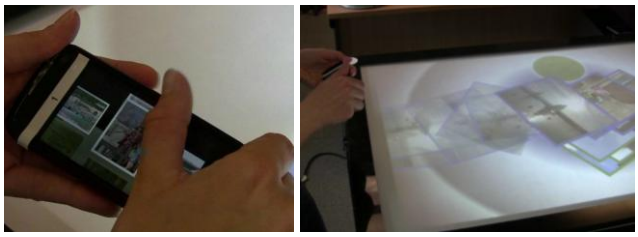


Figure 1. Different colored proxy zones on table identifying different users

INTERACTION CONCEPTS

When connected and the user zone is dragged towards his position around the table, the user can start the simulated gestural interactions. The user flicks through the photos on his mobile phone through the customized photo album application we have developed. Once a photo is determined to be suitable for public sharing the user drags it off the phone screen and "throws" it onto the table as demonstrated in Figure 2a. Once the photo slides off the phone edge it continues its movement towards the table and starts swirling on its surface, as if physically thrown on it, Figure 2b, passing through its owner's proxy until it rests at the table. In this case each user has control over what photos to share and what to keep private. This solves the limitation mentioned in a previous section that relates to privacy where the user has the option now to selectively throw photos and hide them from others around him, unlike some existing applications that transfer everything onto the table when the phone is placed on its surface.



a b

Figure 2. Flicking, throwing and swirling of photos

When a user wants to pick a photo he drags it with his free hand onto his proxy. If it belongs to another user, i.e. it has a different bounding frame color which matches its owner's proxy color, the photo is sent to the user's mobile phone and then returns to the center of the table for others to interact with later. Otherwise, the photo reflects back to its place on the table without being sent over.

TECHNOLOGIES USED

Nokia 5800 phones with resistive 640x360 pixel touch screens were used in the system. The mobile client is written in Symbian C++ and implements OpenGL ES v1.1 for animating the 3D interactions in the photo album.

The viewer application on table was developed with Adobe Flash CS and TouchLib [4] which provides APIs to handle multi-touches on table and translates them into a list of events that Flash can then handle. Because the desktop Flash does not support Bluetooth a Java TCP/IP daemon was developed to connect to all clients and transfer their data back and forth to the table through localhost sockets.

We use a custom built interactive tabletop with a surface area of 91x57cm and a rear-projected screen with resolution 1280x800px. Touch detection is based on computer vision. The employed camera has a resolution of 640x480px and captures images at 120Hz. Highpass, thresholding and dilate filters are applied to make objects on the surface visible.

CONCLUSION

Having an interactive table as a mediator in such scenario is beneficial in social settings as all participants can see the subject photos and interact with or copy them simultaneously, no hassle of turn-by-turn or over-the-shoulder sharing/viewing is experienced. They have control over the visibility of private content and the ability to share what they want through natural gestures. They hold their phones in hand as they would do naturally and interact with them according to their inherent affordances.

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