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The Mutha Rubboard Controller

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ABSTRACT

The Mutha Rubboard is a musical controller based on the rubboard, washboard or frottoir metaphor commonly used in the Zydeco music genre of South Louisiana. It is not only a metamorphosis of a traditional instrument, but a modern bridge of exploration into a rich musical heritage. It uses capacitive and piezo sensing technology to output MIDI and raw audio data.

This new controller reads the key placement in two parallel planes by using radio capacitive sensing circuitry expanding greatly on the standard corrugated metal playing surface. The percussive output normally associated with the rubboard is captured through piezo contact sensors mounted directly on the keys (the playing implements). Additionally, mode functionality is controlled by discrete switching on the keys.

This new instrument is meant to be easily played by both experienced players and those new to the rubboard. It lends itself to an expressive freedom by placing the control surface on the chest and allowing the hands to move uninhibited about it or by playing it in the usual way, preserving its musical heritage.

Keywords

MIDI controllers, computer music, Zydeco music, interactive music, electronic musical instrument, human computer interface, Louisiana heritage, physical modeling, bowl resonators.

INTRODUCTION

Zydeco is indigenous to South Louisiana and was created by its creole peoples. It draws its musical influence from both Cajun music and the Blues. [**?**] It is festive and rhythmic music and is meant to be danced to. Fortunately for this project, this musical genre is known for being a bit more adventurous with technology than either Cajun music or the Blues, in that it frequently employs synthesizers and even the occasional vocoder in its music.

The name "Zydeco" is a derivative of the French word "haricot" or snap bean. It is taken from a classic song by Clifton Chenier (crowned the "King of Zydeco") called "Les Haricots Sont Pas Sale" which means "the snap beans aren't salted," referring to hard times when there wasn't even enough salt to add to the beans. Cleveland Chenier (brother of Clifton) is widely recognized as the father of the "modern" rubboard. He was the first to adopt the metal frottoir, since previously players used the wooden framed classic washboard. The implement used to play the rubboard is called a "key." The rubboard has two keys, one for each hand.

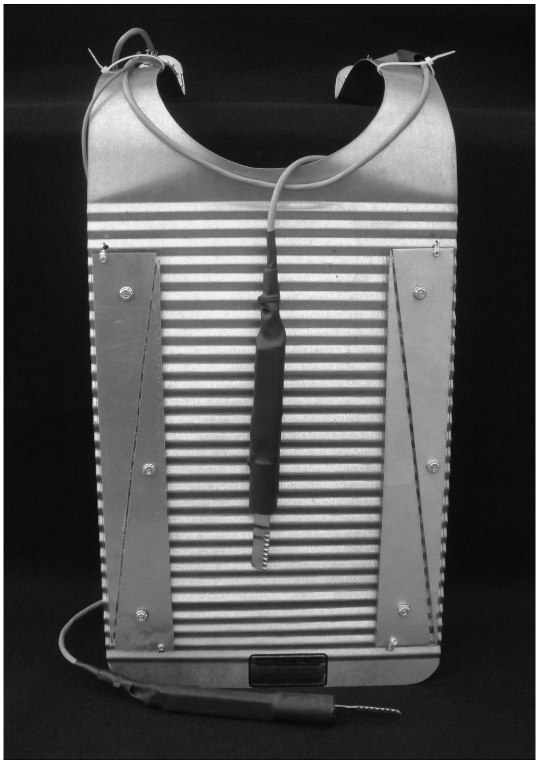

Figure 1: The Mutha Rubboard

Making a tour of Zydeco clubs in South Louisiana it is possible to find keys made from bottle openers, spoons, thimbles and specially modified renditions of any of these, depending on player preferences. The board is slung over the player's shoulders hanging comfortably over the torso leaving the player completely uninhibited in movement by his or her instrument. A simple custom made rubboard is available at any sheet metal shop, made on the spot. It is a piece of sheet metal pressed into corrugation, and the shoulder hooks are bent in a semi-circle for a (relatively) comfortable wear. Figure 1 shows the rubboard we adopted.

