

I-CubeX

A sensor toolkit for developing
interactive media applications

by Axel Mulder

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1. What is I-CubeX ?
2. I-CubeX Hardware
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<http://ICubeX.com>

I-CubeX basics

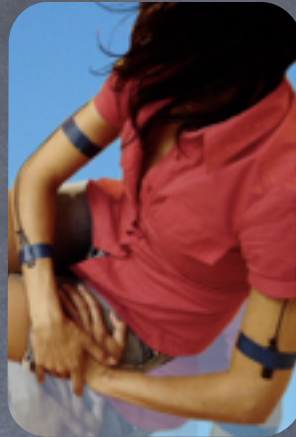


See also <http://icubex.com/about>

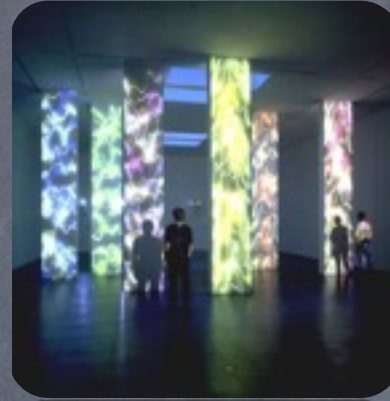
I-CubeX applications



Music



Dance



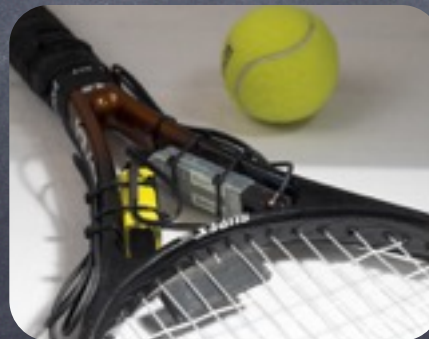
Installation Art



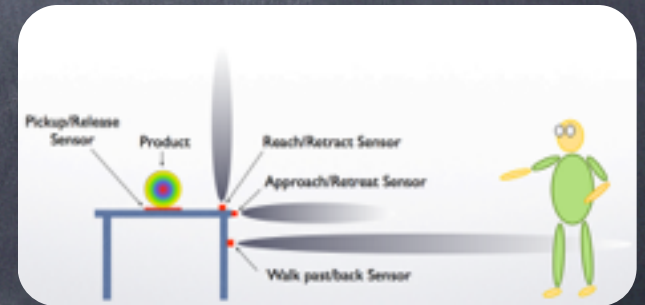
Exhibit Design



Game Dev



Biomechanics



Behaviour Research

Interfaces

- USB-microDig: USB, 8 inputs
- Wi-microDig: Bluetooth, 8 inputs
- Digitizer: MIDI, 32 hi-res inputs
- ArduinoShield: for Arduino
- PiShield: for Raspberry-Pi

USB-microDig

USB sensor interface



Use the USB-microMIDICable to connect with MIDI devices directly.

8 inputs, 10 bit resolution, 6250 Hz sample rate (max), I²C capable

USB-microDig Firmware v7.2

- Analog Sensors -

- Use lookup tables for analog sensors, eg. for linearization or for setting the response curve.
- Convert signals varying around a center value to a value from zero: useful for eg. GForce3D, Magnetic3D, BioVolt.
- Measure time between or frequency of signal peaks or each signal peak and its reset threshold: eg. measure heartbeat BPM with a BioVolt, time between taps on a Touch sensor, frequency of jabs with a GForce3D sensor.

USB-microDig Firmware v7.2

- Digital Sensors -

- Use digital (I²C) sensors such as the Orient3D in standalone mode.
- More efficient protocol for digital (I²C) sensors in host mode.
- Use multiple digital (I²C) sensors on one USB-microDig.

