Observations of a Shared Tabletop User Study

Katherine Everitt, Clifton Forlines, Kathy Ryall, Chia Shen

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Abstract

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Katherine Everitt   Clifton Forlines   Kathy Ryall   Chia Shen

Mitsubishi Electric Research Laboratories
201 Broadway, Cambridge, MA, USA

{everitt, forlines, ryall, shen}@merl.com

ABSTRACT

We present observational user study findings of UbiTable, a multi-user interactive tabletop that provides walk-up wireless connections for multiple personal devices. UbiTable offers shared interactions that allow writing, annotating, drawing, copying, and the transferring of content among the tabletop and associated user devices. Our findings uncovered general design considerations and tradeoffs in the area of multi-user audio feedback, document ownership, and cross-device document transfer in multi-device multi-user co-located computational environment.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces - *Graphical user interfaces (GUI)*.

General Terms

Experimentation, Human Factors.

Keywords

Multi-user tabletop interaction, usage observation.

1. INTRODUCTION

UbiTable [4] provides a multi-person tabletop display that supports the connection of multiple personal devices (see Figure 1). It is implemented with the DiamondSpin [3] Java tool kit, and operates on a DiamondTouch [1] input surface. The UbiTable project explores tabletops in the role of "scrap displays" for supporting face-to-face meetings with walk-up-and-use interactions, providing a gathering place for people to collaborate. People can utilize the larger input and display capabilities of a touch sensitive tabletop while only having to carry around their convenient personal mobile devices.
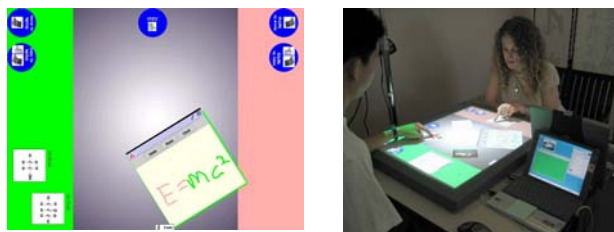

Figure 1. The UbiTable surface is divided into a center shared region, and two side, color-coded Personal Spaces. The circular icons are portals for moving documents to personal devices, and for copying. Each document on the table has a color border, indicating which user is using it, and a color bar on the top indicating ownership.

In this poster, we report observational findings from a user study assessing the feasibility and usability of ubiquitous interactive tabletops in general, and UbiTable in particular. Through analysis of the video from the user study sessions, our findings uncovered design issues specifically related to multi-user co-located environment.

2. USER STUDY TASK

Fourteen paid subjects participated in the study. Subjects sat at opposite ends of the UbiTable and were each given a laptop, as shown in Figure 1. The laptops were networked together with the UbiTable over a wireless LAN. Subjects interacted with their laptop using a standard mouse and interacted with documents on the table using their fingers. Each usage session started with a brief tutorial of how to transfer files amongst the table and laptops, and tabletop UI.

Each laptop contained one image of a molecule from a pair of molecular images. The subjects were each asked to copy their image onto the UbiTable so that there was a pair of molecular images on the table after the copy-to-table operation. The subjects were asked to count the combined total number of atoms in the two molecules. The subjects were then asked to create a draw pane on the table, use it to record the total number of atoms in the pair of molecules, and then save this draw pane on both laptops. An example pair of molecule images and the screen shot of the resulting tally are shown in Figure 2. Finally, subjects were asked to exchange molecule images with each other and save their partner's image on their own laptop.

Subject pairs repeated this counting and exchange with five pairs of images. At the end of the evaluation session, the subjects were required to have all 10 molecule images and all 5 draw panes saved on both laptops. After the study, each subject filled out a questionnaire.
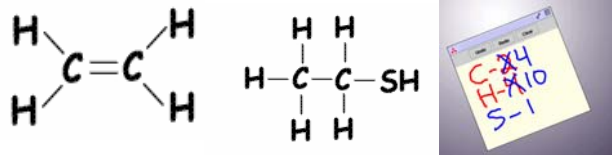

Figure 2. User study files and tally: Molecular files from each of the laptops (left, center), and resulting tally (right).

3. Questionnaire Feedback

We administered a questionnaire including a series of nine statements. Subjects were asked to rate their agreement with each statement on a 7-point Likert scale. The mean agreement with each statement is shown in Table 1.

