Sensors & Touchdesigner

by Axel Mulder

- Intro: capturing human motion
- Overview of I-CubeX
- Connecting ioCube for TD
- Processing sensor signals
- Going wireless
- Controlling motors and more

http://icubex.com/tds.pdf

http://icubex.com/tds.pdf

Schedule

- 10:00 Intro + Overview
- 10:20 Gear Check-in
- 10:30 ioCube
- 11:00 Break
- 11:15 Sensor Examples
- 12:15 Break
- 12:30 Actuator Demos
- 12:45 BLE/WIFI Demos
- 13:00 Gear Check-out
- 13:30 The End

I-CubeX_TDS19.zip

Detect, measure

- Presence or motion of a human
- Proximity of a human or hand
- 2D or 3D position of a finger, hand or human
- Hand or body posture
- Force applied by finger, hand or foot
- Facial features or expression
- Eye or gaze direction
- Heartbeat and body temperature

http://icubex.com/tds.pdf

Motion capture tech

- Optical: Vicon, Optitrack, Motion Analysis, Qualisys, BTS, Kinect, iPiSoft, Blacktrax, Vyv, ...
- Inertial: Xsens, Polhemus, Ascension, Noitom, Nansense, Shadow, Notch, Chordata, ...
- Hand: Cyberglove, Avatar, Hi5, Senso, Leapmotion, 5DT, ...
- Eye: Tobii, ...

see also Axel G.E. Mulder (1994). Human Movement Tracking Technology.

Input devices

- Computer: keyboard, mouse, joystick, track ball, touchscreen, microphone, camera, ...
- Game: Pad, Kinect, Leapmotion, Wii, ...
- Music: keyboards, wind controllers (EWI), control panels (Roli, Push, Launchpad), foot pedals, ...

See also https://www.billbuxton.com/InputSources.html

Sensor technologies

- Piezo-resistance (FSR, strain gauge)
- Piezo-electricity (force, vibration)
- Pyro-electricity (PIR)
- Ultrasound and RF TOF (radar)
- Capacitive coupling (touch)
- Hall effect (magnetic field strength)
- Electro-optical (camera, LED)
- Bio-potentials (EMG, EEG, EOG)

http://icubex.com/tds.pdf

An I/O toolkit for developing interactive media applications

http://ICubeX.com

Sensors, Interfaces & Software since 1995

I-CubeX use cases

- Trigger sound/visual in sync with physical action on stage (TouchMini, http://icubex.com/theatre)
- Sync rotation of CG model with physical object in interactive retail experience (Orient4D)
- Create a basic control panel for QLab (TouchMiniOn)
- 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)

