






Adventures in Casual Instruments and 3D Input

Tim Thompson https://timthompson.com me@timthompson.com

Outline

- Casual Instruments
- 3D Sensors
- Space Palette
- Space Palette Pro

Casual versus Performance Instruments

- Casual Instruments
  - Simple, discoverable with few or no instructions
  - Immediate gratification, fun, and pleasing results
  - Direct control is obvious to the player
  - Each person sounds different and can be uniquely creative
- Performance Instruments
  - Prioritize proficiency and control
  - Proficiency requires instructions, practice, learning curve

Physical Interface Design Goals

- A single physical interface serving both casual and performance use
- Different physical interface semantics for each
- Different GUI interface
- Can be changed on the fly
- Can have more than 2 levels

Physical Interfaces - Dance Pads

- With Wireless QWERTY keyboard

- Woodstockhausen performance – Happy Feet
  - Done entirely on 4 dance pads
  - No hands, No light, and EL-wire-outlined pants

Dancing under the Stars of Lyra

Burning Man 2003

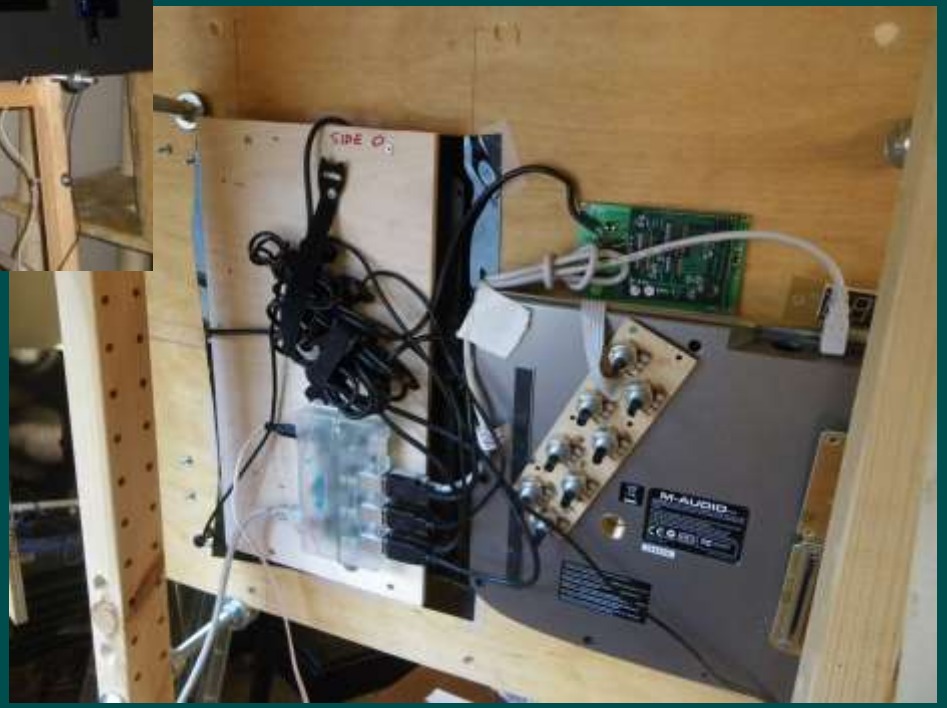
Fingerworks-based Controller

- Capacitive multitouch with finger area detection
- Extremely responsive, excellent driver support
- First exposure to 3D input

Monolith 2.0 at Burning Man 2009

Monolith 2.0 – details

- Korg Nanokeys used as buttons
- M-Audio Trigger Fingers used for drum pads



- Implements two independent 5-track MIDI loopers

UniLooper

- LinnStrument for input
- 4-track MIDI looper
- Loops trigger visual shapes
- Implemented with KeyKit
- Looping Festival in 2015
- Burning Man in 2016

3D Input in Physical Interfaces

- Fingerworks pads showed the expressive potential
- Physical interface providing a third dimension can be:
  - Slider or scroll wheel
  - Pressure (Wacom, Continuum, Eigenharp, Linnstrument, etc)
  - Area (Fingerworks, Magic Trackpad, iPad)
  - Vibration, Orientation, Acceleration (smartphones, joysticks)
  - Spatial (Kinect, Leap Motion, Senz3D)
- 3D input provides natural and expressive input
  - Music: third dimension is useful for vibrato and filters
  - Graphics: very natural for position and size control

