Editor v2.5x
I-CubeX Reference

I-CubeX: The ultimate MIDI controller!

6 October 2005

Customize your own perfect interface
Performer-activated lighting and sound cues
Interactive trade show displays
music synchronization for dance
greater accessibility via alternate controllers

The I-CubeX environment

The I-CubeX is a powerful tool to translate analog voltages such as generated by sensors to MIDI messages. It consists of sensors, one or more wireless and/or wired digitizing devices, and an editor to configure your setup. The I-CubeX is the missing link between you and your MIDI equipment and is at home in both studio and live performance settings. It will allow you to control (and be controlled by) your MIDI gear in ways you never thought possible (or sensible, for that matter).

This help file contains a wealth of information, hints, tips and tricks to tune your sensor setup to your needs, be it in the sound studio, on stage, in the gallery, the exhibit hall, simply in your living, or even outside. The I-CubeX can be taken anywhere. Rest assured that we'll make an official announcement of the first arrival of the I-CubeX on the moon.

Back down on earth, we really hope you will find the I-CubeX a useful tool, something that enables and inspires you to make great art, deep scientific inquiries or insanely funny installations for your friends (or just your cat). Check out the Cube Culture section on our web site to see what others have done with the I-CubeX sofar - we want to make the I-CubeX the best tool for these explorations.

Any technical questions, please contact us at Tech@I-CubeX.com, Skype us at "icubextech", or post a message on the Cube Culture forum (http://I-CubeX.com/forum) to ponder collectively with your fellow I-Cubists. To place an order, please contact Sales@I-CubeX.com. For any other questions contact CustomerService@I-CubeX.com or call toll-free 1 877 4 ICUBEX or from outside North America call +1 514 484 5850. You can also Skype us at "icubex". Find us on the web at http://I-CubeX.com.

I-Cubically,

Infusion Systems Ltd.

Important safety instructions

When using electric products, basic cautions should always be followed, including the following:

1. Read all safety and operating instructions before using this product.
2. All safety and operating instructions should be retained for future reference.
3. This product should not be used near water, ie. a bathtub, sink, swimming pool, wet basement, etc..
4. This product should not be placed near a source of heat such as a stove, radiator, a heat producing amplifier, etc..
5. Connect only to a power supply of the type marked on the top facing label of the digitizing device.
6. The cord to the power supply should always be handled carefully. Never walk or place equipment on the power supply cords. Periodically check the cords for cuts or signs of stress, especially near the plug and the at the point where the cable exits the unit.
7. The power supply should be unplugged whenever the digitizing device remains unused for any period longer than two hours.
8. Water can enter the digitizing device very easily, and not only potentially harm it, but also cause a safety hazard. Do not clean the digitizing device with a damp cloth.
9. Care should be taken so that objects do not fall and liquids are not spilled onto the unit.
10. Infusion Systems Ltd. should be contacted immediately if any problems occur with the regular functioning of any part of the system.
11. The user should not attempt to service this equipment. All service work should be performed by Infusion Systems Ltd..
12. Do not maintain contact between the sensors and the skin of any person. Wearing sensors on the bodty without the proper insulation could be hazardous.

The digitizing device and the sensors provided by Infusion Systems Ltd. are delicate electrical instruments, and are easily damaged. To ensure that you do not unnecessarily harm them in any way we recommend the following:

1. Do not drop the digitizing device or sensors.
2. Be careful not to step on the digitizing device or sensors.
3. Do not connect any devices to an input or output of the Digitizer that draws more than 30 mA per input or output.
4. Do not short the power and ground pins of any of the input plugs on the digitizing device.
5. Do not wet the digitizing device or sensors.
6. Do not use the power supply with voltages other than specified on the power supply unit.

Disclaimer: *Waiver of Liability*

Infusion Systems Ltd. offers no warranty, limited or otherwise, on any of its products. Infusion Systems Ltd. advises any user to immediately notify us on the discovery of any major failure in the functionality of any piece of equipment or software purchased from us.
UNDER NO CIRUMSTANCES WLL INFUSION SYSTEMS LTD. BE LIABLE FOR ANY LOST PROFITS, LOST SAVINGS, ANY INCIDENTAL DAMAGES, OR ANY CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT, EVEN IF INFUSION SYSTEMS LTD. HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

The I-CubeX concept

The I-CubeX line of products aim to facilitate the design and implementation of environments and objects that respond to human actions such as walking, reaching, touching etc. as well as some environmental parameters such as illumination, temperature, humidity etc. The response can be in the form of sound, music, video, graphics, animation, robotic movement, etc. Such responses are generated by 3rd party equipment. The I-CubeX line of products only includes tools to capture the human actions and/or environmental variables and the tools to make these signals available to other equipment such as a computer or a musical instrument.To communicate with such equipment the MIDI data format is used. MIDI is a widely implemented protocol for communications between musical equipment which has also found its way into video, graphics and animation software as well as various equipments, such as lights, used in theme parks and live shows.

To accomodate a wide variety of designs of such responsive environments and objects, the I-CubeX environment consists of the following modular components that can be configured in a multitude of ways:

1. one or more sensors
2. one or more digitizing devices
3. a configuration editor

Sensors connect to a digitizing device through a miniature, flexible cable with a 3-pin plug. Sensors can be positioned on the human body or on animals, on walls or floors or on sculptures.

The digitizing device processes and converts the analog voltage signal from the sensor to a digital MIDI message. A digitizing device can convert upto 8 (miniDig, Wi-miniDig) or upto 32 (Digitizer) sensor signals. A digitizing device such as a Digitizer or a miniDig connects through a MIDI cable to a computer equipped with a MIDI interface or directly to a MIDI capable device. A digitizing device such as the Wi-miniDig connects wirelessly through Bluetooth to a computer that is equipped with Bluetooth. All these digitizing devices use the MIDI data format to encode the sensor signals.

The configuration editor runs on a computer and communicates with the digitizing device using the MIDI cable connection or the wireless Bluetooth connection. The editor sets a variety of parameters in the digitizing device such as the type of processing of the sensor signal and which MIDI message to map to, and provides a simple way to verify if the sensor captures what is required to generate an appropriate response. Once the user has configured the sensors and digitizing device with the editor to his or her satisfaction, the MIDI messages can be sent directly to a MIDI device to generate a response.This method of operation of the sensors and digitizing device without any computer program to process or analyse the sensor data is called stand alone mode. The alternative is host mode, which consists of operating the sensors and digitizing device with a computer program to process and analyse the raw sensor data to obtain more complex response patterns.

In summary, to create a responsive environment or object you will need:

1. I-CubeX environment (sensors, digitizing device(s), editor)
2. MIDI interface (for Digitizer or miniDig) and/or Bluetooth interface (Wi-miniDig)
3. Computer(s) (Windows or MacOS)
4. MIDI device(s) or software(s) to generate required response(s) (3rd party)

In the help section on our website, on the "links" page, a number of 3rd party manufacturers are listed to help you find MIDI gear to generate a suitable response.

Connecting the cables (Digitizer or miniDig only)

Having installed the I-CubeX editing software, you are now ready to setup the I-CubeX hardware – the Digitizer or miniDig.

![warning triangle icon]

Make sure you are using a Digitizer with firmware version 4.1 or a miniDig with firmware version 4.4. Any other firmware may not be compatible with editor v2.5 and you will receive an error message at startup.

This section will help you to make the correct connections as well as diagnose any setup problems you may encounter. Use the section about the hardware of the Digitizer or miniDig in the tech info section for reference. For more info about stand alone mode (process sensor data before outputting it as channel voice MIDI messages) and/or host mode (send out raw sensor data as sysex MIDI messages) see this section.

Making connections

![warning triangle icon]

Before connecting and plugging MIDI cables into your Digitizer or connecting the miniDig MIDI cables into your MIDI interface, disconnect the Digitizer's or miniDig's power. It will lessen the chance of any problems using the editor or other MIDI software.

In order to program the Digitizer or miniDig using the I-CubeX editor, you will need to connect the Digitizer's or miniDig's MIDI output to your MIDI interface's MIDI input, and the Digitizer's or miniDig's MIDI input to your MIDI interface's MIDI output.


Stand alone mode basic MIDI signal path between the Digitizer or miniDig and computer.
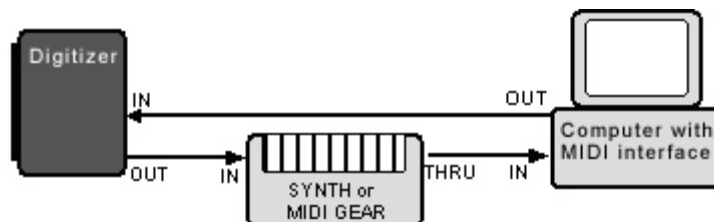
Alternate stand alone mode MIDI signal path including a synthesizer or other MIDI gear.

You may chain other MIDI devices (thru) between the computer and the Digitizer or miniDig (although some older devices may not be able to keep up with the sheer amount of MIDI messages).

For host mode only, we suggest that you plug your MIDI devices between the PC's MIDI output and the Digitizer's or miniDig's MIDI input.
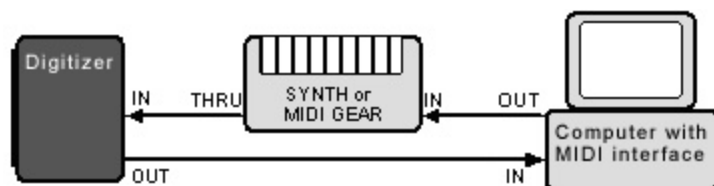
Host mode MIDI signal path including a synthesizer or other MIDI gear.

Next, make sure that your MIDI interface's MIDI thru has been disabled (this passes MIDI messages from the MIDI input port directly out to the MIDI output port). This parameter can be adjusted using the driver or setup programs that came with your MIDI interface. On multi-port interfaces use the supplied MIDI patch bay software to unplug any links between each port's MIDI In and it's MIDI output. This prevents MIDI feedback loops.

