User Interface of Interactive Media Art
in a Stereoscopic Environment

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Abstract. Interactive Media art communicates with audiences using many interfaces. The audience experiences each interface differently. Two different kinds of art experiences can be generated using the same themes. Using a touch screen monitor and Microsoft Kinect motion sensors, in the same gallery environment, we surveyed visitor experiences with both forms of art in a stereoscopic environment. We discovered that motion interfaces are better than touch interfaces for interactive media art, with the changes in depth providing more powerful stereoscopic audience experiences.

Keywords: Interactive Media Art, Natural Interface, Stereoscopic Artwork, Touch Interface, Motion Interface.

1   Introduction

Many artists have been attempting innovative work that emphasizes direct interaction between the audience and the art itself work [1, 2]. The interactive technology used is now much more integrated with the user experience. Viewers know that new technology changes their interaction, as well, because they're familiar with this process in everyday life [3]. Touch screens and better interactive technology has changed the way people interact with many tools, opening the door to new possibilities. For art, possibilities have changed since the era of keyboards, mice and toggles. This new technology, developed originally for commercial and home use, was designed to maximize convenience [4-6]. However, as with all technological innovation, this has also opened the door to a new world for art and the experience of it [7, 8].

Stereoscopic 3D is a technology that makes the viewer feels a stronger sense of space by showing slightly different images to each eye. It's existed in various forms since the 1880's, in the form of stereoscopic glasses and projectors. But as stereoscopic 3D technology has developed, especially since the arrival of the computer age, the potential has radically improved for changing the way we experience 3D spatial interfaces and displays. This has the potential to fundamentally alter the way we experience art, design, and science through 3D interaction [9].

Furthermore, the recent commercial popularity of 3D TVs and movies has created a world in which stereo images are becoming far more familiar. One interesting carryover from the commercial realm is the immediate environment for this new form of art display. Modern media art that uses stereoscopic images requires a darker exhibit environment to maximize viewer immersion, in the same way that movie or other 3D presentations operate [10]. While this technology is liberating in some ways, the result is that the same limitations that affect commercial use apply with its use in art. Interactive displays have to take into account these special limitations. This paper studies audience experiences when dealing with interface changes, when viewing artists' stereoscopic work, via touch and spatial interactions

Section 2 introduces our artwork and related exhibitions using touch and motion interfaces in stereoscopic environments. Section 3 presents a survey that covers the viewer experience of these interfaces and the most powerful factors involved with 3D art. Section 4 draws conclusions and provides scope for further research.

2   Media Art Work in a Stereoscopic Environment

The media art in Figures 3 and 5 are 3D interactive work, titled 'Garden Party 1' and 'Garden Party 2'. They express the same theme and material, exploring the co-existence of nature and human life. The audience colors the sunflower images interactively. If all of the sunflowers are painted, their leaves fly off, as shown in Figure 1. The audience's interaction implies a human interest in nature, which returns a kind of attention or love to its human viewers. 'Garden Party' employed these painted images on canvas in a traditional painting form in order to express this in a comparative analog painting. To deliver the actual feeling of drawing sunflowers, it used a process through which the sunflowers were being painted, changing the sunflowers images through interaction with the audience as shown in Figure 2.

Fig. 1. Garden Party theme

Fig. 2. Sequential sunflower painting

We used natural interfaces in both art forms, designed for intimate use, involving the most current touch and motion interactions. This natural interface is intuitive, not requiring explanations for use, unlike older menu-based interfaces [11]. Since stereoscopic art exhibitions are much darker environments than most exhibition halls, the sensors that can be used are limited in functionality. This reality enforced a resulting simplicity in design. A touch screen monitor is used in 'Garden Party 1' and is good for general exhibitions because images and physical interaction points are matched. However, inexperienced audiences often jump between monitor images and stereoscopic images, which confuses them and inhibits immersion. Microsoft Kinect is used in 'Garden Party 2' for motion interaction, because webcams don't pick up human movement when it's dark.

Figure 3 shows the exhibit image for 'Garden Party 1' and its floor plan, involving a 3D Projector and a touch screen. The touch screen interface is extremely familiar to most audiences at this point, due to the prevalence of smartphones. The touch screen monitor serves as a canvas, and hands as brushes. The parts of the sunflower touched by hands are "painted", which is the reality of direct interaction. When the monitor is touched, the target position is marked on the stereoscopic image, so ideally the audience won't look at the monitor. A butterfly moves to the target position and particles emerge from it. The color "particles" falls onto the sunflowers and "paints" them.