3D Input Sensors I’ve explored

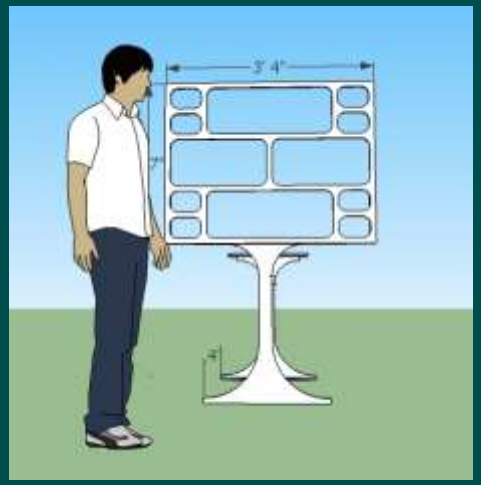
- Fingerworks iGesture pad
  - Finger area is the third dimension
- Microsoft Kinect
  - Breakthrough consumer product, structured light
- Leap Motion
  - Mind-blowing resolution Movie
- Creative / Intel / Senz3D / RealSense
  - Shorter range than Kinect, Time-Of-Flight
- Microsoft Kinect 2
  - Higher-resolution, Time-Of-Flight
- Sensel Morph
  - Multitouch and Pressure-sensitive

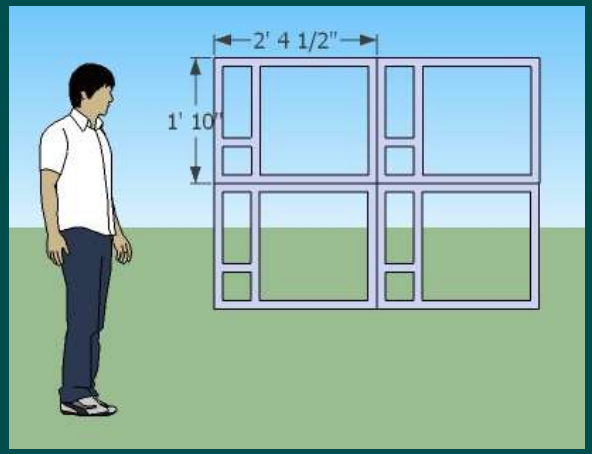
Space Palette - a 3D Instrument Interface

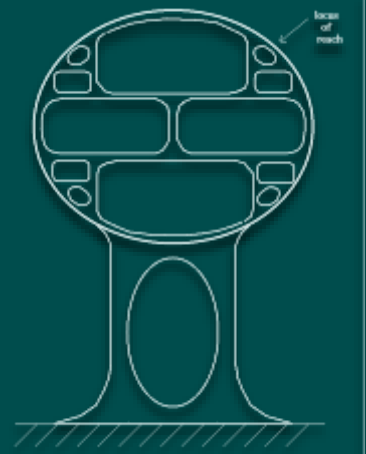
- Holes in a frame become 3D multitouch surfaces
- Any number of hands or objects, simultaneously
- Flexible layout allows many control possibilities
- Immediate access to different sounds/graphics
- Provides frame of reference for player and audience
- Larger visual footprint is more interesting to audience
- Immediately playable, no initial dexterity required
- Larger and less-restricted motion by player is relaxing and expressive

