PoiSynth: An Illuminated Audio Performance Device

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Abstract

We present the *PoiSynth*, a staff-based motion-expressive audio performance system with a correlated visual component. The device derives aspects from traditional controllers and combines them with a response system focused on the movements of twirling with the aim of creating a controllable expressive system utilizing physical skill to create a unique sonic and visual performance.

Keywords: Tangible interfaces, motion controllers, musical expression, performance systems

1. Introduction

The phrase "audio controller" commonly calls to mind a series of devices designed to be situated safely within fingers' reach, their keys and buttons providing an array of sounds and transformations with minimal input from the user [1]. Conversely, experimental performance systems have been developed which rely on full body movement and the use of such mechanisms as gesture and pressure sensing [2]. Such systems require large amounts of interaction on the part of the user, which creates a greater canvas for expression, however these systems can be unpredictable and it is often difficult to find a solid correlation between movement and sound [3].

The combination of these two polar systems can lead to the creation of an instrument that has both definite control and room for expressive interaction. The intention of the PoiSynth is to explore this middle ground between a standard control interface and expressive playback utilizing full body motion without restrictive gestures.

2. Design Development

Fire and dance are not the most obvious starting points for the design of an audio controller. However, fire as an instrument of expression and performance has been used for centuries, from tribal rituals and circus acts to modern day performance art. The art of poi, or fire spinning, is most often a visual counterpart to a musical experience. With the advent of such durable light sources as glowsticks and LEDs, poi has become less about fire and more about creating art through color and light.

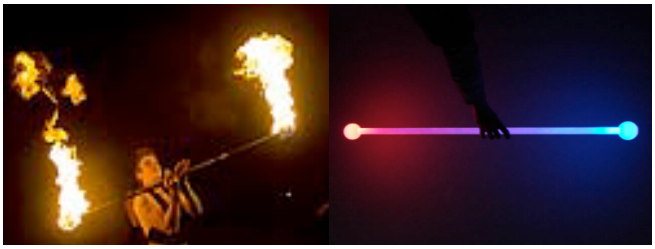

Figure 1. Examples of a fire staff and LED glow staff.

There have been devices created which merge sound with a visual component [4][5], but the PoiSynth aims to take the user away from the static interface and into an all-in-one physical performance. Ideally, the device will respond to input and motion with both an audible and visual response.

3. Implementation

The main cosiderations for the development of the PoiSynth were:

- easy access to definite controls
- expressive control based on typical movement
- real-time program changes

3.1 Mechanical Design

The challenge in the creation of the device was finding a way to allow it to be functional as both a musical controller and a physical performance object. Having based the overall feel and appearance on a fire staff, the resultant physical object created a difficult platform for the inclusion of electronics.

The body was created from two 40mm acrylic tubes, the size being chosen for an adequate handgrip whilst allowing room from an internal microcontroller, and the material being chosen based on its transparency. The light globes are created from hollow acrylic spheres with an internal shell of molded polymorph for diffusion, and are protected by an aluminum cage. The device has an overall length of 1.8m and the battery boxes are placed at either end for adequate weight distribution.

3.2 Interactive Devices

The interactive system utilizes three sets of four buttons each as well as two tri-axis accelerometers. The buttons are color-coded as well as wired in such a way as to be lighted when inactive and dark when pressed, anticipating use in a low-light environment. The button positions were chosen based on areas a user's hands were least likely to come in contact with while spinning, though easily within reach at all times.

Figure 2. Constructed PoiSynth.

The accelerometers are located at the base of the globes on either end of the staff. They are oriented in such a way that the z-axis runs lengthwise. The x and y-axis are not differentiated between, as the orientation of the staff itself to the user would inherently change the axis being affected at any point in time. Instead, the actions are based on any change in acceleration outside of the z-axis. The z-axis is used as a trigger for multiple functions depending on which program is chosen at the time.

3.3 Lighting

The lighting system is configured with its own power toggle, and is powered by the Arduino microcontroller. Each globe contains a BlinkM MaxM programmable RGB LED system. They can be programmed independently, or linked directly to the Arduino for real-time control, with the intention of correlating colors and patterns with the currently playing sound patterns.

3.4 Mapping

The device is based on the Arduino Nano microcontroller, with the buttons linked to the 12 digital pins, and the accelerometers to the analog pins. The blue buttons toggle rhythm loops, the green buttons toggle "freestyle" melodies playable with the x and y-axis of the opposite accelerometer, and the red buttons control the actions of the z-axis. The PoiSynth interacts with the computer via Bluetooth, though a USB port is available for reprogramming of the Arduino. The programming thus far has used Max/MSP through the Sarcuino Max patch.

