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Suzuri-Bako 硯箱

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ABSTRACT

This paper introduces Suzuri-Bako (硯箱), a self-contained electroacoustic instrument. Suzuri-Bako is a wooden box with an audio input, a built-in speaker output and a Teensy running custom DSP effects, controlled by four potentiometers attached to the box. The instrument input is optimised for microphone signal but can also handle line input and is thought to be played through feedback generated from the close contact of the speaker to the audio input source. In this way, the instrument itself becomes a sound generator, thanks to audio feedback, adding particular nuances to the produced sound textures.

Author Keywords

NIME, instrument design, live performance, feedback, embedded hardware, Teensy

CCS Concepts

•**Applied computing → Sound and music computing;** Performing arts; •**Hardware** → Embedded; Interface;

Introduction

The idea for this particular instrument came from my previous experience in the field of electroacoustic performance. I used to perform with different pieces of gear, capturing sound and feedback using piezo microphones, hydrophones or micro-sound microphones and processing everything through different independent effects, mainly delay, reverb and granulation. The scope of this project is thus to merge all these pieces of equipment into an all-in-one box, using custom DSP effects.

Related Works

My interest for all-in-one electroacoustic instruments began when I started performing with the KOMA Field Kit [1], an electroacoustic workstation for motors, sensors, microphones and radio signals. This little wooden box opened a new world of performance possibilities to me but was still lacking my favourite two effects: delay and reverb.

As soon as I started investigating the world of micro-processors for sound and music computing, I ran into the work of Ward J. Slager and his Pandora Box [2]. This instrument has so much potential for feedback electroacoustic music, but yet it’s a bit

over-sized for my purpose. Thinking about a more portable instrument, I thus decided to build something that could fit into a small wooden box, keeping the evocative effects of the Pandora Box.

The name and the concept of Suzuri-Bako refer to old Japanese writing boxes, made of lacquered wood and used to hold writing implements [3]. Japanese culture and aesthetic has always been very influential in my work and this wooden boxes reminded me of the hardware of the instrument itself. The overall aesthetic and philosophical concepts leading to this particular instrument derived also from my personal research in the field of free non-idiomatic improvisation and the Japanese improvisation scene [4].

Hardware

Due to portability requirements, all electronics are mounted within the speaker cabinet.

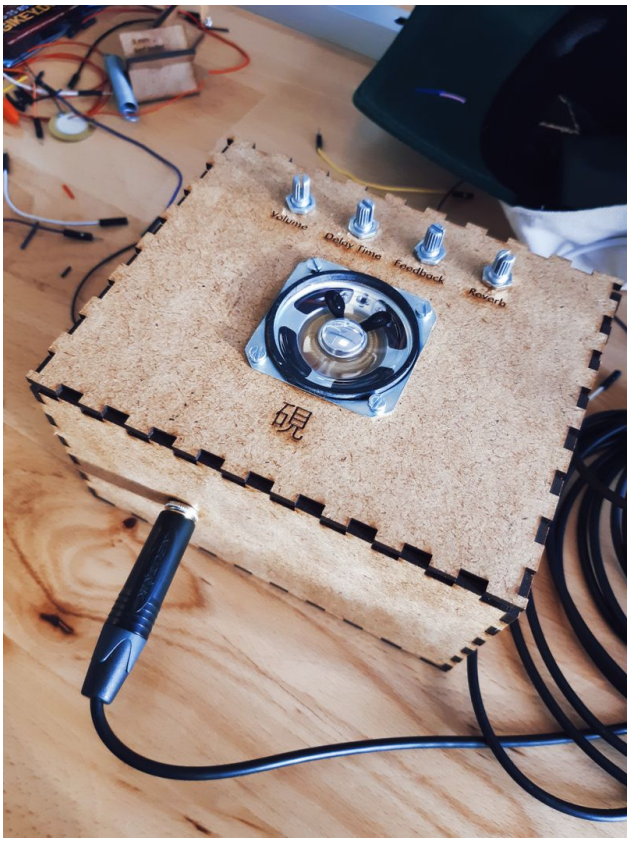

Image 1
Suzuri-Bako seen from the performer's perspective

The wooden box, designed in Adobe Illustrator and laser-cut at Aalborg University in Copenhagen, features four potentiometers, one for each of the controlled parameters (Volume, Delay Time, Feedback and Reverb), a 1W speaker connected to a power amp, a 1/4 inch input jack connector and the Japanese kanji for Suzuri 硯, as well as a hole for a USB-C cable. This is connected to a Teensy soldered to an Audio Shield 4 (Rev D), placed inside the box.

The acoustic characteristic of the wooden box and the speaker lead to a potentially infinite feedback, generated combining the long delay with the self-resonation of the instrument itself, as shown in the Video 1. The instrument can be played with any microphone or line input source and manipulated through tactile interaction. Interesting textures can be achieved moving the sound source in space, in relation to the built-in speaker, creating more feedback effects. Personally, my research and initial project intent led me to perform with hydrophones and contact piezo microphones, looking for particularly characteristic sonic materials.