Movie

Space Palette - Prototypes and Evolution

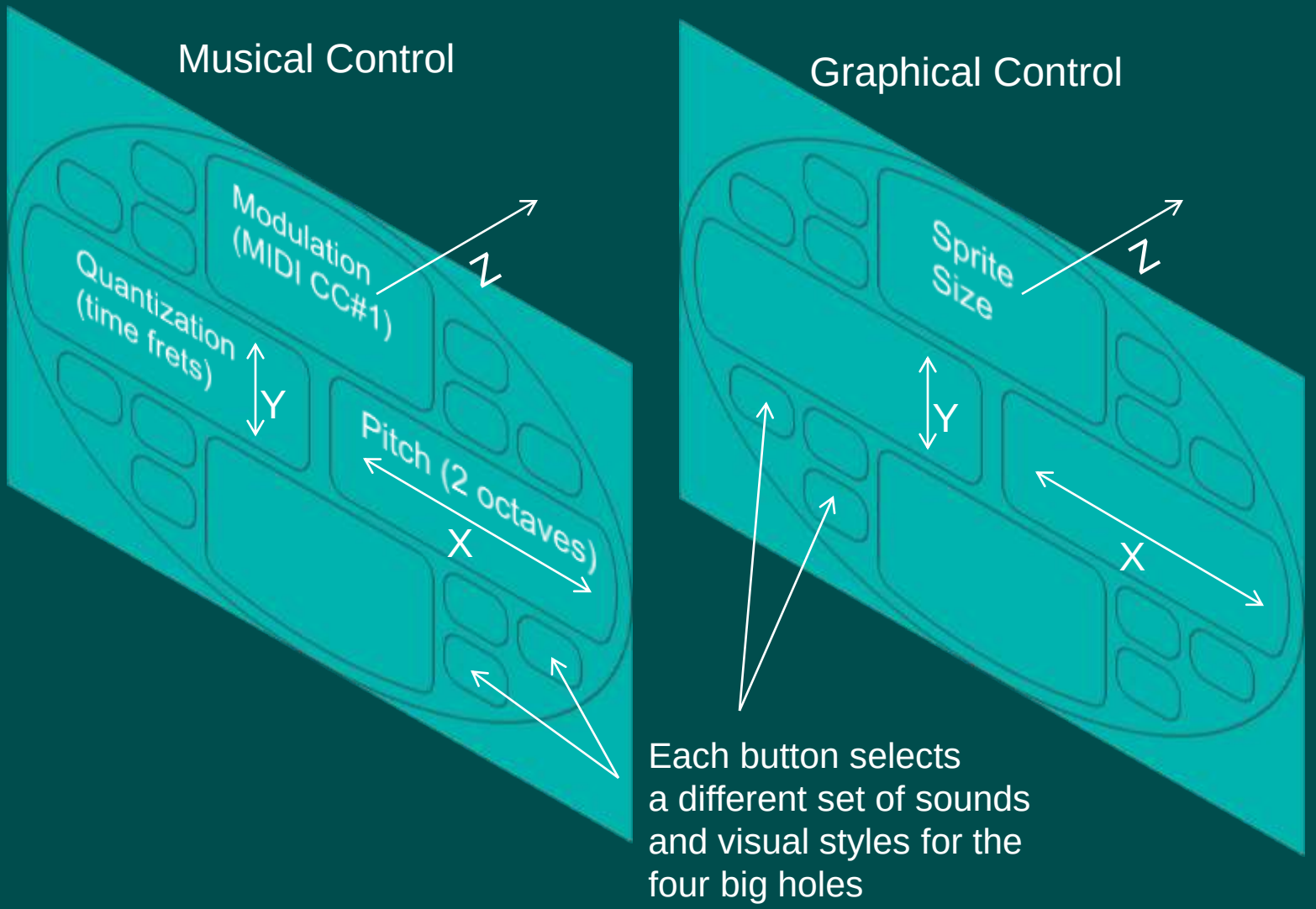






Space Palette - Festival Appearances

Space Palette Interface



Where does the Space Palette fit?

- As a Casual Instrument
  - No learning curve: walk up, play, sound good
  - Natural interaction, effortless, engaging
  - Players recognize that they’re the ones controlling it
- As a Performance Instrument
  - Physical presence, larger movement, and correlation of actions to output engages the audience
  - Frame of reference allows more and better control

