The Spinning Screen:
- A Movable Experience Between Virtual and Real-

Hyun-Jean Lee, Ali Mazalek, Kirti Goel
Synaesthetic Media Lab, GVU Center
Georgia Institute of Technology
Atlanta, GA 30332 USA
{ hyunjean.lee, mazalek, kgoel3 }@gatech.edu

ABSTRACT
In screen-based experiences, the screen itself can become the physical device used for interaction. The "move-ability" of the screen affords interactivity between the screen artifact and the viewer and between the virtual and physical spaces. As a movable screen interface, we have created the *spinning screen*, a two-sided monitor on a revolving base. This interface invites user interaction through the action of spinning the screen to manipulate media content. By allowing viewers to grasp the interplay between visibility and invisibility, the spinning screen can enrich user experiences of virtual imagery through direct tangible interaction in both playful and practical contexts. We describe an art piece and an application for 3D visualization and modeling.

Categories and Subject Descriptors
H.5.2 [Information Interfaces and Presentation]: User Interfaces – ***input devices and strategies, interaction styles, screen design***; H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems – ***video, animations.***

General Terms
Design, Human Factors.

Keywords
Tangible interface, spinning screen, interactive media installation, storytelling, 3D modeling.

1. INTRODUCTION
The screen exists in a boundary between the real space where the viewer is located and the virtual space where imagery is located. Traditionally, for interactive screens, we typically use remote-control devices such as mice or keyboards to navigate around or interact with the world inside the screen [2, 6]. However, sometimes the screen itself becomes the device for interaction or connection, for example in touch screen interfaces.

A movable screen is another example where the screen becomes the interface. The "move-ability" of the screen affords interactivity between the screen artifact and the viewer, i.e. between the virtual space and the physical space. Viewers move (e.g. spin or tilt) the screen to provide input, which controls virtual imagery (and sometimes audible effects) on or "inside" the screen. As the virtual images follow and react to movement, the viewer gains a strong physical relationship to the virtual space through their interactions. Thus the boundary between the viewer/interactor and the screen is blurred.

We have created a movable screen, referred to as a "spinning screen" for both interaction and display. We present a completed media artwork titled *Cross-Being: Dancers*, and an application in development for 3D visualization/modeling in museum settings.

2. RELATED WORK
Computational processes can enhance our playful experiences with optical illusions. They can manipulate media contents (e.g. audio, video, still images), and can also provide controls for the mechanical operation of optical illusion devices (e.g. angle, speed, light effects). For example, a recent work by media artist Toshio Iwai, called *Morphovision* [1], uses a slit-scan method for 3-D visual display, generating optical illusions through spinning techniques. Bob Mumford's "Streak Photography" [4] also uses slit-scan and spinning technologies to construct composite images from multiple images of an object on a turntable. Finally, large rotating LCDs contained visual segments of an interconnected virtual world at the Samsung Experience in NYC [5].

3. THE SPINNING SCREEN
Familiar screen forms like painted canvases and generic video screens present 2-D static views. In contrast, our spinning screen features a two-sided display that users can spin, and which uses doubled or multiple perspectives. Through familiar physical actions, and the spinning screen provides playful and often social media content interaction possibilities for users in both artistic and practical areas. In the following sections, we explain the physical interface and interaction, and different applications and scenarios created for the spinning screen.

3.1 Physical Interface and Interactions
The spinning screen is a two-sided monitor on a stand constructed from gears and two revolving shafts. Each shaft is connected to the two monitors and to a 360-degree potentiometer that calculates the direction, angle and speed of spin (Figure 1). The values of the potentiometer are delivered to a host computer via serial or MIDI communication, and visual data is transmitted from the host computer to the screens via a rotary connector.

The screen provides multiple spatial viewpoints based on where users stand. Moreover, as users spin the screen, they can vary the parameters of spin (direction, speed, and angle). In response, media applications can provide diverse temporal and spatial interactions. For example, the direction of spin can be used to

ACE'07, June 13–15, 2007, Salzburg, Austria.
ACM 978-1-59593-640-0/07/0006.

provide temporal navigation, e.g. moving forward or backward in time. The speed of spin might then be used to control the frame-rate of the displayed video. Spatial responses also can be achieved based on the angle to which the screen spins. Users could, for example, rotate the screen left/right to examine a 3D model of a vase or exploit demarcated viewing angles for specific purposes. Examples of these kinds of interactions are discussed below.

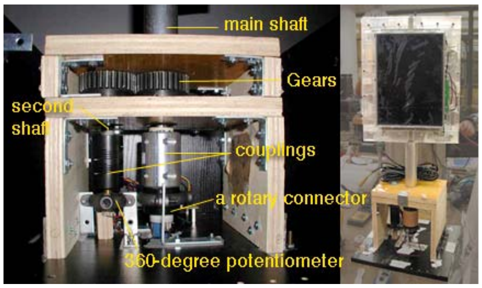

Figure 1. The physical structure of the spinning screen.

