

Pictures at an Exhibition: A Physical/Digital Puppetry Performance Piece

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ABSTRACT

Pictures at an Exhibition is a physical/digital puppetry piece that uses tangible interface puppets to modify a virtual scene projected at the back of the stage in real-time. Telling the story of a heist in an art gallery, the actions of the puppets are digitally reflected in abstract changes to an artwork in the scene. The piece merges traditional puppeteering practices with tangible interaction technologies and virtual environments to create a novel performance for the live stage.

Author Keywords

Performance, physical/digital puppetry, tangible interaction, virtual space.

ACM Classification Keywords

J.5 [Arts and Humanities]: *Performing arts*; H.5.2 [Information Interfaces and Presentation]: *User Interfaces—input devices and strategies, interaction styles*; H.5.1 [Information Interfaces and Presentation]: *Multimedia Information Systems—Artificial, augmented and virtual realities*.

General Terms: Design.

INTRODUCTION

Digital technologies are increasingly shaping novel performance practices [1,2]. Hybrid performance formats are found in traditional theatrical settings as well as in film and video games. For example, *It/I* was a theatre play in which a human character interacted with a computer-driven character on a computer-vision monitored stage [3]. For amusement parks, the Disney attraction *Turtle Talk with Crush* featured live puppeteers backstage controlling an animated performance that unfolds on a large projection screen in a theatre. Movie and TV productions use real-time digital puppetry interfaces (e.g. *Waldos*®) and motion capture technologies to animate virtual characters during the production process (e.g. for the TV series *Sid the Science Kid*). Finally, video games have adopted virtual puppeteering in titles such as the innovative *Little Big Planet* series and the Microsoft Kinect hardware performance.

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Figure 1. *Pictures at an Exhibition* on stage during XPT 2011 at the Center for Puppetry Arts, Atlanta, GA.

Building on these ideas, our work explores the merger of traditional puppetry with tangible interfaces and virtual environments. In *Pictures at an Exhibition*, five physical puppets equipped with sensors communicate data about their movements to a virtual scene projected at the back of the stage, which changes in response (Fig. 1). The piece is inspired Rybczynski's *Tango*, which uses 36 overlaying loops to build a video performance. Our piece extends this concept into the computational realm. Instead of looping the recorded image, we capture animation data from the puppets during the live performance. This data directly affects the virtual background but can also be looped and layered much like the actions in *Tango*. The virtual space becomes a lasting reflection of the current and past story unfolding in the physical space. The mapping between puppet performance and virtual background is often abstracted but addresses key questions of digital performance that deal with the relationship of the body to the digital realm in hybrid performance pieces.

STORY AND PUPPETS

Pictures at an Exhibition tells the story of a heist in an art gallery, involving a security guard, a cat, a gangster, an old lady and a small boy. The piece is performed to a

specifically composed sound track that uses a different instrument for each character and helps to pace the performance.

All puppets are custom-designed variations on hand and rod style puppets with sensors at key points of articulation to capture expressive movements (Fig. 2). For example, accelerometers capture head movements on some puppets, while bend sensors and rotary potentiometers capture arm movements. The sensors are connected to an Arduino board and XBee, which transmit the data to a computer that controls the virtual space.



Figure 2. Front view of gangster puppet (top left) and electronics housed under his coat (top right). Front view of old lady puppet (bottom left) and electronics housed in her back (bottom right).

VIRTUAL ARTWORK

According to the setting of the piece (an art gallery), the virtual background consists of a 3D recreation of a famous art piece (Fig. 3). Four different artworks have been adapted for use in the piece: Warhol's *Silver Clouds*, van Gogh's *Starry Night over the Rhone*, Kandinsky's *On White II*, and French's *Summer*. They range from installation to impressionist to abstract art and cover a wide range of representational formats. The artworks were modeled in Maya as 3D scenes and run in the real-time Unity engine. Different mappings of the main characters were created to

animate certain elements of each piece, including lights, colors, and movement.

The system reads and stores the animation data collected from the puppets. This can be re-played and looped to allow innovative layering of live and recorded animation. Some puppets can thus perform live on stage and affect the virtual backdrop, while looping animations of other puppets mix with these effects on the artwork.



Figure 3. Virtual Kandinsky in the initial state (left) and animated (right).

PERFORMANCE

The tangible interface puppets are performed on a tabletop stage by five puppeteers (one per puppet). A projection screen behind the table displays the virtual artwork that is altered by the actions of the puppets. To one side of the virtual artwork stands an easel with the physical painting prop that is the focus of the heist in the story. Off-stage, a computer receives data from the puppets and sends these to the 3D engine that drives the animation of the artwork.

The piece was a joint project from classes on experimental media, industrial design, and expressive virtual space and was developed for and performed at the 2011 Experimental Puppetry Theater (XPT) show at the Center for Puppetry Arts in Atlanta, GA.

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