

I-CubeX

A sensor toolkit for developing
interactive media applications

by Axel Mulder

- About I-CubeX
- I-CubeX Hardware
- I-CubeX Software

<http://icubex.com/support/I-CubeX.190325.pdf>



<http://ICubeX.com>

A large collection of various electronic components and sensors, including accelerometers, gyroscopes, magnetometers, and other MEMS devices, arranged on a white background. The components are of different shapes and sizes, some with wires, some with connectors, and some with labels like 'WiDiG'. They are scattered across the frame, showing a wide variety of micro-electromechanical systems (MEMS) products.



I-CubeX examples

- Trigger sound in sync with physical action on stage (TouchMini, <http://icubex.com/theatre>)
- Create a basic control panel for QLab (TouchMiniOn)
- Rotate CG model of physical object in sync in interactive retail experience (Orient4D)
- Use heart beat to control tempo in musical performance (BioBeat)
- Detect hand position in laserbeam to trigger sound (ReachFar, <https://youtu.be/BmWxUkhyedc?t=26>)
- Trigger sound upon tap on the chest (Bang, <https://www.youtube.com/watch?v=BmWxUkhyedc>)
- Add control for sound effects on a trumpet (Push3D, <https://www.youtube.com/watch?v=umBVBu6nFbI>)

I-CubeX applications



Music



Dance



Installation Art



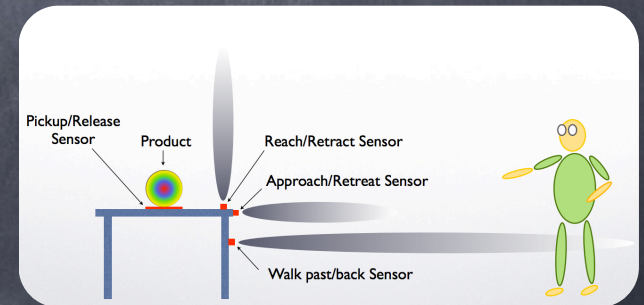
Exhibit Design



Game Dev



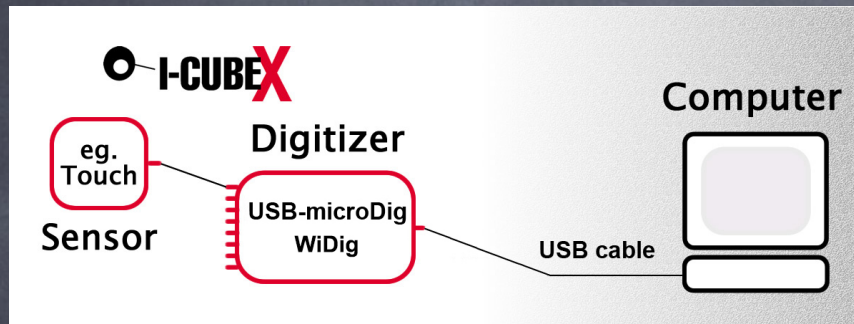
Biomechanics



Behaviour Research

I-CubeX basics

<http://icubex.com/about>



Mode of operation

- Standalone mode: processed & mapped
- Host mode: raw

Sensor technologies

- ② Piezo-resistance (FSR, strain gauge)
- ② Piezo-electricity (also PIR)
- ② Ultrasound TOF
- ② RF TOF (radar)
- ② Bio-potentials (EMG, EEG, EOG)
- ② Hall effect
- ② Electro-magnetic field (capacitance, inductance)
- ② Electro-optical (camera, LED)
- ② Microwave radiation

