Throwing Gesture as a Way for Photo Sharing between Mobile Phones and Interactive Tables

Fadi Chehimi[1], Enrico Rukzio[2/1]

[1] Computing Department, Lancaster University, UK
{chehimi, rukzio}@@comp.lancs.ac.uk
[2] University of Duisburg-Essen, Germany
enrico.rukzio@uni-due.de

Abstract. This paper introduces a multi-user photo sharing system between mobile phones and interactive tables which allows users to "throw" photos off the phone screen onto the table surface for viewing and sharing. The introduced approach depends on having the phone held on hand rather than placed on table to allow for natural gestures and more freedom when interacting with phone-to-table applications.

Keywords: Interactive tables, mobile phones, sharing.

1 Introduction

Integrating mobile phones and interactive tables has captured a lot of academic and industrial attention in recent years. The common goal behind their different approaches is to bridge the gap between the physical world, represented by the phone and the table, and the virtual one, depicted by the digital content that resides on both. They aim to reach a usable and natural solution for the integration through which the two physical entities work collaboratively and the two virtual worlds become one.

To achieve this integration many researchers have looked at different approaches of what the possibilities are to connect the phone and the table [1,9]. Others focused at the interaction paradigms on both physical spaces and how they can be combined to create intuitive user experiences [2,3,4]. This paper tackles the second research area where it introduces an interaction concept based on using the phone for communicating with the table whilst held in hand. Most common approaches for this phone-table integration require the phone to be placed on the table at all times. As such, the table would recognize the phone on its surface, track its position, and allow specific interaction method between both, e.g. drag images off the phone to the table and vice versa.

These approaches are generally acceptable but can incur some limitations when implemented or used. One such issue can be related to privacy and control over the content on the phone. When a user places a phone on the table surface its display is inherently visible to others around and thus whatever on screen is exposed. As a result, if the user is skimming through private content whilst in this posture he will

not be able to prevent others from peeking at it, which might cause embarrassment or be uncomforting.

Another limitation could involve usability issues. Users will have to lean over the phone and return to their normal standing posture every time their attention during interaction switches between the phone display and the table surface. In some cases this can be irritating especially when there are many people around and when performed for long periods of time.

Also some technical limitation may be imposed by this always-on-table placement as there will be a requirement of augmenting the phone with extra features to enable the table of tracking it. This could be through visual QR markers [6] or LED infrared lights [2]. Attaching markers to a phone is not a tolerated fashion practice and infrared LEDs are not common any more on new phone models. An alternative for this could be tracking the phone through shape recognition when placed on the table surface [1]. But this technique is not always efficient in distinguishing phones as most of them have the same appearance and characteristics.

The interaction concept behind the work we present here can overcome these limitations by utilizing the phone as a personal controller for the content it contains. Instead of statically placing it on the table, which may limit the freedom of usage and application scenarios, a user holds the phone in hand and applies gestures on its screen to trigger and control specific actions on the table, as in the related work presented in [5,10]. At the same time they may touch the table surface with the other hand to perform another set of events that communicate back to the phone. The table identifies the location of the phone and identifies its user and the direction of the triggered actions through a proxy circular area that pops up on its surface once a phone connects to it. This has been demonstrated in a photo sharing application which allows multiple users around a table to view and exchange photos they have on their phones, and which simulates natural gestures people are used to when dealing with printed photos: throwing, picking and flicking.

2 Interaction Concept

A user has a set of photos on his mobile phone and wants to share some of them on an interactive table with others who can then manipulate or even take copies of. First a Bluetooth connection is initiated between the phone and the table which creates a circular shape proxy, or user zone, identifying the user on the table to allocate him a place on its surface. Each connected user, or phone, has a different color for his zone which is initially located at the centre of the table, as in Fig. 1. Its owner moves it later to his side of the table to start the interactivity without being bound to placing the phone on its surface or to any augmented features to identify his phone. 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 barrier enforced by the need of having the phone placed on table at all times, and have augmented the user experience and their freedom of interacting with both the interactive table and the mobile phone.