http://icubex.com/tds.pdf

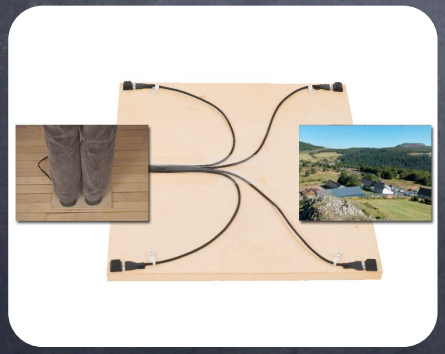
I-CubeX applications

Music

Dance

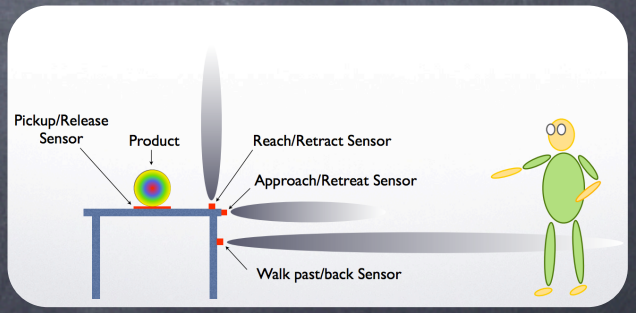
Installation Art

Exhibit Design



Game Dev

Biomechanics

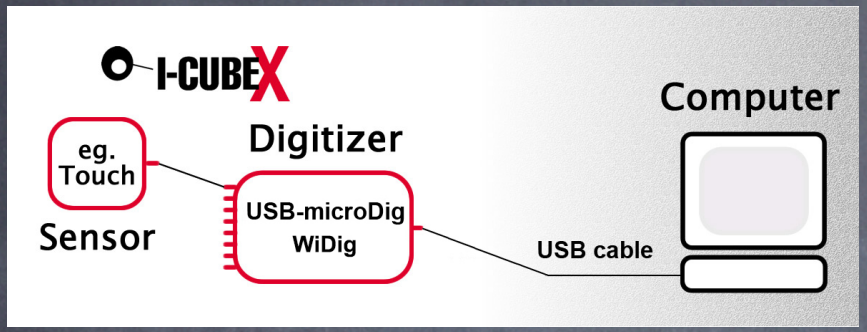


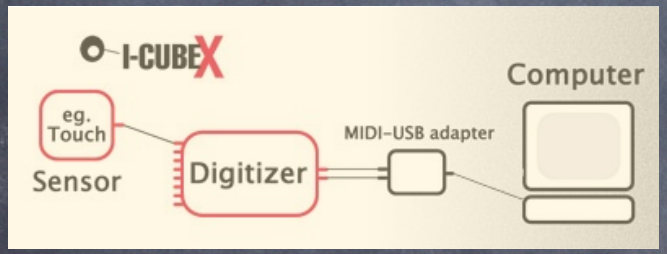
Behaviour Research

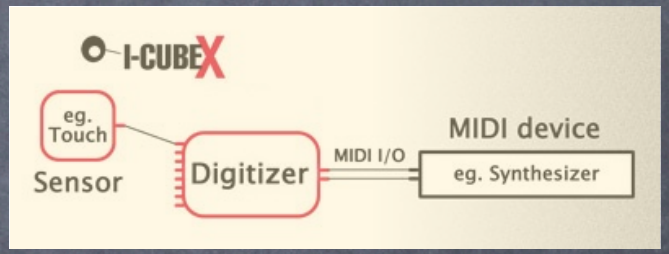
http://icubex.com/applications

http://icubex.com/tds.pdf

I-CubeX basics







Mode of operation

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

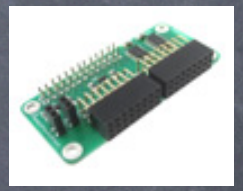
http://icubex.com/about

Interfaces

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

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

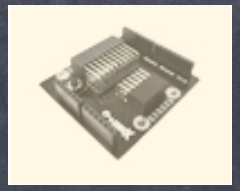
- PiShield: for Raspberry-Pi, 8 + 4 ports



- Wi-microDig: Bluetooth, 8 inputs

- Digitizer: MIDI, 32 12bit inputs

- ArduinoShield: for Arduino

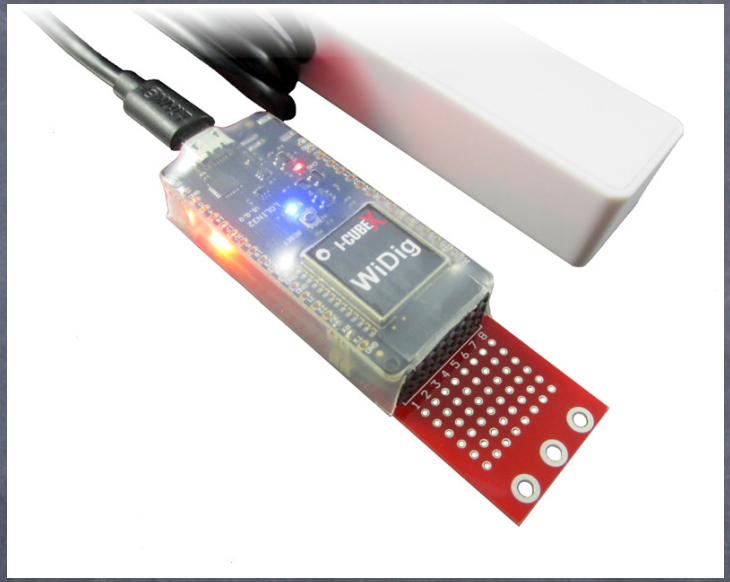


http://icubex.com/interfaces

http://icubex.com/tds.pdf

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, ReachCloseD, 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

Application software

Software used in conjunction with I-CubeX:

- Max, Pd
- TouchDesigner
- QLab
- Matlab
- Unity
- Resolume
- Ableton Live
- Garageband