Interfaces

- WiDig: USB & WiFi or BLE, 8 i/o ports



- USB-microDig: USB, 8 i/o ports



- PiShield: for Raspberry-Pi, 8 + 4 ports



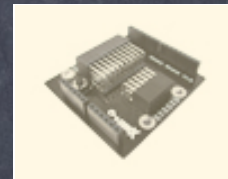
- Wi-microDig: Bluetooth, 8 inputs



- Digitizer: MIDI, 32 12bit inputs

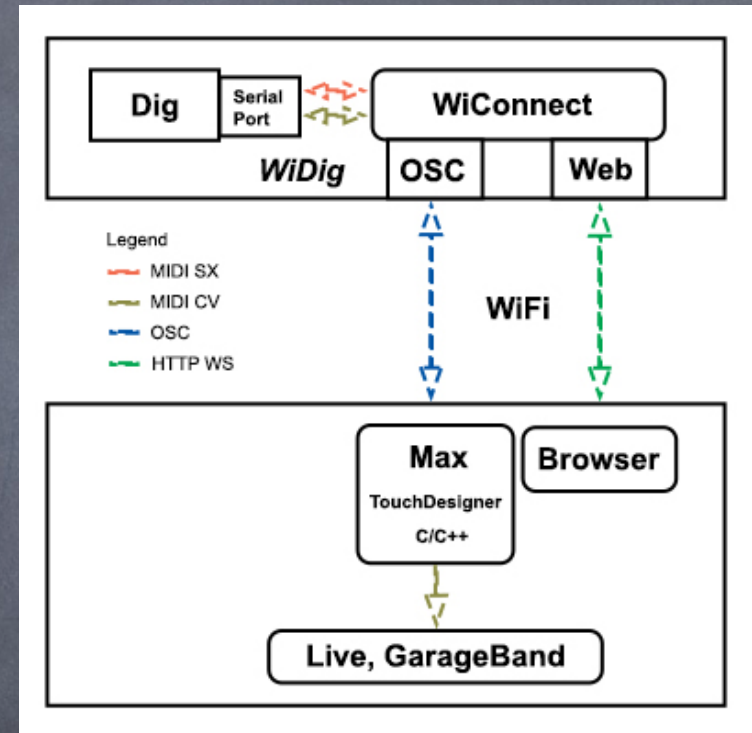
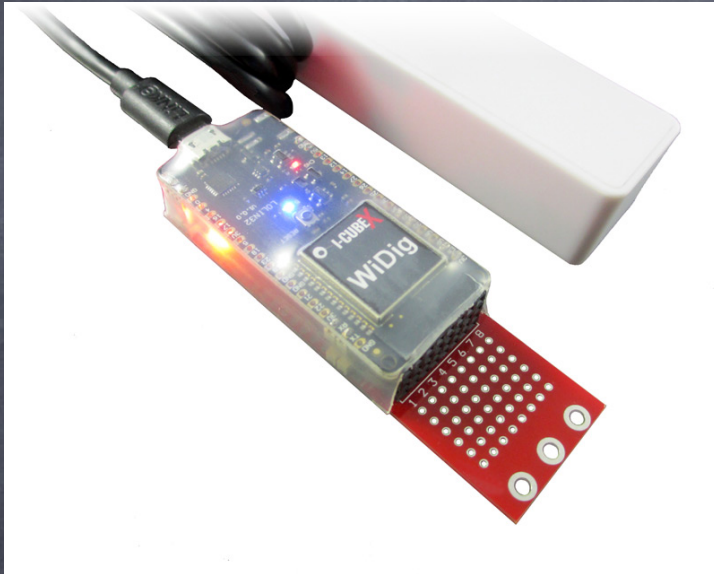


- ArduinoShield: for Arduino



WiDig

Wireless & USB sensor interface



8 input/output ports: 10bit ADC, I²C, TTL, 5760 Hz sample rate (max)

USB serial (MIDI), BLE (MIDI), WiFi (OSC/HTTP/WS)

WiDig Firmware v8.1

– Sensors –

- Digital (I²C) sensor support: Air2D, AngleD, BioBeat3D, BioAirD, HotSpot2D, Light2D, Magnetic3D, Orient4D, ReachFarD, ReachID, ReachOnD, Swipe3D, ..
- Analog sensor signal processing: lookup tables, rectifying, smoothing, threshold/peak detection, peak-peak time/frequency measurement, ..

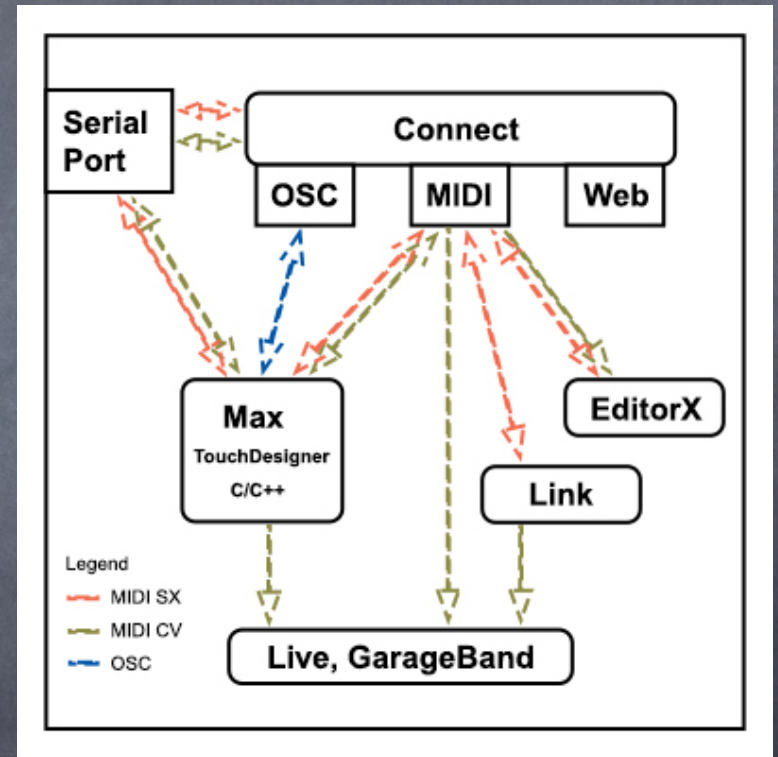
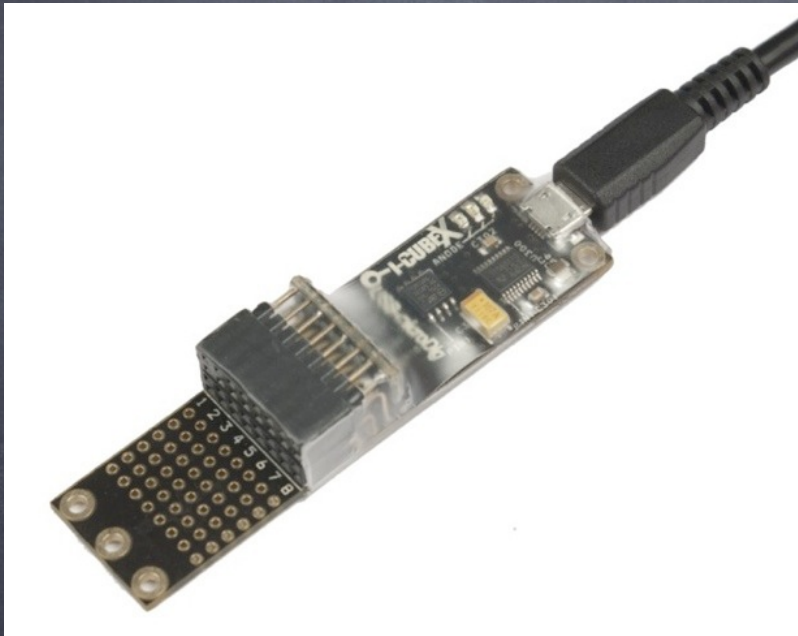
WiDig Firmware v8.1