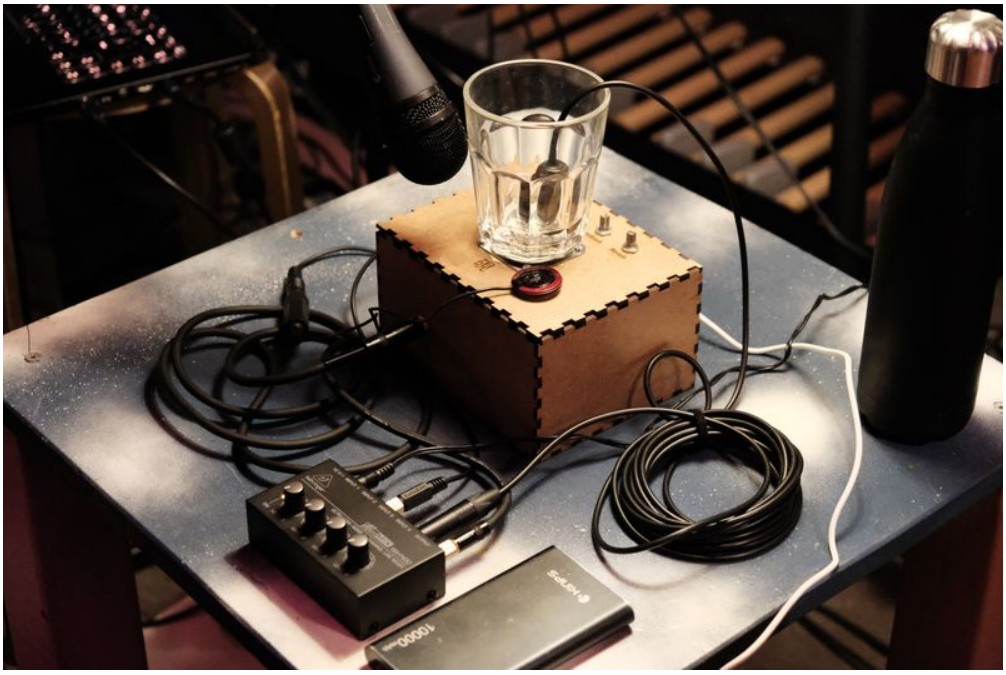

Image 2
Suzuri-Bako live setup for Feedback Musicianship Network event
ukirke, Copenhagen
November 30th, 2021

Software

The main DSP processing algorithm is written in the Faust IDE, using a custom echo function and calling the zita_light method defined by Romain Michon at CCRMA [5]. This reverb is used due to the low computational power of the Teensy, working with both demanding delay and reverb.

```
echo(d,f) = + ~ (de.delay(50000,del) * f)
with{
    del = d*ma.SR;
};
    gain = hslider("gain", 0.5, 0, 1, 0.01) : si.smoo;
    delLength = hslider("delayLength", 0.5, 0, 2, 0.01) : si.smoo;
    feedback = hslider("feedback", 0.5, 0, 1, 0.01) : si.smoo;
    process = echo(delLength, feedback) * gain <: zita_light;
```

The hardware to software mapping of the Teensy and the Audio Shield is made through a Teensyduino script.

```
#include <Audio.h>
#include "Suzuri.h"

Suzuri suzuri;
AudioInputI2S in;
AudioOutputI2S out;
AudioControlSGTL5000 audioShield;
AudioConnection patchCord0(in, 0, suzuri, 0);
AudioConnection patchCord2(suzuri, 0, out, 0);
AudioConnection patchCord3(suzuri, 0, out, 1);

void setup() {
  AudioMemory(6);
  //Serial.begin(9600);
  audioShield.enable();
  audioShield.inputSelect(AUDIO_INPUT_MIC);
  audioShield.inputLevel(1);
  audioShield.micGain(10);
  audioShield.volume(0.4);
  audioShield.lineOutLevel(13);
}

float myMap(float x, float in_min, float in_max, float out_min, float out_max) {
  return (x - in_min) * (out_max - out_min) / (in_max - in_min) + out_min;
}

void loop() {
  int sensorValue = analogRead(A8);
  int sensorValue2 = analogRead(A3);
  int sensorValue3 = analogRead(A2);
  int sensorValue8 = analogRead(A0);
  float gainValue = myMap(sensorValue, 0, 1023, 0.00, 1.00);
  float delayValue = myMap(sensorValue2, 0, 1023, 0.00, 2.00);
  float feedbackValue = myMap(sensorValue3, 0, 1023, 0.00, 1.00);
  float dryWetValue = myMap(sensorValue8, 0, 1023, -1.00, 1.00);
  suzuri.setParamValue("gain", gainValue);
```

```
  suzuri.setParamValue("feedback", feedbackValue);
    suzuri.setParamValue("dryWet", dryWetValue);
    Serial.println(feedbackValue);
    delay(30);
  }
```

Future Work

Future upgrades of the instrument could include the possibilities of having more than one input at a time, with possibly a small mixer to control the gain of the individual audio sources, as well as a balanced line out, to separate the physical sound output and manage it through a PA or a sound-card. Another aspect of interest could be using a bigger and more powerful speaker, in order to extend the frequency range of the instrument towards the low register. Finally, higher computational DSP results could be achieved using a different microprocessor, like a Bela, with the help of C++ or Supercollider code.

Conclusions

The work presented in this paper led to a self-contained, highly portable instrument with a wide range of sonic possibilities. The instrument has been tested and finally successfully introduced in public at the Feedback Musicianship Network [6] event and concert in Copenhagen in November 2021. Using only a contained set of controls and enhancing the sonic characteristic of the performative space and of the instrument itself, Suzuri-Bako stands out as a personal starting point of investigation on electroacoustic feedback instruments and New Interface for Musical Expression.

Acknowledgments

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Video Performance

https://www.youtube.com/watch?v=frbkQF2pSQA

Video 1
Feedback Exploration Ensemble
Live Improvisation Session
excerpt of the Feedback Musicianship Network event
https://feedback-musicianship.pubpub.org/
uKirke, Copenhagen November 30th, 2021

Citations

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