3.5 Potential Configurations

As controller, the PoiSynth can be configured however the user chooses. Currently it is configured musically with four rhythm patterns that can be layered, two harmony loops, and multiple freestyle instruments: two of which have a defined sequence, and the four z-axis selectable parameters which are currently set as a kick drum, a bass with variable distortion, a frequency-variable pad, and spatial panning.

Another configuration in production is that of a soundscape creator. The current example is based on Star Wars: the rhythm buttons instead control atmospheric sounds, two melody buttons are for theme music, the freestyle melodies create accelerometer-controlled lightsaber sounds, and the z-axis is used for special effects.

4. Operation

Operation of the PoiSynth relies on knowledge of what is programmed for each button, though the playback itself is intuitive.

4.1 Physical Dynamics

The PoiSynth is made to be twirled, spun, and lightly struck on the ground as if it were a staff. Continuous movement results in continuous sound, while changes in speed or direction alter it. The buttons are most easily manipulated while the staff is being held statically or with one end resting on the floor.

Figure 3. Diagram of the interactive system.

4.2 User Expression

The device is weighted on both ends much like a proper twirling staff. A novice may have difficulty gaining momentum and mastering the movement required, but an experienced twirler should find it intuitive.

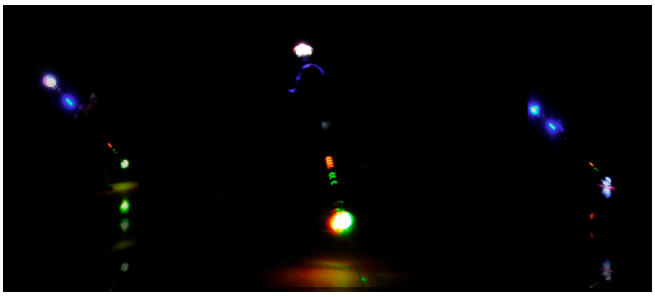

Figure 4. Captured frames of the PoiSynth in action.

The loops are sequenced with each other, and therefore it is only a matter of selecting a few buttons to create an entire backing track for the performance. The freestyle melodies are currently configured to be in tune, and even when out of time still fit the programmed harmonies.

The z-axis triggers are somewhat more complex and require a longer period of discovery. It is easiest to start with it as a kick drum, triggering the sound each time the end of the staff is hit.

4.3 User Difficulties

Difficulties with the PoiSynth were most prevalent as unexpected reactions, though a few physical problems were encountered.

The main physical issue is that the acrylic tubing and the joiner between them are not adequate to support the overall weight of the device. The result of this is some unsettling flexing occurring when the staff is being twirled at high speed, especially upon a change in direction. A solution to this would be to find a joiner that would better reinforce the separation. An unexpected problem arose with the lighted globes: the globes themselves have no problem, but users are very wary of allowing them to come in contact with the ground, which is a vital movement for the use of the z-axis. The solution to this is a matter of becoming familiar with the controller.

The unexpected reactions encountered came predominately from the z-axis controls. When the z-axis program selection is one that relies on the second accelerometer, it affects the melody that is being controlled by the first accelerometer. The only way this could be avoided would be by having that particular z-axis program deactivate the first accelerometer before using the second, however that would result in the loss of the melody. There is no real solution to this problem, and it is recommended to avoid this particular program unless unexpected musical changes are welcome in the current performance.

5. Conclusions

The concept of a controller combining both control and a motion-expressive aspect was achieved, though there is still a large amount of work to be done in making it more accessible and reliable. The mapping can be challenging, as there is so much potential in the way of what buttons can be programmed to control which actions, and it can be difficult to stick with a coherent idea. Due to the conflict between the two accelerometers when using some of the z-axis functions, it is likely the next version will contain only one accelerometer.

The creation of the PoiSynth demonstrates that a combination of control and expression in a controller can be implemented in a fun physical performance device, and the current aim is to progress the idea into a simpler, more easily accessible device.

[1] T. Andersen, R. Huber, A. Kretz and M. Fjeld, “Feel the Beat: Direct Manipulation of Sound during Playback,” in *Proc. Of the First IEEE International Workshop on Horizontal Interactive Human-Computer Systems,* 2006.

[2] G. Castellano, R. Bresin, A. Camurri, and G. Volpe, “Expressive control of Music and Visual Media by Full-Body Movement,” *Proc. Of the Conf. on New Interfaces for Musical Expression (NIME),* 2007, pp. 390-391.

[3] M. Leman, *Understanding Musical Expressiveness*, Ghent University, Belgium: Musicae Scientiae, 2006.

[4] Y. Nishibori and T. Iwai, “Tenori-on,” *Proc. Of the Conf. on New Interfaces for Musical Expression (NIME),* 2006, pp. 172-175.

[5] S. Jorda, G. Geiger, M. Alonso, and M. Kaltenbrunner, “The reacTable: Exploring the Synergy between Live Music Performance and Tabletop Tangible Interfaces,” *TEI,* 2007.