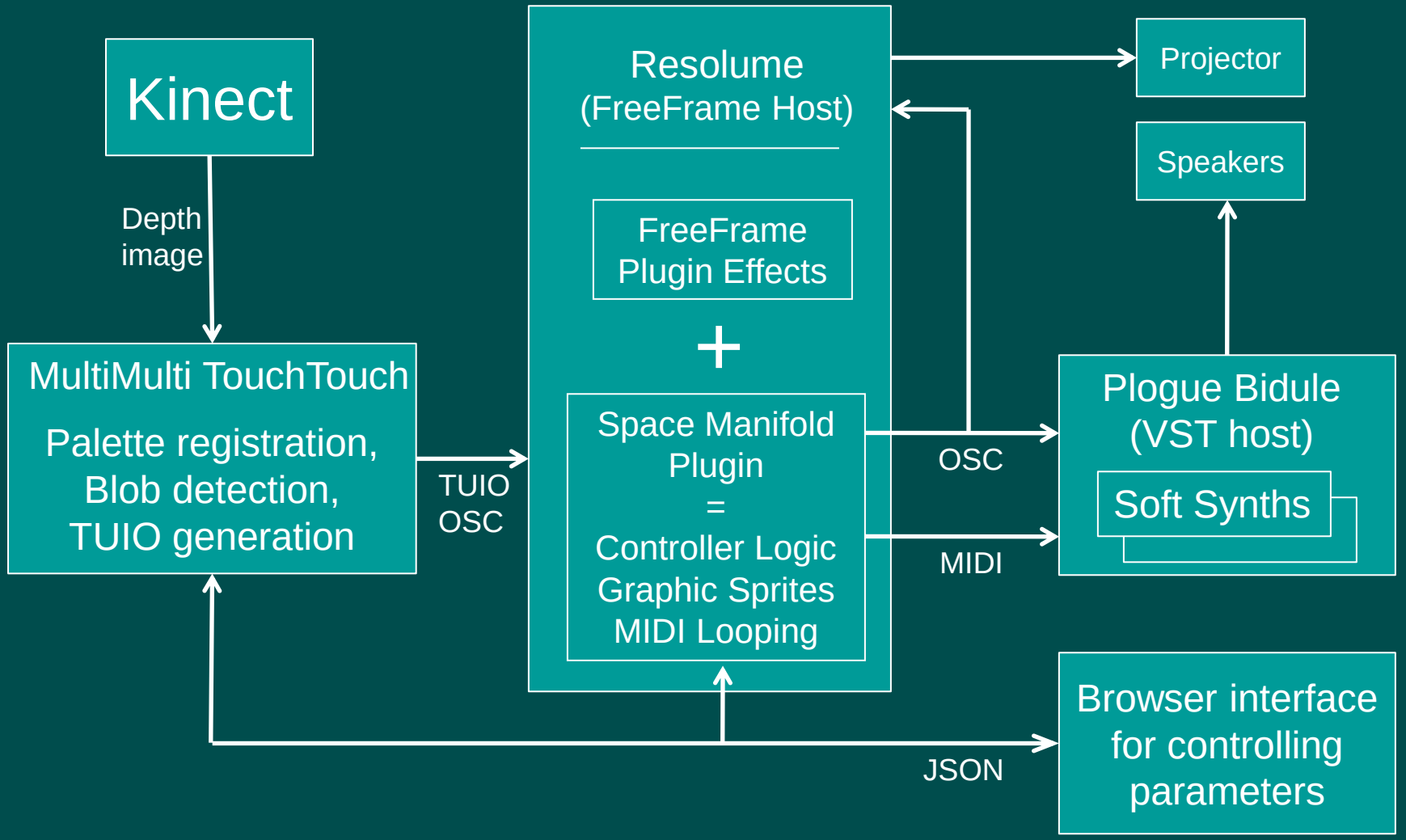
Spatial 3D Input – The Pros

- Large movement is enjoyable, engaging, expressive
- Finger dexterity not necessary
- Unified and simultaneous control of all 3 dimensions
- Simultaneous control of multiple continuous values
- Hands-free (e.g. operating room, vehicles)
- Not just hands
  - Full body
  - Object scanning
  - Objects as fiducials

Spatial 3D Input – The Challenges

- Discrete Control
  - Where is the trigger point?
  - Latency, feedback, confirmation
- Gestural Control
  - When to pay attention?
- Tactile feedback
- Controlling one dimension (or finger) independently
  - Latching values
- Reproducibility
- Historical bias and unfamiliarity

