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# What We Have Lost / What We Have Gained: Embodied Interfaces for Live Performance and Art Exhibitions

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**Abstract**

This paper examines the use of embodied interface design in experiential systems sculpture for art exhibitions, using the piece *What We Have Lost / What We Have Gained* as an example. Looking at musical instruments and MIDI devices for live electronic music performance as a starting point led to developing an interface that allows for more expressive physical gestures, and in turn functions in the area of interactive art. This paper demonstrates how HCI can be applied to and included within art disciplines to increase engagement with the artworks by transforming viewers into participants, players, and co-creators.

**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



**Figure 1:** Prototype screen using visual light along the bottom of each grid square. While functional as an input mechanism, the prototype does not allow for simultaneous rear projection.



**Figure 2:** Two people interacting with the spandex fabric grid interface, and the projector and computer system behind the screen.

## Introduction

As an art installation, *What We Have Lost / What We Have Gained* presents a four by three grid of mouths on a spandex screen. When pressed, each mouth 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. 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.

## 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 [2]. Other innovative tangible interfaces for electronic music production include *Jam-O-Drum* [1], *Reactable* [5], and *Mixitui* [7]. All of these must be used in a horizontal format relying on secondary projection screens to show the audience how they operate, and require the operator to learn a new interface system. *What We Have Lost / What We Have Gained* uses a conceptual model familiar to musicians in an orientation accessible to audiences.

## Background

This piece was originally conceived of as a large-scale MIDI drum pad interface for live performance. During live performance, electronic musicians often generate their music using laptop computers and traditional MIDI interfaces, such as keyboards and drum pads. These interfaces are smaller than traditional instruments, like pianos and drum sets, and due to their reliance on button presses and knob twists for input, lack the expressive gestural quality other musical instruments

provide. The reliance of traditional MIDI interfaces on a tabletop setup limit the ability of the performer to move around the stage while playing, and limit the audience's ability to see what the musician is doing leading them to often believe that the musician is just pressing play. At times playing pre-composed clips is exactly what the musician is doing, so why not make the play gesture visually significant?

This interface addresses these issues by providing a large surface to promote push input requiring the full use of the arm. In this way, the device takes what was a finger press and transforms it into an embodied gesture. It mounts the interface vertically, rather than horizontally, to give the performer more freedom to move around, and to show the audience how the interface is being used. At the same time, the interface is familiar to musicians, as the grid format visual appears similar to a standard MIDI drum pad device, only larger. As a MIDI device, the sounds and videos played are completely customizable.

The interface has evolved from being an alternate MIDI input device for live performance to an art installation piece, but retains the ability to output full MIDI data including note and velocity.

## 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 3. Each grid square provides an analog reading of how hard it is pressed. The size of the interface requires the player to use full arm gestures, or even knees, 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 plays through a speaker below the grid screen. The tactility of the spandex surface invites felt exploration of and pushing into the interface.

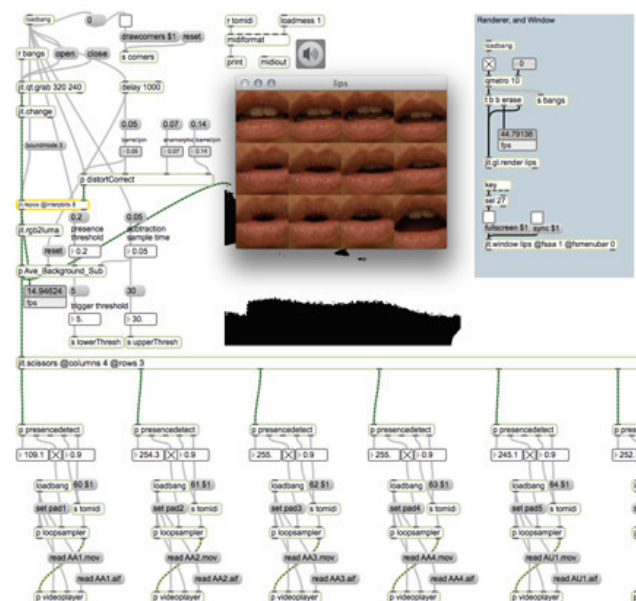


**Figure 3:** Front of rear projected interface and solo user.

### 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 below 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 4, which uses the computer vision data to trigger video streams that are rear projected back onto the spandex screen interface and plays accompanying audio.



**Figure 4:** Max6 patch that translates computer vision into audio and video playback.

### Experience

This interface affords large arm gestures as input, unlike smaller media control systems. The tactility of the fabric surface invites touch, and matches the sensuality of feeling another person's lips, bringing a soft human element to an otherwise hard media [4]. Multiple people can use the interface simultaneously side by side, which allows for duets. Or, 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, putting it in the realm of Digital Live Art [3]. 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, something one would never do 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.

### Conclusion

In previous exhibitions the piece attracts a crowd due to how ready-to-hand the interaction is, and people quickly try to play familiar songs. The tactility of the materials used invites touch and rewards interaction with immediate audio and visual response. Further, the familiarity of the metaphor of the interface allows people to quickly learn the system. Due to their responsiveness and tactility, interactive systems offer an excellent way to increase audience engagement with artworks.

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