## The Rain Flute version 2

Prepared for MUS 66 Presented 5/7/2013 Write-up by Case Jemison Teammates: Tom Cahill, Meredith Packer

## Concept:

The aim of our project was to improve the original Rain Flute design. The first incarnation of the Rain Flute had a few flaws that we wanted to fix, including: overly bulky body, curved, cylindrical body (made it difficult to adhere ribbon strip), loose wiring and electronics, open bottom end of instrument, and unconventional mouthpiece. In addition to these flaws we wanted to give visual performance feedback by adding a strip of LED lights.

As a refresher, the original concept was to create a digital instrument that integrates performance gestures and sonic elements of both a wind instrument and a rain stick. Physical playing gestures are converted into electrical signals by an ultrasonic sensor, a ribbon controller, and a 2-axis accelerometer. In combination, the "rain stick" and "flute" timbres are intended to complement each other and allow for simultaneous control by a single performer. The flute sounds are the lead melody with the rain stick sounds as textural accompaniment.

## Sensors & how it is played:

The ultrasonic sensor serves as a wind controller that generates MIDI notes and controls volume from the player's breath. When the incoming pressure exceeds a certain threshold, a note-on message is triggered and the volume changes as the pressure changes. When the pressure falls below a lower threshold, a note-off message is triggered.

The ribbon controller determines monophonic pitch based on hand position, controlling the "flute sound." Pitch bend messages facilitate continuous pitch control, with a range of four octaves. When a note-on is triggered by the ultrasonic sensor, the pitch of the resulting note-on message is the lowest note in the instrument's range, and the pitch bend at any given time is be given by hand-position the ribbon controller.

A 3-axis accelerometer detects the orientation and acceleration of the instrument, generating an atmospheric, grainy sound. The instrument's orientation relative to the z-axis serves as a means of triggering note on and note off messages for the ambient "rain stick" texture. The sound is triggered when the instrument is oriented about 20 degrees above vertical position. The rate of the grains within the texture increase as the tilt upwards increases, with maximum rate attained when the Rain Flute is held completely horizontal, parallel to the floor.

Buttons are used for program changes of each sound in Reason. Two buttons for each patch control program change up and donw. Four patches are included for

"flute" and "rain stick" sounds, with eight different sounds in total. Patches are designed to emulate elements of these acoustic sounds, but with an electronic twist.

The instrument was intended to allow for some musicality. Change of pitch is legato and follows a continuous pitch bend, rather than chromatic steps, creating brief, yet flavorful microtones between steps. Performing a quick rubbing motion on the ribbon controller creates vibrato. The Rain Flute also utilizes aftertouch to modify the sound of the patch as the player breathes harder into the mouthpiece.

## Parts list:

TruStability SSC Pressure Sensor Kurzweil Ribbon controller Triple Axis Accelerometer Breakout – ADXL335 4 small buttons

Arduino Mega 2560 R3 Protoboard wires

PVC rectangular tube, length 3' diameter 1" tubing

LED strip lights

## Physical design:

The breath sensor, its wires, an LED light strip, and the wiring from the four buttons are mounted within a rectangular length of PVC pipe. Holes punched along the right side of the instrument allow light from the LEDs to be seen from the outside. The four buttons on the middle-left side of the instrument control patch changes. The mouthpiece is constructed from a tube fed into the main body, guiding airflow into the breath sensor within the instrument. The breath sensor is glued to the bottom of the tube. A bottle cap with a hole in it fits around the tube like a washer and "seals" the space between the tube and the body, capping off the top end of the PVC. The ribbon controller is mounted lengthwise along the top of the body of the instrument such that the closer the performer's finger is along the ribbon to the top of instrument, the lower the pitch is. The electronics (the arduino and protoboard) as well as the accelerometer are housed in a plastic enclosure mounted on the left side of the instrument at its bottom.

## Improvements from original design:

In terms of improvements from the original design, the bulky body was fixed by switching to a rectangular piece of PVC. The original body was far thicker than needed to house all the necessary wires and electronics. The body of the second version was slimmed down significantly. Also, the original cylindrical body created problems with adhering the ribbon controller. The rectangular PVC provided a flat surface to easily adhere the ribbon. The electronics and wiring were not protected

in the first version. The arduino was merely inserted into the bottom of the PVC and was not protected as the bottom of the instrument was left open. The second version had a dedicated plastic housing for the electronics. The issue of the unconventional mouthpiece was not solved. We wanted to try to replace the simple plastic tubing with a real recorder mouthpiece, however this proved not to work.

## Max/MSP patch:

See appendices 1.1-1.3 for diagrams of Max objects.

## Reason rack & sound design:

The flute and rain stick sounds each have their own respective Combinator patch in Reason. Combinator 1 is the Flutes combi and resides on MIDI channel 1. The Combinator includes four monophonic Subtractor patches connected to a 6-channel Line Mixer (2 channels unused). The four patches are standard Reason patches that have been slightly tweaked; they include Bad Flute, Microwaves, Mordez Lead, and Tubule. A Pulverizer effect module was also added and was triggered at high velocity notes to simulate an overblowing effect.

Within the programmer, each specific patch is mapped to a different note: C4, D#4, D4, and D#4 respectively. Program changes are made easily by switching the root note in the range. In terms of actual pitch played, however, every patch has a root note of C (of varying octaves) because they are all transposed accordingly in the programmer. Pitch is controlled entirely by the mod wheel on the Subtractor module. Pitch bend range is set at 24 to allow a full 4-octave range, with the root note residing the middle of the range.