3.2 Applications

3.2.1 Cross-Being: Dancers

Inspired by a children’s spinning ballerina toy, *Cross-being: Dancers (2004)* [3] is an interactive video/audio installation by Hyun Jean Lee. Video imagery of a dancer spins as users spin the physical screen, creating fluid and beautiful movements (Figure 2). The two-sided spinning display represents both front and backsides of the dancer. Depending on where viewers stand, they can have multiple perspectives on the same event, which retains a greater part of its original spatial context (source videos from multiple perspectives are required). The dancer’s speed and direction change based on the direction and speed of the screen's rotation. In this sense, the interface can compose the compressed and expanded view of the same event in different ways. Since detailed views of the spinning dancer can be examined in slow motion, the perceptual limitation of our eyes in capturing the single event can be overcome by spatial navigation. The event can also be regenerated non-linearly by spinning the screen in reverse. The piece uses the Max/Jitter to manipulate video and sound.

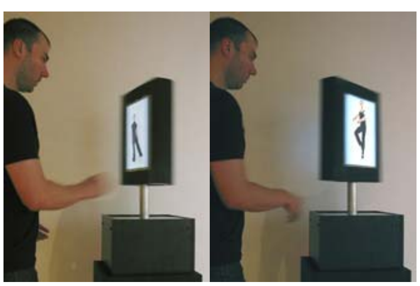

Figure 2. *Cross-being: Dancers* (2004).

3.2.2 3D Visualization in Museum Display

Exhibition displays usually separate viewers from museum objects, so the viewers cannot touch or explore them close up. We are designing spinning screen interfaces for display, navigation and modification of 3D visual data, such as archeological artifacts in museums. By physically spinning the screen, viewers can access different viewing angles of a 3D object as if it were placed on a turntable, e.g. the Greek vase in Figure 3. By incorporating a touch-sensitive overlay, viewers can also directly interact with the displayed object. Using touch, viewers might zoom into the object to reveal greater detail, or bring up additional information (e.g. text descriptions). In modeling mode, users might carve out or add material to a 3D object through a combination of touching and spinning. This combined tangible/virtual sculpting is reminiscent of the way sculptors physically mold clay on a turntable. Our current prototype is implemented using Java 3D.

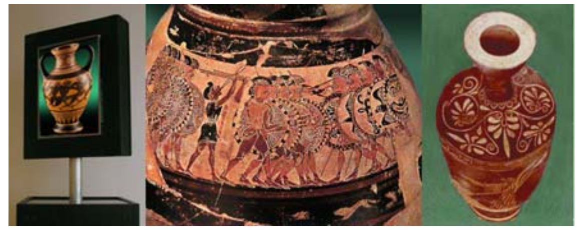

Figure 3. 3D visualization.

4. USER FEEDBACK AND CONCLUSION

Cross-being: Dancers has been displayed in art exhibitions and has received much interest and excitement from viewers. They have responded positively to seeing a multi-perspective event (the dancer's performance) happening in synchrony on the two-sided spinning display. We have also received initial user feedback by conducting walkthroughs of paper prototypes of our information visualization applications. This has helped to target 3D modeling as an interesting application area for the spinning screen. Many users felt that since the spinning screen provides a strong spatial context, it could provide enhanced ways of viewing and manipulating 3D virtual objects that closely relate to the way we view and create models in the real world (e.g. clay sculptures).

The spinning screen is a novel tangible interface for engaging and dynamic user interactions. It provides diverse interactions with media content, such as audio/video and 3D imagery. Our explorations of spinning screen applications have revealed that this can be a new paradigm offering rich interaction possibilities in artistic, entertaining and practical contexts. Future research will include further application development and user evaluations of our existing application designs.

5. REFERENCES

[1] Fukaya, T., Iwai, T., Yamanouchi, Y. Morphovision. In *SIGGRAPH '06 Emerging Technologies*, ACM Press (2006).

[2] Ishii, H., Ullmer, B., Tangible bits: towards seamless interfaces between people, bits and atoms. In *Proc. CHI 1997*, ACM Press (1997), 234-241.

[3] Lee. H.J. Cross-being: Dancers. In *<Baram> 2004 mushroom art space and network's intermedia arts event*, NYC.

[4] Mumford. B. "Streak Photography," http://www.bmumford.com/photo/streak/index.html.

[5] Samsung Experience, NYC, Press release, Sep. 22, 2004: http://www.samsung.com/PressCenter/PressRelease/PressRelease.asp?seq=20040922_0000078473.

[6] Ullmer, B., Ishii, H. Emerging Frameworks for Tangible User Interfaces. In *IBM Syst.J.39, 3-4*, IBM Corp. (2000), 915-931.