Joseph Sprint's

MICROTONE 3D THEREMAX

VOLUME

HAND 1

OSC1	OSC2	FILTER
WAVEFORM	WAVEFORM	FILTER TYPE
TRI	OFF	LOW
OCTAVE	OCTAVE	CUTOFF
0 ve	0 ve	GESTURE
	INTERVAL	Z Rotate
	0	EMPHASIS
VOLUME	VOLUME	GESTURE

HAND 2

OSC1	OSC2	FILTER
WAVEFORM	WAVEFORM	FILTER TYPE
TRI	OFF	LOW
OCTAVE	OCTAVE	CUTOFF
0 ve	0 ve	GESTURE
	INTERVAL	Z Rotate
	0	EMPHASIS
VOLUME	VOLUME	GESTURE

X4	X3	X2	X1		X1	X2	X3	X4

B1	Z Sector 1 Range 15	C#3	F#4	Z Sector 1 Range 44	C#8
F#4	Z Sector 2 Range 16	A5	F#4	Z Sector 2 Range 44	C#8
C-1	Z Sector 3 Range 128	G8	F#4	Z Sector 3 Range 44	C#8
G1	Z Sector 4 Range 40	A#4	F#4	Z Sector 4 Range 44	C#8
E4	Z Sector 5 Range 26	F6	F#4	Z Sector 5 Range 44	C#8
C-1	Z Sector 6 Range 128	G8	F#4	Z Sector 6 Range 44	C#8
C#1	Z Sector 7 Range 70	A#6	F#4	Z Sector 7 Range 44	C#8
A4	Z Sector 8 Range 17	C#6	F#4	Z Sector 8 Range 44	C#8
D#2	Z Sector 9 Range 13	D#3	F#4	Z Sector 9 Range 44	C#8
C-1	Set All Range 128	G8	F#4	Set All Range 44	C#8

MICROTONES

CHORD	PARTIALS

LEFT VOL   RIGHT VOL

CHORD NOTE   PARTIAL

7	3	10	1	1.	2.	3.	4.