Combinator 2 is the Rain Stick combi and resides on MIDI channel 2. The Combinator includes four rhythmic Malstrom patches connected to a 6-channel Line Mixer (2 channels unused). The amount of tilt of the accelerometer corresponds to the Modulation A and B rate parameters. These two parameters are controlled simultaneously by Rotary 1 of the Combinator.

The four patches are standard Reason patches that have been slightly tweaked; they include Arpwave, Rip torn, VS Arpage, and ArpBells. ArpBells is further enhanced with an RV-7 Digital Reverb device. These patches follow the same programming method as Cominator 1, corresponding to C0, D#0, D0, and D#0 respectively. Actual pitches played are transposed to C0 and play that pitch only.

See appendix 2 for a diagram of the Reason combinators.

#### **Issues:**

Although the concept behind the second version was to create a more streamlined, lighter designed, I felt that in actuality it was more cumbersome. Because the PVC was far lighter, the weight of the electronics and housing at the bottom caused it to be weighted unevenly. The recorder mouthpiece could not be added because the whistling noise could not be muted. We tried both plugging the hole and covering it, but in the end had to return to the original tube mouthpiece. The electronics as a hole were very shaky as

visible in our final presentation. The wiring within the electronics housing was a rats nest and many connections came loose easily. Also, the buttons proved faulty for unknown reason.

## **Group Evaluation - Meredith:**

Meredith's experience as a wind player was vital to the group. Her experience playing the flute helped us determine the design of the instrument in terms of ergonomics and interface layout, specifically with the placement of the ribbon sensor and buttons. Like with the first version of the instrument, she was helpful during construction, but at times she would make drill holes in various parts without measuring where to place the hole beforehand.

## **Group Evaluation - Tom:**

Tom was the leader of the group and was a great asset. He handled the electronics as well as the design of the Max patch. Although Tom was an invaluable asset, he was not the best manager, nor did he work very efficiently. Given his expertise in electronics and his control of the overall work schedule, he could have delegated work far better. In terms of layout of the instrument, we could have used more discussion and logical planning of what would go where before we actually did it.

## Self evaluation:

I believe I performed well in the group. Although I did not contribute much expertise aside from the original Reason patches, I was always trying to see what was the next step in order to keep the process moving. I worked well alongside Meredith in physical construction of the instrument. My contributions to the second version include solder work, realizing the issue of the recorder mouthpiece, creating the new mouthpiece, painting the instrument, and attaching the electronics housing.

## Appendix 1.1 – Max Start/Stop & Accelerometer





## Appendix 1.2 – Max Ribbon & Breath



# Appendix 1.3 – Max Presentation view

Start/Stop				Br	eath
Ribbon	A	ccelerometer			
ra0 ra1 ra2	ra3	ra4	r a5		
0 0 347	620	▶469	512		
	х	Y	z	Pressure	Threshold

# Appendix 2 – Reason rack:

MASTER SECTION	DIM -20dB
	MIX
	Flutes combi
PITCH WHEEL Show Devices	D ary 1 Rotary 2 Rotary 3 Rotary 4 Rotary
	Note On SUBTRACTOR 1
	Note On SUBTRACTOR 2
SUBTRACTOR	SUBTRACTOR 3
	Note On SUBTRACTOR 4
Combinator 2	MIX
	Rain Stick combi
Combinator 2 MUTE SOLO	MIX Rain Stick combi Pary 1 Rotary 2 Rotary 3 Rotary 4 Ton 1 Button 2 Button 3 Button 4
Combinator 2 MUTE SOLO Combinator 2 MUTE Sol	MIX Rain Stick combi Pary 1 Rotary 2 Rotary 3 Rotary 4 Ton 1 Button 2 Button 3 Button 4 LINE MIXER 2 9
Combinator 2 MITE SOLO Combinator 2 MITE Sol	MIX Rain Stick combi Rotary 2 Rotary 3 Rotary 4 Rotary 2 Rotary 3 Rotary 4 Rotary 4 Rotary 2 Rotary 3 Rotary 4
Combinator 2 MUTE SOLO Equation 1000 Price Combinator 2 Price Co	Rain Stick combi       Combinator         Image: Stick combined on the stick combined on
Combinator 2 MUTE SOLO Source and the source of the so	NIX         Rain Stick combi       Combinator         O       O       O         ary 1       Rotary 2       Rotary 3       Rotary 4         Ion 1       Button 2       Button 3       Button 4         LINE MIXER 2       O         Arreawes       Image: Conterning and the second meteon       MALSTRöm 1         Rip torn       Image: Conterning and the second meteon       MALSTRöm 3         US Arreage       Image: Conterning and the second meteon       MALSTRöm 3
Combinator 2 MUTE SOLO Paraset of the second se	Rain Stick combi     Rain Stick combi     Image: Stick combi
▶       Combinator 2       MUTE       SOLO         ▼       ■       ■       ■       ■         PITCH       ●       ■       ■       ■         PITCH       WHEEL       ■       ■       ■         ● <th>Rain Stick combi     Rain Stick combi     Image: Combinator     Image: Combinator</th>	Rain Stick combi     Rain Stick combi     Image: Combinator



Appendix 3.1 – Photos, Rain Flute version 1:



Appendix 3.1 – Photos, Rain Flute version 1:



Appendix 3.2 – Photos, Rain Flute version 2:



Appendix 3.2 – Photos, Rain Flute version 2:



Appendix 3.2 – Photos, Rain Flute version 2: