Interactive Phone Call: Exploring Interactions during Phone Calls using Projector Phones.

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ABSTRACT

Despite all the benefits the mobile phone offers, during a phone call it largely remains unused. Access to its applications, services and vast amount of online information is prohibited since the user interface is engaged with an active call. In this paper, we explore interactions during active phone calls to satisfy common scenarios, tasks and support distributed interactions between callers. Using a projector phone we project a virtual mobile phone interface from the bottom of the mobile phone whilst the user holds the device to their ear. Combining this with touch technology we allow the user to directly interact with their mobile phone, applications and services during a call. By considering alternative forms of projection technology, for example an ear worn device which encompasses a pico projector and camera it is possible to support two handed interaction between the projection and the physical mobile phone. This paper presents several real life scenarios which benefit from the ability in being able to interact with a mobile phone during a call.

1. INTRODUCTION

We use our mobile phones to support many tasks; email, maps, pictures, navigation, calendar and access great amounts of online content and information in addition to telecommunication. The mobile phone is an integral part of our lives which we use to satisfy a vast range of scenarios and activities. Largely, the mobile phone remains unused during phone calls. It is used to communicate, which typically requires that that user holds the device to their ear. The mobile phone user interface is not seen by the user and only limited interactions with the phone are possible, for example access to the loudspeaker, call hold functionality and browsing of contacts.

Rather than under utilizing the mobile phone whilst making a phone call we propose that it should be used to its full potential. Access to the user's calendar, photos, maps and online information would be beneficial. This would allow the user to multi-task to complete a goal during a call or possibly assist the person their calling or who called them. Here a concrete appointment could be made with the person at the receiving end during the phone call by referring to one's online calendar, or accurate directions from a map could be relayed over the phone. We currently support these activities by referring to alternative sources of information or by using a nearby computer. Wilts and Nichols [1] describe several scenarios in which a mobile phone is used concurrently with a computer to complete a task.

Gunaratne and Brush report that calling a friend to ask them to look up information, which is sought using a computer is a popular activity [2]. Their evidence suggests that the ability to access and interact with the mobile phone during an active call for sharing is both beneficial and welcomed. Wiltse and Nichols categorize this popular activity as a 'high-urgency' request, i.e. information that was needed at a specific moment in time for a specific purpose [1]. In the real world whilst on the phone we continually resort to asking others in the vicinity to provide information, for instance asking for directions. Alternatively and indeed more popular we simultaneously use a computer which is in front of us when on the phone, whilst at work for example. However, these approaches are flawed in situations where others are not present or when access to a computer is prohibited, whilst on a train for example. Gunaratne and Brush report that with increasing distance to computers users are less willing to physically move to find a computer, and would prefer to use their mobile phone to satisfy the scenario. If currently engaged in an active phone this is not possible to achieve.

In this paper we explore and present a method of interacting with a mobile phone during an active phone call. We combine a projector phone with touch technology to allow a user to directly interact with a projected interface. The embedded projector within the mobile phone projects a secondary display which provides access to the mobile phones applications and services; the mobile display remains unchanged and is occupied with displaying the active call details. By projecting a secondary interface which is significantly larger we increase the interaction space beyond the boundaries of the mobile screen. We can also use the active phone call as a basis to support and assist in distributed interactions between two or more people and support the sharing of content and information. Figure 1 illustrates a concrete scenario.

Figure 1. Touch interaction during a phone call. A projector in the bottom of the phone combined with camera allows the projection of and interaction with the mobiles interface. Here Jack provides his friend Tony with turn by turn directions to his house. The red dot indicates Tony's current location, the blue dot indicates the destination.

2. RELATED WORK

Little work has explored physical interactions with a mobile device during active phone calls as depicted in Figure 1. Newport [2] is a collaborative mobile phone sharing application which facilitates and oversees the sharing of content (e.g. photo's and annotated notes) and context (e.g. location) during active phone calls. Their goal was to enhance communication by making sharing more transparent. Similarly the scenarios described by Wilts and Nichols [1] Newport uses a nearby computer (if available) to provide complementary functions including the viewing and sharing of pictures. All participants in a user study preferred using a computer to assist sharing but only six would actively seek out a computer if one was not in the nearby vicinity. PlayByPlay [1] is a collaborative web browser which allows desktop and mobile users to share their web browsing experience whilst talking on the phone. Users can choose to browse individually or follow others if desired.

Advances in technology have allowed the development of pico projectors which can be embedded directly into mobile phones. They allow the projection of information and content on any surface and potentially any size solving the small screen problem. It is expected that consumers will see widespread emergence of these devices by 2010 [3].

