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Studying Collaborative Surface Use to Guide Large Display Interaction Design

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ABSTRACT

In this poster, we focus on the use of large vertical surfaces (e.g. walls, flipcharts, whiteboards), articulating four unique roles they play in collaboration: *presentation, ideation, reference,* and *notice*. By understanding these roles, we can design interaction techniques that exploit people's expectations and uses of these surfaces. As an example, we realize one design idea in *Pick-and-Point*—a fluid interaction technique that moves content from personal surfaces onto large surfaces that recognizes the collaborative role of large vertical surfaces.

Categories and Subject Descriptors

H.5.3 [**Information Interfaces and Presentation**]: Group and Organization Interfaces – *computer supported cooperative work*

Keywords

display ecology, large screen display, tabletpc

1. INTRODUCTION

Teams collaborate over meeting room surfaces (e.g. walls, tables, flipcharts, whiteboards), using them to engage one another, store and organize information, generate ideas or understanding, and execute task items. Based on a month-long study of three undergraduate engineering teams, we develop an understanding of their use of *vertical surfaces* for a team project. This understanding can help *frame existing* HCI efforts with respect to large displays, and secondly, they can help *guide development* of new interaction mechanisms for these large displays.

Our work is motivated by the desire to support collaborative activity with large display environments (e.g. [1][4]). Our design approach for electronic display technologies is to first observe *how* people use traditional analogues in context: watching how they use the whiteboards, and the walls of their environment; secondly to understand *why* they are using the surfaces the way they do, and then finally develop mechanisms to support these collaborative work practices in electronic environments.

We observed three teams of six members each engaged in a competitive undergraduate term project. Each team was assigned a meeting room (with tables, whiteboards, and PC's) and lab bench space (with PC's, electrical tools such as multi-meters and soldering irons), and spent roughly four hours each weekday for a month engaged in team work to complete this project. We spent at least 15 hours with each group throughout the course of the project, documenting their use of four different large surfaces in the meeting room identified in Figure 1: WhiteboardA, WhiteboardB, Wall, and Table.

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2. ROLES OF VERTICAL SURFACES

In analyzing our observations, we identified four distinct collaborative roles of large vertical surfaces: *presentation role, ideation role, reference role, and notice role.* We describe each role in terms of the *collaborative activities* that they supported, and ground each role in the mechanics of collaboration [2]: low-level interactions that teams must engage in to support collaborative activity.

Presentation Role: Team members often used Whiteboard-A to present information to other team mates seated around the table (e.g. the physical design of a circuit). The content of these presentations would typically be prepared on the board before presentation or discussion began—much like a power point slide deck is prepared in advance. Presenters would often stand close to the whiteboard to point and bring the group's attention to various pieces of information. Content was largely static in this role: the main purpose of this role was for a team member to convey a piece of information to the group. The seating locations around the table may have played a role in the frequent use of Whiteboard-A for this role: team members rarely sat immediately in front of Whiteboard-A. Information rarely changed on Whiteboard-A during presentations as it was largely inaccessible to team members seated at the table. *Information for the presentation role is usually large, static, the focus of attention for a group, and viewed from a non-interactive distance.*

Ideation Role: Sub-groups (2-4 team members) often used a whiteboard to generate and develop ideas in a visible, iterative manner. These groups would work around the whiteboards—variously sitting and standing close enough to interact with the whiteboard, and close enough to see the writing, sketching, and gesturing activities of the other team members. The whiteboard surface was a developing artifact in the context of the discussion, and often the focal point of the discussion as a concrete instantiation of an idea (e.g. brainstorming the design of the circuit; assigning action lists). In many of these cases, groups started with a kernel of an idea and worked to develop or solve the problem together; thus, the sketch would be modified or

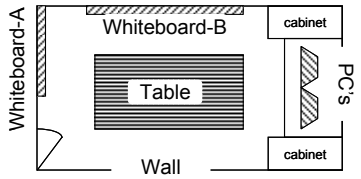

Figure 1: The teams' meeting room layout.

changed frequently (sometimes by others). We call this activity ideation, and the surface is used to form a concrete representation of the developing ideas. *Information for the group interaction surfaces is medium-sized (roughly 2x or 3x the size it might appear on a sheet of paper), dynamic, the focus of attention for a group, and viewed from an interactive distance.*

