Towards Art inspired Innovation:
A Survey of High-Potential Media Art to Inspire Future Mixed Reality

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ABSTRACT: Mixed Reality (XR) has been a popular area of research in both academia and industry. However, it's still unclear how we can design interaction with high benefit, rich experience, and good usability using XR technologies. Interestingly, media artists have used XR technology in their works for decades and sometimes they came up with ideas and concepts that much later were discovered or re-invented in Human Computer Interaction (HCI) research. Artists and researchers are basically different communities, attend different events, and show their work in different ways. In this paper, we provide an overview of artworks that have been inventing or using technologies and concepts of XR before researchers did. We moreover highlight art works with huge potential to inspire future technology and interaction design development of XR.

1. INTRODUCTION

Mixed Reality (XR), a blend of the physical world with the digital world [23], becomes part of more and more domains, such as entertainment, games, medicine, and museums [8]. XR is not only a well-established research area in human computer interaction (HCI), also artists have often not only been early-adopters, but sometimes even innovators of emerging technologies and interaction techniques. Actually artists often designed novel interactions or new technologies, while HCI researchers sometimes rather focus on establishing use cases or guidelines for known concepts. *Grow Flow* created by Myron Krueger in 1969, is an example of such novel technology created as art work [21]. The installation adopted a novel method to interact with people's motion and visitors became part of the media artwork. While virtual reality researches in HCI often aim to provide a very realistic user experience, Myron Krueger focused on the interaction itself. For him, virtual reality was a media to communicate with each other. This notion makes his work different from most research driven virtual reality works. Interestingly, Krueger's work had affected later HCI researches about full-body interaction such as *YouMove* by Fraser Anderson et al. [4].

Another example of XR artworks is the virtual stage project "*The Jew of Malta*" created in 2002 by ART+COM Studio* [22]. ART+COM realized the costumes and stage design for an opera using interactive projection on the background screen and the costumes of the actors. While that approach was novel in 2002 in media art, a similar concept of adaptive room design through projection was noted to be novel in HCI 9 years later with IllumiRoom by Brett R. Jones et al. [20].

In general, media artists try to implement artistic concept using media technologies rather than aiming for technology innovation in the first place. However, in some cases, their interaction design or technology implementation has novelty, might not be known to HCI researchers, and thus, possibly could be later re-invented by them.

2. METHOD AND GOAL

In this paper, we survey past and current MX media artworks. Media art provides a scaffolding for XR: it has the potential to offer novelty that enhances how we currently blend the real and the virtual. This paper aims at contributing HCI research by providing the first comprehensive analysis of past and current media art highlighting its actual or potential impact in the area of HCI.

3. OVERVIEW OF MX MEDIA ART

Media art generally describes artwork using digital media and algorythms [9]. Media art covers broad topics. Actually, when we look at the artwork in Ars Electronica [14], which is a famous media art festival, it covers topic related to computer graphics, interactive art, music and sound, digital communication etc.

Many artists have already used XR technology for their artwork. "*The other in you*" by Richi Owaki, for example, developed as a new way to experience dance in the virtual world[17]. He challenged to explore "selfness" through his artwork, which combines VR technologies with tactile feedback. On the other hand, Augmented Reality technology might also help to visualize a massive amount of data. "*Archive Dreaming*" is an immersive installation to visualize relations among 1.7 million documents using projection mapping that are searched and sorted using machine learning algorithms [2]. The artist also tried to visualize peoples' brain waves by combining with their artwork [3]. These installations are great examples for XR media art using cutting edge technologies. However, these artworks are rather an extension of conventional interaction design.

In this paper, we try to indicate media art, which not only adopt XR technology to their artwork, but to embed to some extend novelty. Here we review media art about the following: 1) interactive kinetic art, 2) light in media art, and 3) sounds in media art.

3.1. INTERACTIVE KINETIC ART

Digital art, in contrast to traditional art, uses motion more often due to its technical opportunity for computational kinetics, which allows artists for expressing modernity, aliveness and dynamics. *Pinokio*, a robotic lamp, for example, can recognize gestures and facial expressions using a built-in camera and express a dynamic range of behaviors [25]. It's a design item, however, it's a sort of indicating objects can have a character and can engage us in new and exciting ways. That's what makes it art.

The usage of motion in art had already started around early 20th century and has been named kinetic art [7]. Kinetic art includes mobile and mechanical sculptures, which use physical motion, as well as op art painting, where the art works seem to rotate or vibrate in front of the eyes. Great pioneer works of kinetic sculpture are *kinetic construction (standing wave)* by naum gabo [18], *rotary glass plates (precision optics)* by marcel duchamp [13], and *light space modulator* by lászló moholy-nagy [24]. The artists were fascinated by the potential of motion in art and they explored art which would encompass a visual experience beyond the boundaries of traditional, static art. Kinetic sculpture has common features using

mechanical elements such as motors, machines, and electrically powered systems to media art.

A difference between media art and kinetic sculptures is the advance of digital technology that allows artists in media art to add interactivity to their projects. Daniel rozin created an interactive mechanical mirror called *wooden mirror* in 1999. It consistsed of wood pieces and one of these pieces reflected its surface when any person was standing in front of the piece [26]. Thus, the mechanical mirror made a difference in interactive relationship between viewers and art compared to traditional static art through empowering the viewers to change the work and to have an impact on its appearance caused by their own body shape and look.