Space Palette Design - 2012

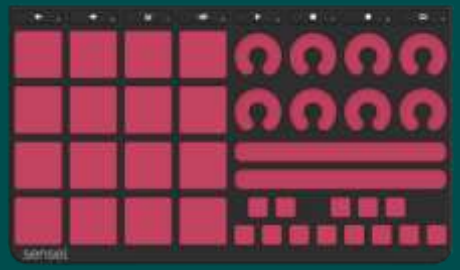


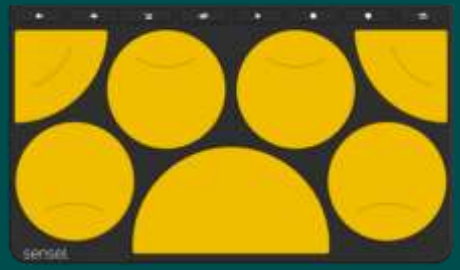
MultiMultiTouchTouch (MMTT)

- C++ program interfacing with the Kinect
- Uses depth image only
- Blob detection using OpenCV
- Trainable interactively on new frames, holes of any shape
- Trainable without a frame, using a specially-colored image
- Browser interface to control it, using JSON over HTTP
- Output is TUIO (a standard multitouch format) over OSC (a standard UDP protocol)
- Windows-only, source code is available

Sensel Morph - a dream come true for 3D input

- 20,000 force-sensing resistors, detects 5g to 5kg
- Raw data is easily obtained
- Overlays for different control layouts





