InterÉlastique

An interactive performance system for control of an audio-visual experience using novel stretchable sensors

Paul Nemirovsky, Dan Overholt

MIT Media Lab
Cambridge, U.S.A.

Abstract

Interactive installations today typically limit the interaction by allowing only one active user at a time, and are commonly based on traditional forms of user input (i.e., keyboards, trackballs, touchscreens, etc.). This paper describes InterÉlastique, a system which allows collaborative tangible interactions through a set of innovative stretchy sensors called eRopes[1].

The system represents an exploration of the relationship between music, poetry/text, visual elements, and physical space. The aim of the system is to allow users to learn about properties of music, and explore relationships between individual musical fragments and the overall composition – without having to learn a system of complex mappings. Users are presented with two projection screens that are "connected" with six eRopes. By pulling these eRopes, the users change the music as well as the relationship between the textual elements on each of the screens. Multiple users can collaborate, modifying poetry and music interdependently, based on the combination of the different eRope's signals.

The installation is composed of the eRopes and their related electronics, several MIDI synthesizers, two projectors, and a computer running the InterÉlastique application, which provides audio-visual feedback to the participants.

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[1] *eRopes (Patent Pending) are electronically active tensile sensors. We have developed this technology in cooperation with Saul Griffith, using a novel technique wherein conductive fibers are braided into the sheath of a bungee cord in order to determine the tension applied to it.*

1 Introduction

Our goal is to create interactive art installations that are both educational and easily accessible to the general public and children. As such, we hope to persuade the user of the future to be much more proactive and creative while interacting with music, art, and technology. By using the eRopes as our interface, we can give the public a method of participating and learning through an innovative installation without feeling overwhelmed or intimidated.

Most installations today are based on trigger-mode sensors (such as buttons and other event-based inputs), whereas InterÉlastique utilizes the tension and elasticity of the eRopes to provide users with continuous control and feedback. The user input is mapped to the audiovisual components of the installation according to a number of predefined rules:

1. The aesthetic forms should change gradually and smoothly from one state to another.
2. The users' expressions should be directly mapped to an audio-visual effect to reflect their transformations.
3. Input from multiple users can be combined to produce predictable emotional/informative system responses.

2 Related Work

The last twenty years have been marked by an explosion of interactive installations, in both the musical and visual domains. Here are a few that inspired us: digital artist Chris Janney has created what he calls "an urban musical instrument" in a subway station in New York [1]. While waiting for a train, commuters could reach above their heads and break beams of light to trigger music. Passengers on each side of the tracks could not only

play the 'instrument' among themselves, but also interact with people on the other side.

Composer Tod Machover created the Brain Opera [2], which explores a variety of multiuser-oriented interaction techniques. The Brain Opera connects a series of hyperinstruments designed for the general public with a performance and a series of real-time music activities on the Internet. Audiences explore the hands-on instruments as preparation for the performance, creating personal music that makes each performance unique.

George K. Shortess in his "Doorways of Meaning" (1996) explored the boundary between inner and outer experience by allowing viewers to generate voices using colored cord networks. Viewers moving in the room cast shadows on the photocells embedded in the installation and changed their resistances. When changes occurred, MIDI signals were sent to a variety of audio devices. The audio outputs were then mixed and played through the speakers in the room.

Finally, the Shape of Sound exhibition series [3] was aimed at creating dynamic environments with the audience defining its relationship to the art at any given moment. The artists involved came from both audio and visual backgrounds and collaborated to create multi-sensorial, immersive experiences which were often described as "ambient". The aesthetic emphasis of the work was "the fluid integration of wide-ranging elements, rather than juxtaposition and contrast".

3 Motivation

The InterÉlastique system is aimed at creating an environment of educational play. Visitors can use the eRopes as an intuitive interface to control the installation. In order to construct this environment, we began by defining our model of interaction. We chose to work in the domains of music, visuals, and poetry, and defined the system's responses for a variety of situations (e.g., idle state vs. a single eRope vs. several eRopes active at the same time).

In order to encourage users to explore the various aspects of the installation, we attempted to provide evocative content by designing an unusual combination of visuals and dynamic textual elements, as well as composing a set of emotive musical patterns. We then conducted user tests in order to refine the system's content. A brief overview of the Design and Testing process follows.

4 Interaction Design

The InterÉlastique system provides real-time response to the users, maintaining the perception of action-reaction for both participants and observers. The goal of InterÉlastique is not only to provide users with an innovative mode of control, but also to encourage collaborative learning through the installation. For example, a group of users pulling several eRopes simultaneously can achieve more complex musical and textual transformations than would be possible with just one person.

In an effort to develop a new way of interacting with musical and textual elements, we mapped the system's audiovisual output to the following emotions (determined by the response curves of the signals from the eRopes): Anger, Joy, Sorrow, and Surprise.