Reference Role: The Wall and Whiteboards were also often used to store information for later use. Importantly, it allows teams to work across the temporal bounds of a particular work session. For example, sketches on the whiteboards from the current activity may be left or redrawn for later use. In this way, the information could be used as a starting point for later activity. Similarly, API diagrams or action lists could be written or posted on the surfaces for later reference. The spatiality of the prior context—the "creation surface" of the surface appeared to be as important in helping team members remember ideas as the artifact itself. As another example, this information could be glanced at by individuals who arrived late, or at a later date altogether. Prior work was often documented in this way, and later used on an individual basis (rarely were they the focus of attention again unless the team revisited a problem). *Information for the reference role is medium-to-large, static, ambient, and frequently viewed from a non-interactive distance.*

Notice Role: Finally, some areas of the whiteboards, the door itself, and the cabinets were used to display small pieces of information (e.g. reminders; schedule for the room; information about facilities use). This type of information was not typically of import to the work activities in the room, and was variable in nature. Different pieces of information appeared on distinct pieces of paper (or post-it notes), or were delineated by lines on the whiteboard. These visual seams allowed team members to quickly distinguish between "work" items and "notice" items, as well as to distinguish between different bulletin board items themselves. *Information for the notice role is frequently small, semi-static, ambient, and intended to be viewed individually very closely.*

The framework we have outlined helps us understand the different kinds of roles that surfaces can play in the collaborative meeting room process. Note that they are simply "roles": a given surface can play multiple roles and even multiple roles at the same time. For example, Whiteboard-A was often used as a group interaction surface even while bulletin-board information coexisted (although this information resided in the top corner of the whiteboard, demarked with a line). We intend to further iterate on this framework by integrating our observations of the tabletop, the PC's, and the transient laptops that were used in the course project, and then validating it in a variety of contexts.

3. PICK-AND-POINT: PROTOTYPING IDEAS FROM THE FRAMEWORK

Based on this framework, we are prototyping several interaction mechanisms. For example, Pick-and-Point allows individuals to move information from a TabletPC to large displays in the environment by using a pen to select an entity on the tablet, and then using the same pen to point at one of the large displays (Figure 2). This Pointing gesture immediately maximizes the item to the large display. Alternatively, users can be able to Tap on the large display itself (like [3]), in which case the item appears at a medium-size. We are prototyping this technique using the Polhemus Fastrak and the EdgeLab.Fastrak and GroupLab.Networking toolkits.

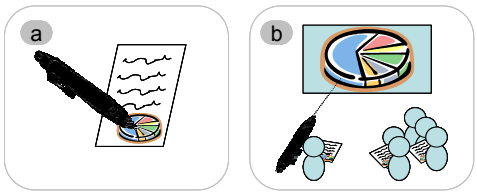

Figure 2: In step (a), one Picks an entity from a tablet. In step (b), one Points at a large display, where it is placed.

The ability to facilitate movement of information across multiple displays has been explored by many researchers (e.g. [1][3][4]). While an exhaustive review is beyond the scope of this paper, Pick-and-Point extends Pick-and-Drop [3] by facilitating both near-reaching (group interaction role), and distance reaching (presentation role). Second, the gesture is also fairly visible to other group members, facilitating floor control acquisition in a socially appropriate manner. Finally, Pick-and-Point supports the mobility of information in a spatially-aware way: a team member gesturing to his right may be pointing at Whiteboard-A, Whiteboard-B, or the Wall—depending on where he is sitting. "Display stitching" approaches are not spatially-aware in this sense.

4. CONCLUSIONS

We have explored how large vertical surfaces are used to support collaboration in today's meeting rooms in order to guide the design of groupware and interaction techniques for large display environments. In this paper, we presented four different roles that vertical surfaces play in collaboration: *presentation, group interaction, poster, and bulletin board*. These roles form a design space that encompasses many existing technologies, and also shows designers the many roles our large displays must play to augment the meeting room environment. To demonstrate this idea, we are prototyping techniques such as Pick-and-Point, which facilitate information mobility to large vertical displays in a manner that recognizes two different roles of vertical displays.

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