What We Have Lost / What We Have Gained: Tangible Interactions Between Physical And Digital Bodies

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Abstract
This paper explores the use of rear projected fabric panel tangible interfaces for use in music performance, interactive sculpture, and experiential systems. This idea is explored using the piece *What We Have Lost / What We Have gained* as an example. This paper demonstrates how HCI can be applied to and included within art disciplines to increase engagement with the artworks by transforming viewers into performers, participants, players, and co-creators. It further argues that by including embodied interactions artworks expand their ability to convey meaning to users.

Author Keywords
Gesture; embodiment; tangible; interface; musical instrument; video; art

ACM Classification Keywords
H.5.1. Information interfaces and presentation (e.g., HCI): Multimedia information systems, H.5.2. Information interfaces and presentation (e.g., HCI): User interfaces, J.5. Computer applications: Arts and humanities

Introduction

As an art installation, *What We Have Lost / What We Have Gained* presents a four by three grid of video projected mouths on a spandex screen. When physically pressed by a user, each video sample animates and sings a different vowel tone back to the player. The volume of the singing increases as the player presses harder and deeper into the mouth screen, physically distorting the display surface. In this way, the piece provides audio and video feedback through large upper body gestures applied to a tangible interface, rewarding the user with a multi-modal experience. This work contributes to the discourse on the intersection of tangible interactions and artwork by providing an example of how interaction design as utilized within sculpture can facilitate engagement and convey meaning.

Figure 1: Front of rear projected interface and solo user. ©Matthew Mosher

Background

This piece was originally conceived of as a large-scale MIDI drum pad interface for live performance. In live performance electronic musicians often use small MIDI interface to play their music, which makes it hard for the audience to visually connect the slight movements of the musician on an interface they can not see to the sounds they are hearing. To address this issue, What *We Have Lost / What We Have Gained* enlarges a drum pad type interface and mounts it vertically making the musician's gestures larger and visible to the audience.

The interface has evolved from being a MIDI input device for live performance to a sculpture piece, but retains the ability to output full MIDI data including note and velocity. Original prototypes looked at using force sensitive resistors to detect presure on large sprung panels, which allowed for a thinner profile interface, but fabric was ultimately chosen for its texture, responsiveness, and increased range of input motion.

Related work

This piece expands on other large format hard surfaced drum pad interfaces by allowing for force, also known as velocity, control over the notes played [6]. While *Zstretch* uses a fabric interface for musical expression it does not include a video element [4]. *Firewall* does include both audio and abstract video elements activated by a pressure sensitive fabric screen, but is limited to a single point of input [1]. *Soak* and *Cloud Pink* by computing collective Everyware do support multi touch on a flexible fabric screen to create generative visual patterns, but lack audio feedback [2]. The *Jam-O-Drum* is percussion based, but must be used in a horizontal format limiting the audience's

perception of playing and asking the musician to learn a new interface system [3]. *What We Have Lost / What We Have Gained* uses the conceptual model of a drum pad that is familiar to musicians and in an orientation accessible to audiences. As an art piece, it constructs meaning by combining sensuality of material and imagery with gentle familiar human sounds and a tactile experience. Similarly, *soft(n)* uses fabric sculpture forms as a tangible interface to connect bodily experience to meaning making [8]. *Stay In Touch* also uses a touch based fabric panel to digitally connect collocated strangers through a visual and felt experience [7]. *We Have Lost / What We Have Gained* presents a digital representation of a stranger without the possibility of encountering her in person later. This assertion that she is not present, and that the viewer only sees a part of her, allows people to be more liberal with their interaction gestures than they may be with a real person.

Interface

This piece presents a large 1.22m by 0.91m grid of pressure sensitive squares using spandex fabric stretched over a metal frame, seen in figure 1. The grid form provides visual unity and rhythm to the aesthetics of the piece. Each grid square provides and analog reading of how hard it is pressed. The size of the interface requires the player to use full arm gestures, or even knees and heads, when interacting with the device, as it can detect multiple simultaneous grid square depressions. Each grid square serves as a rear projection screen for video playback. Audio feedback, in the form of sung vowel tones, plays through a speaker bellow the grid screen. The tactility of the spandex surface invites felt exploration of and pushing into the interface.