Interactions with projector phones were first explored by Greaves et al. [4] and Hang et al. [5] for picture browsing and map interaction. Studies compared interaction with the mobile phone display, projected display and the mobile phone and projected display. In general the results showed that users preferred interacting with the projected display since it was larger. The combination of mobile and projected display also proved positive and presented several advantages. More recently like ourselves, several have explored compelling interactions using personal projectors. Gestural and touch based interactions are popular since they can be recognized with limited hardware and are very innovative. The Sixth Sense system is a wearable gestural interface consisting of a projector and camera attached to a hat or integrated into a pendant [6]. Using this system information can be displayed on any surface and the user can directly interact with the projection via hand gestures that are tracked by the camera using computer vision. The Brainy Hand system is an ear-worn device consisting of a camera, projector, microphone and headphone [7].

To the best of our knowledge no prior work has explored combining pico projectors with mobile phones to support interactions during active phone calls.

3. IN-CALL INTERACTION

A projector in the bottom of the mobile phone permits the projection of a large display in front on the user at arm's reach, an ideal distance to support touch based interactions. One possible solution would be to utilize the large display area to project a virtual representation of the user's mobile device. The virtual representation functions as the mobile phone does and provides access to the phones applications and services through touch.

Figure 2 illustrates our proposed solution. Here the user is currently touching the projected mobile phone interface. Selecting applications on the mobile phone opens them on the larger display. Alternatively, rather than having to force the application or content to be opened and viewed on the projected display automatically it could occur at the users discretion. Here the action of dragging content beyond the physical confines of the mobiles display would transfer it to the projected display automatically.

Figure 2. Interaction during an active phone call. The user can interact with the phone by touching the virtual interface. Shortcuts provide access to frequently used applications. The large display presents multiple applications, alternative visualization of information and desktop interaction paradigms.

In addition, the large projection space permits access to and allows the user to fulfill many tasks at once as we currently do when using laptop computers. In Figure 2 the user is occupied with browsing photos, map navigation and scheduling a meeting during a phone call. Shortcuts to frequently used applications and services could be available through the touch of a button, a tap at a specific location or through a gesture.

Direct touch interactions are novel and highly intuitive and certainly possible using the mobiles camera in conjunction with the projector. The projected display in Figure 2 is large enough to support multi-touch interactions. However, this would depend on whether the user has two hands free. In Figure 2 the user only has a single hand free, an ear worn projector would leave the user with two hands free. In addition to interactions using direct touch we could also support interactions in mid air slightly above the projected display. Simple hand gestures within the 3D space would provide simple and effective user interactions, for example *push*, *pull* and *swipe*. Here the swipe of the hand could temporarily clear the display from prying eyes.

Sharing content to assist the user and satisfy the 'urgent-request' [1] is simplified by projecting the remote caller's mobile device onto the surface, Figure 2. The iconic representation is a symbolic link which acts as a portal. Dragging content into the portal for example a map instantly transfers it to their mobile device.

3.1 Large Display Information Visualization

The desire to keep mobile phones as small as possible results in a small screen. The size of screen unfortunately limits and restricts both the design of the user interface and how we perceive and consume the information displayed on the device. Mobile phones typically use lists to present vast amounts of information. This requires switching between multiple screens, for example viewing a list of emails when compared to viewing an actual email. A larger mobile projected display combined with touch technology extends both the input and output space beyond the confines of the mobile screen. By using the larger space we can present and visualize information in alternative forms. We can also realize metaphors which are akin to the desktop and tabletop computing environments whilst in mobile settings. For example desktop mail clients allow the user to scroll a list of emails, whilst at the same time viewing a preview of the currently selected email. The limited size screen on mobile devices currently restricts this behavior. However the larger display and interaction space would allow this and also provide alternative views of information.

3.2 Two Handed Interactions

Figure 2 illustrated one approach in foreseeing interactions during phone calls by projecting a virtual representation of the user's mobile device. However, in Figure 2 the user is limited to interactions using a single hand since the remaining hand is used to hold the phone. Wearing the projector on the user's ear which communicates wirelessly with the mobile device would enable both multi-touch and two-handed interactions between devices (Figure 3.) The physical mobile phone is placed on the surface within the projection area and can be used as normal. The act of introducing the mobile device into the projection space could be used as a cue to trigger specific interactions. For instance, introducing a mobile device into the projection area or onto the projection surface automatically projects a map which was displayed on the mobile device onto the surface. The projected map has a greater resolution, size and an increased level of zoom providing several benefits. Here the two representations support overview and detail interactions. Alternatively in the future we could imagine a mobile phone, projector and camera as a single ear worn device without a display.