BEND RANGE

MIDI 46	116 Hz

A#₂

80   GLIDE SPEED

MIDI 78	739 Hz

F#₅

80   GLIDE SPEED
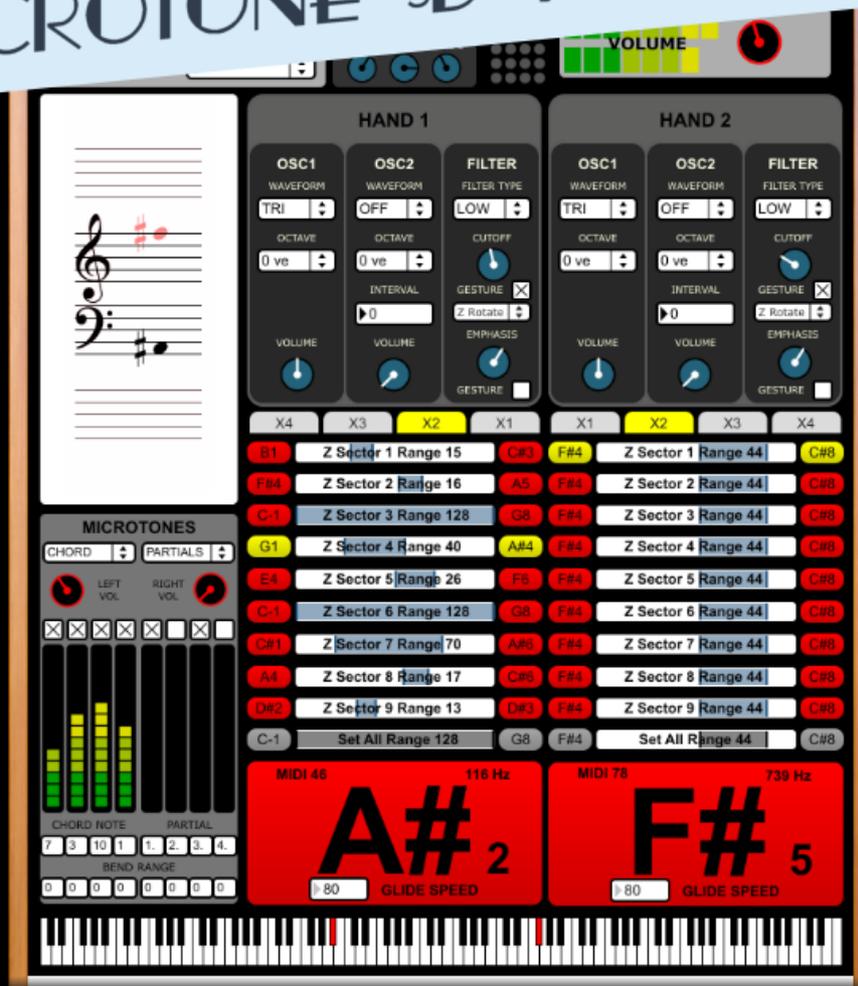
OPERATION MANUAL

VERSION

Microtone 3D Theremax v.1.0
Microtone 3D Theremax Operation Manual v.1.0

CREDITS

Joseph Sprint:
Design and Build

Requires the Leap Motion gesture controller available from
https://www.leapmotion.com/

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Welcome to Microtone 3D Theremax Operation Manual

Microtone 3D Theremax is a gesture instrument designed for the Leap Motion controller interface.

Its basic functioning principle is like that of the original Theremin. The user moves their hands in the air to generate sounds that can be controlled and manipulated through gestures to create music. However, this is where the similarities end.

The Theremax maps multiple gestures to control many different sound parameters which allows the user to create expressive musical works over a 8 octave range.

It can be used with either one hand or two, with each hand offering the same control over the sound.

Aspects of the sound controllable through gestures are pitch, volume, filter cut-off, filter resonance, tremolo, vibrato, and 4 user pre-defined chord notes or harmonic partials that can be controlled in both pitch and volume. All controllable from a single hand, and all independently for the left and right hands.

There are a number of performance related controls not connected to gestures which include a subtractive synthesizer, note glide, user savable presets, delay effect, selectable musical modes, selectable key, and a note range slider.

It also features a unique, configurable pitch matrix which gives the user the opportunity to perform melodic note progressions in any dimension. The pitch matrix allows very unique and often unpredictable melodies.

Like a real instrument, it takes time to learn and understand its nuances to truly master. That said, it is instantly accessible for anyone to start having fun with.

Why is it called a 'Microtone 3D Theremax'?

Originally it was just a Theremax. Named tongue in cheek because it was like a Theremin but more so. Later came the addition of the pitch matrix which allowed performing on three dimensions. Lastly came the chord/partial control which were named Microtones. So you see it all fits together nicely.

Orientation

The performing area is split in two down the center. The left side is for hand one and the right side is for hand 2. Hands are designated as 1 and 2 because they are assigned a side based on the order in which they are detected. So if you put your right hand in to the field first it will be controlling the left side of the Theremax and vice versa.

To use the Theremax you will need to orientate it so your left hand is to the left of the Leap Motion and your right hand is to the right. There is no reason hands should ever cross the center line of the Leap Motion because some controls only work on the correct side such as the Pitch Matrix and Filter Cut-off when switched to x-axis gesture via the menu, each discussed later.
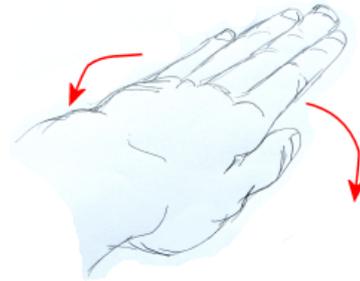
Gesture Control

Volume Off   **Volume On**

Varying the size varies the volume level.
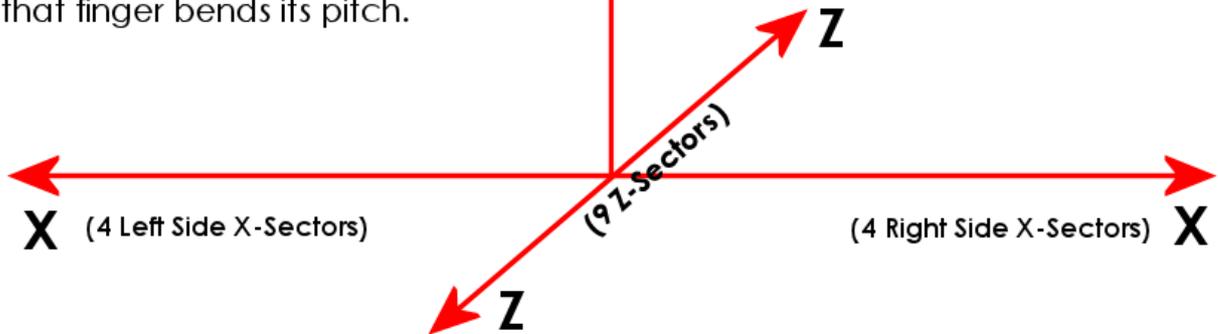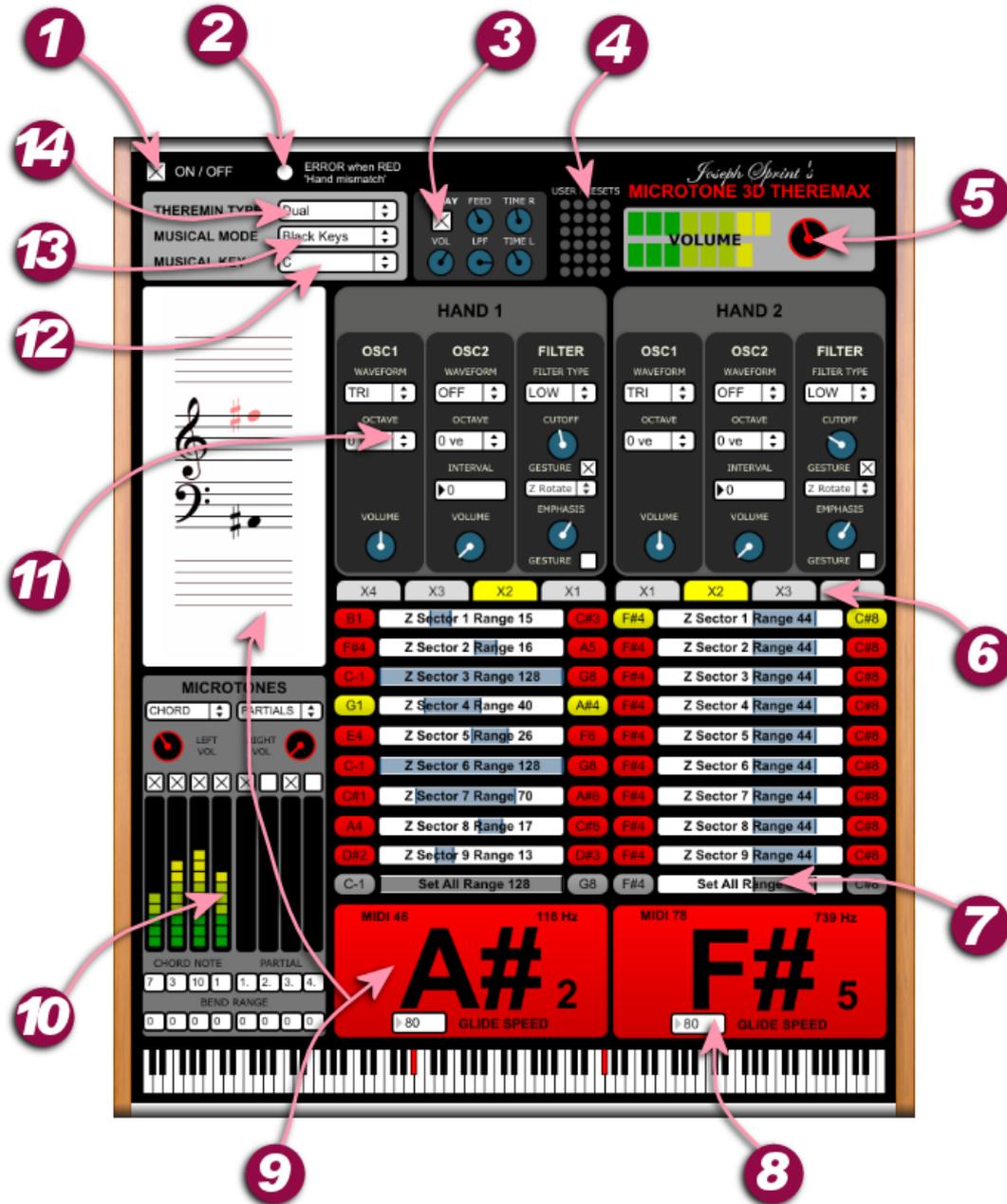
1 2 3

4
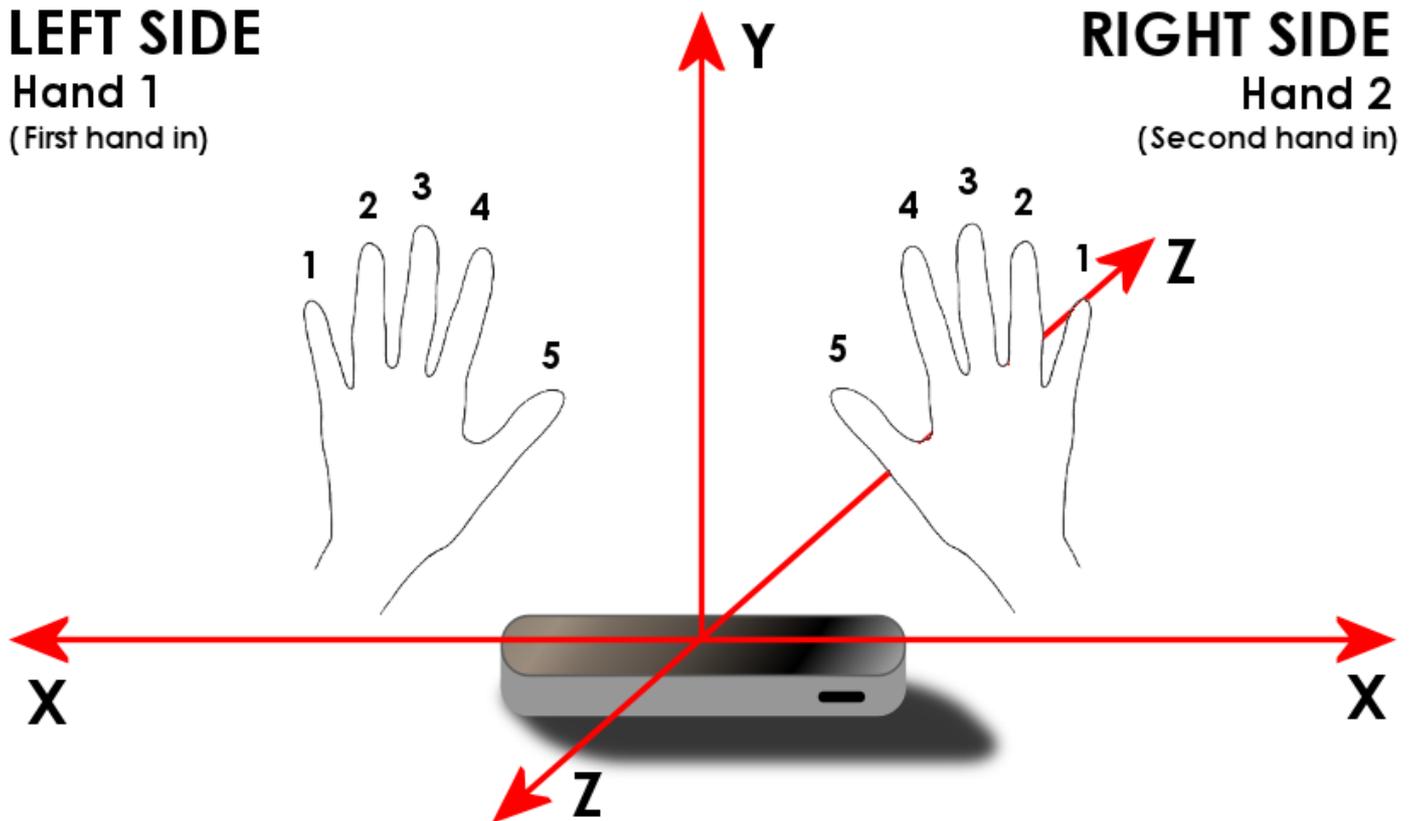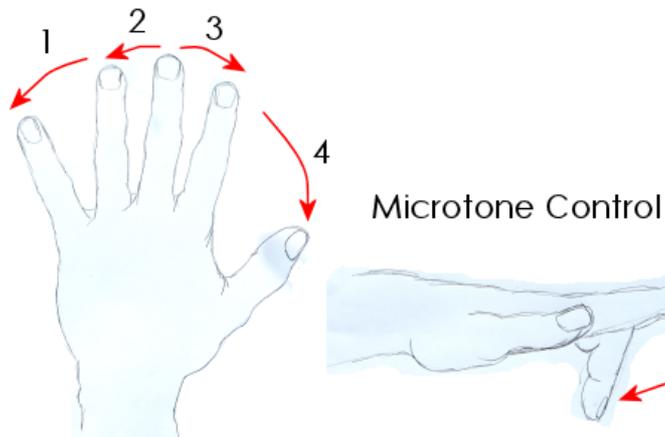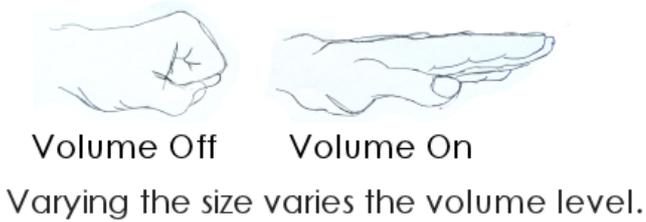
Microtone Control