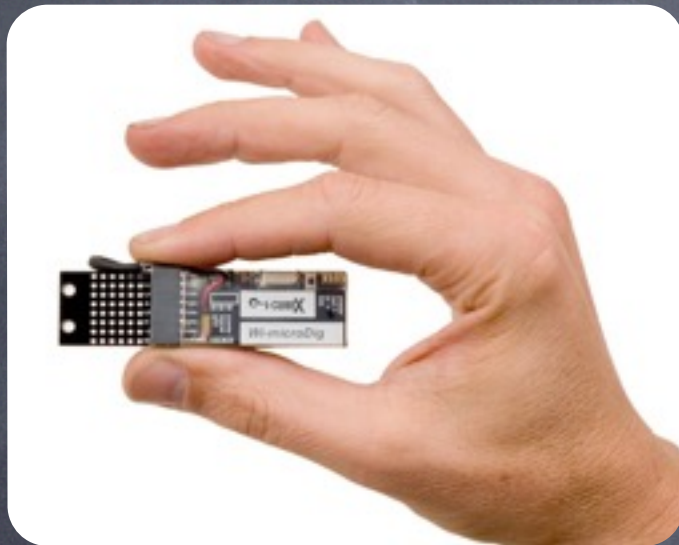
USB-microDig Firmware v7.2

- Actuator Outputs -

- Set actuator outputs to PWM signals: eg. for RC servo control, or dimming of LEDs.
- Map (multiple) sensor input(s) to an actuator output: trigger/dim LEDs, control servos or any other device connected to the actuator outputs in standalone mode directly with (analog or digital) sensors; no need for software on a computer to map inputs to outputs.
- Various other communication protocol improvements.

Wi-microDig

Wireless sensor interface

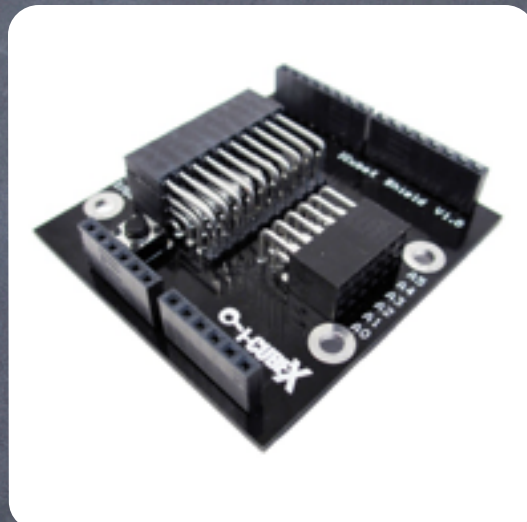


8 inputs, 10 bit resolution, 5760 Hz sample rate (max)

100 meter range (Bluetooth class 1), I²C capable

ArduinoShield

Adapter board for Arduino

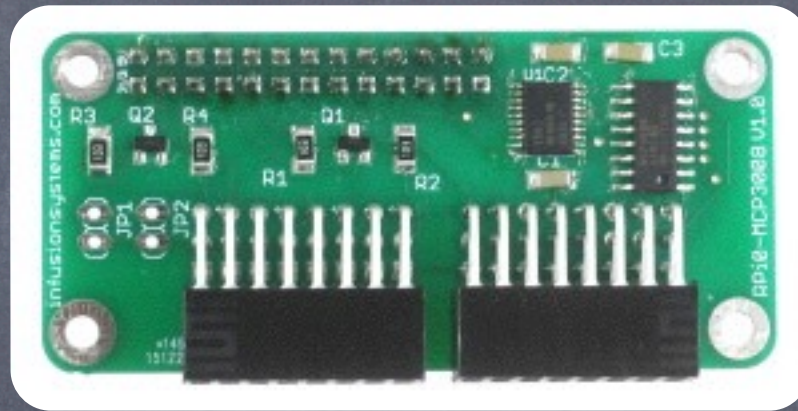


6 analog inputs, 10 digital inputs/outputs

iCubino sketch enables Arduinos to be used with I-CubeX software.