Anger is mapped to strong, irregular movements of the eRopes with large amplitude swings over time. Joy is recognized as a smooth, continuous movement of the eRopes with a rising speed of modulation. Sorrow is expressed by slow continuous changes in tension with an overall decline in modulation speed. Finally, surprise is mapped to the collaborative interaction such that, soon after one of the eRopes is triggered, several others follow in a similar manner.

All of these parameters affect the audiovisual elements presented to the visitors. These are: triggering of various musical and textual elements from pre-composed libraries, speed and direction of the text movement on the screens, color and intensity of the visuals, text sizes, controlling audio levels and filters, etc. The interactions are partially pre-scripted, but the interaction manner is left completely up to the users, dependent on the way they choose to control the eRopes.

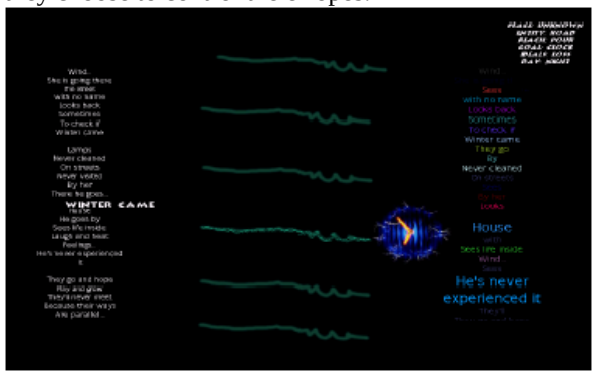

Figure 1: InterÉlastique software

The InterÉlastique software (fig. 1) has been designed using the Lingo programming language, with additional Visual C++ modules for serial port access, MIDI playback, and visual effects.

5 Structure of InterÉlastique

The InterÉlastique hardware (fig. 2) is based on the eRope technology that has been developing at the MIT Media Laboratory. The prototype eRope electronics system uses a custom-built circuit board that has a Microchip PIC microcontroller (with a built-in analog-to-digital converter), as well as analog signal conditioning components.

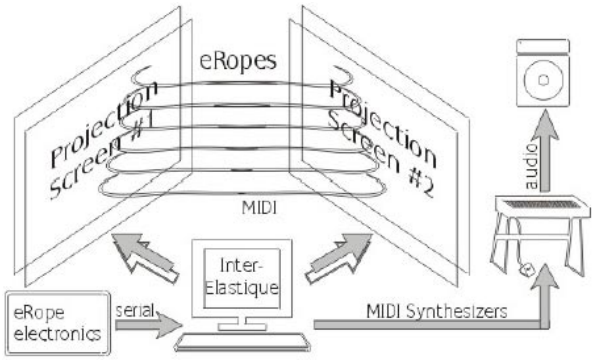

Figure 2: InterÉlastique hardware

The microcontroller runs a custom operating system, which does data acquisition for each of the eRopes, and provides serial RS-232 communication to the main computer. The tension in each of the eRopes is converted into an 8-bit value and sent to the main computer, which is running the InterÉlastique system. This computer controls several MIDI synthesizers which produce the music, as well as two video projectors which display the poetry and visuals.

6 Evaluation and Testing

The InterÉlastique system was installed in the central atrium of the MIT Media Laboratory, providing us with much informal feedback. In order to gather more formal data, a group of twenty-four users (four sessions each with six users) was asked to interact with the system, creating new collaborative musical / visual experiences. We asked the users whether the system was responding to their actions in a way they considered natural and engaging. Many of the users reported that the system led them to think about new and interesting ways to control music, verifying that the system has provided an engaging environment for learning.

We did not observe a significant difference in interaction between users that were given an explanation of the system before they tried it, and those that were asked to figure it out by themselves. The system facilitated interaction - users that were given an explanation first tended to be more proactive, asking others to join them in the creative process. Users have also reported that they enjoyed the process of learning as an integral part of their experience (rather than as an annoying first step). Additionally, the data seems to show that users tend to synchronize their interactions with the system after a short period of adjusting to each other.

7 Future Work

We would like to create a distributed model of the InterÉlastique system with multiple clients running simultaneously via a network. That will allow remote control of the installations, and will open the way to redefining collaborative learning and participation in an art installation setting.

We hope to expand the scope of our work by defining more generic modes of interaction based on non-discrete interfaces, with the ultimate goal of allowing each user to become an artist. We hope that this will serve a variety of artistic and educational purposes, and help blend the distinction between the passive audience model and the proactive model of artistic communication.

8 References

[1] Janney, C. - "REACH - New York", 1996.
[2] Machover, T. Hyperinstruments: A Progress Report. Cambridge: MIT - Media Lab, 1992.
[3] The Shape of Sound, www.lonestar.texas.net/~monorecs/bos/sos.html
[4] Roads, C. - "The Computer Music Tutorial", MIT Press, 1998.