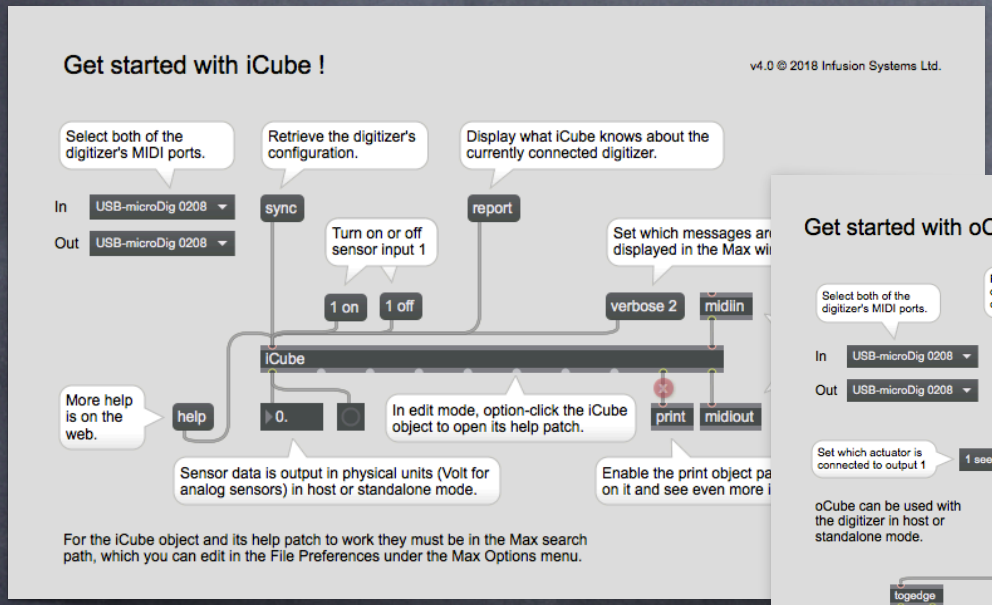
Software plugins

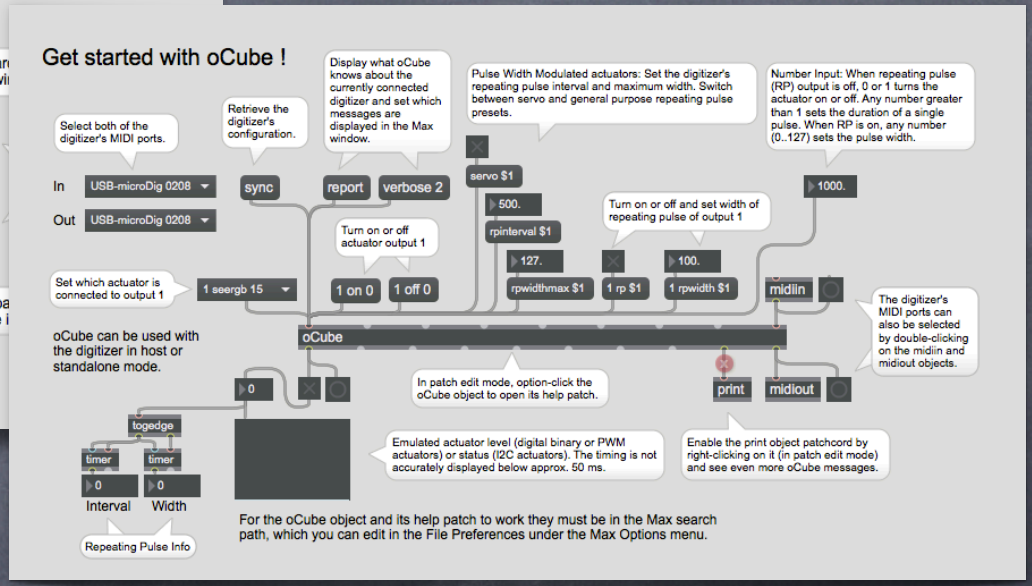
- Touchdesigner node: ioCube (MacOS/Windows)
- Max external: iCube, oCube (MacOS/Windows/Linux), digitizer (MacOS, Windows)
- openFrameworks ofxICubeX addon (MacOS/Windows/Linux)
- C/C++ API (MacOS/Windows/Linux)
- Processing interface (MacOS/Windows/Linux)
- Ableton Live plugin: Dig4Live (MacOS/Windows)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

http://icubex.com/tds.pdf

iCube/oCube

I-CubeX plugins for Max





iCube

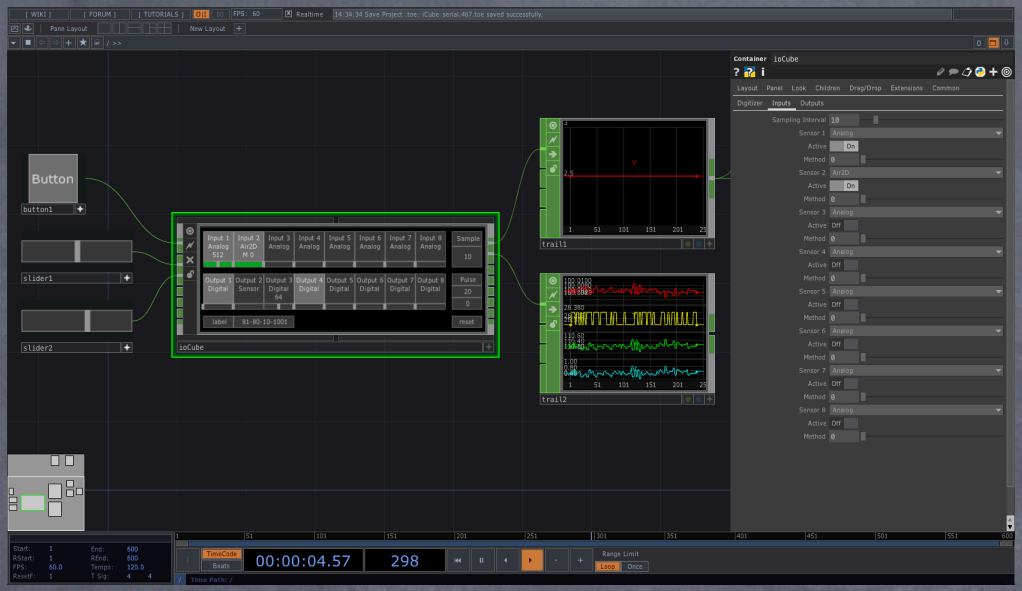
Max object for I-CubeX digitizer configuration and sensor data processing

