Extending Tabletops to Support Flexible Collaborative Interactions

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Abstract

Tabletops have been used to support a range of co-located activities, from games to image sorting. However, their limited display space and resolution can restrict the kinds of collaborative interactions that take place. Our research is concerned with how to extend the tabletop by integrating it with other spaces and artifacts in the physical world. Our goal is to design workspaces that support a wider range of collaborative tasks, determining which are well suited to the tabletop and which are better performed using physical representations and spaces. We describe a physical-digital space that we built for this purpose and then a study that compared how groups collaborate on a design task when using this versus solely the tabletop. The findings showed that extending the tabletop into a physical space enabled groups to collaborate more easily and flexibly.

1. Introduction

Interactive tabletops have been used to support co-located groups for a range of activities. These include playing games, selecting and viewing images, sorting information and town planning. An assumption is that small groups of people can collaborate more naturally, comfortably and effectively around a tabletop display compared with sitting in front of PCs or other vertical displays [18, 23]. They do this by readily 'diving in'; pointing at and selecting information that is being displayed, while simultaneously viewing theirs and the others' interactions.

Tabletops are ideally suited to activities that involve looking down on information from above, such as visualizing, arranging and comparing. A key design challenge is to develop interaction styles that map onto these kinds of tasks that enable all the individuals sitting at different sides of the table to read, access, manipulate and pass to each other the information. Styluses, physical tokens and touch screens have been used as input devices in place of mice that are awkward to use on a horizontal surface by multiple users [3]. One of the most innovative designs is MERL's DiamondTouch touch surface, that allows direct hands-on interaction, where users simultaneously point, tap and slide their fingertips across the tabletop surface to select and manipulate information [3]. It also enables simultaneous interactions by interpreting input from multiple users by sending unique signals through them and into receivers located on the floor, which then send information back to the computer about which parts of the table surface each user is touching. The accompanying DiamondSpin software enables a range of novel finger-based interactions, including images being literally spun around the tabletop, and images being automatically expanded and switched orientation towards the person they are moved towards [8]. A very natural way of collaborating is afforded, where the surface invites people to reach out and touch the interactive surface using their fingers [23, 24].

However, touch surface tabletops can be limited in the kinds of interactions they can effectively support. While a number of finger gestures (e.g., tapping, stroking) can be effectively mapped onto a core set of interface commands (e.g., selecting, scrolling), it is less obvious how to adapt those that require a higher level of dexterity and precision. 'Fat' fingers are clumsier than pointing devices and hence can be more error-prone when performing precise operations. For example, sets of options that are represented via adjacent icons, menu lists or thumbnails are more awkward to select with a finger than when using a mouse. A further interface problem is that the use of projectors limits the amount and resolution of information that can be displayed, that in turn affects the amount of information that can be shared, compared and worked on at a given time [18, 20]. While groups work well together when interacting with small numbers of images at a tabletop it becomes more awkward for them to sort and manage larger sets [19].

To address these limitations we have been exploring how to extend the touch surface tabletop. Our approach

0-7695-2494-X/06 $20.00 © 2006 IEEE