PiShield

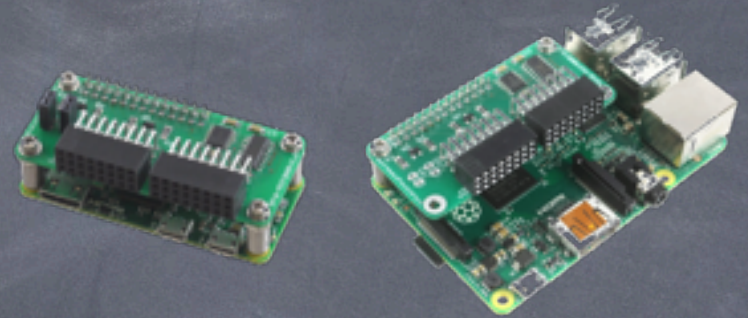
Adapter board for Raspberry-Pi



8 analog inputs, 4 digital I²C ports



SensePlay platform



- Embedded interactive media platform
- Raspberry-Pi: compact, low cost, standalone
- Hardware sensor interface + software system
- HD video, audio, sensor input
- Simple user interface: USB media-based content loading
- See also www.Sense-Play.com

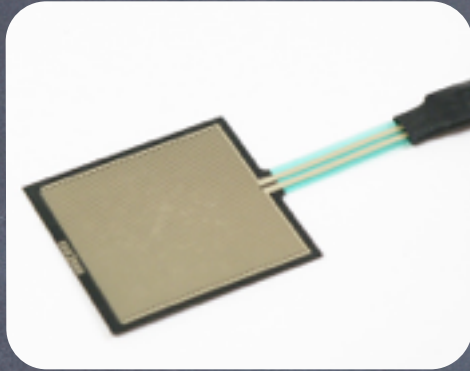
Sensors

- Contactforce, Buttons
- Knobs, Sliders
- Distance, Position
- Acceleration, Orientation
- Biopotential
- Environment

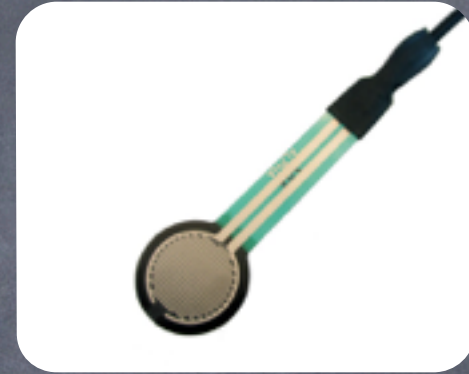
Touch

force sensors

Touch



TouchMini



TouchMicro-10



TouchMicro-05



ReachClose, ReachFar

distance sensors



0.1 - 1.5 m range

approx. 50 Hz update rate



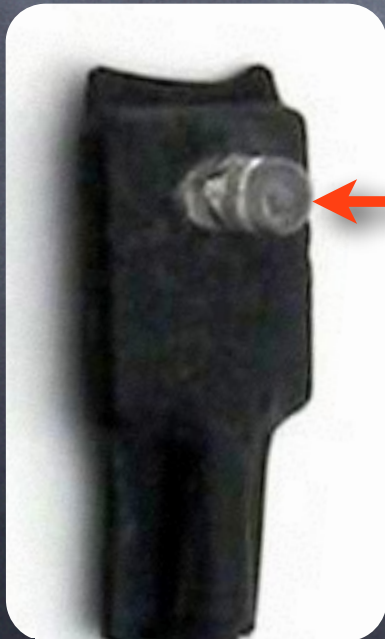
1.0 - 5.5 m range

approx. 50 Hz update rate

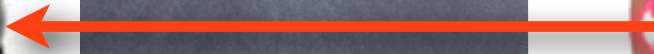
Flash, SeeLaser

trigger beam

Flash



SeeLaser-Red



GForce3D-6

acceleration sensor



Use Wearability straps
to mount on body.

