Tuppence-a-Board

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ABSTRACT

This paper describes the development and performance capabilities of a digital musical instrument known as "Tuppence-a-Board." The instrument is a small board outfitted with a microphone and piezoelectric sensors, which capture gestural data from spinning and scraping coins. The prototype is used in conjunction with a Max/MSP patch to perform the semi-improvised piece "More Money Than You Know What to Do With."

KEYWORDS

microphone, piezoelectric, coins, Max/MSP, improvisation

INTRODUCTION

One of the principles in Perry Cook's paper "Principles for Designing Computer Music Controllers" is that "everyday objects suggest amusing controllers" [3]. This has been previously explored in various projects, some more relevant examples (to this project) including O'Mohdrian and Essl's CrumbleBag and PebbleBox [4], and Allen's BoomBox [1]. The "everyday" concept, along with the author's interest in using childhood games and toys in previous improvisational work,[1] inspired this controller.

The idea for this project was to use spinning coins as a control device. In his article "Interactive Composing: An Overview," Joel Chadabe writes that "the choice of performance device influences the behavior of the system (and the music it produces), because each type of performance action evokes a different musical sensibility" [2]. Spinning coins can produce a sound akin to a soft drum roll, so this suggested the use of a microphone to capture the actual sound. The coins' unpredictable trajectories suggested the use of sensors to detect the position of the coins as they moved across a surface.

The controller is what Miranda and Wanderley refer to as a touch controller, since "any controller that uses manipulative gestures but does not resemble existing acoustic instruments can be considered a touch controller" [5]. Indeed, the intention for this project was to use coins to induce noise, but the performer could use the same interface by scraping, rubbing, and tapping his fingers on the board.

The controller is called "Tuppence-a-Board," in reference to the song "Feed the Birds (Tuppence a Bag)"[2] from the film *Mary Poppins.* It consists of a small board on which the performer will spin and scrape coins. Sensors placed underneath will feed into a Max/MSP patch to elaborate the sensor data and create a piece of music, titled "More Money than You Know What to Do With."

DESIGN CONCEPT

The primary criteria behind this project was to make an interactive digital instrument that would be simple to build and enjoyable to play. Initially, the concept was to construct a board which could detect the movement of a spinning coin and to use this movement to generate sound. Due to the time constraints of the project, simple (and perhaps less elegant) tracking methods were preferred. Thus, the complexity of the musical performance derives mainly from the manipulations performed in the associated Max/MSP patch rather than from the types of sensors employed.

[1] Such as *Behind the 8-Ball* (2005) and *Yahtzee* (2006).

[2] "Tuppence" is a common name for the 2-pence coin used in the United Kingdom.

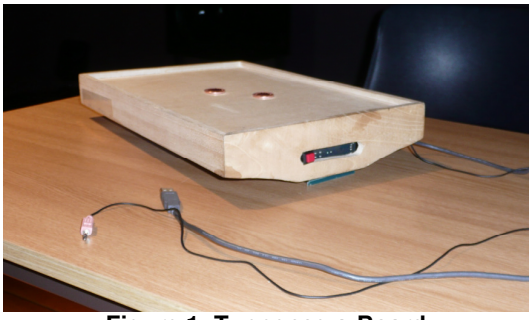

Figure 1: Tuppence-a-Board

IMPLEMENTATION

A small wooden tray was purchased, with the bottom of the tray used as the performance surface, and the top of the tray used to house the components. The higher walls of the top of the tray would therefore protect the components.

The sensors for the project included one inexpensive General Electric computer microphone, three piezoelectric discs, and one button. The microphone was connected directly to the line-in of the computer, while the piezo discs and button were connected to the analog I/O of an Arduino board.[3] The Arduino was then connected to the computer via USB.

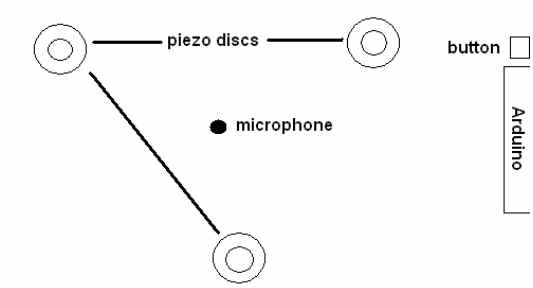

Figure 2: Components of Tuppence-a-Board

The board interfaces with a Max/MSP patch which will be described in the following section. Essentially, it uses the microphone input for some sections, and the piezo inputs for other sections. The button is used to select the next section to be performed.