Table 1. Higher numbers = more agreement with the statement.

Statement	Mean
I always knew what documents were my documents.	4.38
The machine always understood what I wanted to do.	4.75
I was always certain I had the documents I wanted.	4.88
Moving a document onto the laptop was easy to do.	5.13
I always knew what documents I could copy.	5.25
I always knew where my documents were located.	5.38
It was easy to remember how to do what I wanted to.	5.75
Giving a document to my partner was easy to do.	6.38
Moving a document onto the table was easy to do.	6.50

4. OBSERVATIONS

We found in general that the fingertip direct manipulation of UbiTable showed good potential for easy learnability. This confirms the findings of similar multi-person interactive environments. Some people initially hesitated in exploring the interaction, but by the end of 5 tasks, they were interacting smoothly with the table, and not preoccupied with ownership or region issues. From our evaluation, we identified several important issues relevant to the design of multi-user interactive surfaces.

Simultaneous identical audio feedback confused users. When we work alone on a desktop or a laptop, audio feedback can provide effective notification, warning and alarm. In a multi-user setting, audio feedback is audible by all. We observed that as the two users simultaneously interacted with the table, they often carried out operations simultaneously on the tabletop, although sometimes in different regions and on different documents. For example, they both could send a document back to their own respective laptop. When two operations were simultaneous, the same audio feedback from two different portals confused the users; they could not tell whose operation the feedback was for. Similarly, an error sound for one subject was often misinterpreted by their partner as being meant for them.

Don't Put That on MY Laptop, but do put that in my Personal Space on the table. In the implementation of UbiTable used for this user study, a simple finger slide could bring one person's file into another user's "send to laptop" portal and directly onto their laptop. One user was quite concerned about the integrity of his device, asking: "Do you mean that he can put files on MY laptop?" It is interesting to note that the user experience might have been very different in other approaches, such as dragging a file to a personal icon to email it to that person as done in the BlueBoard [2]. Another user commented: "I shouldn't just be able to put things in his laptop. It is his laptop." On the other hand, as we observed the users carry out their tasks, they actually became comfortable in directly dragging files across the tabletop surface into their partner's Personal Space. Co-located collaboration and the ease of moving documents to and from the table raise new privacy and security issues.

Ownership was often unclear. Ownership was also a concern. We thought that the ownership (i.e., who a document belongs to, and which laptop a document originally came from) of documents on the table would be obvious. It is important that users can correctly anticipate the system's response to their actions; users did notice and understand the colored ownership bars across the top of documents. However, many subjects very much wanted to know the source of the documents on the table. Since the task included exchanging files, many people asked "Did this file come from my laptop or my partner's?" While the ownership bars predict the behavior of the system, they do not always represent the originating location of the document as document ownership can change. What is surprising is that even in a face-to-face co-located situation, in which only two users have all the devices and files right in front of them, tracking document ownership is still a cognitively demanding task. One woman commented that "It is hard to trace whose files are where."

File ownership in this co-located environment has many dimensions. First, there is the *original owner* or the creator of the file. Second there is the *current owner*, i.e., the person who is actually updating/annotating the file. Third there is the *keeper* or recipient after the current meeting has ended. The ownership bars, with one unique color for each user, only indicate the current owner of a file, not the original or the keeper. Visual feedback should support this expanded notion of ownership.

Coordination was challenging. Given the reach-out-and-touch nature of the UbiTable DiamondTouch surface, our video data showed quite a few simultaneous interaction intentions. There were times when both people wanted to write the tallies into the draw pane at the same time. Different users seemed to take different approaches in resolving these potential conflicts. For example, one user raised his hand in midair to block the other person's approaching hand with his voice saying: "I'll give you this after….", so that he would be the first one to write into the pane. At other times, we have noticed that the users politely pass the draw pane back and forth by moving and rotating the draw pane towards their partner so that explicit turn taking is carried out.

5. CONCLUSION

As is often the case, many of the problems we expected to find by putting real people in front of the UbiTable turned out to be non-issues. For example, people quickly mastered document transfer and were quite tolerant of projector shadowing. On the other hand, design decisions that seemed "obvious" to us sometimes confused users. Our observations of user reactions will inform future design. We will use the above insights to guide improvements to UbiTable; we believe that these findings will be useful to others as well in their development of ubiquitous shared surfaces.

6. REFERENCES

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