Spreading any single finger outwards
increases the volume of one microtone,
either a chord note or a harmonic partial.
Lowering that finger bends its pitch.

Y (Pitch Range, 8 Octave Default)

Rotating the hands inwards and
outwards controls expressive effects.
Inwards towards center line is Tremolo.
Outwards is vibrato.

Rotating the hand from flat
to upright controls the
filter cut-off.

Z

(9 Z-Sectors)

X (4 Left Side X-Sectors)   (4 Right Side X-Sectors) **X**

Z

1 ▪ On / Off

This is the main "power" switch for the Theremax. Turning this off will both disable the audio and stop the Leap Motion data from flowing. The Theremax will load already turned on for ease of use.

2 ▪ Error Light

ERROR when RED 'Hand mismatch' says the text, and it would be true. Occasionally the Leap Motion is not as quick as it likes to think it is. In these cases it gets confused about which hand is which and even sometimes thinks there's a third hand introduced. This leads to the hand ID's changing. The hand ID's are the very thing that tells the software where to stream the data from the Leap. In the event of a red light it is often quickly rectified by removing a hand or both and re-entering them into the Leap Motion's infra red field. This will be fixed in the future. Until then, Leap carefully.

3 ▪ Delay

This is a very simple delay featuring independent left and right delay times, 1 second of delay, a low pass filter, and a volume control. Very simple but very effective.

4 ▪ User Presets

By holding down the shift key and clicking on one of the small circles it will store all the current settings. The user can store up to 24 presets which are indicated by a darker coloured circle. To recall a preset just click on the circle.