The inspiration for the Mutha rubboard is drawn directly from the true performing nature of the rubboard in Zydeco music. The rubboard player, in addition to playing, provides theatrics to the Zydeco performance. The player often incites the audience, working the entire edge of the stage, all the while taunting his band members. It was this showmanship and the simplicity of the board that beckoned for a new musical controller.

INTERFACE CONCEPT AND DESIGN

One of our primary goals was to maintain the original playing capabilities of the board itself. This serves several purposes. First, since the instrument is meant to be played by experienced rubboard players, we wanted to maintain their natural relationship with the instrument. This is important for both the player and the audience, since, especially for traditional music audiences, the psychological leap from the simple board to a computer controller may not be so obvious. For this reason, we felt that it was important to retain the traditional foundation of the rubboard. As it turned out, maintaining its original playability fit in neatly and easily within the expanded design since the antennas are placed along rubboard edges.

Our next concern was how this controller could seize the gestural nature of the rubboard. The ability to detect the position of the key not only along the surface of the board, but normal to the rubboard plane was the obvious goal. After looking at several possibilities, we settled on the capacitive sensing system of Max Matthew's Radio Baton [**?**]. However, we decided to use two sets of receive antennas rather than the two dimensional square antenna array of the Radio Baton. This set of two parallel planes was an ideal adaptation for the standard up and down motion of the keys while adding an additional gestural dimension normal to the playing surface.

Finally, we wanted a versatile, intuitive, and unobtrusive system of mode control. We wanted the ability to change MIDI and real-time audio synthesis mappings on the fly, and to engage or disengage raw audio and/or MIDI at any time. We settled on two ergonomically placed buttons on each of the keys, one set for mode cycling and mode engage, the other two for MIDI and raw audio output on/off. The buttons are placed in such a way that the player can control, at the squeeze of a fingertip, the entire functionality of the system without missing a beat or being noticed by the audience.

HARDWARE IMPLEMENTATION

There are essentially two principle data paths for the Mutha: 1) key position to MIDI and 2) a raw audio stream from each key (see figure 2). The MIDI instructions that are issued from the Parallax Basic Stamp [**?**] are proportional to radio signal strengths based on key position in a 2D plane normal to the board. Raw audio is extracted through piezo contact elements mounted on the keys, amplified on the circuit board, and sent off to a standard audio digital I/O. Additionally, mode control is processed through the stamp, taking input from the 4 buttons on the keys.

Capacitive Sensing

The key position is sensed by detecting a change in capacitance between the radio transmitters on the keys and the receiving antennas mounted on the rubboard. The receive antennas are wedge shaped thin conducting metal electrodes. There are two independent circuits each tuned to a specific frequency (the left at 45khz and the right at 70khz) to allow each circuit to function independently.

The following description relates to one channel, but is identical for the other channel, as well. The lengthwise position (Y direction) is determined by the signal strength proportional to the width of the wedge at a given position. By comparing the strength of the received signal between the two wedges, the Y placement can be calculated. By looking at the summed signal strength of the two wedges, we can calculate the normal (or Z) distance of the transmitters from the receive antennas. The MAXIM 1270 ADC [**?**] converts dc voltages proportional to a signal strength and passes them to the Parallax Basic Stamp, which issues continuous MIDI instructions accordingly.

Piezo Audio Pickup

Each key is fitted with a piezo element attached directly to the metal base of the key. Its purpose is to simply pick up the kinetic vibration imparted by scraping the plastic key tip across the corrugated surface of the board. The plastic serves to reduce the direct acoustic contribution of the keys. The voltage transients are then amplified to commercial audio levels, and sent to the computer via a standard digital audio interface.