[3] The button and piezo discs were assembled specifically for this project, with 10kΩ resistors on the piezos' ground wires in order to eliminate noise.

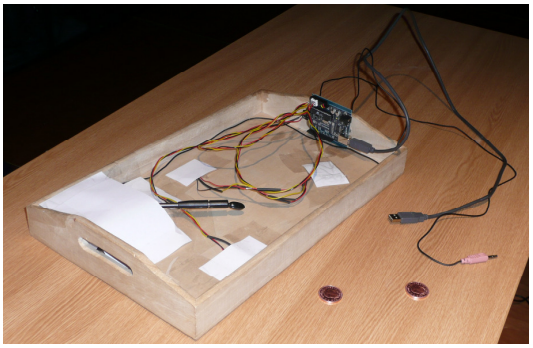

Figure 3: Underside of Tuppence-a-Board

The board combines Miranda and Wanderley's concepts of direct and indirect data acquisition. It shows direct acquisition by using the piezo sensors to detect position and amplitude, but it also uses a microphone. "Unlike direct acquisition, indirect acquisition provides information about performer actions from the evolution of structural properties of the sound being produced by the instrument" [5]. The microphone, besides providing source material for digital signal processing, also provides information about the position of a coin and the coin's velocity and rhythm.

MUSICAL APPLICATION

Following Cook's advice to "make a piece, not a controller" [3], a brief piece titled "More Money Than You Know What to Do With" was created. This piece consists of a Max/MSP patch with six subpatches displaying different uses of the performer's input data. The performer will spin and scrape coins on the surface of the board, while pushing the button to navigate through the series of subpatches.

The beginning and ending of the work is simply amplifying the microphone output. The second section features highpass filtering and tremolo. These are set to vary continuously, but are only activated when the piezo input reaches a certain threshold.[4] This allows the player to pause (and resume) the sweeping of the filter cutoff frequency and the increasing/decreasing of the tremolo speed.

[4] Because of the resistance used (found by trial and error as a proper amount for eliminating noise), the resulting piezo signals needed to be amplified in Max/MSP prior to this threshold detection.

The third section fades out the microphone, using the piezo inputs to control resonant filters. When the input reaches a threshold, it triggers and impulse to be sent to the filters. Each piezo is set to a different frequency, so that as the coins move they will trigger a randomized arpeggiation of precomposed sonorities.

In the fourth section, the piezo inputs control oscillators. Here, the amplitude is mapped to frequency, with each piezo mapped to a different band of frequencies. This creates some very short, semi-randomized bleeps reminiscent of computers from old science fiction films. In the fifth section, the piezo inputs are used to trigger samples, with a similar threshold architecture to the third ("resonating filter") section. The samples chosen for the piece are quotes about money from several different films, including *Wall Street* and *Get Shorty*.

The microphone returns in the sixth section, run through a comb filter with varying amount of delay (and perceived pitch), which the player may pause in the same manner as the second ("tremolo") section. In the final section, the unaltered microphone returns, before the performance fades out.

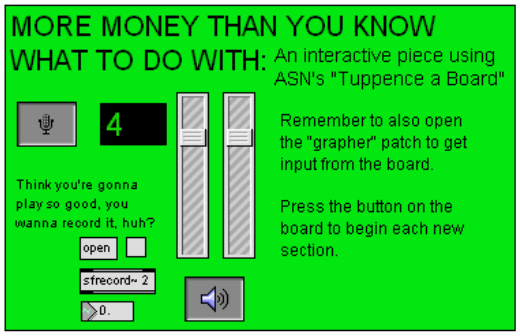

Figure 4: Max/MSP interface

CONCLUSION AND FURTHER WORK

Tuppence-a-Board is a simple and enjoyable interface for creating music, which could appeal to musicians and nonmusicians alike. Due to its use of a common childhood activity, the author feels that it may especially appeal to children. Further work to be done on the piece includes expanding the possibilities of sound manipulations and constructing a more physically robust version of the board (the prototype is held together primarily with pins and tape, which certainly would not be robust enough for child performers!).

Although the initial use of this instrument is for the concert piece "More Money Than You Know What to Do With," the instrument would work quite well as an installation. For this purpose, the board could be expanded to a table on which the visitors could spin and scrape coins, driving a revised Max/MSP patch. Likewise, the board could be used in group improvisation contexts, and could be used in possible future pieces written specifically for an ensemble of "Tuppence-a-Boards."

REFERENCES

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