5 ▪ Master Volume

This is self explanatory. It controls the volume going to the sound card. It has been set to a default of zero to ensure no nasty, loud surprises. It works on a linear scale which is a bit rubbish for audio so this will get an update in the next version.

6 ▪ Customisable Pitch Matrix

This allows the user to set up a three dimensional playing area rather than just the single y-axis of pitch. With careful, or even not so careful, set up of this system using the individual range sliders the user can create some interesting melodic passages by utilising the two other dimensions (X and Z).

At the top of this section are a row of tabs called X1, X2, X3, and X4. If you notice, these change when you move your hands along the x-axis (providing you have plugged in your Leap Motion.). This is because these tabs correspond to four areas the user can move his hand into down the x-axis.

Each tab has 9 range sliders. These sliders again correspond to areas you can move your hand into. If you notice, these change when you move your hand along the z-axis.

What this means is you have 36 distinct areas which you can move you hand into. Think of this as a surface which is divided up into into 36.

Each range slider corresponds to one of these areas and controls the range of notes available within that area when moving your hand up and down along the y-axis.

This results in a large 3D area in which moving in any direction will give a different set of notes. In theory this can be set up in clever and complex ways that I will leave entirely up to the user to discover.

7 ▪ Master Range Slider

Below the rows of range sliders sits a master range slider which when used will change every row in every tab to the same setting. This is useful if you don't want to use the pitch matrix but want to set the left hand and right hand differently, for instance a bass side and treble side. Each range slider can be changed by either moving the slider or scrolling through the note names at the side.

I believe an update to allow range sliders to link to each corresponding slider on the x-axis will save some hassle. Maybe a little button at the side of each called link-x.

8 ▪ Note Glide

This controls the amount of time it takes to move to a new note when waving your hands about. It goes from 10 milliseconds to 3 seconds.

9   ▪ Readout Displays

The Theremax includes a readout of the current note playing for a visual aid when performing. This includes a notation slider, a keyboard showing where the current note is, a readout of the frequency, a readout of the MIDI note number, a readout of the actual note name, and a readout of the notes octave from -1 to 8. This all corresponds to A4 as 440Hz making middle C have the C4 name.

10   ▪ Microtone Configurator

This allows you to set up 4 notes/partials which can then be controlled by fingers 1, 2, 4, and 5. There is a selection menu to choose between notes and partials.

Notes setting allows you to set up notes between the fundamental and 1 octave.

Partials setting allows you to set up multiples of the fundamental frequency of the hand. This allows the user to control the sound spectrally, although only in a limited way (soon to be rectified).

The last control is the bend range. This allows you to set a range in which the user can bend the note/partial when moving the finger. This goes from half a semitone for subtle beating with the fundamental, to two octaves.

You can set this in a way so it allows you to create multiple chords with one hand. For instance you could set up finger 1 as a flattened 3rd, finger 2 as a 3rd, finger 4 as a 5th, and finger 5 as a 7th. If you then practice the combinations of spread fingers you can change between Minor, Major, Minor 7th, Major 7th, and 5th. This gives the user access to a powerful and expressive musical instrument.

The partial setting will be overhauled to allow full control of the sounds spectrum so with the movement of the fingers the user can go from a pure side wave to a square wave and everything in between. This won't be easy to do but it will be a great addition. When in this new partial mode, the synthesizer waveform will default to a single sine wave.

⑪ ▪ Synthesizer

The synthesizer is of the subtractive type. It offers 2 oscillators which you can blend together for the desired sound. Each oscillator has selectable Sine Wave, Triangle Wave, Sawtooth Wave, and Square Wave, and selectable octave from -1 to +1. Oscillator 2 has the option to set it as an interval of oscillator 1.

Each oscillator has an independent volume dial for blending the two signals. This will be updated to a single blend dial for ease of use.