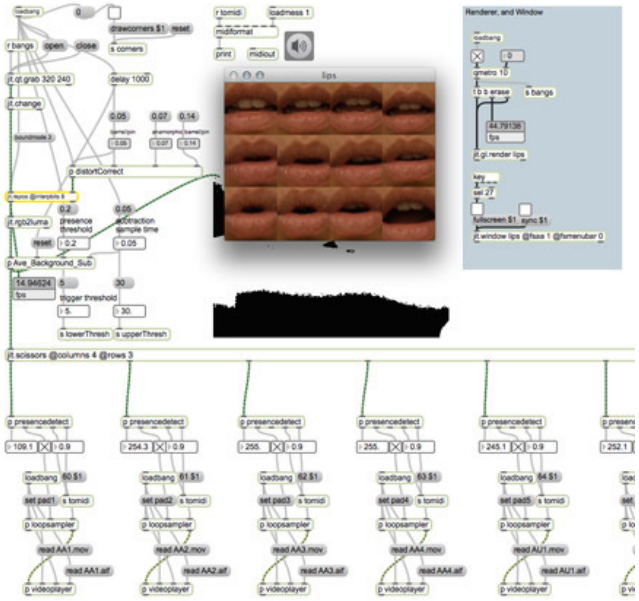

Figure 2: Max6 patch that translates computer vision into audio and video playback. ©Matthew Mosher

Technical specifications

The top of the interface grid is 1.83m above the ground and the bottom is 0.61m above the ground. The interface is constructed from thin metal tubing that is covered in stretched spandex fabric. This allows each grid cell to be pushed in independently from its neighbors. Due to the elasticity of the spandex, the cells can be pushed roughly 0.3m back. Each grid cell is illuminated vertically from bellow with infrared light, which creates a hotspot on the fabric that increases in size as the fabric is pushed harder. Deflections in the grid are tracked with an infrared camera, allowing for analog readings of the pressure applied to each cell.

These readings are sent to a computer running a Max6 patch, figure 2, which uses the computer vision data to compute the playback timing and volume of video streams that are rear projected back onto the spandex screen interface. Through this process the touches on the interface are converted into blobs. The blob location on the grid determines which video activates while the blob size, which increases with touch pressure, is mapped to volume.

Experience

This interface affords large arm gestures as input, unlike smaller media control systems. Multiple people can use the interface simultaneously side by side, which allows for duets, figure 3. Alternatively, shorter children can play the bottom rows while adults play the top rows. The responsiveness of the system and its mappings let participants know that their touches have consequence and allows for immediate playability [5]. The tactility of the fabric surface invites touch, and matches the sensuality of feeling another person's lips. The title of the piece references some of the affordances of digital media systems, in that here people are invited to touch a signifier of a stranger's mouth, a provocative and intimate gesture, and something one would never do to a stranger in person. At the same time it acknowledges that the connection people feel they are having is decidedly not with another human, but an abstraction. It asks the user, what is the experience of using your body to interact with digital representations of another's body? In so doing, the art becomes the multimodal sensory experience called to life by the user through activating the otherwise static interface with their body. The nature of this interface and its experience links it to the conference themes of body as generator of expressive interactions and body as somaesthetics.

Figure 3: Two people interacting with the spandex fabric grid interface, and the projector and computer system behind the screen. ©Mathew Mosher

Conclusion

Based on informal observations of people interacting with the piece at past exhibitions in Arizona, USA a few points stand out. People are hesitant to make first contact with an artwork, particularly in traditional gallery venues where a "do not touch the art" mentality thrives. A simple "please touch" sign alleviated this, and once people saw someone else using the system they would quickly join in. Interacting with the piece often resulted in smiles and pulling in friends to share the experience, while others would comment on the meaning of the gesture of pushing into another's mouth. By including interactive elements in this sculpture people actively engaged it and created their own music.

The title of this piece recognizes the recent societal turn towards preference for digital communications and interactions, and the piece itself reinstates human sensuality and sensory perception to the media. This paper contributes to the discourse of embodied interface design and sculpture by showing how the two may be joined together to create a meaningful experience for participants. Due to their responsiveness and tactility, interactive systems offer an excellent way to increase audience engagement with artworks while simultaneously presenting provocative questions for contemplation.

Acknowledgements

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Video

A video demonstration of the piece is available at:
https://youtu.be/rMy0p4P9owo

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