Connect the supplied power adapter to the Digitizer's or miniDig's power supply socket. Insert the adapter plug in a suitable wall socket or power bar. Turn the miniDig on using the power switch. The Digitizer has no power switch, so it will turn on immediately. To turn the Digitizer off, simply unplug the power adapter from the Digitizer's power supply socket.

Having connected the hardware, you are now ready to configure the I-CubeX software to work with your Digitizer or miniDig.

Setting up MIDI communications

Plugging and unplugging MIDI interfaces on Windows computers

If you need to unplug a MIDI interface from your Windows computer's USB port, please note the following:

1. Make sure to remember which USB port it was plugged into, because if you plug it back into a different USB port you will have to re-install the drivers.
2. Before unplugging the MIDI interface, exit the I-CubeX editor, or close the MIDI port using the Configure | MIDI connections dialog, then "stop" the MIDI interface using the Windows "Safely remove hardware" icon (look for a tiny green arrow) in the system tray. If you fail to follow this procedure you will have to restart your computer.

If you plug a MIDI interface into your computer you will need to quit the I-CubeX editor before you can see it in your list of MIDI interfaces in the Configure | MIDI connections dialog.

None of the above applies to MacOS computers (fortunately !).

Configuring your MIDI setup

1) Go to Configure | MIDI Connections. Select the MIDI input and output drivers for the MIDI interface connected with the I-CubeX Digitizer or miniDig. This MIDI link is vital - it is the only way for the I-CubeX editor to communicate with the Digitizer or miniDig.

MIDI connections dialog window on Windows.

MIDI connections dialog window on MacOS.

2) Test the MIDI connection by clicking "Check connections". If the test wasn't successful it is possible that the Digitizer or miniDig is too busy sending out MIDI messages (if your Digitizer or miniDig was never used before, ie. you just bought it, this shouldn't be the case) or receiving MIDI messages. If it is too busy sending out MIDI messages (that were not forwarded from the MIDI input using the Digitizer or miniDig MIDI thru option), increasing the sample interval (lowering the sample rate) may resolve this. If the Digitizer or miniDig is too busy receiving MIDI messages check which other MIDI device may be sending these messages.

3) Go to Configure and make sure MIDI Thru is off (unchecked).

4) Go to Configure | Reset. Select sysex ID to make sure the system exclusive ID of the Digitizer or miniDig is set to zero. Normally this step is not necesary because at startup the Digitizer's or miniDig's sysex ID is set to zero.


Using the Configure menu to reset the Sysex ID to 0.

5) Go to Configure | Mode. Select stand alone mode. You should see the Digitizer's or miniDig's yellow MIDI input LED flash briefly. If this doesn't happen, you have not chosen the right MIDI drivers (repeat step 1). Normally this step and the following is not necessary because at first startup the Digitizer or miniDig is set to stand alone mode.
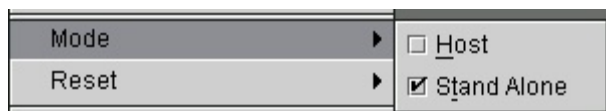
Using the Configure menu for setting the mode of operation.

6) Power off and then power up the Digitizer or miniDig. Note the number of the green MIDI output LED blinks at power up. Ensure that your Digitizer or miniDig is switched to stand alone mode.
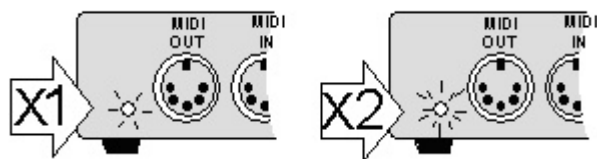
Number of flashes of the Digitizer or miniDig MIDI out LED on power-up indicates the mode. Host mode is indicated by one green flash during power up. Stand alone mode is indicated by two green flashes during power up.

Setting up Bluetooth (Wi-miniDig only)

Having installed the I-CubeX editing software, you are now ready to setup the I-CubeX hardware – the Wi-miniDig. If any part of the procedure below fails, it may help to re-power the Wi-miniDig before re-starting the procedure (normally there should be no need to re-install any drivers).

MacOS

1. Install the Bluetooth drivers and applications provided with your Bluetooth interface. Refer to the installation instructions included with the Bluetooth interface. Before continuing make sure your Bluetooth interface is operational.
2. Apply power to your Wi-miniDig.
3. Run the BlueMIDI application and press the *connect* button. A Bluetooth configuration panel will open.

4. From the device category drop-down list select "Discoverable devices".
5. Click the s*earch* button to search for Bluetooth devices.
6. Click on the "SPP" entry from the device that matches your Wi-miniDig (verify the serial number) and click the select button.
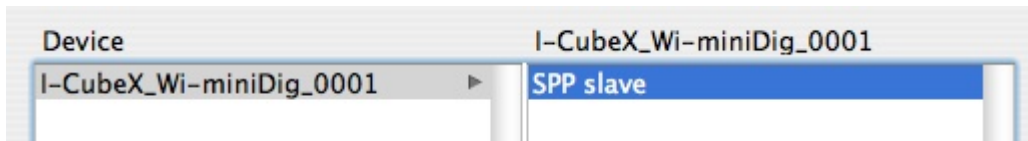
7. If a PIN code is required to pair the Wi-miniDig to your Bluetooth interface, use the value "1".
8. The BlueMIDI *connect* button should now be greyed out, the *disconnect* button will be enabled.
9. Your Wi-miniDig is now available on the BlueMIDI port number listed at the top of your BlueMIDI window.

If you quit the BlueMIDI window by clicking on the red "X" in the top left corner, you will need to restart the BlueMIDI application if you want to specifically use the same BlueMIDI port. Otherwise, any new BlueMIDI ports created after closing the window will be numbered higher than the one you closed

Windows

1. Install the Bluetooth drivers and applications provided with your Bluetooth interface. Refer to the installation instructions included with the Bluetooth interface. Before continuing make sure your Bluetooth interface is operational.

2. Apply power to your Wi-miniDig.
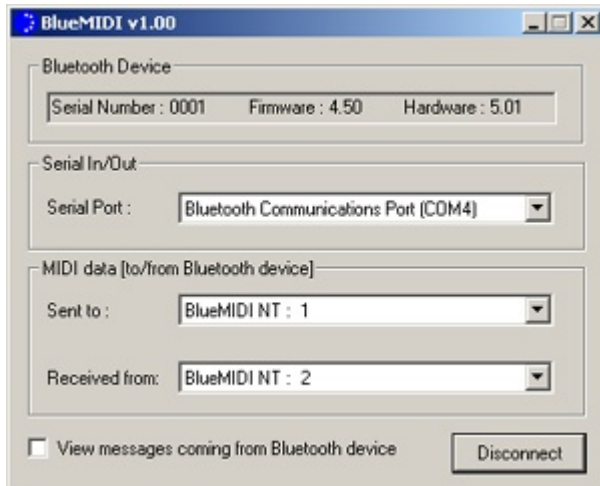3. Open "My Bluetooth Places" on your computer.

4. Click *Bluetooth setup wizard* and select "I want to find a specific Bluetooth device and configure how this computer will use its services". Click *Next.*
5. Select the device that matches your Wi-miniDig (verify the serial number) and click the "SPP slave" entry.
6. If a PIN code is required to pair the Wi-miniDig to your Bluetooth interface, use the value "1". Click *Initiate pairing.*
7. Select and/or note the COM port number. Click *OK.*
8. There should be an item in the "My Bluetooth places" window now, matching the name of the device you selected, that is connected as indicated by two green arrows. If the green arrows don't show, right-click on the item and select *connect* (if necesary repeat this procedure after re-powering the Wi-miniDig).
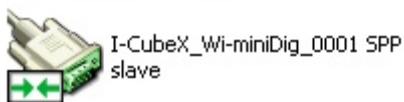
9. Start the BlueMIDI application and select the same COM port.
10. Select the BlueMIDI input and output ports you want to use (do not use the same ports for input and output) and press the *connect* button. The Wi-miniDig device name selected above should appear in the Bluetooth device box.

BlueMIDI v1.00

Bluetooth Device

Serial Number : 0001   Firmware : 4.50   Hardware : 5.01

Serial In/Out

Serial Port :   Bluetooth Communications Port (COM4)

MIDI data [to/from Bluetooth device]

Sent to :   BlueMIDI NT : 1

Received from: BlueMIDI NT : 2

☐ View messages coming from Bluetooth device   Disconnect

11. Your Wi-miniDig is now available on the BlueMIDI ports as per your selection. In the editor, make sure to use the MIDI ports correctly, ie. the input and output as specified in the BlueMIDI window should be regarded as the input and output of the computer, not of the Wi-miniDig.

Setting up MIDI communications

Plugging and unplugging MIDI interfaces on Windows computers

If you need to unplug a MIDI interface from your Windows computer's USB port, please note the following:

1. Make sure to remember which port it was plugged into, because if you plug it back into a different port you will have to re-install the drivers.
2. Before unplugging the MIDI interface, exit the I-CubeX editor, or close the MIDI port using the Configure | MIDI connections dialog, then "stop" the MIDI interface using the Windows "Safely remove hardware" icon (green arrow) in the system tray. If you fail to follow this procedure you will have to restart your computer.

If you plug a MIDI interface into your computer you will need to quit the I-CubeX editor before you can see it in your list of MIDI interfaces in the Configure | MIDI connections dialog.

None of the above applies to MacOS computers (fortunately !).

Configuring your MIDI setup

1) Go to Configure | MIDI Connections. Select the MIDI input and output drivers for the MIDI interface connected with the I-CubeX Wi-miniDig. This MIDI link is vital - it is the only way for the I-CubeX editor to communicate with the Wi-miniDig.

