Facets of Distributed Display Environments

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INTRODUCTION

Distributed Display Environments come in diversely varied flavors and thus can arise and be applicable in different forms and spaces. In an interactive environment with multiple display surfaces, input interaction and output visualization are both equally important and challenging, and both can be characterized as multi-channeled and multi-sourced. In this position paper, we will discuss the workshop goals focusing on new interaction research in multi-surface DDEs. By multi-surface, we mean that a DDE in which walls, tables, tablet PCs, desktop displays and PDAs can be used in concert. The potential of DDEs goes beyond single-user multi-monitor desktop applications. Multiple physical information surfaces have long been used in certain industries that may offer us insights into both the fundamental HCI issues and the future for interaction and information visualization of DDE.

We will first briefly discuss two application domains that have had long tradition and extensive experience in using multiple display and interaction surfaces in day-to-day work and operation. Note that what is presented here is not meant to be an exhaustive examination of the field, rather it is intended as an introduction to raise our awareness of this rich pool of knowledge and users. We will then list some of our recent attempts at piecing together the puzzles of multi-device multi-display DDE, and discuss issues related to the goals of this workshop.

MULTI-SURFACE DISTRIBUTED DISPLAY APPLICATIONS

Control Rooms

In industrial control rooms, as well as utility service centers, multiple surfaces have long been used to situate the user, to inform the operator and to provide interactivity. Figures 1 & 2 depict a western design (e.g., US and European) and an eastern design (e.g., Japanese) of plant control rooms, respectively. Most control room designs utilize each type and orientation of display surface in a well-understood and surprisingly similar manner, as shown in the labels in Figure 2. The "Mimic Panels" reflect what the actual real world information and control look like out in the field (e.g., in the plants); the "Meters and Computer Monitors" provide filtered information, as well as measurements. The "Bench Board Panels" provide users the controls and interaction affordances, while tabletops are general interaction spaces. The multiple display surfaces together provide an environment where information visualization and human-computer interactions are supported in concert.

Figure 1 A US and European designed control room.

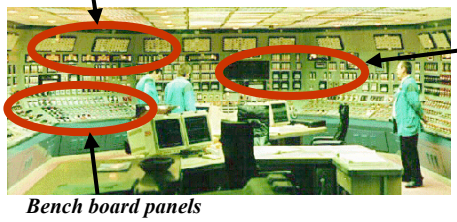

Figure 2 A Japanese designed control room.

Figure 3 A new generation of control rooms.

Figure 3 is Barco's new control room concept (http://www.barco.com/controlrooms/), designed for Stadtwerke Düsseldorf AG public utility company. All the surfaces are still there for display and interaction, similar to the conventional control rooms. However, display and interaction technologies have changed, most noticeably are the presence of multiple computer displays, and the replacement of physical knobs with virtual screen displayed controls, and for this workshop, the most relevant.

Urban Design and Engineering Practice

As another application example, Figures 4 illustrates the current practice in urban design and engineering from Parsons Brinckerhoff Inc. (www.pbworld.com), one of the oldest and largest engineering firms for buildings, transportation, and railroads. PLACE^{3}S design process is used to support decision making. Physical maps, menus (in the right image of Figure 4) and digital data on mobile laptops are used in concert on tables and walls to allow citizens and engineers work side-by-side. This practice is now also being transformed into a multi-surface distributed display environment.

Figure 4 Engineers evaluate and design (left). Citizens visualize and understand (right). (Photo credit: Parsons Brinckerhoff Inc.)

NEW MULTI-SURFACE INTERACTION RESEARCH

The above two example applications illustrate a few important requirements for a new generation of distributed display environment. For example, some of the interactive surfaces, such as tables, seem to be best supported by direct-touch surfaces [1] and gestural input [4]. Others, such as laptops and desktops, will have keyboards, mice and stylus as interaction input devices. Interactions on electronic walls/whiteboards will depend on the application at hand, the work style and the informational relationship between the wall and other displays. This indicates that such multi-surface distributed display environments will embody multiple interaction tools. New interaction techniques will be needed for users to fluidly interact across the interactive display surfaces while transition amongst different interaction tools.

Orientation of Displays

In our previous research on UbiTable [2, 3], we have examined some of the design issues regarding distributed display environments with a horizontal tabletop display and multiple walk-up laptops as shown in Figure 5. UbiTable provides interaction techniques for (1) virtual association between mobile laptops and the table, (2) data movement, sharing and visualization among the displays, and (3) a division of private space, personal space and shared public space.

Interaction in the UbiTable environment is supported by multiple input styles. The tabletop is a multi-user direct-touch DiamondTouch [1]. Thus users interact with their finger touch, while interactions on the laptop are supported by conventional keyboard and mouse. The different affordances, and the switching back-n-forth between a laptop and a tabletop revealed interesting research issues regarding (1) surface usage scenarios (what type of display surface is more appropriate for certain tasks), (2) visual and audio feedback problems, (3) design dilemma with respect to position of tools and menus, and (4) workspace arrangement.

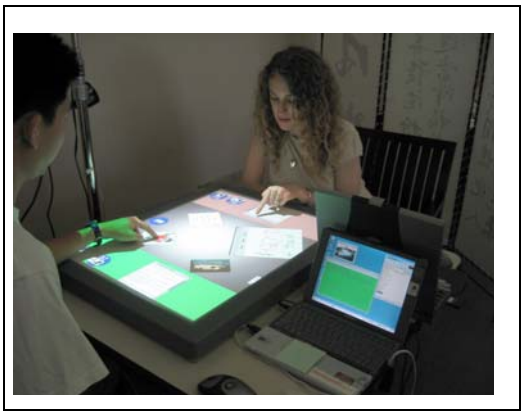

Figure 5 UbiTable.

CONCLUSION

Our past research has revealed challenging research issues in the design of interaction techniques for multi-user collaborative DDEs involving interactive tabletops and laptop displays. In this workshop, we hope to share our experience and ideas on interaction and evaluation of DDEs, as well as charter out the broader research space of DDE.

REFERENCES

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