Mutha Mode Control

Two buttons on each key serve to control two independent functional characteristics. First, mode select and engage buttons allow the player to cycle through potential modes (while still playing on the currently selected mode) and engage the desired mode with the other button. The second set of two buttons will allow the player to, independently of mode selection, turn on or off the MIDI generated or raw audio output. The buttons are standard grounding buttons,

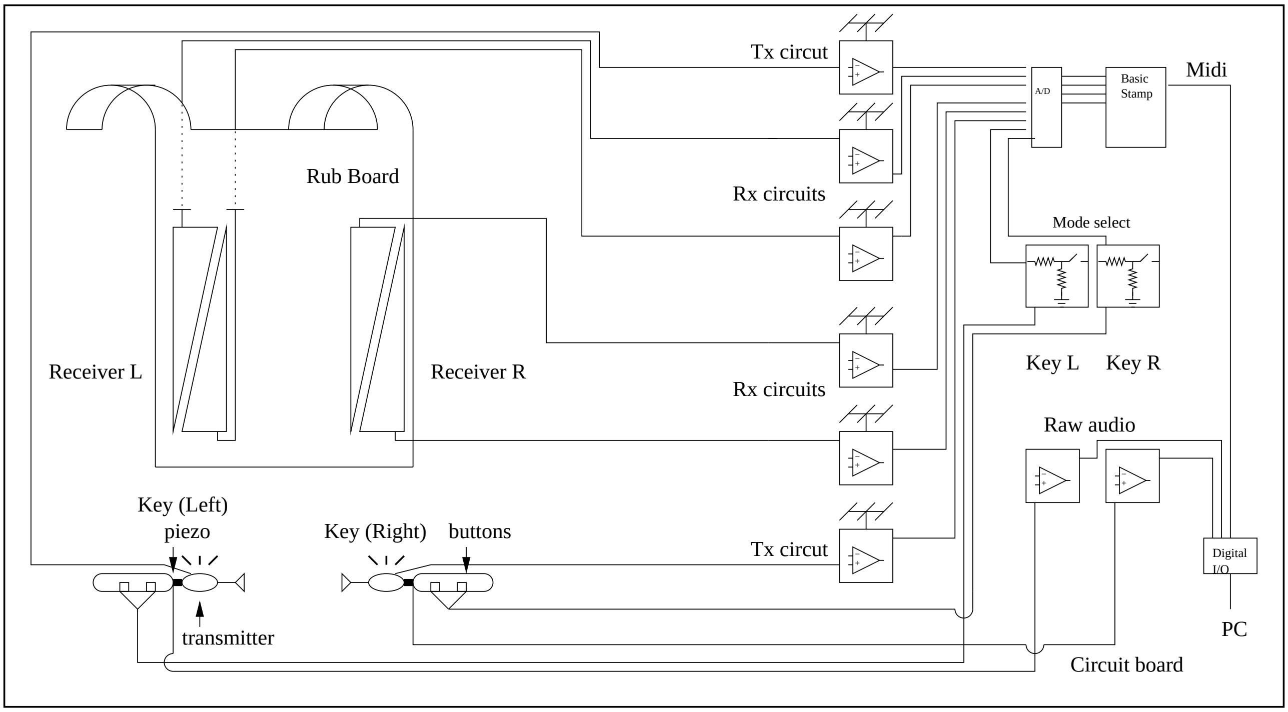

Figure 2: The circuit for the rubboard.

whose voltage is converted by the ADC, and further converted to a MIDI signals by the Basic Stamp, which can then be mapped for any use.

MUSICAL APPLICATIONS

We have divided the approach on the use and mapping of the board into two general categories: percussive mappings (traditional) and non-traditional mappings. There is always the invitation to combine the two, limited only to the creative imagination of the performer/composer. We envision both solo and support roles for this instrument.

Percussive Mappings

Percussive or traditional mappings refer to mappings which would be intuitive to an accomplished rubboard player.

Raw Audio Only. Here we start with the simplest facet of the Mutha. The raw audio picked up by the piezo elements can be used directly by applying effects (reverb, filtering, flanging, etc.) for a real-time output. This can be also useful in masking latencies, when used in combination with MIDI output. It is possible to alter the effects applied to the raw audio depending on where the key is on the playing surface.