*MIDI connections dialog window on Windows.*
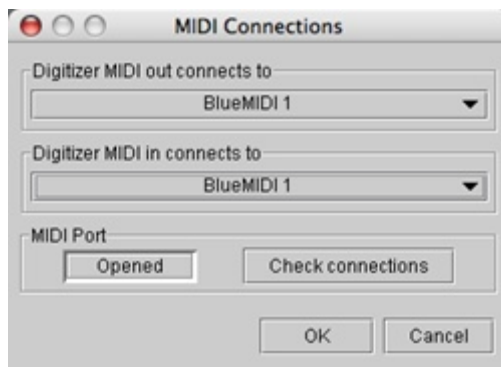
MIDI connections dialog window on MacOS.

2) Test the MIDI connection by clicking "Check connections". If the test wasn't successful it is possible that the Wi-miniDig is too busy sending out MIDI messages (if your Wi-miniDig was never used before, ie. you just bought it, this shouldn't be the case) or receiving MIDI messages. If it is too busy sending out MIDI messages, increasing the sample interval (lowering the sample rate) may resolve this. If the Wi-miniDig is too busy receiving MIDI messages check which other MIDI device may be sending these messages.

3) Go to Configure and make sure MIDI Thru is off (unchecked).

4) Go to Configure | Reset. Select sysex ID to make sure the system exclusive ID of the Wi-miniDig is set to zero. Normally this step is not necesary because at startup the Wi-miniDig's sysex ID is set to zero.
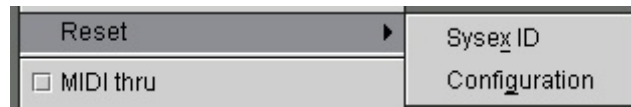
Using the Configure menu to reset the Sysex ID to 0.

5) Go to Configure | Mode. Select stand alone mode. You should see the Wi-miniDig's yellow MIDI input LED flash briefly. If this doesn't happen, you have not chosen the right MIDI drivers (repeat step 1). Normally this step and the following is not necessary because at startup the Wi-miniDig is set to stand alone mode.
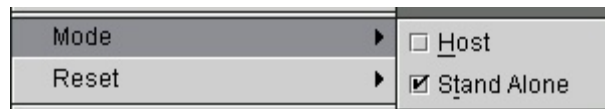
Using the Configure menu for setting the mode of operation.

6) Power off and then power up the Wi-miniDig. Note the number of the green MIDI output LED blinks at power up. Ensure that your Wi-miniDig is switched to stand alone mode.

Testing the I-CubeX environment

Having set up your hardware (the digitizing device) and software (the I-CubeX editor) and it's connections, you are now ready to make some creative connections – those that connect your I-CubeX sensors to your MIDI gear.

This section will demonstrate how to connect sensors to the digitizing device, as well as how to use them with your MIDI equipment.

Getting sensor input

1) Find the Turn sensor included with your I-CubeX package.

2) Connect the Turn sensor to the digitizing device's first sensor input (labeled '1') by inserting the 3-pin sensor plug (see here) vertically (with the red wire pin on top) to sensor input 1.

3) Start the I-CubeX editor.

4) Clear the configuration by selecting File | New.

5) Turn the first sensor on. Use Configure | Add sensor, then click the "On" button.

6) Map the first sensor to a volume controller on MIDI channel 1. Set the MIDI Channel to 1, select "*Control-change*" from the *MIDI map* pull down menu, and type 7 in the Control field.

7) Turn the knob and observe the green monitor bar at the bottom of the sensor window for activity.

8) Congratulations! Your turn sensor is controlling MIDI volume on channel 1. Let's test this with your MIDI gear.

9) Connect the digitizing device's MIDI Out a MIDI keyboard's MIDI In. Set your MIDI keyboard to receive on MIDI channel 1. Also turn your keyboard's local control on. Select a patch on your keyboard (on MIDI channel 1). Play and hold a few notes.

10) Now tweak the Turn sensor. You are now controlling MIDI volume.

11) You may save your configuration by selecting File | Save.

12) Leave the I-CubeX editor on.

13) Let's continue by utilizing your See actuator!

Sending actuator output (Digitizer only)

14) Find the See actuator (LED) included with your I-CubeX package.

15) Connect the See actuator to the Digitizer's first output (labeled 'Outputs 1' / Sensor input 25) by inserting the 3-pin connector (see here) vertically (with the red wire pin on top) to output 1.

16) Start the I-CubeX editor (unless it's already running).

17) Set the actuator outputs MIDI Map channel to 1 (go the outputs window and set the remote MIDI control channel to 1).

18) Set the outputs MIDI Map base note to 60 (middle C) - go the actuators window and set the MIDI Map base note to 60.

19) Set the first actuator output to trigger mode (click on the first mode button until it displays the up-down arrow). This actuator output will turn the See actuator on when note 60 (middle C) is pressed down, and will turn the actuator off when note 60 (middle C) is released.

20) Save your configuration by selecting File | Save.

21) Connect your MIDI keyboard's MIDI output to your Digitizer's MIDI input.

22) Set up your keyboard to play on MIDI channel 1. Play middle C (or note 60). The See LED will turn on. Release the note and the LED will turn off.

23) Start turning the Turn sensor to control volume, play middle C to control the See LED.

Congratulations, you have created your very first I-CubeX sensor environment.

A MIDI mixer example

For this example, we will be using 8 Turn sensors. You can still do this tutorial if you have fewer Turn sensors by allocating fewer sensor inputs (in step 6).

1. Label each one with a number (1 through 8). You may wish to mount your sensors on a panel by drilling a 1/4" diameter hole for each Turn sensor. Remove the sensor knob by loosening the small screw on the side of the knob. Remove the washer. Pass the sensor through the hole. Put the washer back on the sensor. Tighten the nut so the sensor stays firmly in place. Put the knob back onto the sensor, and tighten the screw on the side of the knob).

2. Connect each Turn sensor to the I-CubeX digitizing device's inputs (starting from input 1) by inserting the 3-pin of each sensor connector vertically (with the red wire pin on top) starting with input 1.

3. Connect the Digitizer or miniDig to your MIDI interface (see Cabling section) or, for the Wi-miniDig, make sure your Bluetooth interface and BlueMIDI port is setup (see Bluetooth section).

4. Start the I-CubeX editor (the I-CubeX editor can be started directly from the Windows start menu under programs). Verify the editor is setup to comunicate with your digitizing device through the correct MIDI ports using Configure | MIDI.

5. Clear the configuration by selecting File | New.

6. Create 8 sensor windows (or fewer if you're using fewer Turn sensors) by selecting Configure | Add sensor. Note that the new sensor windows use sensor inputs 1 through 8.

7. Find the first sensor window (which has been assigned sensor input 1). Go to the *MIDI Map* section and select "*Control-change*" from the list box. Set the channel field to 1. Set the *Control* field to 7 (ie. volume).

8. Repeat step 7 for the second sensor window (assigned to sensor input 2). This time set the *MIDI Map Channel* field to 2, but set the *Control* field again to 7 (ie. volume).

9. Repeat the above step for each consecutive sensor window (up to 8, or less if you're using fewer turn sensors) each time incrementing the *MIDI Map Channel* field only.

10. Set all 8 (or fewer sensor windows) on by clicking the "on" button for each sensor window.

11. Select each sensor window and start turning the corresponding knob (The input monitor will only monitor the MIDI activity of the selected sensor). If you see no activity, make sure that you're turning the correct knob.

12. Save your masterpiece by selecting File | Save (or File | Save As..). Name it eg. "My MIDI Mixer".

13. Set the digitizing device's MIDI output to "thru" mode by selecting the Configure menu and putting a check mark by MIDI thru. This will allow the digitizing device to pass MIDI from your keyboard controller.

14. Congratulations, you created your very own MIDI mixer!

Configure it !

The basic element of the I-CubeX editor is the configuration. Each configuration represents up to 32 sensors (using up to 32 sensor windows), 8 actuators (using the actuators window) and a few system variables (using the system window and the configure menu). Each configuration can be sent to and retrieved from the digitizing device, as well as stored and loaded from your hard drive. In effect this turns the I-CubeX editor into a librarian. Now that you know how to configure your I-CubeX environment, go wild and make some interactive connections with your MIDI gear !
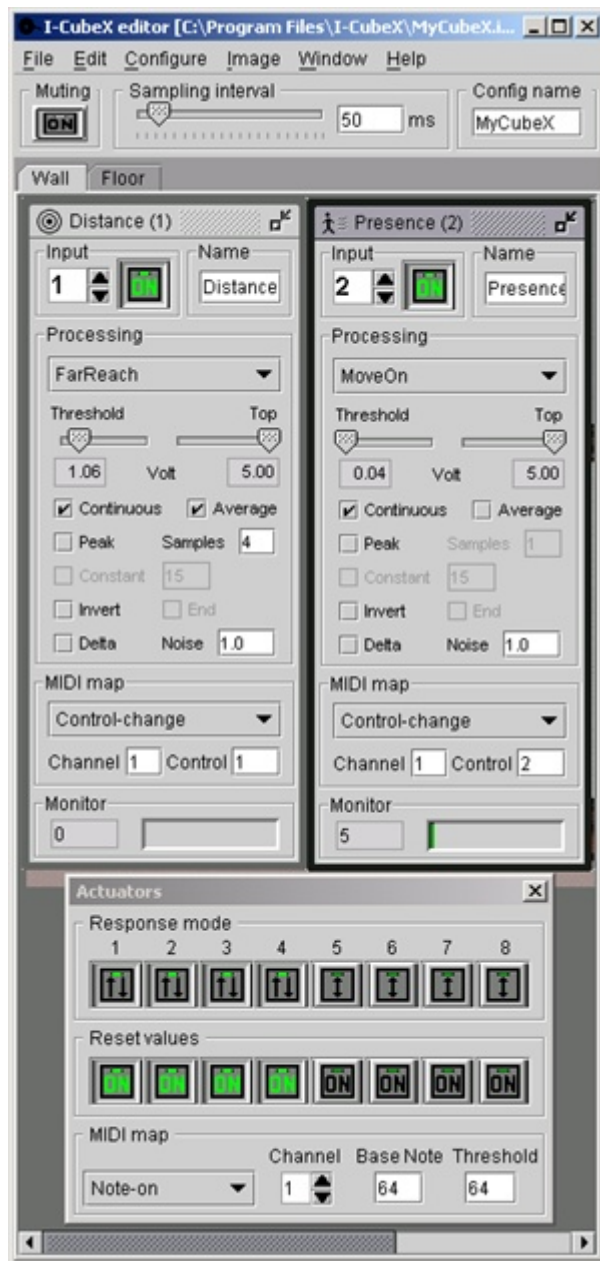
The I-CubeX editor with two sensor windows, actuators and system window. Go here to see the background image. To explore the shown configuration, load MyCubeX into the editor. It can be found in the I-CubeX program directory (shown on the top bar of the application

window).