oCube

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

http://icubex.com/tds.pdf

ioCube I-CubeX plugin for Touchdesigner



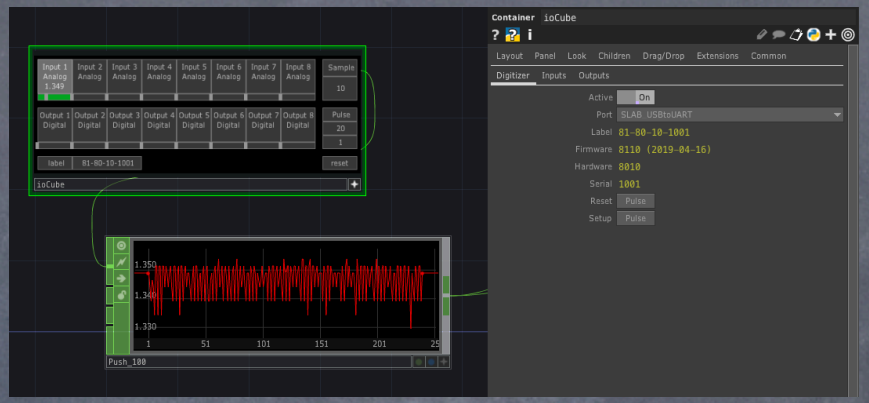
ioCube Touchdesigner node for I-CubeX digitizer configuration, sensor input and actuator output control

install the virtual serial port driver from icubex.com/silabs

see also the ioCube wiki page.

http://icubex.com/tds.pdf

USB-microDig & ioCube



- Connect via USB serial port
- View status and data in the node
- Configure inputs for analog or digital I2C sensors
- Configure outputs for binary or digital I2C actuators

ioCube.toe

Sensors

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

http://icubex.com/sensors

http://icubex.com/tds.pdf

MoveOn

Motion sensor

Outputs a short pulse when any movement of humans and warm-blooded animals is detected.

http://icubex.com/moveon

http://icubex.com/tds.pdf

Orient4D

Orientation sensor

Use Wearability straps to mount on body.

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

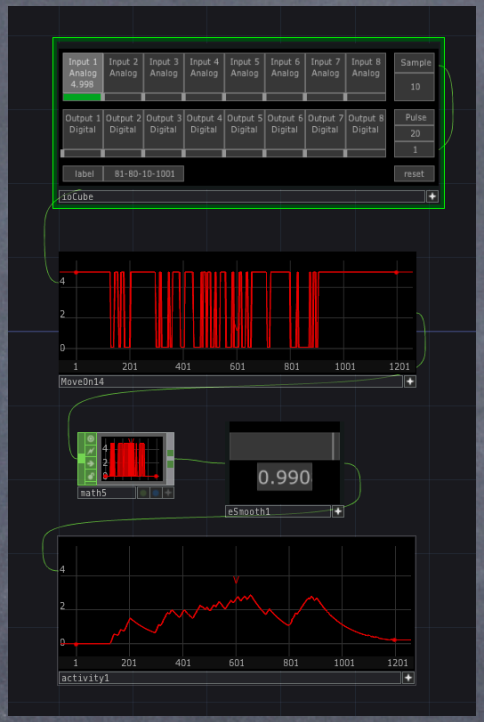
http://icubex.com/orient4d

http://icubex.com/wearability

http://icubex.com/tds.pdf

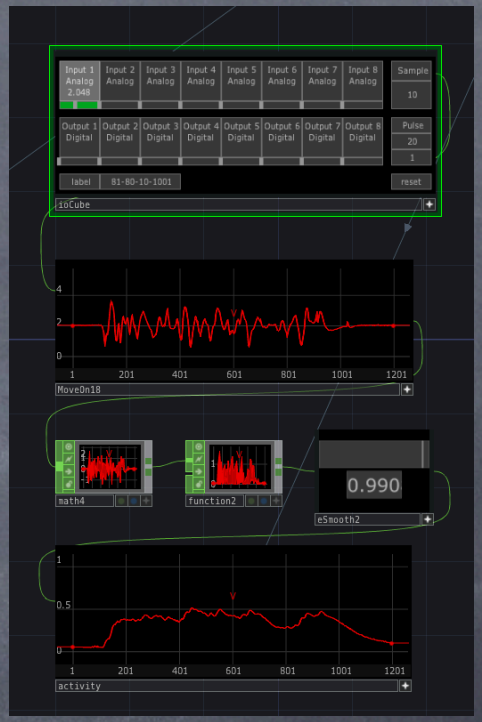
MoveOn signal processing

Process the MoveOn output to get a measure of human activity in a room.