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

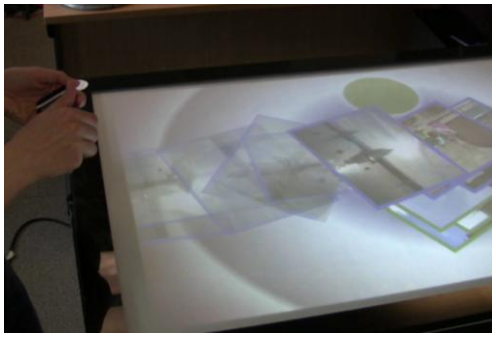
When connected and the user zone is dragged toward the user's location around the table, the interaction metaphor become possible. The user flicks through the photos he has on his mobile phone through the customized photo album application we have developed, Fig 2a. Once a photo is determined to be suitable for public sharing the user drags it off the phone screen and "throws" it onto the table as demonstrated in Fig. 2b. Once the photo slides off the phone edge it is transferred to the table and starts swirling on its surface as if physically thrown on it whilst passing through its owner's proxy until it rests at the centre of the table, Fig. 2c. In this case each user has the control over what photos to share on the table and what to keep private. This solves the limitation mentioned in the previous section that relates to privacy as the user has the option now to selectively throw photos, unlike some existing applications that transfer everything onto the table when the phone is placed on it.

It is worth noting that a coloring scheme has been implemented to identify the owner of photos on the table. This is apparent in the color of the bounding frame of the photo as in Fig. 3 which matches that of its owner's user zone. It helps in quickly correlating and picking photos when there are many on the table.

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. has a different color, the photo is sent to the user's mobile phone and then returns to the center of the table so that others can interact with it as well and take copies of. Otherwise, the photo reflects back to its place on the table without being sent over.

Having an interactive table as a mediator in such scenario is beneficial in normal social settings as all participants can see the subject photos and interact with or copy them directly, no hassle of turn-by-turn viewing or over-the-shoulder viewing is experienced as usually experience when viewing/sharing photos between multiple mobile phones. It is worth noting here the advantage that an interactive table has in this context over public displays: it provides direct, all-users interactivity with the displayed digital content which adds another dimension to the overall sharing experience.

a b



c

Fig. 2. Flicking, throwing and swirling of photos

Fig. 3. Photo frame colors correspond to users' proxy colors

3 Technologies Used

The infrastructure to facilitate this interaction concept relies on having a front-end client application on the phone and another one on the table.

The mobile devices used are the Nokia 5800 XpressMusic with resistive 640x360 pixel touch screens running S60 5th Edition on Symbian OS v9.4. The mobile client

application was written in Symbian C++ and implements OpenGL ES v1.1 for animating the 3D interactions in the photo album. The device however does not have a graphics processing unit (GPU) which causes a noticeable effect on the overall performance of the 3D visualizations but not on the interaction mechanism.

The viewer application on table was developed using Adobe Flash CS and TouchLib library [8] which provides the needed APIs to handle multi touches on the table and translate that into an appropriate list of events handled by Flash.

Because the desktop version of Flash does not support Bluetooth communication a daemon application had to be developed to liaise that task. It is written in Java and it connects to all mobile clients and transfers their data/commands back and forth to the table through a localhost TCP/IP socket connection. This extra mediating layer between the phone and the table has introduced some delays during throwing and picking photos but doesn't interfere with the general experience.

We use a custom built interactive tabletop with an active surface area of 91cm by 57cm and a rear-projected screen with a resolution of 1280px_800px. Touch detection is based on computer vision. The employed camera has a resolution of 640px by 480px and captures images at 120Hz. Any object in contact with the surface is clearly visible after applying highpass, dilate, and thresholding filters.

4 Conclusion and Future Work

The work presented here shows how mobile phones and interactive tables can be integrated to facilitate photo sharing between multiple users without the need for a user to lean over the phone whilst placed on the table to perform desired activities, or expose private content he has on his phone to all participants around the table. Instead the user holds the phone in hand and interacts with it naturally in compliance with its affordances and has a complete control over what to make public and what to retain private. A user study will be performed to confirm these arguments.

This type of control and interaction could be utilized very well in the future for collaborative multi-player games where the phone holds the player's game content and the table acts as the playing board for example, the poker surface game in [7] demonstrates the possibilities of this. Another good example for this which could be explored in the future is cards games where the user holds his cards on the phone and flicks them off to the table. Each card can be related to its owner through the coloring scheme introduced above or by possible attachment of the player's face thumbnail on a corner. Face thumbnails can also be attached to the proxies on the table to allow better identification of content ownership.

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