On the other hand, artists often use real objects to explore their interests, even if it's not enough to function. "*android theater*", a good example of this, is really interesting [19]. They presented shortplay, played by a human actress and a woman-like humanoid robot called *geminoid f*. This kind of robotic art is two aspects: one is the development of human-like natural motion for a robot(i.e. *Alter* [11]), and another one is on a cognitive aspect to investigate human presence. Purpose of android theater is the latter. Now artificial intelligence technology hasn't reached the level that allows a robot to talk like a human, however, still we talk with robot like they are human, especially when someone controls the robot remotely. This work is confirming that functional kinetic sculptures have the potential to affect our cognitive ability.

Nowadays, many artists tend to include mechanical elements in their artwork, while others use digital technology such as images and videos. However, also animated images and video create motion, mechanilca elements often seem to create a stronger sense of motion due to the physical character of the moving elements.

3.2. LIGHTS IN MEDIA ART

Another aspect of kinetic art is Op art. Op art mainly consists of geometric patterns or color patterns that cause visual illusion [6]. *Box* by Bot & Dolly, for example, is a project where an actor interacts with projection images on two screens that are controlled by industrial robot arms [12]. The projection images cause optical illusion based on black and white geometric patterns and completely synchronize

with movements of robots and actors. The result is an experience that displays computer graphics into the real world.

Another example of media art using visual effects is *Particles* by Motoi Ishibashi et al. [16]. *Particles* is a lighting installation and is an organically spiral-shaped rail construction with a number of LED balls. LED balls roll on the rail while these LED balls are blinking at different intervals and it allows us to see a spatial drawing of light particles in different kinds of shape. This artwork, in contrast to the aforementioned *Box* by Bot & Dolly [12], enabled to illustrate more spatial drawing, even if having only low resolution.

Another example of light in art is the use of monochromatic light. "*Room for One Color*" by Olafur Eliasson [15], people can only see one color irradiated by monochromatic light. Monochromatic light has a very narrow light spectrum and objects appear black if they can't reflect irradiated light. Thus, the use of the monochromatic light will lead viewers in the one color and black world. Eliasson stated, "In reaction to the yellow environment, viewers momentarily perceive a bluish afterimage after leaving the space." Interestingly, giving the limitation of perceived color causes an effect on our perception. Although many artists in Op art achieved visual illusion using color pattern, Eliasson went a step further and attemped it to space design in the real world.

3.3. SOUNDS IN MEDIA ART

After emerging digital audio technologies, sound and substances like musical instruments have separated. Digital telchnologies such as a synthesizer allows people to treat these sounds as information and style to enjoy music is totally changed, while live musical sounds only created from substances. Maywa denki, a group of art, challenged this issue and they developed mechanical musical instruments, which are enabled to control either in manually and automatically [10]. Their art work intended to remind people of the relationship between the substance and musical sounds.

A sound installation interested in the separation of sound and substances is *chijikinkutsu*. In this uniques sound installation, which consists out glasses of water, a floating sewing needle by surface tension of water in the glasses pull by magnetic force to hit inside of each glass and cause a sound [1]. The artwork did neither use color patterns, nor amplifying sound or led light

because the artist let people experiencing the pure sound and focus on it by eliminating disturbing factors. A similar sound installation was created more recent with *clinamen* by céleste boursier-mougenot [5]. This work is a type of minimal art. It adopts a simple construction, which consits of real objects that cause sounds, to let viewers emphasize their internal senses.

4. DISCUSSION

In the previous chapter, we introduced media art using mechanics, light and sounds. In the following section, we will anlyze the work we discussed reagarding their potential to inspired research and to create novelty in XR interface and interaction design.

4.1. MECHANICAL ELEMENTS IN XR

As we mentioned above, mechanical elements have a stronger sense of motion. This is because of the material that digital technology doesn't have. Daniel rozin's *wooden mirror* comes from the idea that including material in his art is a way to tap our collective intuitions [26]. We spend entire life in the physical world and develop intuition regarding behaviors in the physical world. The use of physical material also has the potential for future xr interaction.

Another point is to include a metaphor about the physical world. Rozin utilized the metaphor of a mirror in his work and it makes easier to understand the interaction design because people know how a mirror works. Digital technology takes advantage of the flexibility of computation, however, the flexibility sometimes makes things more complex to understand how things work in the digital world.

4.2. DIMINISH VARIOUS MODALITIES

Researchers in XR, especially in AR, did researches to augment our reality such as adding/overlapping information in our view. In contrast to these AR researches, there is a research called Diminished Reality (DR) to remove or diminish objects in our view [27]. Researchers in DR often focus on visual perception and their interest is how accurately remove objects without an incompatible sense. However, their approaches usually suppose to generate plausible images to real environments in visible spectrum. It might be easier to make a virtual-real boundary with less noticeable if we suppose to see in a different spectrum like

Eliasson's work [15]. At least, we can expect some effects on our cognition because of more narrow spectrum of light.

Moreover, some projects in media art are suggesting that diminishing a human sensory allows people to emphasize their other senses. *Chijikinktsu* by Nelo Akamatsu didn't include not only light effects but also an architectural theory of western music that some sounds art relies on the foundation [1]. Therefore, sounds in his work are purer and more minimal and allow people to emphasize their internal senses because the work eliminates elements that will be noise in the art. There is an only fewer example to decrease auditory perception, while visual DR is common in existing researches. There is no example of DR related haptic sensation and taste. As some projects in media art suggested, the development of DR interaction to various modalities has potential in HCI researches.

5. CONCLUSION

In this paper, we reviewed several mx artworks in media art and discuss how they can influence hci research project. This could foster further novel xr development. We indicated two topics that potentially could provide novelty to hci research inspired by media art: 1) xr device combining with mechanical elements, and 2) xr device as an opportunity to diminish various modalities in xr. We believe that our survey can support hci researchers to get inspiration from media art, but also media artists to get acknowledged by researchers.

6. ACKNOWLEDGEMENT

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