MoveOn v1.4
Invert and Smooth

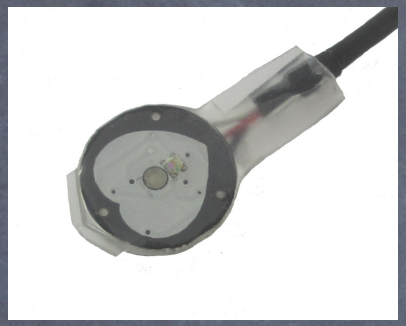
ioCube_example1_MoveOn-14.toe



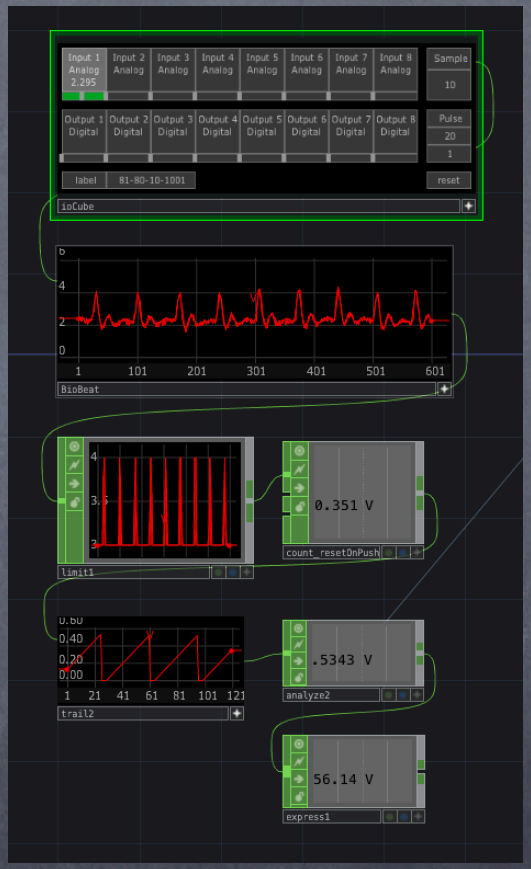
MoveOn v1.8
Offset, Rectify and Smooth

ioCube_example2_MoveOn-18.toe

BioBeat signal processing



Use limit, count and peak detection for the BioBeat output to calculate the heartbeat rate



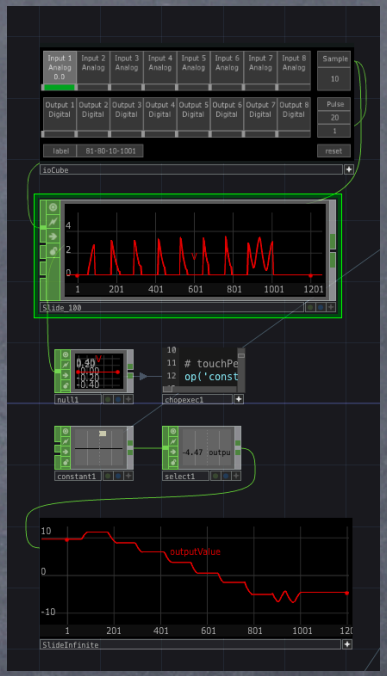
http://icubex.com/biobeat

ioCube_example3_BioBeat-21.toe

http://icubex.com/tds.pdf

Slide signal processing

Apply peak detection to the Slide output to hold the last touched value



Use a CHOP execute DAT to create an infinite slider

http://icubex.com/slide050

ioCube_example4_Slide050-10.toe

ioCube_example5_Slide050-10.toe

http://icubex.com/tds.pdf

Actuator Control

Control motors, servos, LEDs, haptics and more.