Figure 3. Two handed interaction with the projection and the physical mobile phone. Here the projector is in the form factor of an ear worn device which communicates with the mobile phone wirelessly. The mobile phone is placed within the projection space, and can be used as normal.

4. INTERACTION SCENARIOS

Figure 4 illustrates interactions over the phone with a friend to share pictures, a common scenario for mobile devices which typically occurs using Bluetooth. Although photo sharing was supported by Newport [2], sharing could only occur after the phone call had ended, not during. Here synchronous sharing is achieved during an active phone call; pictures stored on the mobile phone are all accessible using the projection. Since sharing happens during the phone call we can support requests such as "Can you send me the holiday photo where.." the photo is then shared and displayed on the receivers projection instantly, for which he replies, "No, not that one! The one where…" The notion of a portal as described here [8] is used to share content with remote users. Dragging a picture to the portal immediately shares the picture.

Figure 4. Whilst speaking to his friend, Jack searches his mobile phone for his recent holiday pictures. Moving a picture to the sharing portal automatically sends the picture to the receiver.

Phone calls are not only limited to conversations between two people. Figure 5 illustrates a conference call between three people. Here the two co-located friends use their projector phones to complete separate tasks but are also engaged in a shared task. One user browsers a map whilst at the same time discusses possible locations over the phone with the remaining two callers. Simultaneously the second co-located user whom is wearing a Bluetooth headset searches his calendar by touching the projection for suitable dates.

Figure 5. Supporting conference call between three friends. One user discusses possible places when planning a day trip, the other browses his calendar looking for suitable dates.

The calendar in Figure 5 currently resembles a monthly view, alternative views, for example weekly or daily could help the user make a more informed decision when choosing a suitable date. The additional output space and natural touch input could foresee this. For example a touch and hold interaction on a specific date could overlay the daily agenda on top of, or near the monthly view. Alternatively the action of drag and drop on a date, or multiple dates, would display daily agendas within the interaction space and permit comparisons. Simultaneously since all the information is displayed the user could easily re-schedule appointments. Local comparisons and interactions can be intuitively inferred by crossing or overlapping projections. Figure 6 illustrates booking a meeting. When the projections overlap the resulting projection indicates free appointments. Here the users speak to each using wireless headsets whilst holding their projector phone in their hands.

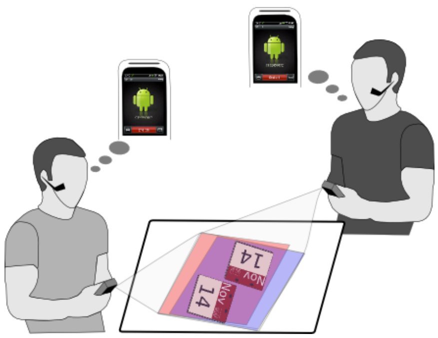

Figure 6. Booking a meeting during a conference call with three people. Overlapping projections permit fast and intuitive booking of meetings [8].

5. PROPOSED IMPLEMENTATION

We plan on implementing the interaction concepts and scenarios using the Android SDK. When connecting a pico projector to mobile devices with TV-OUT the resulting projection is an identical copy of the mobile phone screen. For this reason we shall use the approach described in our previous work [4, 5]. Here the pico projector is connected to a laptop computer which communicates wirelessly with the mobile phone.

Prior work in applying touch and gestural interactions to project displays has relied on using computer vision techniques or using a tracking system [9]. OptiTrack is an optical tracking system which is capable of tracking multiple objects in 6 degrees of freedom with high accuracy. Since we are familiar in using the OptiTrack SDK we shall use it to support direct touch interactions on the projected display. This will allow us to quickly explore and implement the concepts and scenarios described in this paper. Although this confines the system to a fixed laboratory environment it is a feasible option since pico projectors lack brightness which constrains their use to low light conditions, currently using them outdoors is unpractical. We could assume that in the foreseeable future tacking technologies exist which do not require an external infrastructure.

6. CONCLUSION & FUTURE WORK

In this paper we have explored interactions using the mobile phone during active phone calls. By combining a pico projector with a mobile phone we create a large interaction space for which we can project a virtual interface which mimics the mobile phone and allows interactions whilst maintaining an active phone call. Here we support interpersonal distributed interactions between two or more people. The larger interactive space also invites interactions beyond the confines of the mobile display and permits alternative interface designs akin to desktop user interfaces.

In our future work we plan to implement the concepts and scenarios described in this paper and perform a formal evaluation evaluating the usability of direct touch interactions for mobile projected interfaces during active calls.

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