- Actuators -

- Digital (I2C) actuator support: FeelVibe, SeeRGB
- PWM output: servo/motor control, dimming of LEDs, ...
- Binary (TTL) output: turn actuators on/off
- Map (multiple) sensor input(s) to an actuator output

USB-microDig

USB sensor interface

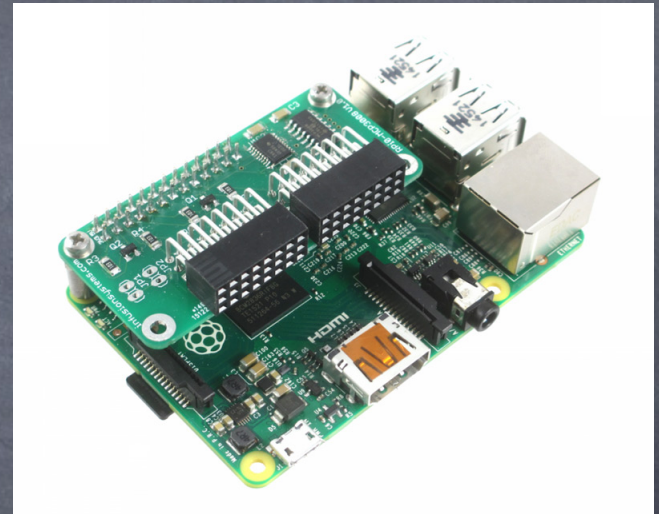
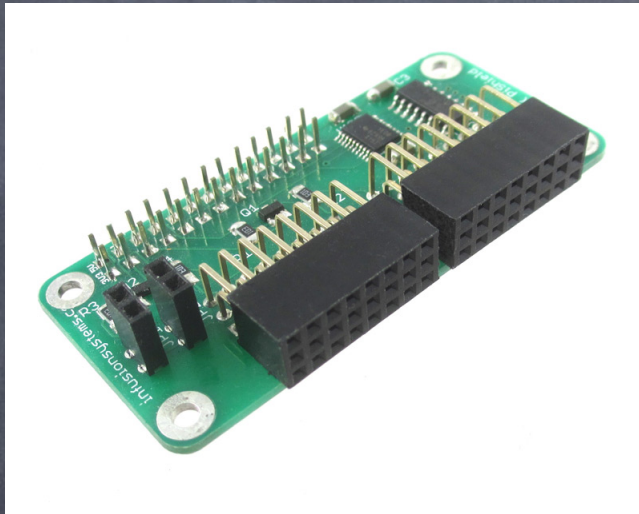


8 input/output ports: 10bit ADC, I²C, TTL, 6250 Hz sample rate (max)

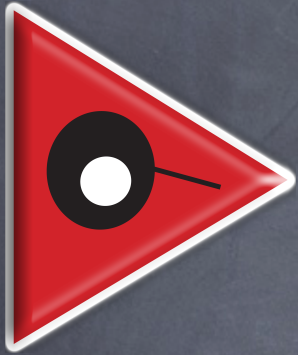
USB serial (MIDI), MIDI (via USB-microMIDICable)

PiShield

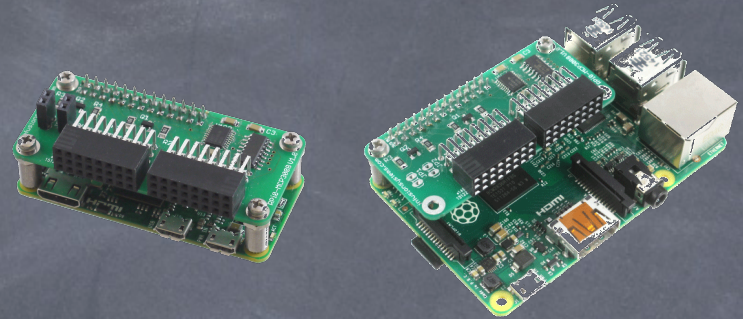
Adapter board for Raspberry-Pi



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
- Biometric
- Environment

Orient4D

Orientation sensor



Use Wearability straps
to mount on body.

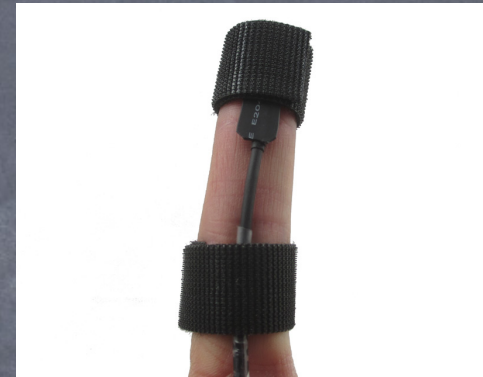
Orientation in quaternions or Euler
angles; acceleration, angular velocity,
magnetic field strength, temperature

BioBeat3D

Heartbeat sensor



Heartbeat rate (BPM), pulse,
blood oxygen (SpO2),
temperature



Use straps to
mount on finger.

BioEmo

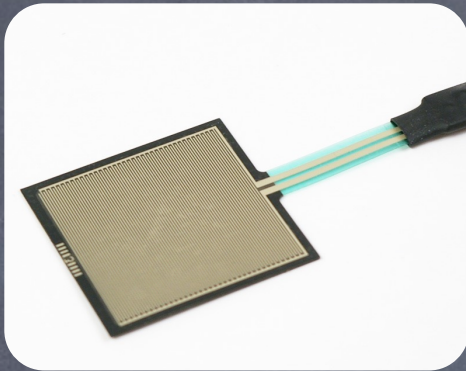
"mood" sensor



Touch

Force sensors

Touch



TouchMini



TouchMicro-10



TouchMicro-05



ReachCloseD, ReachFarD

Distance sensors



2 m range

max 50 Hz update rate



4 m range

max 50 Hz update rate

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

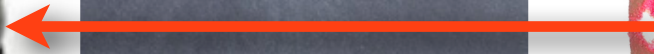
Flash, SeeLaser

Trigger beam

Flash



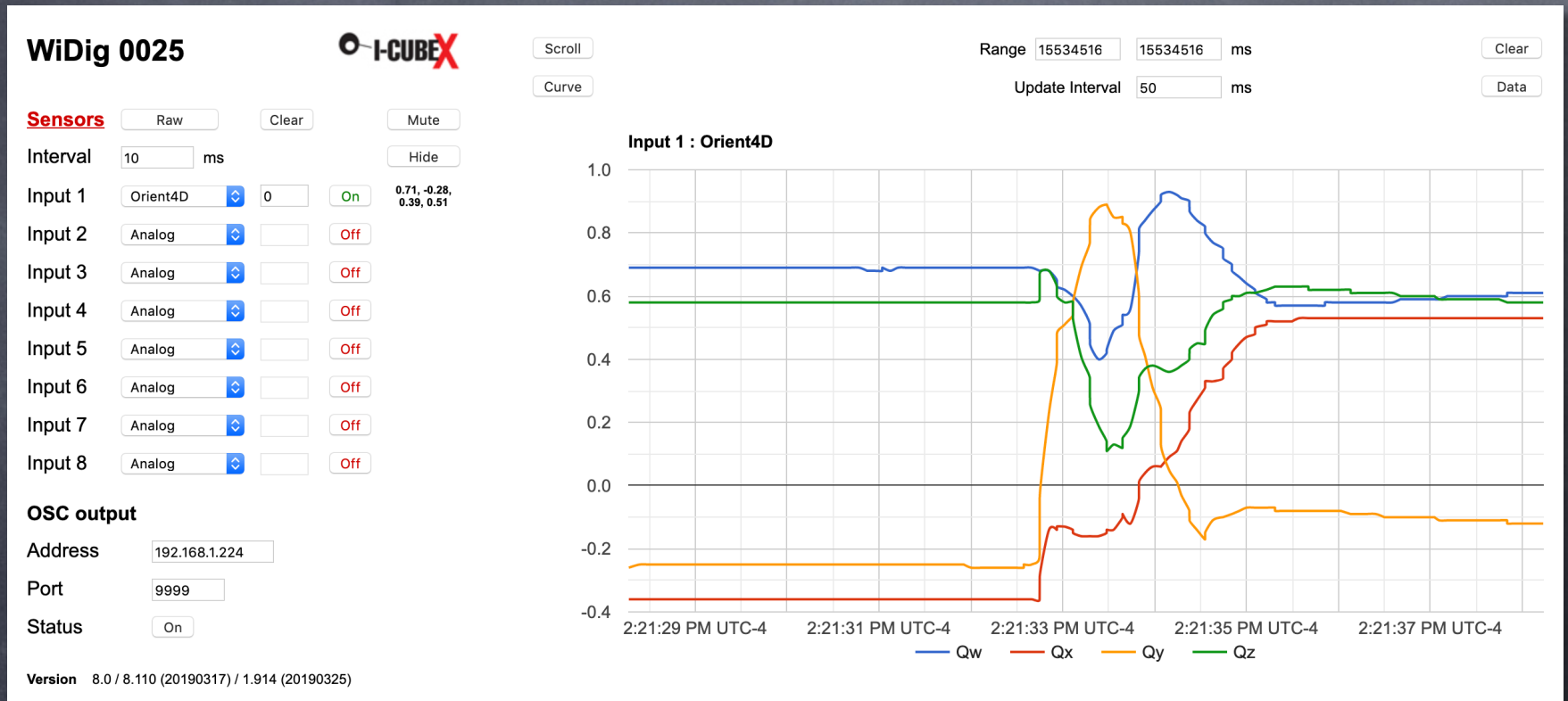
SeeLaser-Red



Software Apps

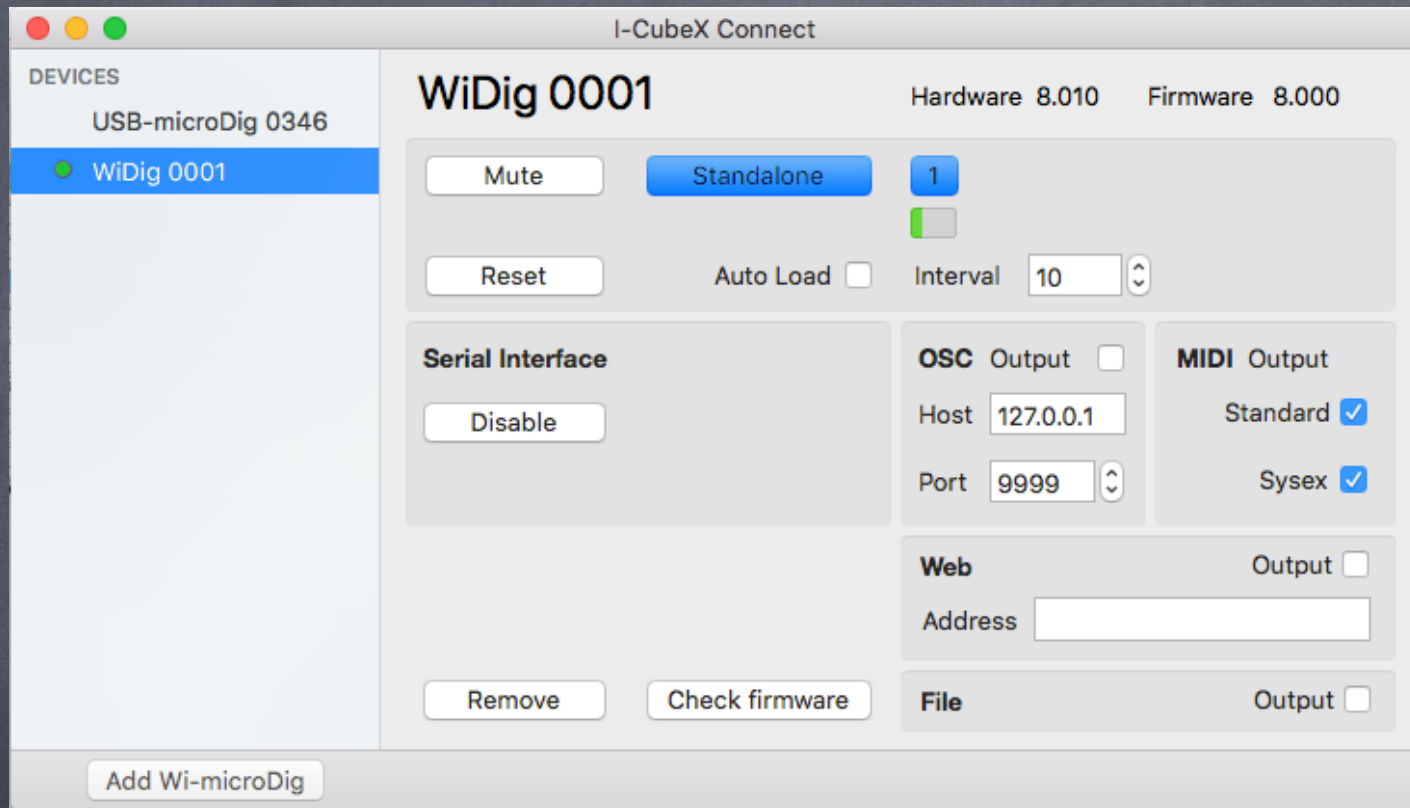
- WiConnect
- Connect
- EditorX
- Link
- SensePlay
- SensorX, BioBeat3D, BioEmo, MuscleTrainer, GForce3D-6, Orient4D, Air2D, Light2D, PitchColor, TouchGloves, HotSpot2D, ..

WiConnect



Web app for configuring a WiDig and viewing / saving data

Connect



Serial to virtual MIDI / OSC / Webhook / file converter

EditorX

Standalone mode editor

EditorX

EditorX 8.10

Questions ?


[click for updates](#)

Digitizer Standalone ?

USB Refresh

Port WiDig 0025

Label 81-80-10-0025

Settings ?

Digitizer Clear M

EditorX Update Store R

File Save Load

Data ?

MIDI Out Port

OSC Off Edit

Recording Start Open

Sensor Inputs ?

	1	2	3	4	5	6	7	8
	On	Off	Off	Off	Off	Off	Off	Off
C								
	Edit	Edit	Edit	Edit	Edit	Edit	Edit	Edit

Sampling ?

All Inputs Off

Muting Off

Interval 10

Actuator Outputs SX Current ?

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

Pulse Width Modulation

Pulse Servo

Interval 20 ms

Width 1 ms

Link

Host mode editor

The screenshot displays the Link 1.40 Host mode editor interface, which is divided into several sections:

- Main Panel (Link 1.40):**
 - Digitizer:** Port (USB-microDig 0141), Label (73-72-00-0141), and a Refresh button.
 - Options:** Interval (>10), Mode (Host), and Muting (Off).
 - Settings:** File, Save, Load, and M buttons.
 - Sensors:** A grid of 8 sensors (1-8) with status (ON/OFF), analysis (edit), processing (edit), and output (edit) buttons. Sensor 1 is currently ON.
 - Actuators:** A row of 8 actuators (1-8) with OFF status and an edit button.
 - Smoothing:** A vertical slider for smoothing, ranging from min (0.00) to max.
 - Input Range:** A vertical slider for input range, ranging from min (0) to max (1023). A Set Range button is present.
 - Absolute Value:** A vertical slider for absolute value, ranging from min (512) to max.
 - Threshold:** A vertical slider for threshold, ranging from low thresh (0) to high thresh (700). An Options... button is present.
 - Output Range:** A vertical slider for output range, ranging from min (0) to max (1023). An Invert checkbox is present.
- Analysis - Sensor 1:** A window showing data for Sensor 1. It includes a Data section with raw, smooth, and peak values. The raw value is 301. The smooth value is 301. The peak value is 3136. It also includes a Calibration section with a file path (_no_calibration.txt) and a refresh button. A Valid range is set from 0. to 1023. A View plot button is present.
- Record:** A window showing recording time (0:0:0) and buttons for Start, View, Clear, and Save.
- Output - Sensor 1:** A window showing the output for Sensor 1. It includes a Message Type dropdown (MIDI control change), a Controller Value (37), a Controller (1), a Channel (1), an Output (On Change), and a MIDI out port (AU DLS Synth 1).

SensePlay

Interactive Media player

SensePlay 1.00

HelpQuestions ?


[click for updates](#)

Digitizer

Refresh

PortWiDig 0025

Label81-80-19-0025

Interval10ms

Options

Stop All

Restart

☒ Audio1

☒ Play one media file at a time only

☒ Restart after10s inactivity

Settings

Clear

FileSaveLoad

SensePlay4.json0

Source 1

Input Number1

Raw Value57

Smoothing0

Trigger

Threshold50



Trigger☒ above☐ below

AudioFireCrackle.mp3

Start

Resume

source1

Stop

Autoloop

source1

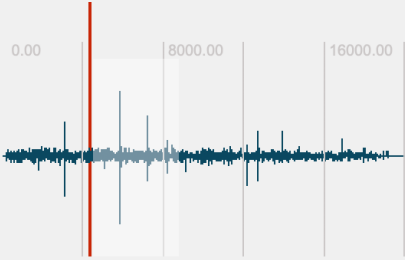
0.1

Choose Source

Trigger Enable

Choose Source

0.008000.0016000.00



Start Time4492.0410End Time8679.569

Ignore Triggers0

Load FileClear

+

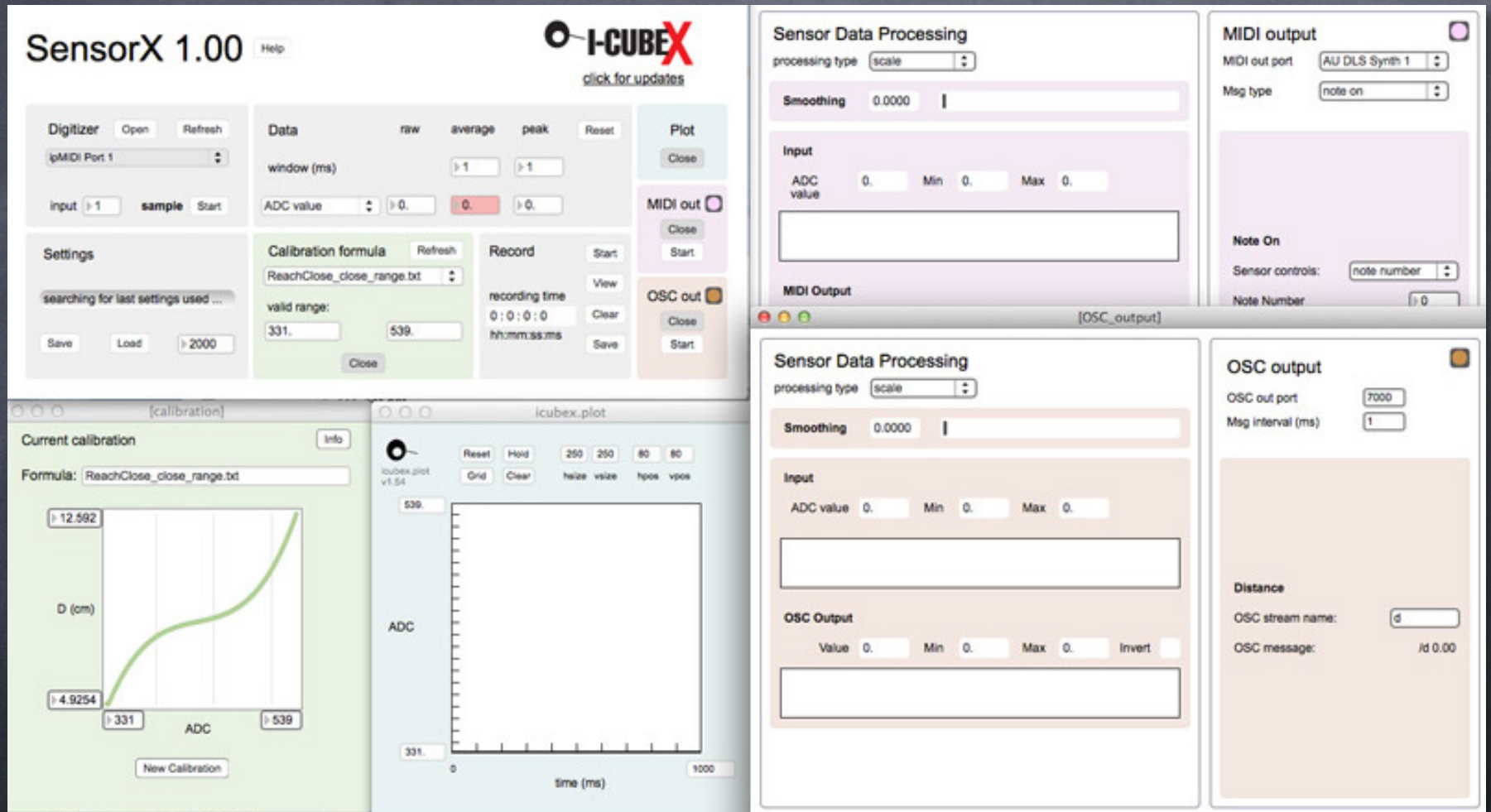
Add new source

+

Add new output

SensorX

Analog sensor data
processor / viewer



Software plugins

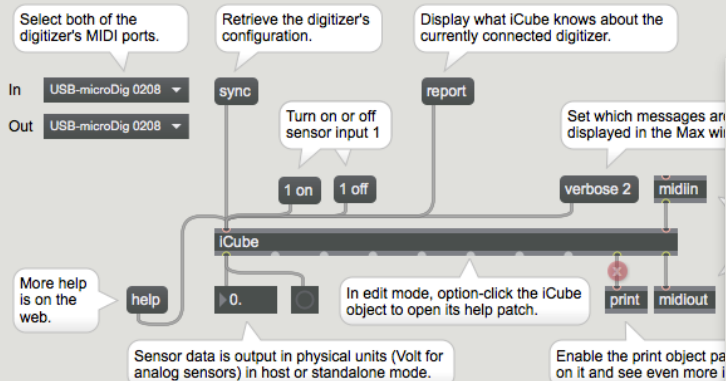
- Max plugins: iCube, oCube (MacOS/Windows/Linux), digitizer (MacOS, Windows)
- openFrameworks ofxICubeX addon (MacOS/Windows/Linux)
- C/C++ API (MacOS/Windows/Linux)
- Processing interface (MacOS/Windows/Linux)
- Ableton Live plugin: Dig4Live (MacOS/Windows)
- EyesWeb plugin (Windows)

iCube/oCube

I-CubeX plugins for Max

Get started with iCube !

v4.0 © 2018 Infusion Systems Ltd.

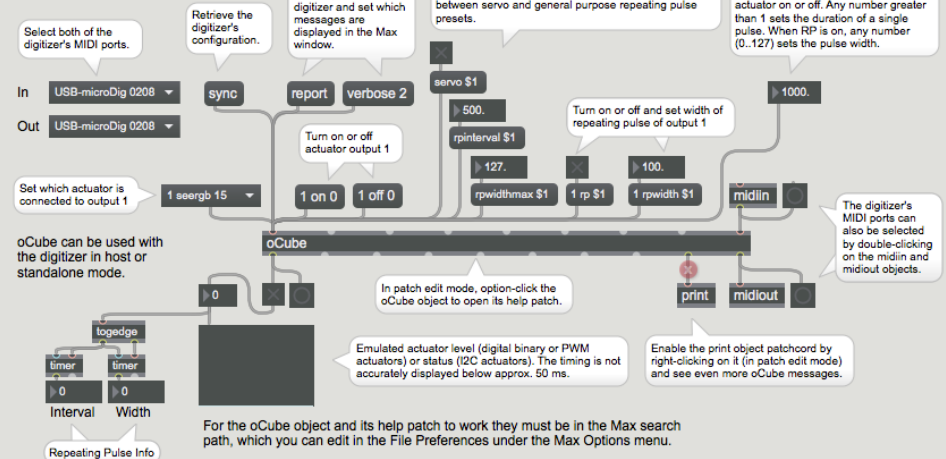


For the iCube object and its help patch to work they must be in the Max search path, which you can edit in the File Preferences under the Max Options menu.

iCube

Max object for I-CubeX digitizer configuration and sensor data processing

Get started with oCube !



For the oCube object and its help patch to work they must be in the Max search path, which you can edit in the File Preferences under the Max Options menu.

oCube

Max object for I-CubeX digitizer configuration and actuator output control

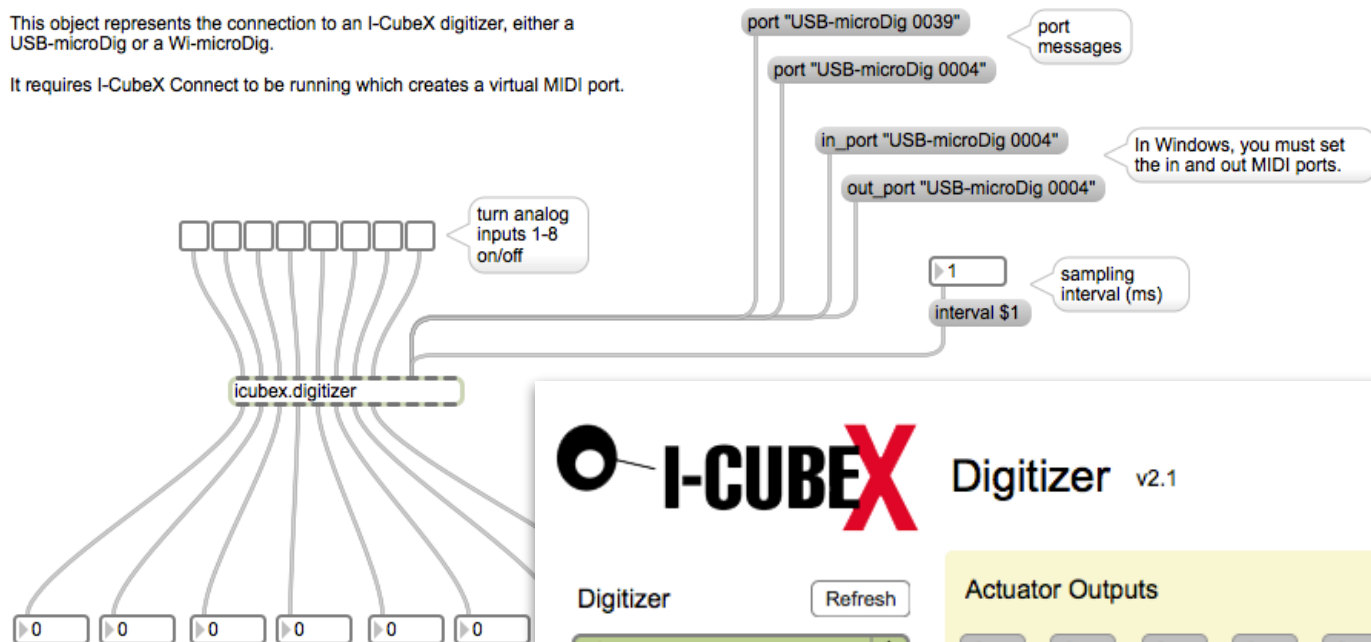
icubex.digitizer

I-CubeX plugin
with UI for Max

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

Reset

All Inputs On

OFF OFF OFF OFF OFF OFF OFF OFF

Sampling Interval 100 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)

ofxICubeX

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

Application software

Software used in conjunction with I-CubeX:

- Max, Pd

- Unity

- TouchDesigner

- Resolume

- QLab

- Ableton Live

- Matlab

- Garageband