ioCube_example6_SwitchPower-10.toe

ioCube_example7_SeeRGB-10.toe

ioCube_example8_SeeGreen-21.toe

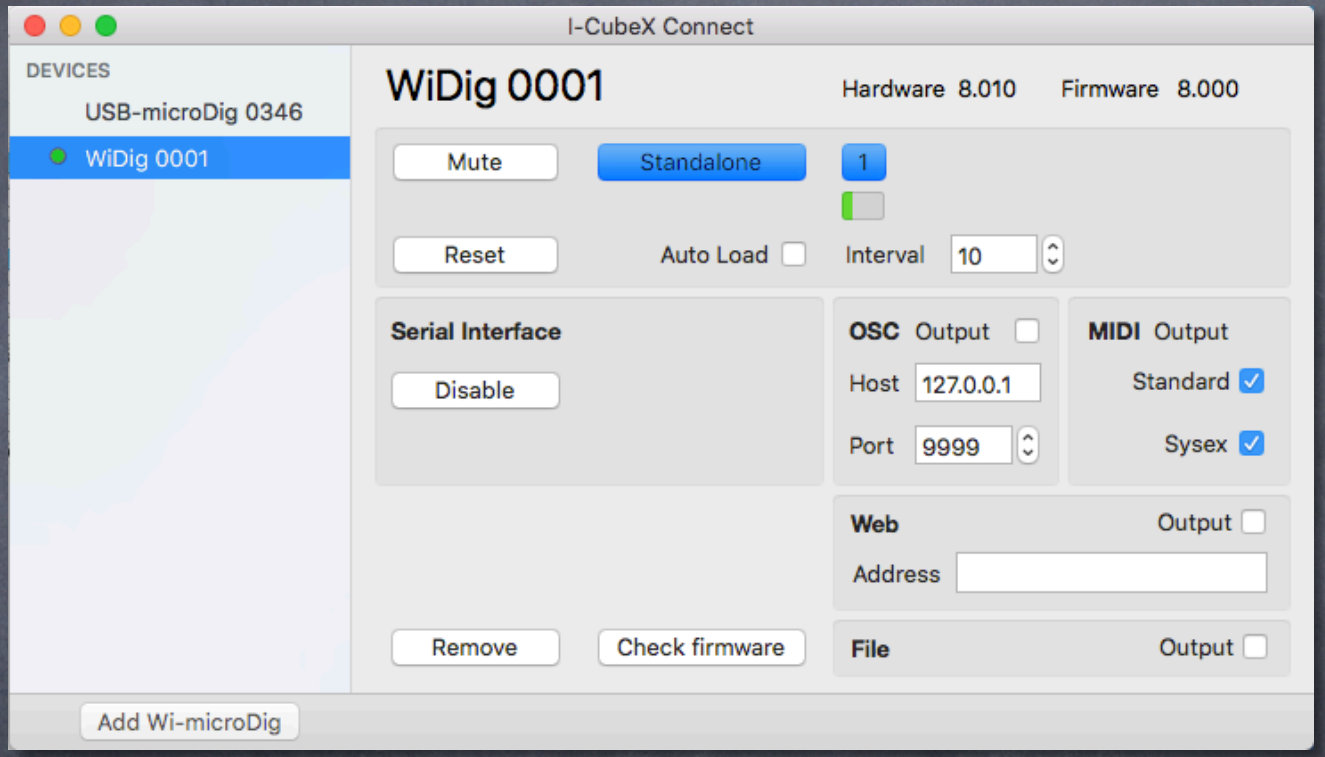
ioCube_example9_Servo.toe

Software Apps

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

see also http://icubex.com/download

Connect



Serial to virtual MIDI / OSC / Webhook / file converter

http://icubex.com/connect

http://icubex.com/tds.pdf

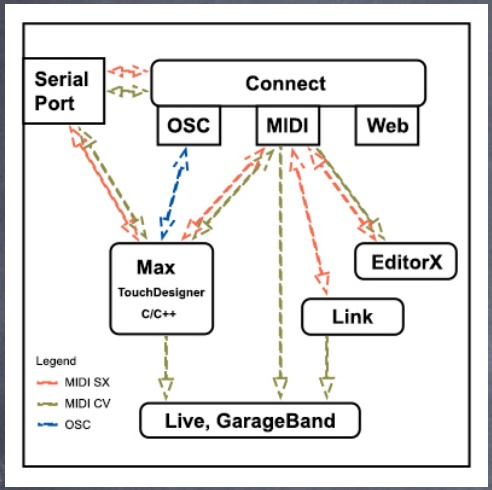
EditorX