- Magnets in overlays allow detection and swapping
- No overlay == blank canvas

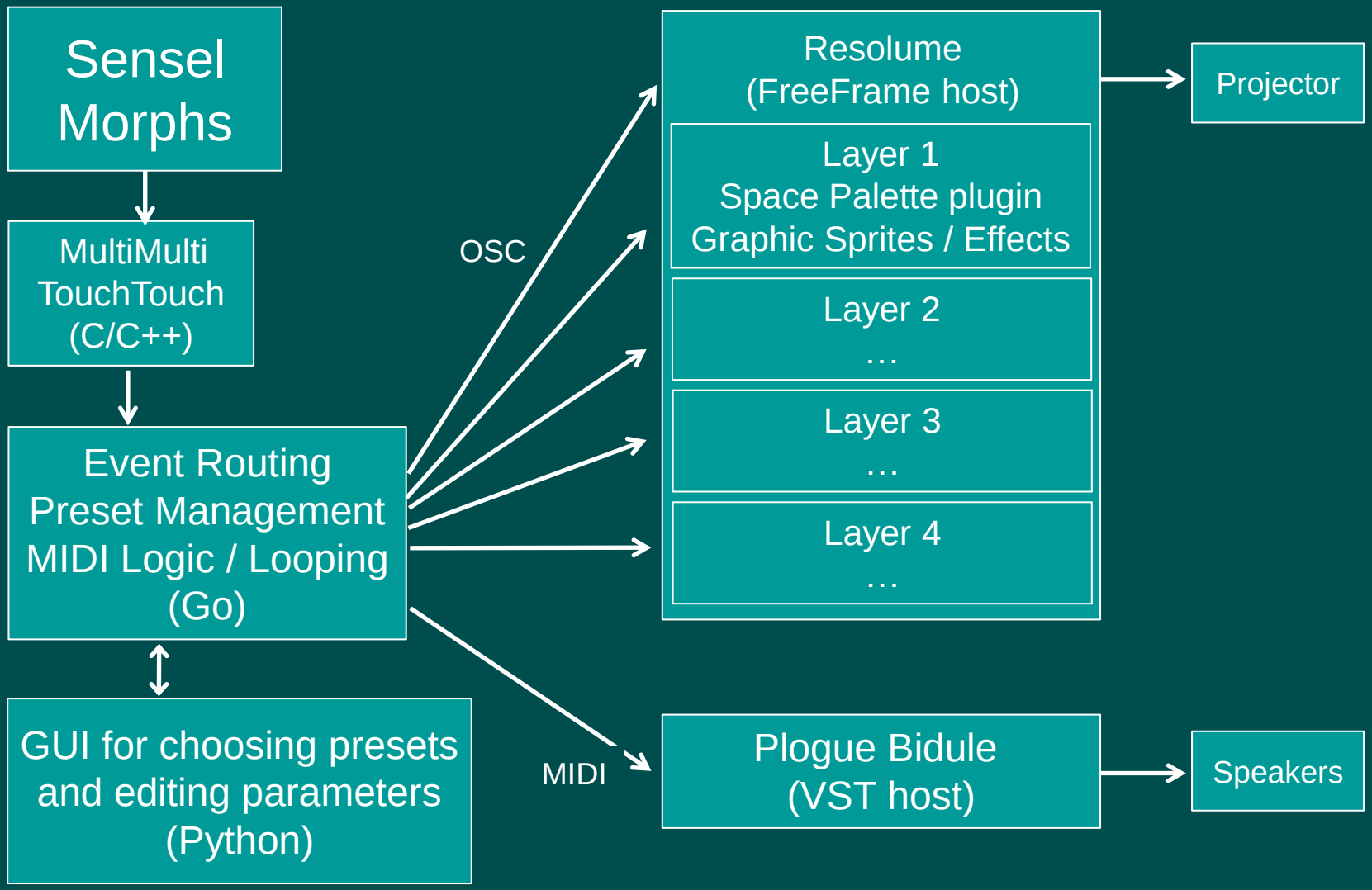
Space Palette Pro

- Differences from Space Palette:
  - Sensel Morphs and a touchscreen
  - Pressure rather than depth
  - Five 3D cursors per hand
  - Separate visual layers, greater variety

Space Palette Pro - Overview

- Each of the 4 Morphs has independent control of:
  - Gesture looping; gestures generate both MIDI and graphics
  - Visual effects applied to graphics within Resolume
  - Sounds (Omnisphere 2)
- Python-based GUI for preset selection and editing
- Go-based router
  - Handles all input - TUIO, MIDI, APIs
  - Generates MIDI output
  - Realtime looping of gestures
  - APIs for parameter and preset control (used by GUI)

