Extended Interface Solutions for Musical Robotics

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Abstract

We present a framework for coupling musical robots with interfaces based on open-ended control architecture, allowing for new and expanded forms of expression. The MahaDeviBot allows for a single performer to simultaneously control up to 12 drums. The ESitar doubles both as a multi input control interface, and as a traditional sitar. Finally, the BricKTable represents a completely open-ended control interface possible of multi user interaction, and real-time control data feedback.

1. Introduction

Incorporating robotic systems into multimedia frameworks expands the potential for expression by a performing artist. Traditionally, a single performer can only execute a limited number of tasks at once. By adding robotic systems, the same executed tasks can be used to control a multiple number of concurrent events actuated by mechanical parts.

Taking advantage of these new possibilities requires the creation of interface solutions in order to control the robots. At first glance, an unlimited amount of control over a system might seem useful; however, the glut of options quickly becomes overwhelming, and soon creates a stunted control flow. A balance must be struck between options and usability. To address this, creating interfaces with open-ended control architecture allows for project specific design without rebuilding the hardware.

Previous work in designing musical interfaces to address these issues, such as the Hypercello [1], musicBottles [2], and the reacTable [3], have all greatly influenced our own work in musical controller design; while work in musical robotics by the Logos foundation [4], as well as the Waseda University's anthropomorphic robot [5], has influenced our work in musical robotics design. A small group of artists such as Trimpin with his Chronos robotic orchestra [6], and Eric Singer's Robosonic [7] project, have brought these two worlds together.

We present an exhibition of tangible and musical interfaces for 12 arm robotic drumming. In section 2 we will present details of the MahaDeviBot, section 3 discusses both the BricKTable and the ESitar, and finally section 4 shows how we integrate all of these together.

2. The MahaDeviBot

The MahaDeviBot [8] is a twelve armed, solenoid-based, drumming robot built around traditional north Indian folk percussion instruments. Each arm uses one of several different solenoid-based actuators in order to trigger a series of drums, including frame drums, bells, and shakers. The robot allows for a single performer to add expressive percussion accompaniment to their playing in real time. Through control of timing and dynamics, the robot can create a variety of timbre that would be difficult to artificially reproduce through audio synthesizers and sample playback. Lastly, as an exhibition piece the robot provides visual feedback of how the machine is creating the sounds through mechanical movement.

3. Interfaces

A. BricKTable

BricKTable is a tangible and multi-touch interface using the reacTIVision [3] fiducial and finger-tracking framework as its base. Tangible object and finger touch data are sent over the TUIO protocol[1]. This is parsed out in order to control the specific needs of individual projects. The table's open-ended architecture allows for an extremely modular and customizable control interface, while also providing the potential for real-time interface feedback. In an exhibition setting, the table allows for multiple users to simultaneously interact with the interface; users engage with the multimedia software and each other.

[1] http://tuio.lfsaw.de/

B. Electronic Sitar

The Electronic Sitar (ESitar) [9] is a modified sitar using a variety of sensors to capture performance data and transform it into MIDI. The frets use a series variable resistive network to narrow the band in which then an algorithm analyzes the pitch data coming from a custom humbucker pickup, a pressure sensor for the thumb tracks the stroke data for note onset, and a series of buttons and knobs act as assignable controller inputs. In addition, the ESitar plays as a traditional instrument, allowing for the blending of both acoustic and electronic musical performance.

4. Open-Ended Interface Design

A. Evolution

Don Buchla[2] is considered one of the pioneers in interface design. While working with Morton Subotnick and Ramon Sender, Buchla developed a capacitive touch interface for inputting pitch information. This design allowed for flexibility in the use of the control input.

If this represented the first generation of thought towards an open-ended control design, then hyper instruments like the ESitar represent a second generation of thought. This hybrid between traditional instrument, and open-ended control architecture, allows for customization of the control data. New methods of playing the instrument can be combined with more traditional techniques to interface with projects on a unique and individual bases.

Finally, the BricKTable can be thought of as a third generation interface, in that it is not only completely open-ended in the control architecture, but also allows for interface feedback. In this way it achieves the idea of leaving behind previous paradigms of instrument control, becoming a tool for creating new ways to interface with music. Furthermore, by also beginning to leave behind the need for physical representations of the control inputs, the table is not hindered by the physical limitations of real world physics.

Fig. 1, BricKTable, MahaDeviBot, and ESitar

[2] http://en.wikipedia.org/

B. Integration

First, we are running several different software programs on the BricKTable, which allow users to directly interact with the robots drumming. One program will allow users to use their fingers to press virtual buttons and play the drums in real-time. A second program will use three objects running a beat database tied to a global tempo class. The position of the objects along the x-axis will query the various rhythms in the database for each object, the y-axis will drive various manipulations of the global tempo class, and the rotation angle will control the dynamics of each object's database.

Second, we have integrated all three devices in a way that allows us to perform together as a four-part ensemble. Two of the authors play the BricKTable, sending data to the robot and controlling audio software from the table, while the third author performs on the ESitar while also sending control data to the MahaDeviBot. The robot acts as fourth performer, providing rhythmic content to the performance.

Through the use of open-ended control architecture, we are able to overcome the limitations of fixed hardware and use software to mold the interfaces into a variety of different designs. Coupling this with the robot allows for a wide range of expression and potential performances.

5. References

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