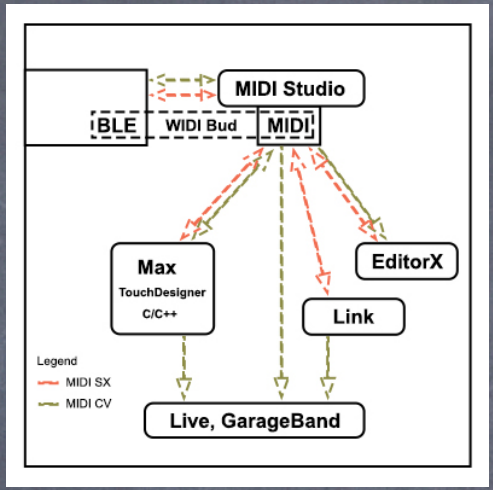
Standalone mode editor

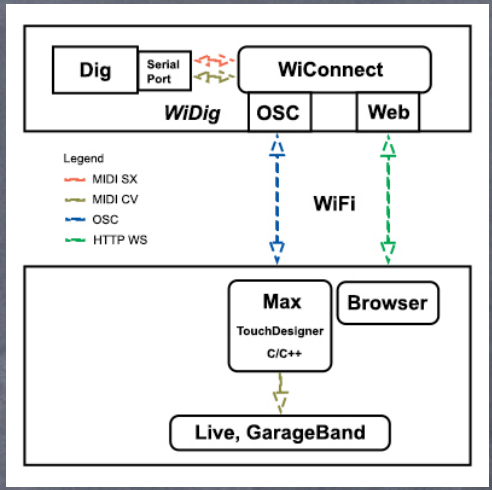
http://icubex.com/editorx

http://icubex.com/tds.pdf

USB, (BLE) MIDI, (WiFi) OSC







Connect: MIDI via USB serial and as OSC

WiDig: MIDI via BLE

WiDig: OSC via WiFi

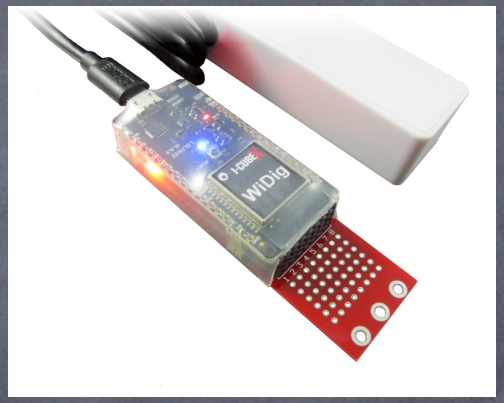
http://icubex.com/about

http://www.nime.org/proceedings/2019/nime2019_006.pdf

http://icubex.com/tds.pdf

Wireless orientation sensing

