ExART (Exploring with Artists' Real Tools): A Table-Based Interface for Families; Using Tangible Input to Connect to Works of Art

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ABSTRACT

In this paper we describe the design and development of ExART (Exploring with Artists' Real Tools), a table-based interface using tangible objects to trigger multimedia content. The design was created for use at the San Francisco Museum of Modern Art (SFMOMA), Koret Visitor Education Center. The prototype we discuss builds on SFMOMA's tradition of creating interactive educational multimedia and explores the affordances of a drop-in 'learning lounge' frequented by a broad range of visitors, including families. Our prototype shows how moving beyond the 'one person to one mouse' paradigm often seen in art museum multimedia presentations can engage family audiences. We present our iterative design process and the implementation of the table using Radio Frequency Identification (RFID) technology.

Introduction

The work described here is motivated by the fact that we know that the museum experience is a social one [5,8,9,13] and yet (with notable exceptions) most art museums tend to design educational media interfaces for stand-alone computer kiosks which privilege a 'one person to one mouse' configuration. The ExART project was conceived to design for the social nature of a museum visit and to engage families with relevant multimedia content. We also sought to engage aspects of the art-making experience that are removed from the gallery space, in particular connections to the artist's process and our sense of touch.

Design Goals

In observations conducted at SFMOMA in both permanent collection galleries and in their new drop-in 'learning lounge,' we found that the disconnect between social experience in galleries and solitary experience of multimedia kiosks was particularly difficult for parents and children. Parents who wanted to show their children the museum's multimedia programs were frustrated because the interface didn't make sense to the children, but it was the kids who wanted to drive with the solitary mouse. In some cases we found children idly clicking, never finding the appropriate content, while their parents awkwardly propped them up to reach the screen. We also noted that to provide something fun and social for families with children the museum had created a corner where children could play with good old-fashioned building blocks. While children we observed were definitely enjoying the blocks, it did not provide any of the multimedia content available.

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The ExART Table is an attempt to bridge this space. It brings together the social and tangible affordances of building blocks with the advantages of rich multimedia content. It creates an offering for families in the conceptual space between standard kiosks (Figure 1) and building blocks (Figure 2).

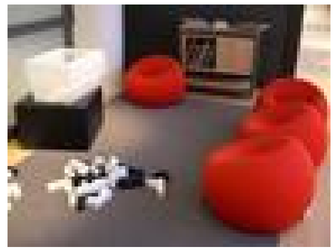

Figure 1: Museum kiosk set-up **Figure 2: Building blocks for families**

Our design goals for the project were to:

1) Create a multi-user interface that works with the social nature of a museum visit.
2) Develop an interface that encourages families with children to access multimedia content.
3) Present artists tools and materials as entry points for learning about works of art in a museum collection.
4) Teach visitors that similar tools and materials can lead to very different works of art.
5) Build bridges connecting the galleries and the education spaces.

Foundational Work and Learning Principles

The ExART table builds on SFMOMA's tradition of interactive educational multimedia development [18] and their more recent creation of a drop-in education space for visitors [12]. We were also influenced by work in ubiquitous computing [20], tangible interfaces [7,10], table-based interfaces [19], and recent social interface development in museums [2]. From the research that has occurred we took up the challenge that Ishii and Ullmer put forth that it "is not about making 'computers' ubiquitous per se, but rather about awakening richly-afforded physical objects…"

Drawing on theories of progressive education and development we identified our learning principles as a desire to promote:

1) Learning from social interaction and guided participation [5,17]
2) Learning as an active, educative experience [1]
3) Learning through sensory engagement [4]

What We Designed

We designed a table-based user interface for parents and children where interaction with physical objects triggers multimedia content. The prototype uses a variety of art making practices as the lens for which to view artworks from the collection. Art making practices (painting, photography, drawing, collage) are embodied in the tangible tools that artists use. When one such tool (a paint brush, camera, or jar of glue) is placed on the table, works of art made with it appear. In this way the family is able to see a group of works related by the process of making. If more than one tool is on the table works related to them are shown and the family is also able to see that some works are in fact made with both tools.

Interaction

1) Table has introductory concept and no tools on it. (Figure 3)
2) Visitor places an artist's tool on table. Content related to the tool (for example: paint brush) is triggered. Digital images of artworks made with the tool appear linked to it. (Figure 4)
3) Visitor places a second object on the table. Content related to the tool (for example: glue bottle) is triggered. Digital images of artworks made with the tool appear linked to it. (Figure 5)
4) If there are artworks that share the 2 tools then combined content is revealed. (Figure 6)
5) Digital images are always touchable for more content related to individual works of art (in most cases video of the artist working).