The filter section offers a choice between Low Pass, High Pass, Band Pass, and Notch. The filter cut-off dial can be either set to be controlled by the dial itself or by its gesture. The gesture can be changed from forward rotation of the hand on the z-axis, to the hands movement on the x-axis. In this 'X Axis' setting, the filter emphasis can now be controlled by the other gesture. The gesture for filter emphasis will not work when filter cut-off is set to 'Z Rotate' regardless of the state of its gesture switch.

⑫ ▪ Musical Key Menu

The musical key menu allows the user to select the musical key of the musical mode. When new keys are selected the original notes shift in their positions. This means that where you would expect to find C1 in the y-axis plane you will now find the route of the selected key. This allows the instrument to be easier for some to play, as well as easier to fit into musical accompaniments.

⑬ ▪ Musical Mode Menu

This gives the choice of musical mode. It has 'Free' which is a "fretless" mode, 'Tempered' which gives every note on the keyboard, 'Black Keys' which gives just the black keys, then 'Major', 'Minor', 'Aeolian', 'Dorian', and finally 'Mixolydian'. In each mode the notes that are available are located in exactly the same place on the y-axis. More modes will be added in the future.

⑭ ▪ Theremin Type Menu

This offers the choice of a traditional Theremin type control where one hand controls pitch and the other hand controls volume, or the Dual mode where both hands control both pitch and volume. This dual mode is the default. When in traditional mode the first hand to enter the field becomes pitch and the second hand, volume.

What is Missing?

All volume dials are currently working on a linear scale. This means as the dial turns, the relative volume change we hear is not equal. It also means the usable range of the dial is reduced. Changing these to logarithmic scales will be done for the next release.

Currently there is a master range selector which changes each of the 4 tab's 9 range sliders. It is an easy way to reset every slider without going into each tab and tediously changing each one. However, what if the user wants to set up different note ranges along the z-axis but keep them all the same on the x-axis? Currently this will require setting each tab up separately. So a button next to each range slider on tab 1 will be added which will allow that range slider to control the relative slider in each tab.

Currently all scales for the gestures are set based on my own hands. Things such as the volume gesture and the microtone control gestures might not work as accurately when used by someone with much smaller hands. To solve this problem a small pop-up menu allowing the user to select their hand size from a chart will be added. This will change the scale offsets of some of the gestures. This will require some testing with people of different hand sizes to get the scale values right and the in between hand sizes can be guessed from two extremes of size.

Currently there is no way to change the fundamental sound of the oscillators. For instance, to go from Sine to Saw by using gestures is impossible. I looked at ways to achieve this but there was no time to implement anything for this version. However this idea has been flirted with in the microtone partial control. Currently this only allows 4 partials to be generated. What if there was some way to have these repeated and then have their levels controlled. A gesture to change the volume of every odd harmonic, a gesture to change the volume of every even harmonic, a gesture to control the relative levels of them all. Couple this with the filter gesture and we will have a way to generate sine waves to square waves and everything between with simple finger gestures. This also leaves open all the hand movements for creating expressive music. Imagine that level of control. I regret not starting a week earlier. if I had we might have this feature or something close in this release.

What are the Problems?

Occasionally the Leap Motion gets confused about which hand is which and sometimes thinks there's a third hand introduced. This leads to the hand ID's attached to the hands becoming different than what they were when the hands were first introduced to the field. The hand ID's are the very thing that tells the software where to stream the data from the Leap. In this event it is often quickly rectified by removing a hand and re-entering it into the Leap Motion's infra red field.

I am not sure how to fix this currently. I need to find a way to ensure that hand 1 is always hand 1 and hand 2 is always hand 2 and hand 3, 4, 5, 6, etc., simply do not exist.

Currently it requires both a Leap Motion (+drivers), Java, and Max 6. However this won't be the case soon. The problem with creating a stand alone that doesn't require Max is that the Leap Motion external is not included in the build. Once this is figured out it will be stand alone and not require Max 6, hopefully very soon.

Joseph Sprint's

MICROTONE 3D THEREMAX

www.josephsprint.co.uk/theremax/