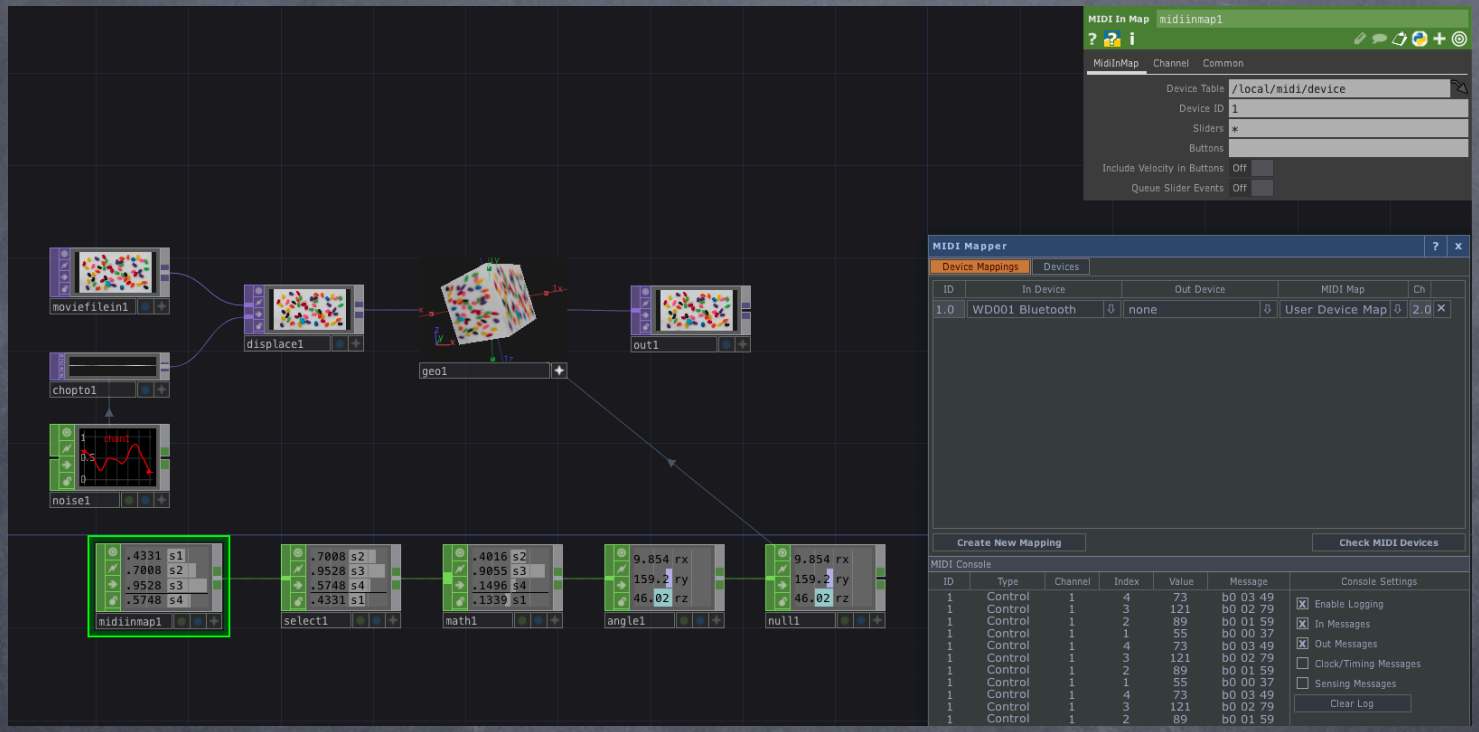
Orient4D



WiDig

http://icubex.com/tds.pdf

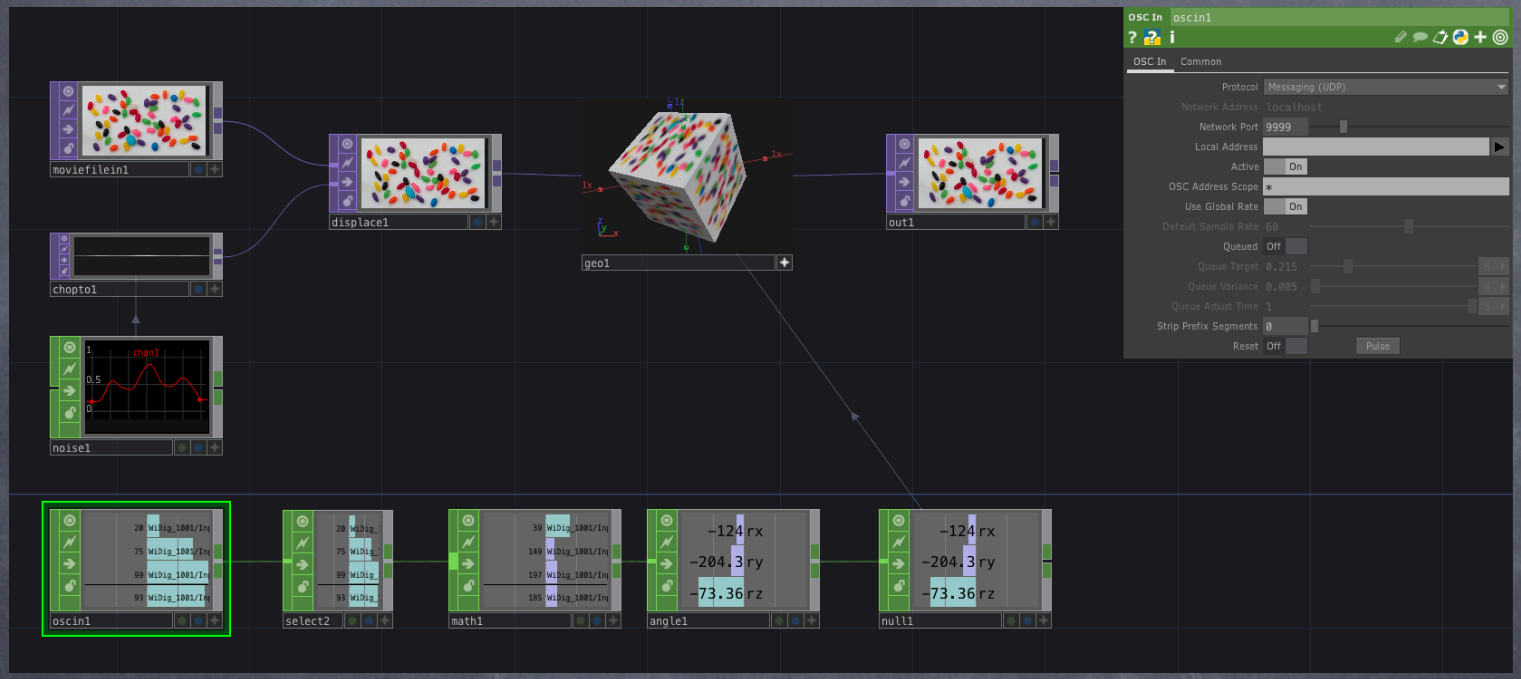
Via BLE-MIDI



WiDig_and_TouchDesigner_via_BLE-MIDI.toe

https://youtu.be/wGgp3Lzivgk

Via OSC



see also WiDig_and_TouchDesigner_via_OSC.toe

see also https://youtu.be/Z8JV8hqJNcA

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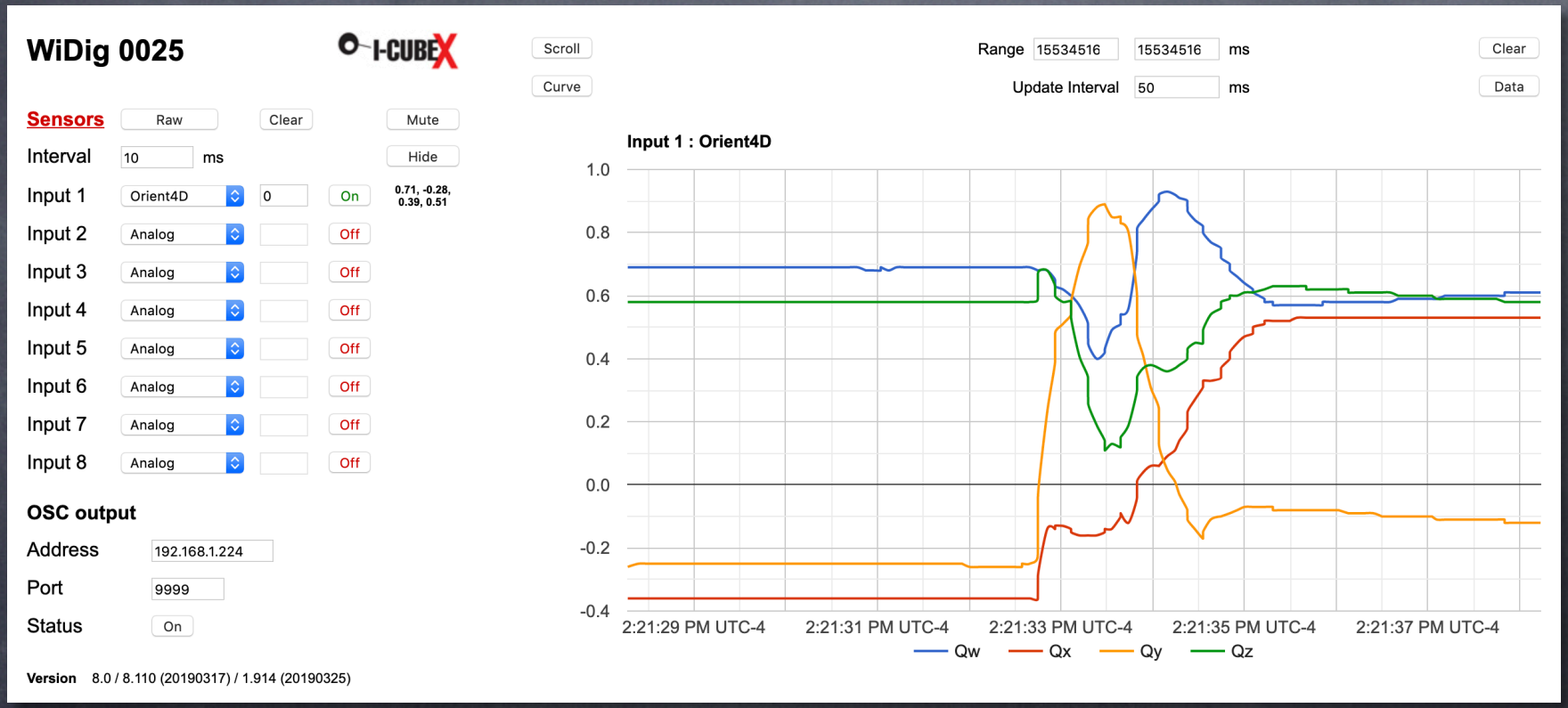
WiConnect



Web app for configuring a WiDig and viewing / saving data