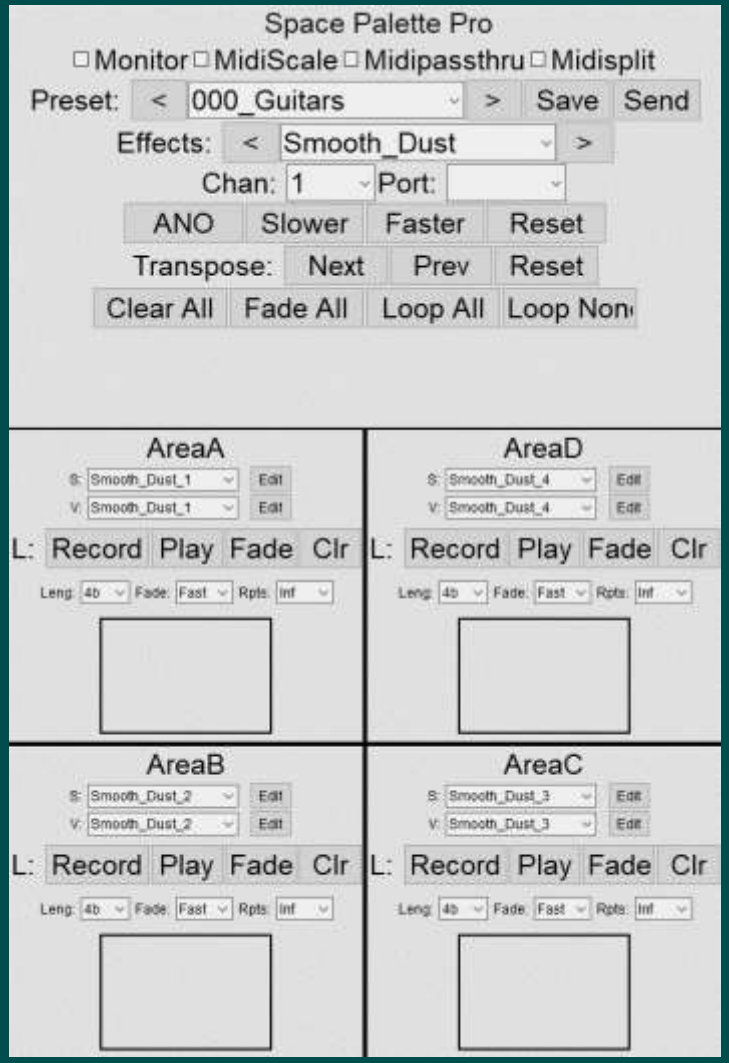
Space Palette Pro - Design



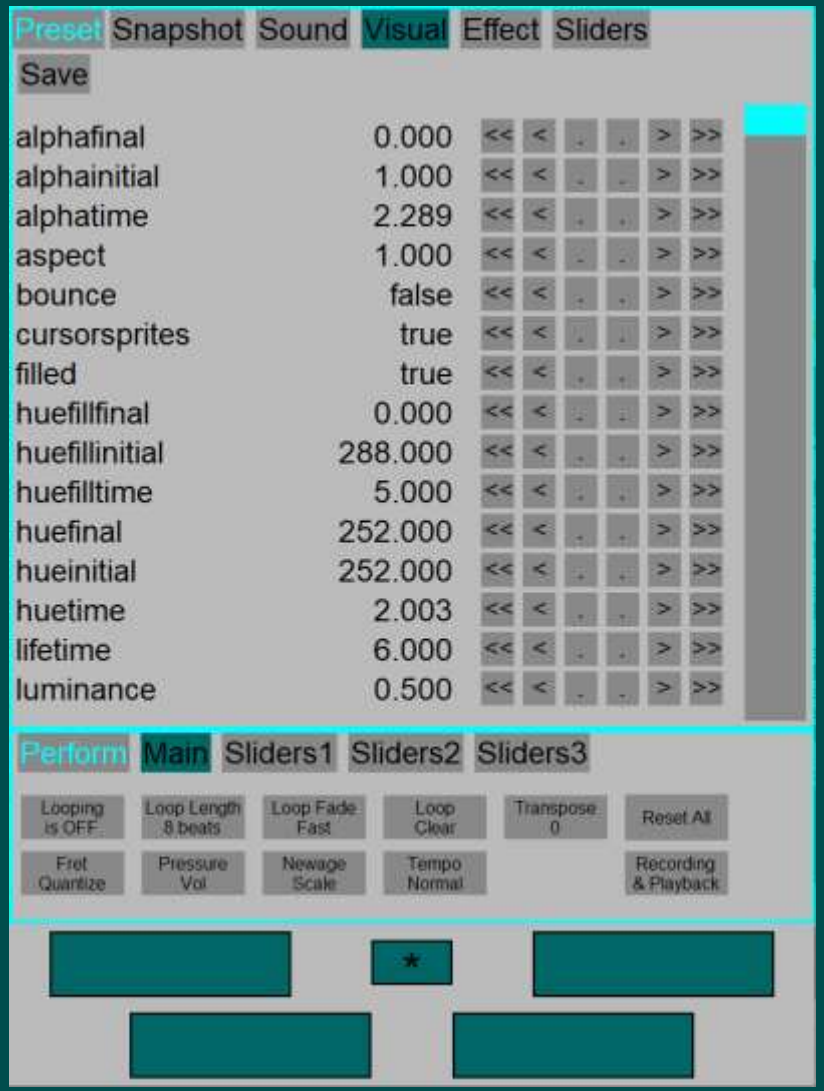
Space Palette Pro - GUI

Casual

Performing



Space Palette Pro – Performing GUI (take 3)



Space Palette Pro - Burning Man 2019

- Photon Salon

- PlayAlchemist Grand Pyramid

Movie

Future

- Open sourcing of CNC data, parts list, software
- Two-handed control
- Phrases rather than notes
- Scanning sequences
- Samchillian style
- Etc etc

Links

Slides:

https://timthompson.com/talks

Source code:

https://github.com/nosuchtim
https://github.com/vizicist





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Tim Thompson https://timthompson.com me@timthompson.com