1.5g or 6g acceleration, 4 mg resolution
-180° to +180° inclination

BioEmo

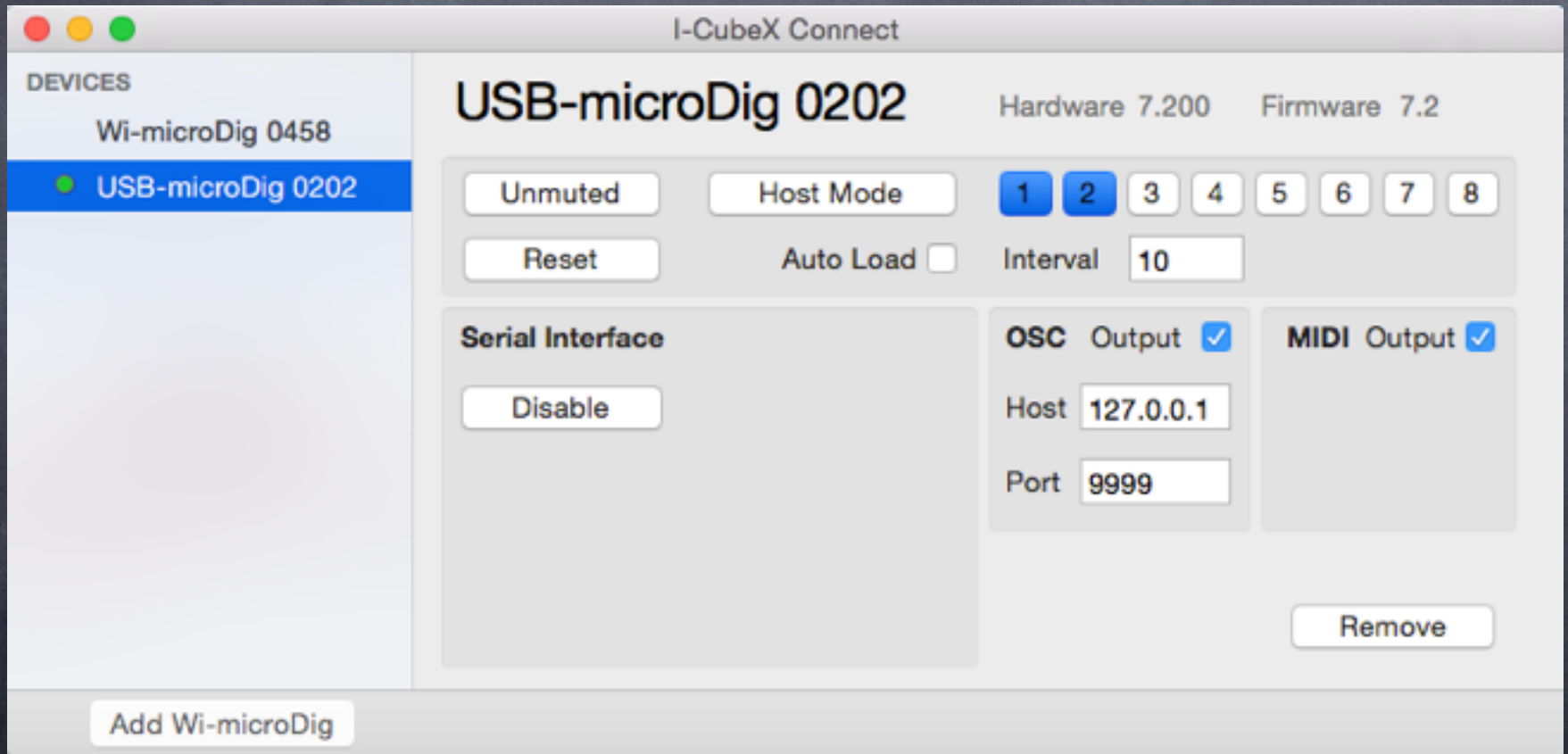
“mood” sensor



Software Apps

- Connect
- EditorX
- Link
- SensePlay
- SensorX, BioEmo, MuscleTrainer, GForce3D-6, Orient3D, MoveAlong, MoveAround

Connect



EditorX

EditorX 7.24

I-CUBEX
click for updates

Setup ?

Digitizer

Port

Label

Options ?

Sampling Interval

Mode

Muting

OSC Output

Settings ?

Digitizer

EditorX

File

Sensor Inputs ?

	1	2	3	4	5	6	7	8
	<input type="button" value="On"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>	<input type="button" value="Off"/>
C								
	<input type="button" value="Edit"/>	<input type="button" value="Edit"/>	<input type="button" value="Edit"/>	<input type="button" value="Edit"/>	<input type="button" value="Edit"/>	<input type="button" value="Edit"/>	<input type="button" value="Edit"/>	<input type="button" value="Edit"/>

Recording ?

Control

Data

File

Time
hh:mm:ss.ms

Actuator Outputs ?

	1	2	3	4	5	6	7	8
	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>
	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>	<input type="button" value="OFF"/>
	<input type="text" value="1.0"/>	<input type="text" value="1.0"/>	<input type="text" value="1.0"/>	<input type="text" value="1.0"/>	<input type="text" value="1.0"/>	<input type="text" value="1.0"/>	<input type="text" value="1.0"/>	<input type="text" value="1.0"/>

Pulse

Interval ms

Width ms

Link

The screenshot displays the Link 1.30 software interface, which is divided into several functional panels:

- Link 1.30 (Main Panel):** Features a configuration section with "open", "save as...", and "Auto-load" options. It includes the I-CUBEX logo and a "click for updates" link. Below this, the "Digitizer" is set to "USB-microDig" on port "SLAB_USBtoUART" with a "sampling interval (ms)" of 10. A grid of 8 sensors is shown, with Sensor 1 currently "ON" and displaying a value of 386. Other sensors are "OFF".
- Analysis - Sensor 1:** Shows "Data" with a "window (ms)" of 10, a "Raw value" of 386, and "average" and "peak" values of 386. It includes a "Calibration" section with a file path "_no_calibration.txt" and a "Valid range" of 0 to 1023.
- Processing - Sensor 1:** Displays "from sensor" value 386 and "processed value" 386. It features five vertical sliders for "Smoothing", "Input Range" (0 to 1023), "Absolute Value" (0 to 1023), "Threshold" (0 to 1023), and "Output Range" (0 to 1023). There are also "Set Range" and "Options" buttons.
- Output - Sensor 1:** Shows "Message Type" as "MIDI control change" and "Controller Value" as 47. It also includes "Controller Number" and "Channel" set to 1, and a "MIDI out port" set to "AU DLS Synth 1".

SensePlay

senseplay

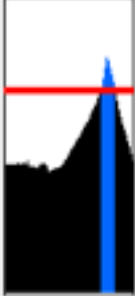
SensePlay v0.64

Connection **SLAB_USBtoUART** refresh ports Settings Only play 1 media file at a time
interval ms reset save load Restart video after minutes

Source 1

input number

raw value: 44

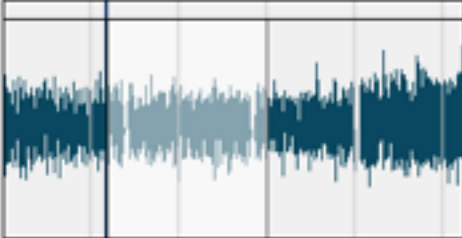
Threshold 

Trigger when crosses above below

smoothing:

Add new source

Audio



Filename "Yemaya 1,2,3,5.mp3"

Start time 76482 End time 192748

Ignore subsequent triggers for seconds

Add new output

SensorX

SensorX 1.00 help **I-CUBEX** click for updates

Digitizer Open Refresh
ipMIDI Port 1

Data raw average peak Reset Plot
window (ms) > 1 > 1
ADC value > 0. 0. > 0.

Settings Refresh
ReachClose_close_range.txt
valid range: 331. 539.
Save Load > 2000

Record Start View Clear Save
recording time 0:0:0
hh:mm:ss.ms

MIDI out Close Start
OSC out Close Start

Sensor Data Processing processing type: scale
Smoothing: 0.0000
Input: ADC value 0. Min 0. Max 0.

MIDI output MIDI out port: AU DLS Synth 1
Msg type: note on
Note On
Sensor controls: note number
Note Number

[calibration] Current calibration
Formula: ReachClose_close_range.txt
D (cm) 12.592
4.9254
ADC 331 539
New Calibration

icubex_plot
Reset Hold 250 250 80 80
Grid Clear
ADC
time (ms) 0 1000

Sensor Data Processing processing type: scale
Smoothing: 0.0000
Input: ADC value 0. Min 0. Max 0.

OSC output OSC out port: 7000
Msg interval (ms): 1
Distance
OSC stream name: d
OSC message: id 0.00

Software plugins

- Max plugins: iCube, oCube (MacOS/Windows/Linux), digitizer (MacOS, Windows)
- openFrameworks C/C++ API (MacOS/Windows/Linux)
- Ableton Live plugin: Dig4Live (MacOS/Windows)
- EyesWeb plugin (Windows)

iCube/oCube

iCube Max object for decoding and processing I-CubeX sensor data

v3.1 © 2014 Infusion Systems Ltd.

Select the serial ports at 1a-c or MIDI ports at 1d-g ...

... then click commands at 2, 3 and 4.

double-click the patcher to view the full command list description

2 command list

1-4 connect 1-4 1-4 preset 55 0 interval 10

3 turn virtual output 1 through 3 on or off

4 display current iCube config

reset digitizer and object

iCube commands

The iCube's rightmost inlet resolves sensor information from the digitizer.

virtual output #1, virtual output #2, virtual output #3, virtual output #4, error warning outlet

The iCube's rightmost command information

iCube takes 4 optional arguments. The first number indicates the number of outlets (virtual outputs, in this case 4). The Sysex Device ID of a connected digitizer in order to work. If you enter only one number, that number will indicate the number of virtual outputs and the Sysex Device ID will default to 0. The second argument (a string of max. 100 characters) can be used to identify messages from the object in the Max window. It can be left empty by typing "" (two double quotes). The fourth argument "T1" if no firmware is specified, iCube will assume default digitizer specs (maximum 32 inputs, maximum 12-bit digitizer upon receipt of the first MIDI byte. See also the version command).

iCube

oCube Max object for controlling I-CubeX actuator outputs

v3.1 © 2013 Infusion Systems Ltd.

Select the MIDI ports at (1a-c) or serial ports at (1d-f) ...

digital output inlets: send 1 to turn on, 0 to turn off

click the patchers to learn about outputting pulses automatically

repeating_pulse_example

single_pulse_example

the oCube's rightmost outlet sends command information to the digitizer

error warning outlet

complete command list

digital output status outlets: synchronize events in your patch with automatically generated pulses

gate 2

command_list

Serial (USB, Bluetooth)

(1d) View available serial ports in Max window

(1e) select port

(1f) connect digitizer

MIDI

(1a) update MIDI ports

(1b) MIDI Out port

(1c) connect digitizer

oCube takes three optional arguments. The first argument is the MIDI Sysex Device ID, which must match the Sysex Device ID of a connected digitizer in order for the digitizer to respond to the messages from the oCube. If no number is entered the Sysex Device ID will default to 0. The second argument (a string of max. 100 characters) can be used to identify messages from the object in the Max window. The third argument specifies whether the digitizer outputs are assumed to be on (1) or off (0) at the time the oCube object is loaded. If no value is entered it will default to 0.

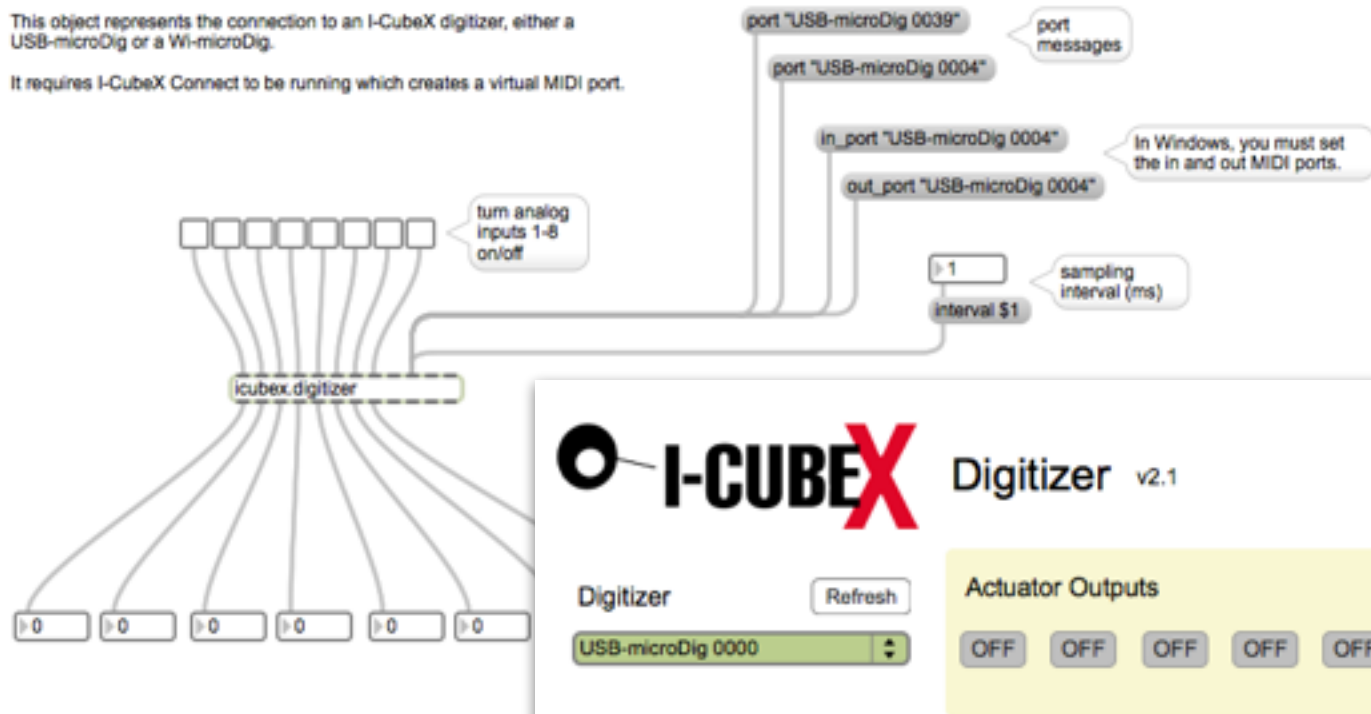
oCube

icubex.digitizer

icubex.digitizer

This object represents the connection to an I-CubeX digitizer, either a USB-microDig or a Wi-microDig.

It requires I-CubeX Connect to be running which creates a virtual MIDI port.



Digitizer v2.1

Digitizer

Refresh

USB-microDig 0000

Actuator Outputs

OFF OFF OFF OFF OFF OFF OFF OFF

Sensors

1 2 3 4 5 6 7 8
OFF OFF OFF OFF OFF OFF OFF OFF

Reset

All Inputs On

Sampling Interval ms

I-CubeX API

- Open source C++ Library for interfacing with I-CubeX digitizers and sensors.
- Platform support for
 - Windows
 - Mac OS
 - iOS
 - Linux (desktop, raspberry Pi)
 - Android (experimental)



McGill

Input Devices and Music
Interaction Laboratory
(www.idmil.org)

openFrameworks Addon

- ofxICubeX

- openFrameworks addon for I-CubeX
- allows "oF"-like access to API features

The logo consists of two lowercase 'm' characters in a bold, black, sans-serif font, positioned side-by-side.

movement + meaning

- Middleware Framework for Acquisition, Processing, Rendering of movement-related data across a network
- Centralized service registry, modules for processing input, feature detection, processing, output rendering
- Multiple ways of interfacing: Service/Client, Adapters, I/O ports
- Built on top of Yarp platform (www.yarp.it)
- Hands-on tutorial will expose I-CubeX sensor data to network