Fig. 3. Garden Party 1 and floor plan

Fig. 4. Butterfly painting sunflowers

Figure 5 illustrates 'Garden Party 2' and its floor plan. A 3D projector is used for stereoscopic images and a Kinect sensor is used for motion detection. The audience can move freely, participating in the artistic creation, because of the spatial interface. As a viewer approaches the work, the viewer's shape appears on the work image in stereoscopic form. "particles" flow out from their hands, "fly" to sunflowers and paint them in accordance with audience movement. The viewer's body becomes a painting tool.

Fig. 5. Garden Party 2 and floor plan

Fig. 6. The body shape painting sunflowers

3   Exhibition Visitors Survey

To carefully examine the touch screen user experience and the motion-based spatial interface used for this interactive media art, a survey of the participating viewers was conducted. The main objective of the survey was to investigate the two methods' effectiveness, the degree of correlating stereoscopic image experiences, and their immersion in and participation with the work.

3.1   Survey Methodology

We surveyed 36 people, 18 male and 18 female, ranging from their early 20s to their 50s (20s: 10, 30s: 14, 40s-50s: 12). No explanations about the interface or details, or instructions, were provided. The average length of the experience for these participants was about around three minutes.

We surveyed the topics listed in Table 1 to evaluate the differences between the two interfaces and the factors involved in this stereoscopic artwork and improvement of this interface. Our questionnaire contains four questions, three with one selection choice and one with multiple selections.

Table 1. Surveyed topics

General	Q1. Which artwork is your favorite?
	① Garden Party 1, ② Garden Party 2, ③ Similar
Interface	Q2. Which interface is easier to control artwork?
	① Touch, ② Motion, ③ Both, ④ Both are difficult.
	Q3. Which interface is better for artwork in stereoscopic environments?
	① Touch, ② Motion, ③ Similar
Elements	Q4. What elements are most impressive? (multiple selection with order)
	① Sketchbooks, ② Butterfly, ③ The hands of participant, ④ Particles from butterflies, ⑤ Particles from hands, ⑥ Sunflower animation, ⑦Flying sunflowers leaves

There were three questions about the influence of the interface and a last question about how the elements affected the audience in this stereoscopic environment. The elements in the art had different characteristics, as shown in Table 2.

Table 2. The characteristic of elements

Element	Characteristics
Sketchbooks	Image change (2D / 3D)
Butterfly	Slow depth change and slow reaction
The hands of participant	Small depth change and fast reaction
Particles from butterfly	Small depth change (downward)
Particles from hands	Fast and large depth change (inward)
The animation of sunflowers	Color change
The flying of sunflowers leaves	Fast depth change (outward)

3.2   Survey Result

First question is about the audience preference for both of the art presentations they experienced. Figure 7 shows that the preferences are similar for 'Garden Party 1' and 'Garden Party 2'.
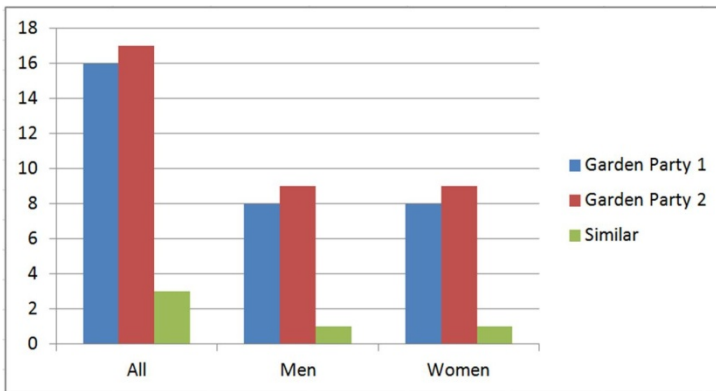

Fig. 7. Art preferences

Figure 8 shows the type of interfaces that they had previously experienced. Most of the audience had previous experience with both interfaces. More men experienced the motion sensor than the touch sensor. Women's responses were similar.