Configurations saved in I-CubeX editor version 2.1, 2.2, 2.3 or 2.5 can only be loaded in version 2.1, 2.2, 2.3 or 2.5 and cannot be loaded in editor version 2.0 or 1.5 nor vice versa. To convert a configuration file from an older editor to a newer one, load the configuration with the appropriate editor into the digitizing device and then obtain the configuration from the digitizing device using the newer editor.

When running two instances of the editor on Windows 98SE the second instance will halt and needs to be ended using the task manager. On Windows NT/XP it is possible to run two instances of the application but it is unknown whether it leads to any problems. On MacOS it is not possible to run two instances of the editor. In all cases it is best to verify whether the editor is already running before starting it again.

The file menu

This menu manages the storage and retrieval of your sensor configurations.

New (Ctrl+N)
Creates a new configuration (and clears the digitizing device's memory if auto update is on). A new configuration contains the actuators window, the system window, but no sensor windows. If you were editing a configuration, you will be asked whether you wish to clear that configuration or not. This gives you an opportunity to save your work.

When using File | New when auto update is turned on (see the Configure window) the action will clear the digitizing device's memory.

Open (Ctrl+O)
Opens a saved configuration (and sends it to the digitizing device if auto update is on). Again, if you were editing a configuration, you will be asked whether you wish to clear that configuration or not. This gives you an opportunity to save your work.

Save (Ctrl+S)
Saves your configuration. If the configuration has never been saved, you will be prompted for a file name. See the section on file formats for information which features of the configuration are saved in the file.

Record (Ctrl+E)
Record all channel voice MIDI data received by the MIDI input device specified in the MIDI connections window to a file. This function enables the recording of MIDI message values as they are sent by the digitizing device. All active sensors are recorded simultaneously. Each value is, together with a time stamp in milliseconds, written to a file. Selecting the Record function will bring up a window to select/create a file to save the MIDI message values into. The values are saved as a text file (ie. ASCII data) in the following format (using only integers): "time,sensor input number,MIDI channel,MIDI control number or note number or -1 (in the case of program-change, after-touch or pitch-bend),MIDI value" eg.:
"
0,1,2,1,55
277,2,3,64,60
300,3,1,-1,1069
"

This sequence of data represents a MIDI control or note number 1, controller or velocity value 55 computed from sensor input number 1, sent on MIDI channel 2 at the start of the recording, then a MIDI control or note number 64, controller or velocity value 60 computed from sensor input number 2 sent on MIDI channel 3 at 277 ms after starting recording, then a MIDI pitch bend value 1069 computed from sensor input number 3 sent on MIDI channel 1 at 300 ms after starting recording.

Note that the values are written asynchronously (ie. the interval between time stamps varies)

because the digitizing device only sends out a MIDI message when the sensor value has changed more than the noisegate value.

Exit (Ctrl+Q)
Exits the I-CubeX editor. Make sure to save your edited configuration.

# The edit menu

Copy (Ctrl+C)
Cut (Ctrl+U)
Paste (Ctrl+V)
Standard cut, copy and paste functions. You can cut, copy o paste any field which you select (sensor name, etc...). You cannot cut, copy or paste an entire sensor window.

Tabs (Ctrl+T)
Tabs are windows that allow you to subdivide your sensors into different groups with separate tasks so that it's easier to keep track of all the sensors in your art installation. Each tab can hold a different background image in which each sensor window can be minimized and placed to provide a visualization of your setup. New tabs can be added, deleted and renamed.
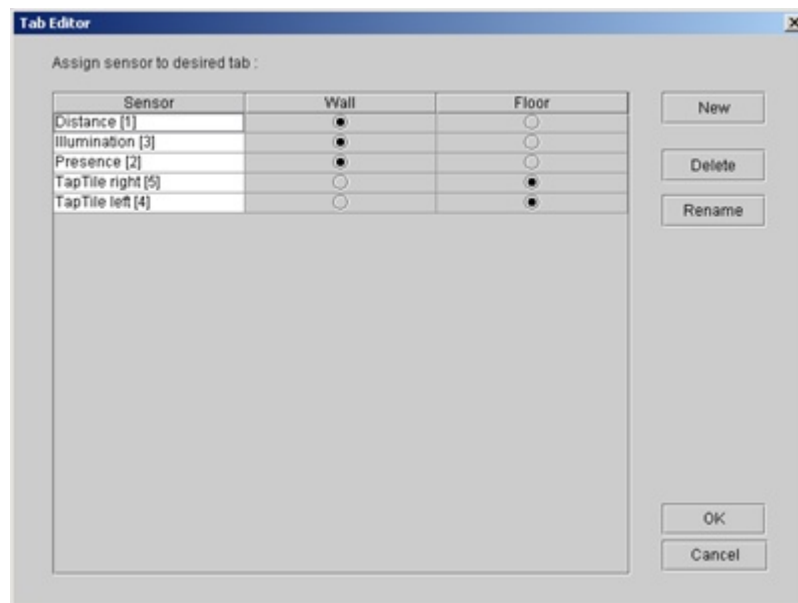
The tab editor.

The configure menu

```
Add sensor         Ctrl-Insert
Delete sensor      Ctrl-Delete
☑ Auto update
Receive            Ctrl-R
Send               Ctrl-D
Mode                          ▶
Reset                         ▶
☐ MIDI thru
☐ Running status
MIDI connections
```

The configure menu.

Add/Delete sensor (Ctrl+Ins/Ctrl+Del)

Inserts a new sensor window or delete an existing sensor window. You can add up to 32 sensor windows.

The editor doesn't check whether a digitizing device is connected or whether the device has changed when adding a sensor. The new sensor window may be preset for configuring a digitizing device input for which a sensor window is already present. When deleting a sensor window using Delete sensor, the editor does check whether the digitizing device is connected but not whether or not it is the same device. Make sure the digitizing device remains connected at all times, and if in doubt use the Send or Receive option of the Configure menu to update the digitizing device configuration.

Auto update

If checked, all configuration parameter changes are sent to the digitizing device as soon as they are changed in the editor. If unchecked, parameter changes are not stored in the digitizing device - use the Configure | Send command to store the changes. [default: checked]

When auto update is turned on, the MIDI connections are never checked before sending updates of the digitizing device parameters (when using "Send" and "Receive" the MIDI connections are checked). If for some reason your MIDI connection is unreliable (test it with the "Check connections" button in Configure | MIDI connections), the digitizing device may miss a command to change a parameter sent by the editor and no warnings will be displayed.

If the editor was started with auto update turned off and turned on later, you need to either Send or Receive a configuration to/from the digitizing device to make sure the editor

displays the same configuration as stored in the digitizing device.

Send (Ctrl+D)

Sends the current configuration to the digitizing device (regardless whether auto update is checked). A transfer progress bar indicates the state of the MIDI transfer.

Receive (Ctrl+R)

Requests and receives the configuration from the digitizing device's memory (regardless whether auto update is checked). A transfer progress bar indicates the state of the MIDI transfer.

Configure | Receive will only obtain the configuration of sensor inputs that are turned on, ie. are sampling sensor signals and subsequently sending these out as MIDI messages.

The MIDI connections are checked when executing Send or Receive - if no digitizing device is found there will be a warning displayed.

After adding a sensor and subsequently receiving the Digitizer configuration it may occur that the workspace is not properly redrawn. Move the lower left window corner momentarily with the mouse to initiate a screen redraw.

Mode

Switch the digitizing device between host or stand alone mode. Note that upon startup of the editor as well as when clicking "check connections" in the Configure MIDI connections dialog, the digitizing device will be set to stand alone mode. Another way to find out the digitizing device's mode of operation is to power off and then power up the digitizing device and count the number blinks of the green MIDI output LED at power up. Host mode is indicated by one green flash during power up (see Fig. 1-6). Stand alone mode is indicated by two green flashes during power up (see Fig. 1-6). Do not set the digitizing device to host mode unless you are planning to communicate with the digitizing device in MIDI system exclusive mode using some other program. [default: stand alone]

Using the Configure menu for setting the mode of operation.

The digitizing device must be in stand alone mode to be able to use all of the editor's

functions.

Reset

Reset sysex ID: In order to configure the digitizing device, the editor communicates with the digitizing device using a proprietary MIDI system exclusive (sysex) protocol. For host mode operation, the digitizing device can be set to have any device ID between 0 and 127. The device ID 0 is used by the editor for all stand alone mode configuration programming. The "Reset system exclusive device ID" option gives the user the possibility to reset the device ID to 0 in case it was set to another value during a host mode session. Note that upon startup of the editor as well as when clicking "check connections" in the Configure MIDI connections dialog, the digitizing device's sysex ID is reset to 0.

Reset configuration: reset the digitizing device configuration to the default factory settings. This is the same operation as executing *File | New*.

Using the Configure menu to reset the Sysex ID to 0.

Running Status

Sets the digitizing device to use MIDI running status. When this feature is turned on, the digitizing device does not send a status byte when the status byte is the same as in the previous MIDI message. This feature allows more sensor data to be sent by the digitizing device in the same amount of time effectively increasing the throughput. Note that at startup the editor cannot determine whether this feature is turned on or off, hence it is shown as undetermined - click the check box to turn it on or off. [default: off]

MIDI thru

Determines whether the digitizing device's MIDI output port acts as a MIDI thru or not. With MIDI thru active, the digitizing device will pass on every message that is not intended for the digitizing device to the next MIDI device in the MIDI chain. Note that at startup the editor cannot determine whether this feature is turned on or off, hence it is shown as undetermined - click the check box to turn it on or off. [default: off]

MIDI connections

Enables you to select the appropriate MIDI interface (MIDI input and output) to connect to the I-CubeX digitizing device.

