# Shuffle, throw or take it! Working Efficiently with an Interactive Wall

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### ABSTRACT
In this paper, we report on interaction techniques for very large displays such as interactive walls. Since display space is a crucial aspect for most visually-oriented tasks, we developed an interactive wall with an active area of 4.5 meters width, 1.1 meters height, and with 3072x768 pixels. At this wall, three users are able to work simultaneously on separate areas using pen, finger, and hand gestures. They can shuffle display objects around, throw them to other users standing at the opposite side of the wall, they can take objects from the wall and put them back at another location without explicit mode changes.

### Keywords
computer-augmented reality, roomware, gestures, pen-based computing, group interfaces, interaction techniques

### INTRODUCTION
Space has always been a delicate subject for the design of software for visually-oriented tasks and graphical user interfaces in general. Since people are used to having enough space for their work in the real world, they often feel hampered when using software on computer monitors of 17" or even 14" in diagonal. Higher resolutions combined with larger screen sizes surely reduce this feeling but are still a compromise. This effect becomes more evident in collaborative situations, e.g. in project team rooms. These rooms are mostly covered by a large amount of diverse material, like charts, timelines, plans, maps, etc. Sometimes this material is in order, most of the time it is not and the team re-arranges parts of it constantly.

As a first step in addressing the problem of display space, interactive electronic whiteboards [1] have been developed. Their major advantage is the ability to present information to a group of people. For interactive tasks with more than one user, the input facility of these boards has to be shared [3] since the boards are still single-user devices. This situation is intensified by the boards' resolutions which are comparable to those of desktop computers. In short, these boards are still too small. A device that is able to facilitate group work in settings like project rooms has to be much larger and the user interface for it has to reflect this.

### THE DYNAWALL
In order to provide a large work space for project teams, we designed an interactive wall called *DynaWall*. The DynaWall is one of the *roomware* components developed within the i-LAND project [7]. By roomware we mean computer-augmented components of rooms, like walls, furniture, or doors.

The DynaWall is 5 meters wide and 2.7 meters high with an active area of 4.5 meters width and 1.1 meters height and with a resolution of 3072x768 pixels. This area was realized as a combination of three interactive rear-projection whiteboards provided by SMART Technologies™. Each board/wall segment has its own computer inside. Thus, three users can work simultaneously with the DynaWall. The wall segments were covered in a special way to create the illusion of one very large homogeneous working area. On the software side, the displays were also coupled to support this effect. The rest of the wall is used for passive elements, like speakers, pen trays, etc.

Although the current hardware setup is not very sophisticated, it is sufficient to express the basic ideas of such a workplace of the future that combines elements of the real world with the virtual, digital world of information. After all, the challenges certainly lie in the software area, especially in the design of user interfaces for this new type of device.

### CONTRIBUTIONS TO HUMAN-COMPUTER INTERACTION
The sheer size of the DynaWall opens a new dimension in human-computer interaction. First, users normally are not able to perceive all of the contents of the display at once. The user interface has to address this issue. Secondly, interacting with the wall means much more physical work compared to desktop computers, with respect to arm movement, head turning, walking along the wall, and so

on. Thus, the user interface has both to facilitate the interaction with the wall and to minimize those physical actions. Our approach to this problem is the consistent use of gestures, either by hand/finger or by pen, and gesture-sensitive widgets such as gedrics (*gesture-driven icons*) [2]. In the following sections, we briefly describe the first three interaction styles we implemented for the DynaWall: shuffling, throwing, and taking displayed objects.

### Shuffling

The mechanism of shuffling displayed objects is a convenient and quick way of re-arranging objects within an area of medium size, say twice the span of an arm. Users shuffle objects across the display by writing directed strokes on special widgets/handles. The software reacts on the input by moving the object by one length of its dimensions. This motion value is pre-defined for the shuffling operation. For example, if a user wants to move an image of 200x300 pixels aside to the right, she simply has to write an almost horizontal quick stroke from the left to the right on top of one of the image's handles. As a consequence, the image will be moved by one window width to the right.

### Throwing

Moving objects across larger distances can be achieved by a different set of gestures. Here, users first write a short stroke to the opposite direction the object should be moving, followed by a longer stroke in the correct direction. The longer the first stroke becomes compared to the second one, the higher the pace of the thrown object. We find that throwing objects requires some training to be used in an efficient way since there is no pre-defined motion value.

### Taking

Similar to the pick-and-drop mechanism as described by [4] we introduced a modeless way of taking an object from the display, 'carrying' it to another location and putting it back on the display. With the DynaWall, this is done by laying the user's hand on one of the object's handles and waiting about half a second. The software will then shrink the object which disappears behind the hand (sucked). Laying the hand afterwards on an empty area of the wall lets the object re-appear and grow behind the hand to its original size (spilled). Inbetween the take and the put operation - technically a cut-and-paste – the software is in a temporary state and it is only possible to take another object if the previously taken one has been put back.

## EARLY USER FEEDBACK

Up to the time this paper was written, no emprirical evaluation has been taken place. However, the DynaWall as well the new interaction techniques were demonstrated at our institute's open day. We visualized our ideas by means of an interactive presentation and several hundred visitors provided very positive response concerning the importance of huge display spaces such as the DynaWall as well as our proposed interaction styles. Some visitors even tried the techniques and became enthusiastic. This early feedback encouraged us to continue working in the same direction and empirical evaluations will follow.

## IMPLEMENTATION NOTES AND FUTURE WORK

On the basis of the view system provided by the COAST framework [5], we were able to combine the physically separated displays of the three electronic whiteboards to one logical work space. Our sample application for the DynaWall provides similar functionality to that of the meeting-room software DOLPHIN [6], which gesture set has been extended to fulfill our requirements. Since DOLPHIN and COAST were designed to support cooperative work, several persons can work simultaneously with the DynaWall, one person or group per segment.

In terms of improvements for future versions, a very important aspect which has not been covered by our work yet, is the ordinary system feedback in terms of dialog boxes, warning messages, etc. Standard mechanisms like displaying these boxes in the middle of the screen do not work for the DynaWall because the users in front of it cannot see the whole content. Therefore, we plan to integrate sensors into the wall to find out where users are working and where to place those dialog boxes.

Another open question is the mechanism of taking and putting back objects in a multi-user environment. Since the DynaWall can be used by multiple persons at once, taking objects can happen simultanously more than one time. We hope to solve this problem by making use of the sensor technology mentioned above.

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