Figure 9 shows the answer for question 3, broken down by gender and age. The participants prefer the motion interface in stereoscopic environments. By gender and age, more men than women preferred the motion interface and more young people than old people liked the motion interface.
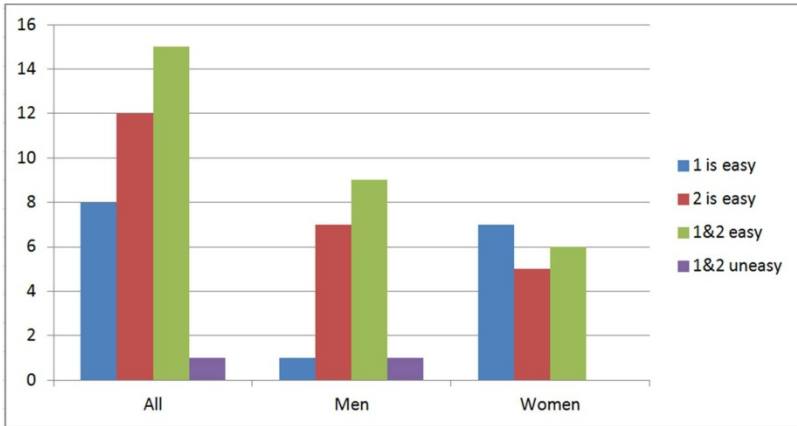
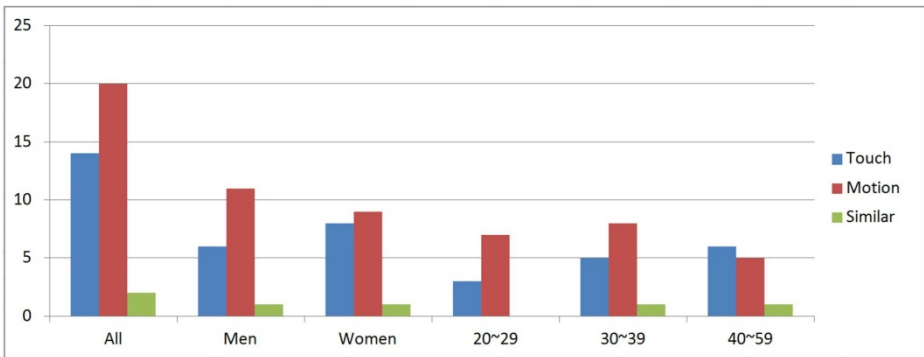**Fig. 8.** Easy interface for control artworks in stereoscopic environment

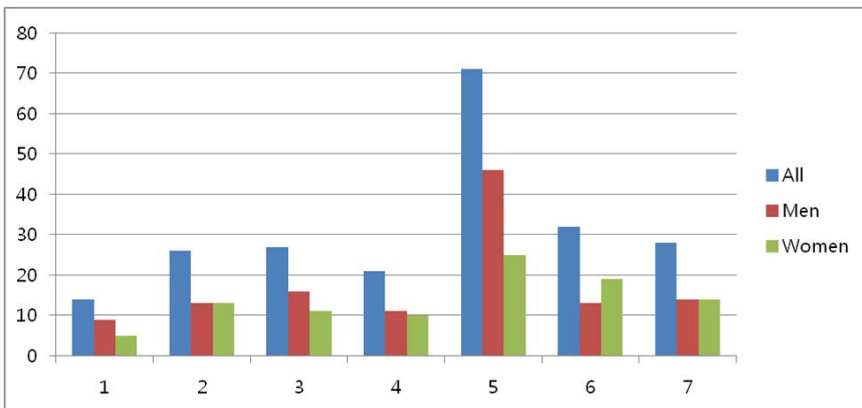**Fig. 9.** Preference for interface style in stereoscopic environment

Fig. 10. Impressive elements in stereoscopic environment

Finally, the important factor in stereoscopic artwork was analyzed by selecting what was perceived as the most impressive elements. The audience selected three items in Table 2 in order of preference. The first answer scored three points, the second answer two and the last, one. Figure 10 shows a graph of the totals. The impressive element was particles from hands, and the least, sketchbooks. The second highest score was the painting of the sunflowers, and the third was that of leaves flying toward the audience. Elements that moved in and out aroused the most audience interest. Men preferred elements have that had quick reactions.

4   Discussion and Conclusions

We surveyed 36 visitors to evaluate the experience involved with touch and motion interfaces in stereoscopic interactive artwork. Men were partial to the motion, while women preferred the touch display. The audience found the spatial interfaces using Kinect, rather than the touch screen, more interesting, but at the same time considered them appropriate for this stereoscopic environment. The spatial interface allowed immersion in the work by providing a sense of space, along with movement, whereas the touch screen's weak point was the tendency to split the viewer's attention between the touch screen and the stereoscopic display. The audience was impressed with the elements involving depth and speed of motion.

Media art can use many different technologies, depending on the goals and intentions of the artist, but for stereoscopic images and spatial interfaces, maintaining the appropriate relationships between art and its viewers, and providing a good sense of immersion, requires a good grounding in how the space between these actors is used. Small differences in responses based on gender and age appeared to be the result, according to our survey.

This survey, though small, opens up the field for further research. It hints at questions for further research. It might be fruitful to explore the relationship between the interface used for this type of interactive art and different responses to it stemming from gender and age-related life experience.

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