# The configure menu - MIDI Connections item

MIDI connections
Enables you to select the appropriate MIDI interface (MIDI input and output) to connect to the I-CubeX digitizing device.

MIDI connections dialog window.

The *Check connections* button enables you to test the reliability of the MIDI connections. Under normal circumstances all tests should be successful.
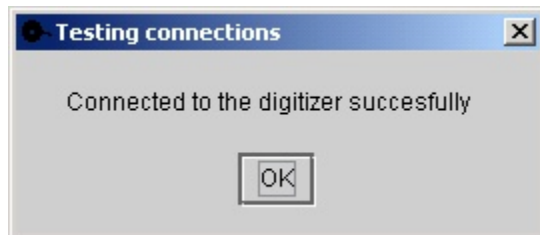
Check connections dialog.

If not all of the tests were successful after pressing Check connections it is possible that the digitizing device is too busy sending out or receiving MIDI messages. If it is too busy sending out MIDI messages (that were not forwarded from the MIDI input using the digitizing device MIDI thru option), increasing the sample interval (lowering the sample rate) temporarily may resolve this. If the digitizing device is too busy receiving MIDI messages check which other MIDI device may be sending these messages.

A host mode Reset message is sent to the digitizing device each time the MIDI connections are checked. In case of the Digitizer, the Reset message may change the status of the actuator outputs (ie. power supplies of inputs 25-32).

If the Wi-miniDig is set to stand alone mode and configured with at least one sensor input active, MIDI data won't be sent by the unit until it has received a host mode Reset message.

The sensor window (Ctrl+Ins)

A sensor window maps one sensor input to a standard MIDI message (a note-off, note-on, key-pressure, control-change, program-change, after-touch, or pitch-bend message). It is created in Configure | Add sensor. Up to 32 sensor windows can be created, one for each sensor input, per configuration. A sensor window is composed of the following user interface components:

- Input section: number selector*, on/off* button
- Name section: *Name* field
- Input processing section: Preset pull down menu*, Threshold* and *Top* sliders and number displays*, Continuous*, *Peak/Dip*, *Average*, *Constant*, *End* and *Delta* check boxes, *Noise, Constant* and *Samples* number fields
- MIDI map section: Message pull down menu, *Channel* selector, 1st data field (*Control, Note,* or n/a)
- Monitor section: Monitor slider and number display
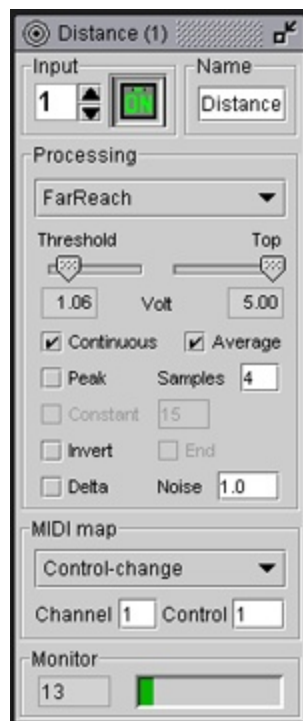
A sensor window.

The sensor window - input and name sections

The input and name sections of a sensor window.

Input number selector: Selects the sensor input number (ie. the input of the digitizing device used for connecting the sensor to the digitizing device) to be used with the sensor window. You can scroll through all unused sensor input channels (channels which are not used by any other sensor input objects). Each sensor input object must use a different sensor input. [default: first sensor input number that is not used by any other open sensor window]

On/off button: This button turns the sensor input on and off (ie. if the sensor input is turned on the digitizing device will send out MIDI messages in response to sensor value changes). [default: off]

Leaving an input on without a sensor plugged in will cause signal noise to be translated to MIDI messages and may cause large amounts of MIDI data to be output, very often overloading your MIDI interface or other MIDI gear! Make sure to turn unused inputs off.

Name field: Allows you to name the sensor configured with this sensor window. This label can indicate the type of sensor used, the location of the sensor, the function of the sensor, or anything else. The name is updated in the window title bar. By keeping this label short, the entire label can be visible when the object is minimized (great if you are using all 32 sensor input objects). [default: "Sensor"]

The sensor name is not stored in the digitizing device and hence is entered as "Sensor" when retrieving a configuration from the digitizing device.

The sensor window - processing section

The processing section enables you to maximize the sensitivity and response of the sensor.
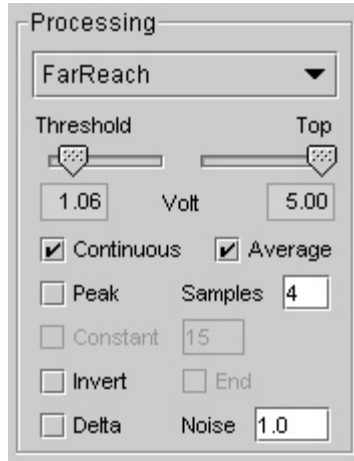
The processing section of a sensor window with the FarReach preset selected.

Preset pull down menu: To facilitate configuring the processing section of a sensor window, a setting can be selected from a list of presets for all of Infusion's sensors. You can add your own processing settings by editing the presets.ini file in the directory where the I-CubeX program is stored. See the File Formats section for information on the presets.ini file format. [default: "no processing"]

The processing preset names are not stored in the digitizing device and hence are left blank when retrieving a configuration from the digitizing device. The processing settings are correctly retrieved, just the name is not stored in the digitizing device.

Threshold slider: Sets the lower limit of the effective sensor input voltage range (any voltages applied to the sensor input below this point return 0). When *Peak* is checked this parameter is also used as the trigger for starting a peak search. Raise *Threshold* to something other than 0 - let's say 1.02 Volt. When the sensor value rises above 1.02 Volt and the number of samples specified in the *Samples* field have been obtained, it triggers a MIDI event. When it drops again below 1.02 Volt, and if *End* is checked, it triggers another MIDI message. This value cannot be set above the *Top* setting. [default: 0.00]

Top slider: Sets the upper limit of the effective sensor input voltage range (any voltages applied to the sensor input above this point return 127). When *Dip* is checked this parameter is also used as the trigger for starting a dip search. Lower *Top* to something other than 5 - let's say 3.98 Volt. When the sensor value drops below 3.98 Volt and the number of samples specified in the *Samples* field have been obtained, it triggers a MIDI event. When it rises again above 3.98 Volt, and if *End* is checked, it triggers another MIDI message.This value cannot be set below the *Threshold* setting. [default: 5.00]

Continuous check box: When checked, any new sensor values will be output. Use this feature when you are interested in all the sensor values. Checking *Continuous* will allow checking

Average. When a new sensor window is added, turning the sensor on sets *Continuous* to checked by default. [default: checked when the input is turned on]

Peak/Dip check box: When checked, peak/dip detection is active. By default the processing algorithm looks for a peak - if *Invert* is checked the algorithm looks for a dip in the sensor signal. When the sensor value raises above *Threshold* (in case of peak detection) or drops below *Top* (in case of dip detection) the peak/dip search starts. The number of samples taken before the peak or dip value is determined is set using the *Samples* field. The output value is scaled between *Threshold* and *Top*. Use this feature when you are interested in detecting sudden significant changes in the sensor values, ie. when they are occasionally jumping to a high or a low value. Checking *Peak/Dip* will also allow checking *Constant* and *End* detection. [default: unchecked]

Checking both *Continuous* and *Peak/Dip* will set the processing algorithm to first look for a peak/dip in the sensor signal according to the *Samples* value, and then output sensor values as key-pressure values until the sensor value drops below *Threshold* (in case of peak detection) or rises above *Top* (in case of dip detection).

Average check box: When checked, sensor values will be averaged. The number of samples to be taken for calculation of the average is set using the *Samples* field. Use this feature if the variation of the sensor values due to noise is almost as large or larger than the variation of the sensor values due to stimulus variation. The average operation is only available when *Continuous* is checked. [default: unchecked]

Samples number field: Use for entering the number of samples to be taken before the peak/dip value (*Peak/Dip* checked) and/or average value (*Average* checked) should be computed. If both *Continuous* and *Peak/Dip* are checked the *Samples* value will first be used for peak/dip detection and then for averaging. [default: 0]

Delta check box: When checked, only the difference between the current and the previous sensor value will be output. It is useful when you are interested in the changes of the sensor values only, not the sensor value itself. The delta operation is a simple form of obtaining the differentiated sensor value, better known as its velocity, speed or rate of change. The delta operation is applied after any averaging and/or peak/dip detection but before the noise gate operation. [default: unchecked]

Noise number field: Use for entering a noise gate value such that the MIDI mapped value of a sensor is only output if it changes at least by the number entered in the *Noise* field. The noise gate value depends on the MIDI map selected. When using 7-bit resolution MIDI messages such as note-on and control-change messages a noise gate value of 0.5 means that the MIDI message needs to change at least by one half up or down, ie. the sensor value needs to change at least 0.02 Volt (ie. 20 milliVolt) before a MIDI message is output. When using pitch-bend messages a noise gate value of 4 means that the pitch-bend value needs to change by at least 4 up or down, ie. the sensor value needs to change at least 0.0012 Volt (ie. 1.2 milliVolt) before a MIDI message is output. Use this feature if the variation of the sensor values due to noise is much less than the variation of the sensor values due to stimulus variation. The noise gate operation is applied after any averaging and/or peak/dip detection and/or delta operations. [default: 0.5]

Constant check box: When checked, no peak or dip value is computed but the *Constant* number field is used instead for immediately (ie. the number specified in the *Samples* field is irrelevant)

outputting the MIDI message specified in *MIDI map* when *Threshold* (in case of peak detection) or *Top* (in case of dip detection) are passed. Useful when you want to make sure the MIDI message is always the same when your sensor is activated. The constant operation is only available when *Peak/Dip* is checked. [default: unchecked]

Continuous number field: Use for entering the *Constant* value to use in the MIDI message when *Threshold* or *Top* are passed. Only available when *Constant* is checked. [default: 15 when *Constant* is checked]

End (detection) check box: When checked, a MIDI value zero will be output whenever the sensor value drops below the *Threshold* value (in case of peak detection) or above the *Top* value (in case of dip detection) selected. The end detection operation is only available when *Peak/Dip* is checked. [default: unchecked]

Invert check box: When checked the MIDI output value decreases with increasing sensor values. When *Peak* is checked the processing algorithm will look for a dip in the signal instead of a peak (and vice versa). [default: unchecked]

The sensor window - MIDI map section

This section enables you to map the sensor value to three standard MIDI messages.
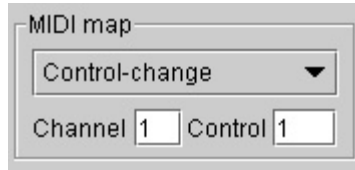
The MIDI map section of a sensor window with the sensor value mapped to a control-change number 1 message on MIDI channel number 1.