Figure 3: The ExART Table introductory screen

Figure 4: The ExART Table after paint brush is placed

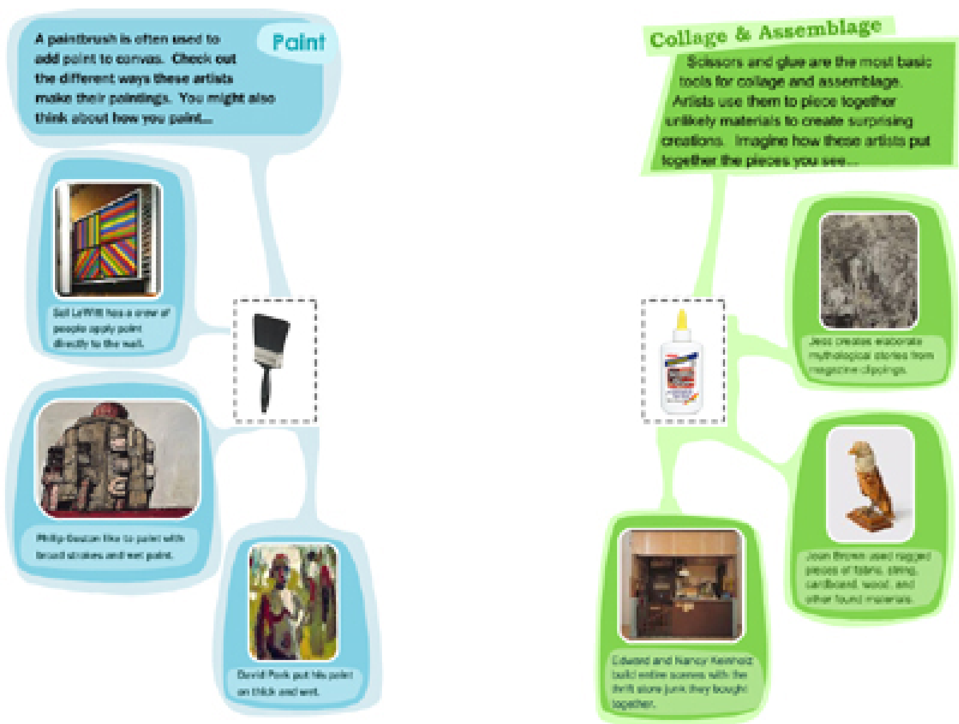

Figure 5: The ExART Table with 2 objects

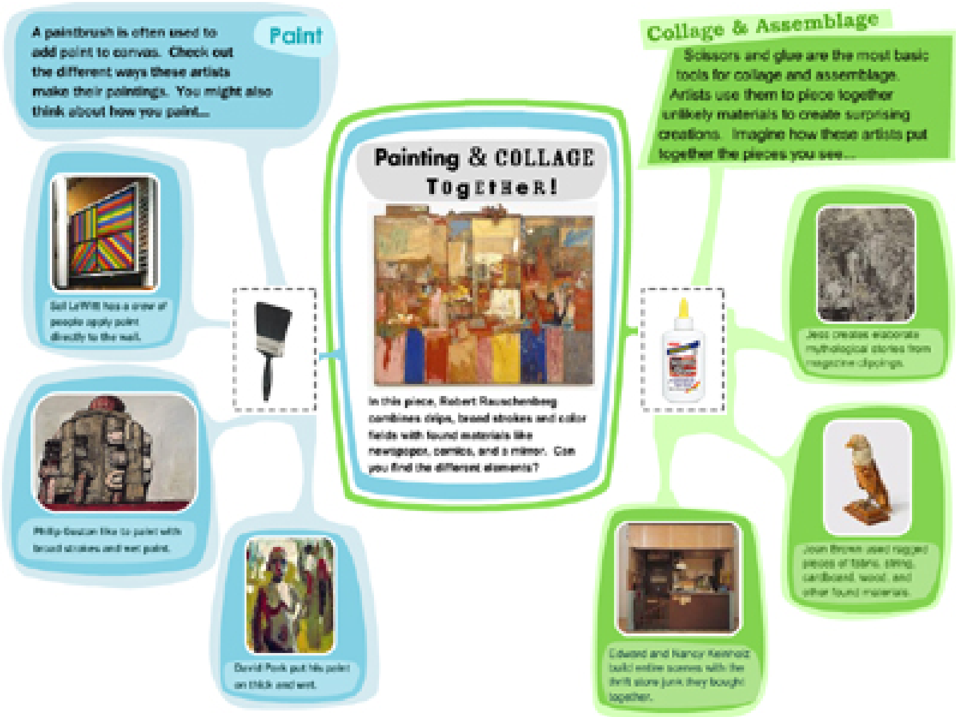

Figure 6: The ExART Table with combined content

<u>How the Technology Works</u>

A Flash program drives digital content displayed on the table. Interaction between the physical objects and the table is accomplished by tagging the objects with Radio Frequency Identification (RFID) tags. When the objects are placed on the table that houses the RFID reader, the Flash program reads the identification tag and displays appropriate material.

