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# Cutouts: Flexible Workspace Management For Tabletop Groupware

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## ABSTRACT
Tabletop work surfaces have several natural advantages for small-group collaboration, but tables also have physical constraints that can make group work difficult. In particular, tables are sometimes inflexible: artifacts on the table are always oriented improperly for some members of the group, and it is difficult to work in the same location as another person. In this video, we introduce a new display infrastructure that greatly improves the flexibility of digital tabletop systems, and allows tables to better support the variable organization of work that is evident in real-world tabletop collaboration. Our approach – called *cutouts* – allows users to interactively create multiple views of the tabletop workspace. Cutouts allow people to work on objects from a different location, and allow people to move and re-orient a group of objects quickly and easily. Cutouts solve some of the usability problems that exist in current tabletop systems, but also provide a new interface paradigm that makes a wide variety of new interactions and manipulations possible.

## Categories and Subject Descriptors
H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces—*computer-supported cooperative work, synchronous interaction, collaborative computing*.

## General Terms
Design, Human Factors, Experimentation

## Keywords
Tabletop groupware, tabletop displays, interaction techniques, computer-supported cooperative work, cutouts

## 1. INTRODUCTION
Digital tabletops are becoming common in CSCW research. One reason for the interest is that tables are a natural setting for collaboration, and provide many advantages for group work. In particular, tables allow for easy verbal and visual communication; simple awareness of presence, location, and activity; and a strong shared focus for the group. However, there are also problems that occur with tabletop collaboration. For example, the spatial arrangement around the table means that some people must look at work artifacts sideways or upside down; it can be difficult to see what is going on because parts of the table can be occlude by others around the table; and it can be difficult to work on a part of the table where someone else is already located.

Although digital tabletop systems provide the flexibility needed to solve some of these problems, the approaches do not match the way in which people divide up work on a table. For example, some systems allow the workspace to be rotated, but still only allow one person at a time to see the table in the correct orientation (e.g. [5]).

This situation is similar in some ways to problems encountered with early distributed groupware systems which enforced a strict WYSIWIS view policy. The solution was to relax the WYSIWIS requirement, and allow different people to have different views onto the workspace. This same idea of multiple views can be used to improve the flexibility of collaboration support on a digital co-present tabletop system as well.

We have developed a new view infrastructure for tabletop groupware, called *cutouts,* that provides multiple flexible views of the artifacts on a shared tabletop. It allows people to work on objects from different locations, and allows people to move and re-orient a group of objects quickly and easily. Cutouts provides solutions to several tabletop collaboration problems:

- they allow people to work near one another without causing physical collisions of arms and bodies
- they allow reorientation of a set of objects to suit the position of the person working on the objects
- they allow a temporary grouping of objects for moving or showing to others

In addition, the idea of cutouts combined with the digital nature of a computational workspace makes many other things possible:

- digital cutouts can be dropped back into the original location seamlessly
- digital cutouts can be a view of the original objects (rather than moving the actual objects themselves), allowing others to still see and manipulate the same objects
- digital cutouts can be changed in ways that are impossible with physical ones (e.g., they can be resized or copied)
- digital cutouts can be used to create a variety of useful views such as radar views of the entire workspace

Multiple views and portals have been seen before in single-user applications (e.g., [2,3]) and in groupware (e.g., [7]), but they have never been applied to co-present tabletop systems. In this context, they can solve some of the problems that reduce the effectiveness of tabletops as supports for group work, and they can make possible a number of work and view styles that could not be accomplished before. A small usage study also suggests

that cutouts are an effective way to support group work, and that the system helps users to access distant work areas and to track others' activities [6].

## 2. VIDEO OVERVIEW

In this video, we describe the two main parts of the cutouts infrastructure: views and containers. C*utout views* provide portals to other regions of the workspace, and users can use views to manipulate objects that are located in those regions. Users can reposition views in their personal workspace so that they can interact with remote items more easily, regardless of their location and orientation. The view itself does not contain objects—it contains references to objects, so destroying a view does not affect the original workspace.

Views can be transformed into *cutout containers* by cutting or copying objects from the workspace. A container holds objects rather than references to objects, allowing users to perform operations on more than one object at a time. Unlike the view, changes to the container's size, rotation, and position are applied directly to the objects held in the container.

We close the video by demonstrating four applications of the cutouts system: radar views, managing screen space, tool access, and sharing content.

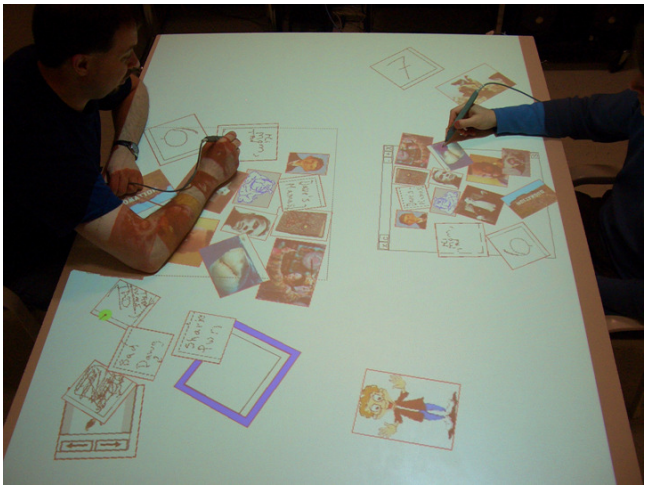

Figure 1. Cutouts infrastructure in use

## 3. BACKGROUND

Multiple views on a large workspace have been known since the first windowed user interfaces; however, the idea of views that are part of the workspace itself is more specialized. One of the first common implementations of the idea was in the *portals* of the Pad++ system [2,3], which were rectangular regions that looked onto other parts of the workspace. Portals could be scaled arbitrarily, and allowed people to manipulate objects inside the portal, providing long-distance visibility and long-distance action to other regions of the space.

The idea of portals has been reinvented several times in different forms. For example, Frisbees [4] and Drag and Pop [1] provided a way to reach distant objects on large-screen displays, and WinCuts [8] provided a similar mechanism, but intended for space-multiplexed windowed displays. Despite the many variations, however, portals have not to our knowledge been used on collaborative tabletops.

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