Message pull down menu: This menu enables you to map the sensor value to all 7 standard MIDI messages - note-off, note-on, key-pressure, control-change, program-change, after-touch and pitch-bend. [default: control-change]

The pitch-bend MIDI map maps a sensor signal to MIDI values in steps of 4 because the picth-bend range is 14 bit (ie. 0-16383) while the sensor values are sampled with 12 bit resolution (ie. 0-4095).

Channel selector: Sets the MIDI channel for the MIDI *Message* selected above. [default: 1]

1st data field: Sets the controller number (if *Message* is set to Control-change) or note number (if *Message* is set to Note-on, Note-off or Key-pressure) mapping. Disabled otherwise. [default: same number as sensor input number]

The sensor window - monitor section

This feature displays the MIDI value as output by the digitizing device of the sensor configured with the current sensor window.

The monitor section of a sensor window.

Displays: A moving bar (left to right) indicates the sensor's MIDI value. When mapped to a continuous controller message the bar is blank if the sensor value is 0 and full if the value is 127. In the case of a pitch-bend mapping, full bend up (MIDI value 16383) is indicated by a full bar, and full bend down (MIDI value 0) is indicated by the blank bar. In the case of a note event mapping, an empty bar represents a note off, while a full or semi full bar indicates a note off (the bar's level indicates the note velocity of the event).

If the MIDI map is identical for two sensor inputs the monitor functions in the respective sensor windows in the editor will both show the sensor signals of the two sensor inputs, which may appear as a noisy signal.

The actuators window (Digitizer only)
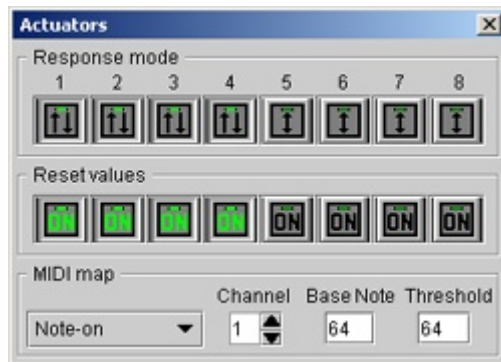
Actuators window with outputs 1-4 set to toggle mode and on after reset with the remainder in trigger mode and off after a reset

The actuators window configures all 8 actuator outputs (ie. power supplies of sensor inputs 25 - 32). The 8 actuator outputs are controlled by sending MIDI messages to the Digitizer's MIDI input port. The actuators window is composed of:

- Response mode section: 8 *Trigger/Toggle* buttons
- MIDI Map section: Message pull down menu, *Channel* selector, *Base Note/Control* number field, *Threshold* number field

The actuators window (Digitizer only) - response mode section

The response mode section of the actuators window with outputs 1-4 set to toggle mode.

Trigger/Toggle buttons: This strip of 8 buttons determines the response mode for each actuator output. [default: toggle]

 Trigger: The two-sided (up and down) arrow setting indicates that the actuator output responds as a trigger to note-on events: a note-on event turns the output on, while a note-off event turns the output off.

 Toggle: The other two-arrow (one up, and one down) setting indicates that the actuator output responds in toggle mode to note-on events: consecutive note-on events toggle the output on and off (the first note-on turns the output on, while the next note-on turns the output off).

The actuators window (Digitizer only) - reset values section

The reset values section of the actuators window with all outputs set to turn on after a Digitizer reset.

The reset values section of the actuators window enables you to control which state each actuator output will be in after resetting the Digitizer (e.g. after a power up). [default: ON]

The actuators window (Digitizer only) - MIDI map section

The MIDI map section of the actuators window.

This section enables you to configure the MIDI message that, if sent to the Digitizer, will activate the actuator connected to a Digitizer output.

MIDI map channel: This parameter sets the MIDI channel on which note-on/off messages will be received. [default: 1]

MIDI map base note/control: This parameter sets the note or control number that is mapped to activate the first actuator output. For example, If the base note is set to 60 and activates actuator output 1, a note on message with note number 67 will activate the 8th actuator output. The valid range of this parameter is from 0 to 120. [default: 64]

MIDI map threshold: Sets the value above which the actuator is activated. [default: 1]

The system window
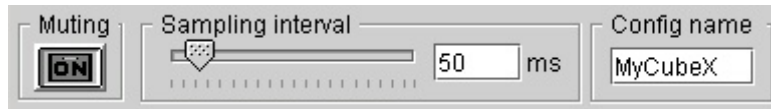
The system window.

The system window controls the following parameters:

Muting: This button enables you to stop any sending out of MIDI messages by the digitizing device. [default: off]

Config name: The configuration name can be used to store a name with a configuration stored in the digitizing device, so that it is easier to recognize which configuration was last stored in the digitizing device. Maximum length is 8 characters. [default: Digitize]

Sampling interval: This parameter determines the digitizing device's sampling speed or rate and is the same for all inputs. The sampling interval ranges from 4 milliseconds (ie. a sampling rate of 250 times per second or 250 Hz) to 16.380 seconds, ie. 16380 milliseconds (ie. a sampling rate of 3.7 times per minute or 0.061 Hz). The slider can range up to 400 milliseconds. For larger sampling intervals, use the number box to the right of the slider. [default: 100 ms]

Using a small sampling interval (20 ms or less) requires a lot of processing (and may cause a crash on slower computers). Using a small sampling interval with a large number of sensors increases this risk. To avoid this, disconnect the MIDI output cable from the digitizing device and increase the sampling interval.

Using a very large sampling interval (3000 ms or more) may make the digitizing device behave as if it was "dead" (ie. there doesn't seem to be any response coming from the digitizing device when changing a sensor value) since sensor data is sent infrequently.

All of the above parameters are instantly updated in the digitizing device's memory if auto update is checked in the Configure menu. Whether or not auto update is checked, all sensor windows, and the actuators window settings can be stored in the digitizing device using the Send (Ctrl+D) command found in the Configure menu.

The image menu

The image menu enables you to add background images to each tab. This feature aims to help organize your sensor setup by providing a visualization of the physical layout of the sensors.

Load/Remove (Ctrl+L/Ctrl+M)
Load or remove an image file as a background image in one of your tabs.

Show/Hide (Ctrl+W/Ctrl+H)
Make the selected image(s) visible or hide them.

Record/Restore position(s)
Record or restore the position of all the minimized sensor windows wrt. the background image. Make sure to record the positions in order to include them in the configuration when saving it as a file.
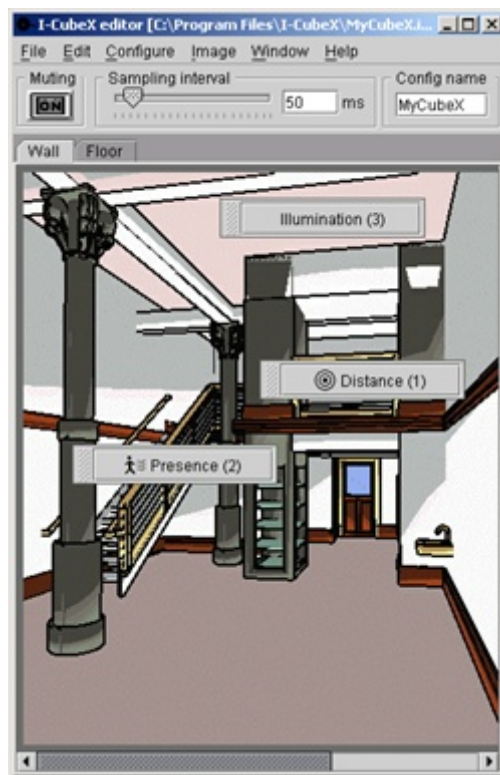
An example of using an image as a background for your I-CubeX sensor setup. Go here to see the sensor windows opened.

The window menu

Tile
Standard windows function to clean up the position of sensor windows.

Actuators (Digitizer only)
Brings the actuators window to the front. If the actuators window has been closed, this command will bring it back again. [default: present]

System
Brings the system window to the front. If the system window has been closed, this command will bring it back again. [default: present]

The help menu

About
Brings up a window with the I-CubeX logo, website link and version information.

The About window.

Error messages

Configuration setting error
The digitizing device received a MIDI system exclusive message containing instructions for storing a configuration that doe not make sense. For example setting the base note value higher than 120 does not make sense because the 8th actuator output would be mapped to note value 128 which is an illegal value.

MIDI protocol error
The digitizing device received a MIDI message that doesn't conform to the MIDI protocol. Check which device(s) is(are) sending MIDI to the digitizing device and that the MIDI data is not corrupted.

Receive buffer is full
The digitizing device cannot process all the MIDI messages it receives. Please check your MIDI connections and reduce the number of MIDI messages being sent to the digitizing device. This error may also occur when you change one of editor settings continuously for some time, while auto-update is on.