We are using the PhidgetRFID board, which is an Universal Serial Bus (USB)-based controller for RFID applications. Phidgets is a company that produces a set of low-cost building blocks (motors, sensors, etc) that connect to and can easily be programmed by a computer for creating physical, tangible interfaces. Each Phidget has a USB connector and can be programmed using a variety of languages. The PhidgetRFID has a read range of approximately 3 inches and reads only tags with unique IDs.

The PhidgetRFID readers must be able to communicate the ID number of the tag they are reading to Flash. This communication requires that two programs be running simultaneously on the table. The first program, an RFID program, is written in C++ and deals with the RFID sensing and sending the number of that tag. The second program is a Flash program that handles the multimedia content by taking the ID number it has just received from the RFID program and displaying the appropriate content. The two programs communicate through an open port which is created by the RFID program. After opening the port and waiting for the Flash movie to start, the RFID program reads the tag ID number on the reader and sends it to Flash as XML. Flash, then parses that XML to receive the ID number and displays the associated content for that tag. The diagram below describes our setup. (Figure 7)

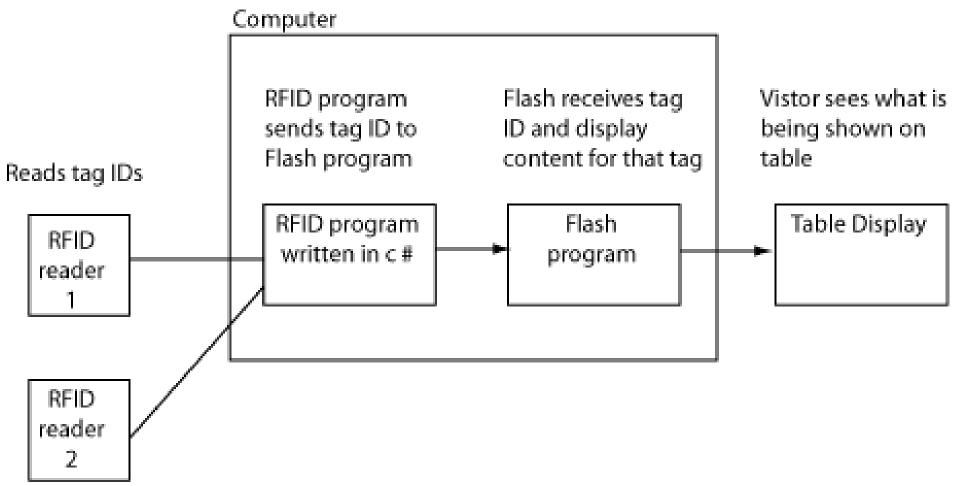

Figure 7: How Content is Triggered with RFID

Evaluation

Our design evolved through successive rounds of user testing and design iteration. We tested the prototypes with both Stanford undergrads (Figure 8) and with multiple families (Figures 9, 10). In our user studies we focused on different levels of interaction:

1) Comfort with and affinity for using the physical objects
2) Relationship of content layers
3) Table use (both ideal physical dimensions and related social configurations)
4) Family interaction

Figure 8: Paper prototype testing with undergraduates

Figure 9: Paper prototype testing families at the museum

Figure 10: Interactive prototype testing with families

Results

We affirmed that visitors were quite compelled by using physical objects in the museum. As predicted by museum staff, the children were excited to be allowed to touch and in essence fondle the paint brushes. They also were interested in uncovering the relationship between the physical objects and the multimedia content as it was revealed. Families were lead by children's tactile exploration and parents responded by reading text and asking questions. We were also surprised to see that children picked up cues from the video of artists working that guided the way they played with the tangible tools. For example, watching Guston paint (a Guston work and video were revealed when a child put the paint brush on the table) led one girl to do imaginary painting along with him.

As we had hoped, our tests informed our vision for the table's shape and size. We concluded that the table needs to be low enough for kids to stand at it and for parents to sit on chairs. This led us to commit to coffee-table as opposed to dinner table form-factor.

Several possible additions to the table interaction came out of our testing as well, including printing a gallery map based on visitors' exploration on the table. Another concept we discussed with families that holds promise would be the ability to pick up potential triggers (perhaps paper versions of tools) while in the galleries and bring them to the table. There was enthusiasm among staff and parents for this option that explicitly connects the galleries and the learning lounge.

Conclusion

The ExART Table is still only a prototype, but as it moved from paper to multiple stages of interactive prototypes we have consistently seen family audiences respond positively to the use of tangible objects to trigger multimedia content. In particular the use of artists' real tools is motivating for learning about works of art. We look forward to finalizing the table's form factor and testing it more fully in the museum.

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