MobIES: Extending Mobile Interfaces Using External Screens

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ABSTRACT

Recent mobile phones allow users to perform a multitude of different tasks. Complexity of tasks challenges the design of mobile applications in many ways. For instance, the limited screen space of mobile devices allows only a small number of items to be displayed. Therefore, users often have to change the view or have to resize the displayed content (e.g., images or maps) to view the required information. We present the system MobIES, which allows users to extend the mobile interfaces of their mobiles phones using external screens. Users connect their mobile phone with an external display by holding it on the border of the external display. When the connection is established, the user interface of the currently active mobile application is distributed on the phone and the external screen. This enables users to take advantage of using existing screens in their environments and temporarily benefit from an extended screen space. In this paper, we discuss the concept of MobIES and present a prototype implementation.

Categories and Subject Descriptors

H.5 [**Information Interfaces and Presentation**]

General Terms

Human Factors.

Keywords

Mobile Phones, Extended User Interfaces, Cross Device.

1. INTRODUCTION

Today's mobile phones enable users to perform all kinds of tasks while being on the go. For instance, users can edit photos, movies, or text documents as well as performing many other complex tasks. One of the main limiting factors is the size of the mobile phone screen. It allows only a small number of items to be displayed at once [1]. Hence, only few information and details can be displayed on one application page. Therefore, users often have to switch between different pages or views to access different pieces of information or resize content such as maps or images to view the needed level of detail. Further, jointly viewing of content such as photos is limited to a small number of users. In contrast, users find large displays in their environments yet cannot make use of them by exploiting the available screen space. For instance, public displays at airports or train stations, TV sets, or information kiosks can be found in many situations and users' environments. In this paper, we present an approach which allows users to establish an ad-hoc connection between their mobile devices and external displays by holding the phone on the border of an external screen (see Figure 1(a) and (b)) in order to temporarily extend the mobile user interface across the mobile and the external screen. This allows users to take advantage of existing large displays in their environments through spanning the mobile application user interface across multiple displays which allows to display more information at once (see Figure 1(b) and (c)). In addition, multiple users can take advantage of an external screen as a shared interactive surface that allows for instance, sharing and transferring data from one device to another (see Figure 1(d)).

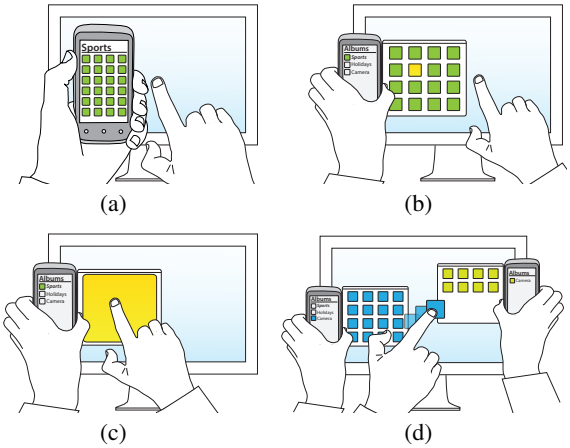

Figure 1: The MobIES concept: a) the mobile screen is limited in size, and b) can be extended on an external screen, which c) provides additional screen space. d) Sharing data with others straightforward.

A large body of related work addresses the challenge of integrating mobile devices into existing device infrastructures in order to facilitate the interaction. For instance, Rekimoto and Saitoh investigated hyper dragging for seamless interaction across multiple devices [5]. Hinckley et al. present stitching, which allows users to connect multiple tablet PCs to create a larger logical screen and to transfer data between the devices [2]. Lucero et al. investigated how multiple mobile phones can be integrated in order to create a shared screen [3]. In contrast to the MobIES, their approach is

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based on each participating user providing an additional mobile screen. Lyons et al. investigated how application user interfaces can be distributed across multiple screens [4]. In the following, we discuss the concept of MobIES, detail the prototype implementation, and conclude the paper.

2. CONCEPT OF MOBIES

The concept of MobIES is based on users connecting their mobile phones with an external screen to create for a limited period a larger logical screen. Options for interaction are the relative position of the phone to the screen, i.e., the position where the phone touches the external screen. Further, users can perform input rotating the phone while touching the rim of the external screen. For instance, the phone can be used like a turning knob to adjust a value. The third option for performing input is (given corresponding hardware capabilities) touch-based input on the large screen and the mobile touch screen. To illustrate how MobIES supports interaction, we give a short scenario: Alice wants to show some pictures she made with her phone to her friends. Since the phone screen is rather small, they have to pass around the phone. In order to jointly view the photos, Alice connects her phone with a nearby screen. Now she can control which photos are displayed on the external screen while interacting on the phone screen.

3. IMPLEMENTATION

We implemented a prototype system, which allows multiple users to connect their phones with an external display (Dell 23" dual touch display). We placed an array of Near Field Communication (NFC) tags on the border of the screen in order to detect the event of connecting the phone with external display (see Figure 2). Each tag stores the following pieces of information: location, Wi-Fi name, and server IP. This approach causes low costs and any existing screen can be augmented. As mobile phones we used Samsung Nexus S devices, which are equipped with an NFC module.

Figure 2: An external display equipped with NFC tags on the border for detecting the physical connection. (a) Uncovered NFC tags. (b) Prototype screen with tape covered tags.

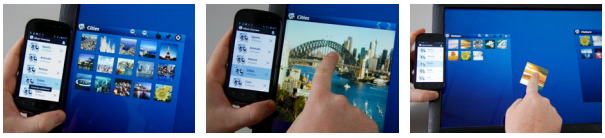

Figure 3: The photo sharing application: (left) extended overview; (middle) focus on a single image; (right) sharing images with other user by dragging an image from one extended interface to another.

We implemented three demo applications (photo album (see Figure 3), map application (see Figure 5), and a web browser (see Figure 4)) that can be operated each in two different modes: mobile only and mobile and extended screen. The current state of the application (e.g., which web page is being displayed in the web browser) is transferred from one state to the other. That is, the same content is displayed after connecting or disconnecting the external display.

Each mobile application that supports the connection to the external display requires a matching software component on the external display side. A server application running on the computer that controls the external screen manages which component is launched when a phone connects to the screen.

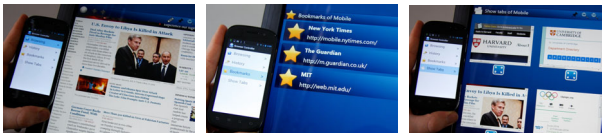

Figure 4: The web browser application: (left) extended web page view; (middle) selecting bookmarks; (right) browser tab overview.

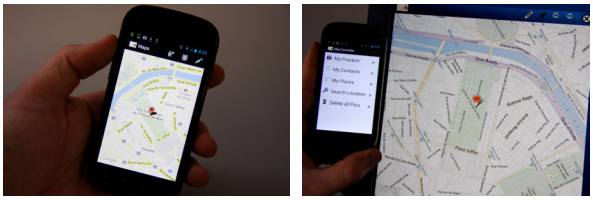

Figure 5: The map application: (left) mobile mode; (right) the map displayed on the large display, options on the mobile display.

4. CONCLUSION

Users of mobile phones often have to change the view or resize the content they are viewing on their mobile screens. We presented MobIES that enables users to temporarily connect their mobile devices with larger displays in their environment. The approach is simple and low cost and any exiting display can be equipped with the required hardware. We have implemented a prototype system that shows how standard mobile applications such as a mobile web browser or a photo album application can benefit from the MobIES approach.

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