MIDI byte has been scrambled
The digitizing device cannot recognize the signal it receives through the MIDI cable as a MIDI byte. Check your MIDI connections and make sure the cables are in good order.

Mode of operation

An I-CubeX digitizing device can function in one of two modes - host and stand alone. Unless you have software that can send and receive the MIDI system exclusive messages required for host mode (such as the iCube and oCube objects used within the Max programming environment), your I-CubeX digitizing device should remain in stand alone mode.

To check whether the I-CubeX is in host or stand alone mode, observe the green MIDI output LED (at the side of the digitizing device, to the left of the MIDI output port) when powering up.

Host mode is indicated by **one green flash** during power up.

Stand alone mode is indicated by **two green flashes** during power up.
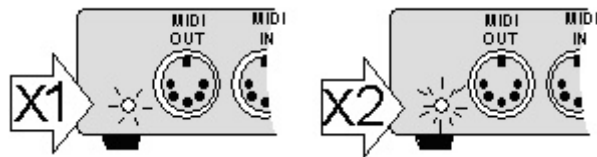
Stand alone mode

Stand alone mode allows you to use the I-CubeX digitizing device directly with any MIDI device (keyboard, module, sequencer, light controller, drum machine, micro wave oven). As the digitizing device has no front panel controls, all editing must be performed using the I-CubeX editor. An edited sensor configuration is stored in the digitizing device's memory and remains there even after power down. This allows you to edit the digitizing device, plug it directly into your MIDI equipment, and go!

Stand alone mode allows the digitizing device to map any sensor input to a standard MIDI message (note-on/off, key-pressure, control-change, program-change, after-touch or pitch-bend). In addition, the 8 actuator outputs (ie. the power supplies of sensor inputs 25 to 32) can be turned on and off using MIDI note-on/off, key-pressure or control-change messages. While not quite as flexible as host mode, stand alone mode maximizes portability of your sensor setup.

Note that at startup of the editor the digitizing device is set to stand alone mode and the digitizing device's system exclusive ID is set to zero.
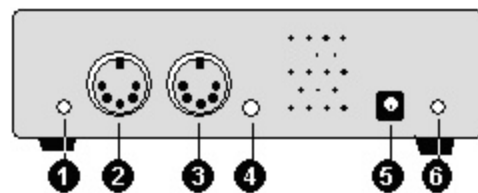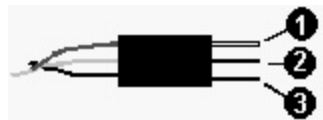
The I-CubeX hardware: Digitizer v4.01

Front view
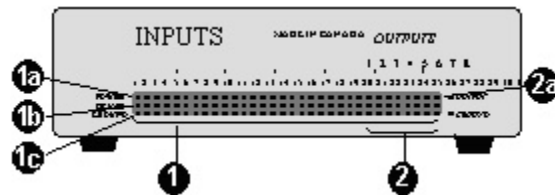
(1) Sensor inputs (12 bit resolution)
(1a) Sensor power supply (5VDC / 30mA for each sensor)
(1b) Sensor signal input
(1c) Sensor ground
(2) Actuator outputs (power supplies of last 8 sensor inputs)
(2a) Actuator signal output (5VDC / 30mA for each actuator)

Back view

(1) MIDI output indicator
(2) MIDI output (also MIDI Thru) jack
(3) MIDI input jack
(4) MIDI input indicator
(5) Power supply socket (7.5VDC / 1A)
(6) Power indicator

Sensor Connector

(1) Power pin (+) - red wire
(2) Signal pin (signal) - white or grey wire
(3) Ground pin (-) - black wire

I-CubeX technical specifications for Digitizer v4.1/4.01

Version firmware v4.1, hardware v4.01

Sensor input

Number of inputs 32 (power supplies of inputs 25-32 are also outputs)

Range 0 to 5 Volt

Resolution 12 bit or 7 bit (user selectable)

Sampling interval programmable from 4 ms (minimum) - 16380 ms (maximum) in steps of 4 ms (actual sampling rate below)

Sampling rate		*active inputs (signal processing set to continuous)*							
		1	*1-2*	*1-4*	*1-8*	*1-16*	*1-24*	*1-32*	
stand alone mode	*control*	244	225	154	95	48	32	24	Hz (max)
	pitch	240	192	125	74	37	n/a	n/a	Hz (max)
host mode	*7 bit*	244	244	244	238	138	93	83	Hz (max)
	12 bit	244	244	200	149	82	56	45	Hz (max)

Sampling latency 1.5 ms (min) - 4.0 ms (max) (one active input without signal processing)

Signal processing functions

inversion
scaling (0.04 Volt minimum range, leaving 5-bit resolution)
threshold detection (0.04 Volt minimum step)
peak/dip detection (over 16 samples maximum)
averaging (over 16 samples maximum)
differentiation (between 2 consecutive samples only)
noise gate (5 Volt maximum range)

Supply voltage 5 Volt

Supply current 30 mA per sensor (typical)

Actuator output

Number of outputs 8 (power supplies of inputs 25 - 32)

Range 0 to 5 Volt

Resolution 1 bit (off = 0 Volt, on = 5 Volt)

Switching rate 1540 Hz (maximum)

Switching latency 1.3 ms (minimum)

Output current 30 mA per actuator (maximum)

Communications data format

Host mode MIDI system exclusive protocol

Standalone mode

MIDI pitch-bend (12 bit resolution, up to 16 inputs),
note-on/off, key-pressure, control-change,
program-change or after-touch (7 bit resolution)
messages for sensor data mapping
MIDI note-on/off, key-pressure or control-change for
actuator output control

Connectors

Sensor / actuator 3 pin row (2.54 mm / 0.1" spaced)

MIDI 5 pin DIN (input, output with software switch-able thru)

Power 2.1mm / 5.0mm (inner/outer diameter) coaxial plug
with center positive

Form

Dimensions 121 mm x 94 mm x 34 mm (4.75" x 3.75" x 1.3")

Weight 0.180 kg (0.39 lbs.)

Known bugs of the I-CubeX Digitizer v4.1/4.01

For the most recent bug listing please check our website !

Digitizer firmware version 4.1, hardware version 4.01

We are not aware of any bugs. Please notify us if you think you may have encountered a bug.

# The I-CubeX hardware: miniDig v5.00

Front/top/side view

Back/top/side view

Sensor Connector
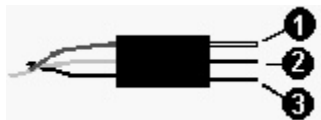
(1) Power pin (+) - red wire
(2) Signal pin (signal) - white or grey wire
(3) Ground pin (-) - black wire

I-CubeX technical specifications for miniDig v4.4/5.00

Version firmware v4.4, hardware v5.00

Sensor input

Number of inputs 8

Range 0 to 5 Volt

Resolution 10 bit or 7 bit (user selectable)

Sampling interval programmable from 4 ms (minimum) - 16380 ms (maximum) in steps of 4 ms (actual sampling rate below)

Sampling rate		*active inputs (signal processing set to continuous)*				
		1	*1-2*	*1-4*	*1-8*	
stand alone mode	control	128	82	48	26	Hz (max)
	pitch	125	79	47	25	Hz (max)
host mode	7 bit	111	106	98	82	Hz (max)
	10 bit	108	99	85	66	Hz (max)

Sampling latency 3.2 ms (min) - 10.8 ms (max) (one active input without signal processing)

Signal processing functions

inversion
scaling (0.04 Volt minimum range, leaving 5-bit resolution)
threshold detection (0.04 Volt minimum step)
peak/dip detection (over 16 samples maximum)
averaging (over 16 samples maximum)
differentiation (between 2 consecutive samples only)
noise gate (5 Volt maximum range)

Supply voltage 5 Volt

Supply current 30 mA per sensor (typical)

Communications

Data format

Host mode: MIDI system exclusive protocol

Standalone mode:MIDI pitch-bend (10 bit resolution), note-on/off, key-pressure, control-change, program-change or after-touch (7 bit resolution) messages for sensor data mapping
MIDI note-on/off, key-pressure or control-change for actuator output control

Transmission

MIDI cable (serial port profile: 31250 kbs, no parity, 1 stop bit, 8 data bits, current loop)

Connectors

Sensor / actuator 3 pin column (2.54 mm / 0.1" spaced)

MIDI 5 pin DIN (input, output with software switch-able thru)

Power 2.1mm / 5.0mm (inner/outer diameter) coaxial plug
with center positive

Form

Dimensions 80 mm x 40 mm x 20 mm (3.15" x 1.57" x 0.79")

Weight 0.11 kg (3.9 oz), incl. MIDI cable but excl. power supply

Known bugs of the I-CubeX miniDig v4.4/5.00

For the most recent bug listing please check our website !

miniDig firmware version 4.4, hardware version 5.00

We are not aware of any bugs. Please notify us if you think you may have encountered a bug.