Percussive MIDI Instrument. Here we suggest using mappings in MIDI which reflect the rhythmic and/or percussive nature of the instrument allowing the board to be controlled by gestures inherently known to players. Examples could be maracas, drums, snare, hi-hat or even a physical model of the rubboard itself. In this way, the player has an instantaneous connection with the Mutha's capabilities, and the gratification of making music with MIDI, which will more easily lead to exploration into more non-traditional mappings.

Non-Traditional Mappings: a physical model of a singing bowl.

We used the Mutha rubboard to control a physical model of a bowl developed as an extension to Pure Data [**?**] called ebowl∼. Aside from following our theme of traditional musical instruments, we feel that the gestural commonality between the bowl and rubboard is intuitive.

There are two principal techniques for playing a Tibetan bowl. It can be struck with a mallet (strike mode) or exited to resonate by applying force circularly around its lip (sustain mode), which produces a sustained sound. This latter method is similar to rubbing the lip of a wine glass in a circular motion with a wetted finger.

The physical model we developed can also be played by either being struck or by the sustaining technique. Several fundamental parameters are controllable depending on which mode the Mutha is in. These parameters are: the size of the bowl which determines the fundamental frequency and the partials of the bowl, the force of the excitation (realtime), and the velocity of the stick ringing implement (realtime).

In order to obtain an efficient real-time model we used digital waveguides [**?**]. The waveguides are excited either by a sustained frictional mechanism similar to the one of a string excited by a bow (see, for example, [**?**]), or by a striking mechanism typical of the excitation in percussion instruments.

In strike mode, the left channel is mapped with frequency to the Y direction, while the right channel mapped with the impulsive (strike) exitation to the Z axis. (see Figure 3) In sustain mode, the left channel is mapped with stick force to the Z direction, and the right channel mapped with sustain exitation velocity to a circular pattern in both the Y and Z direction.

As with a real bowl, we can obtain an impulsive excitation by striking the board, calculating the position and the force of the excitation, and letting it resonate. On the other hand, we can also obtain a sustained excitation by moving the exciter with an almost constant speed in the vertical and perpendicular position to the board with a circular motion.

We also provided the instrument with discrete buttons which are used to choose the combinations of resonating bowls that the performer desires to maintain. In fact, there may be a situation where the performer wants to let a sustaining bowl resonate while at the same time triggering either another sustaining bowl or strike an entirely new one. All these different modes are chosen using the buttons located on the keys.

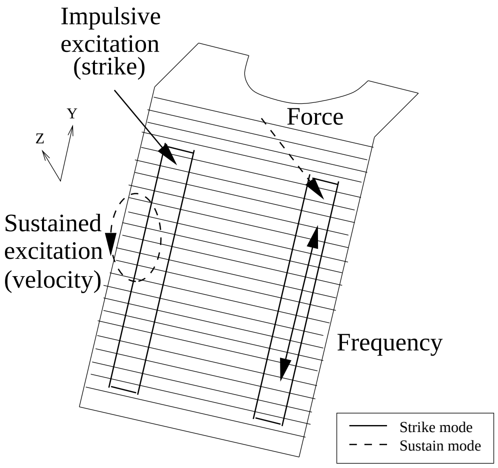

Figure 3: Mapping of the parameters from the ebowl∼ object to the Mutha Rubboard.

Future Work

There are three areas of improvement that we would like to pursue for the Mutha in the near future. First, we would like to improve on the durability of the board. In order to survive the energetic performing atmosphere common to this instrument, we will need to make significant improvements to its structural integrity. Second, we would like to explore adding the full 3D capability (a la Radio Baton), to even further open up the playability. And finally, give back its true independence by making it wireless. See the Mutha Rubboard's webpage at http://www-ccrma.stanford.edu/ carrlane/mutha/muthahome.html for updates.

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