The I-CubeX hardware: Wi-miniDig v5.01

Top view

Front/top/side view

Sensor Connector
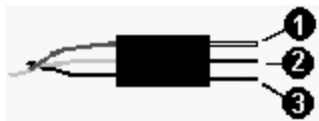
(1) Power pin (+) - red wire
(2) Signal pin (signal) - white or grey wire
(3) Ground pin (-) - black wire

I-CubeX technical specifications for Wi-miniDig v4.5/5.01

Version firmware v4.5, hardware v5.01

Sensor input

Number of inputs 8

Range 0 to 5 Volt

Resolution 10 bit or 7 bit (user selectable)

Sampling interval programmable from 4 ms (minimum) - 16380 ms (maximum) in steps of 4 ms (actual sampling rate below)

Sampling rate		active inputs (signal processing set to continuous)				
		1	1-2	1-4	1-8	
stand alone mode	control	128	82	48	26	Hz (max)
	pitch	125	79	47	25	Hz (max)
host mode	7 bit	111	106	98	82	Hz (max)
	10 bit	108	99	85	66	Hz (max)

Sampling latency 3.2 ms (min) - n/a ms (max) (one active input without signal processing)

Signal processing functions

inversion
scaling (0.04 Volt minimum range, leaving 5-bit resolution)
threshold detection (0.04 Volt minimum step)
peak/dip detection (over 16 samples maximum)
averaging (over 16 samples maximum)
differentiation (between 2 consecutive samples only)
noise gate (5 Volt maximum range)

Supply voltage 5 Volt

Supply current 30 mA per sensor (typical)

Communications

Data format

Host mode: MIDI system exclusive protocol

Standalone mode:MIDI pitch-bend (10 bit resolution), note-on/off, key-pressure, control-change, program-change or after-touch (7 bit resolution) messages for sensor data mapping
MIDI note-on/off, key-pressure or control-change for actuator output control

Transmission

 Bluetooth® v1.1 class 2 (serial port profile: 115 kbs, no parity, 1 stop bit, 8 data bits, data flow ON)

Connectors

Sensor / actuator 3 pin column (2.54 mm / 0.1" spaced)

Power 2.1mm / 5.0mm (inner/outer diameter) coaxial plug
with center positive

Form

Dimensions 80 mm x 40 mm x 20 mm (3.15" x 1.57" x 0.79")

Weight   0.05 kg (1.8 oz), excl. power supply

Known bugs of the I-CubeX Wi-miniDig v4.5/5.01

For the most recent bug listing please check our website !

Wi-miniDig firmware version 4.5, hardware version 5.01

We are not aware of any bugs. Please notify us if you think you may have encountered a bug.

I-CubeX editor file formats

The following details the formats of some important files used by the I-CubeX editor.

*.ICU
Files that contain an I-CubeX configuration. Configurations saved in I-CubeX editor version 2.1 or 2.2 cannot be loaded in editor version 2.0 or lower and vice versa. To convert a configuration file from an older editor to a newer one, load the configuration with the appropriate editor into the Digitizer and then obtain the configuration from the Digitizer using the newer editor.
The format is as follows:
"
Editor software version number [float eg. 2.20]
Configuration name [8-character text, eg. MyCubeX]
Sampling Interval value [4-16383]
MIDI Thru [true or false]
# of Tabs [integer]

For each Tab:
Tab name [text]
End of For loop

For each given Tab:
sensors for the Tab [integer]
End of For loop

For each sensor in a Tab:
Tab number the sensor is in [integer]
Sensor name [text]
Sensor number [0-31]
Sensor on/off [true or false]
Preset number [integer]

If Preset number is equal to zero:
Threshold value [0-127]
Ceiling value [0-127]
Invert on/off [true or false]
Continuous on/off [true or false]
Peak/Dip on/off [true or false]
Average on/off [true or false]
End detection on/off [true or false]
Constant on/off [true or false]
Delta on/off [true or false]
Samples value [0-15]
Constant value [0=off, 15-127 in steps of 16]
Noise value [0-127]
End of If statement

MIDI map name [0-6]
MIDI channel number [0-15]
Note/Ctrl number [0-127]

Window position X value [integer]
Window position Y value [integer]
Window position X value when minimized [integer]
Window position Y value when minimized [integer]
End of For loop

# of output channels [8]

For each Output Channel:
Response Mode on/off [true or false]
Reset State on/off [true or false]
End of For loop

Threshold [0-127]
MIDI map name [0-3]
MIDI Channel number [0-15]
Note/Ctrl number [0-127]

For each Tab:
Background Image path [text, eg. C:\My Documents\My Pictures\]
End of For loop
"

.TXT (or any files with recorded sensor data)
Files that hold recorded sensor values as MIDI values use the following format (using only integers):
"time,sensor input number,MIDI channel,MIDI control number or note number or -1 (in the case of program-change, after-touch or pitch-bend),MIDI value" eg.:
"
0,1,2,1,55
277,2,3,64,60
300,3,1,-1,1069
"

This sequence of data represents a MIDI control or note number 1, controller or velocity value 55 computed from sensor input number 1, sent on MIDI channel 2 at the start of the recording, then a MIDI control or note number 64, controller or velocity value 60 computed from sensor input number 2 sent on MIDI channel 3 at 277 ms after starting recording, then a MIDI pitch bend value 1069 computed from sensor input number 3 sent on MIDI channel 1 at 300 ms after starting recording.

PRESETS.INI
This file holds the processing settings used as presets in the sensor window and can be edited to incorporate your own settings. The format is as follows:
"
first line:
number of lines in file [integer]
for each preset listed on one line:
Preset name [text, may contain spaces etc. but no comma],
Threshold [0 = 0.00V, 127 = 5.00V],
Top [0 = 0.00V, 127 = 5.00V],

Invert [0 = normal, 1 = invert],
Continuous on/off [0 = off, 1 = on],
Peak/Dip on/off [0 = off, 1 = on],
Average on/off [0 = off, 1 = on],
Constant on/off [0 = off, 1 = on],
Constant value [0=off, 15-127 in steps of 16],
End detection on/off [0 = off, 1 = on],
Delta on/off [0 = off, 1 = on],
Samples value [0-15, 0 = 1 sample],
Noise gate value [0-127, 0 = off]CR
"

For example the line:
"BendMini,15,110,1,1,0,0,0,0,0,0,0,1"
represents the BendMini setting with threshold 15 and top 110 and invert and continuous
activated and the noisegate set to 1 (displayed as 0.5).

ICUBEX.CFG
This file saves the following settings for the editor:
"
Auto update [true or false]
System window visible [true or false]
MIDI input device last used by the editor [integer, if -1 editor will open with MIDI configuration
panel]
not used [integer]
MIDI output device last used by the editor [integer]
Actuator window visible [true or false]
Main window top position [integer]
Main window left position [integer]
Main window width [integer]
Main window height [integer]
Main window state [integer]
Output window top position [integer]
Output window left position [integer]
number of MIDI input devices last used by the editor [integer]
directory last used by the editor for file opening and saving [text]
"

Known bugs of the I-CubeX editor

For the most recent bug listing please check our website !

Windows editor version 2.50

We are not aware of any bugs at this time. Please notify us if you encounter one.

MacOS X editor version 2.50

We are not aware of any bugs at this time. Please notify us if you encounter one.

The Sensorium

Which sensor should I use ?

At Infusion Systems we develop the coolest bizarre ways of controlling gear. The I-CubeX comes with a Turn sensor and a See actuator to get you started and check out the list below for more possibilities!

All of our sensors are continuous control but can also act as switches (note on/note off). They are 'tuned' and pre-wired to work with the I-CubeX - no additional electronics or soldering required. Please note that the sensors and actuators listed below and their specifications are subject to change. Please see our web site for the latest available sensors and actuators or for their technical specifications.

The sensor/actuator column indicates the sensor/actuator name. The Env. (or environmental) column indicates whether the sensor/actuator is influenced by / influences the environment around it or not – thus needing to be reconfigured in the editor whenever the sensor/actuator is moved. The Interaction column describes the form interaction with the sensor/actuator. The Applications column provides some suggested uses for the sensor/actuator.

Interaction	Env.	Sensor	Applications
Airpressure	Yes	Air	Blow your brains out and see the light come on. Measures from 15 to 115 kPa (150 to 1150 mBar).
Acceleration	No	GForce2D, GForce3D	Senses acceleration and deceleration in two or three dimensions simultaneously. Attach these to Whirling Dervishes, kinetic sculptures or Fido as he chases the neighborhood cat. A visually exciting sensor. Can be held in the palm of your hand. Bonus: the GForce2D is identical to the Tilt2D so can sense inclination too ! The GForce2D detects upto 2 G, the GForce3D upto 35G which makes it a good sensor for impact (rapid deceleration) measurement.
Contact position	No	Slide, SlideLong, SlideWide	Is your keyboard lacking a cool ribbon controller? Or maybe you want 5 more... The Slide is a position sensor perfect for adding to your keyboard or DJ setup. The Slide and SlideWide ranger upto 165 mm (6.49"), but note that 2 SlideWides can be stacked on top of each other to obtain an XY touch sensitive pad. The SlideLong ranges upto 388 mm (15.3").
Contact position	No	Push, Push2D	This is the classic fader, slider (but of course we had to name it differently). Use it to tweak tweak tweak those sounds. Create your own front panel display. Performance oriented. The Push has 100 mm (3.94") range. The Push2D senses in 2 directions and has ± 5 mm (± 0.2") range, and is spring-loaded (ie. will return to middle position when not touched)..

Contact pressure	No	Touch, TouchMini, TouchMiniOn, TouchMicro, TouchStrip, TouchStrip On	A sensor no one should do without. Contact pressure provides continuous control. Can be easily worn or applied to a variety of flat surfaces. Trigger those samples! The Touch, TouchMini, TouchMicro and TouchStrip all sense from 1 N (0.1 Kg, 0.2 lb) all the way upto 100 N (10 Kg, 23 lb) respectively on a square surface of 37.5 mm (1.48") x 37.5 mm (1.48"), on a 13 mm (0.51") diameter disk, on a 5 mm (0.2") diameter disk and along a strip of 60.9 cm (24.0") length and 13 mm (0.50") width. The TouchMiniOn is the low-res version of the TouchMini. Triggers at 1 mm (0.04") travelor 2.0 N (0.20 Kg, 0.45 lb) weight. The TouchStripOn is the low-res, stomp version of the TouchStrip. Triggers at 1.5 mm (0.059") travel or 3 N (0.3 g, 0.7 lb) weight. Both low-res versions are suitable for control freaks who think button, knob, button, slider, foot switch, ...
Contact pressure	No	TouchGlove	A controller for drum machines at your fingertips. A very expressive and natural sensor. Includes 6 pressure sensors per glove - five on the fingertips and one on the palm, each 13 mm (0.51") in diameter and capable of sensing from 1 N (0.1 Kg, 0.2 lb) to greater than 100 N (10 Kg, 23 lb).
Distance	Yes	FarReach	Create a huge presence. Ultrasonically senses distances of objects, persons, walls from 0.15 to 12 m (0.49 to 39 ft.). Is invisible to the audience. Not suitable for low volume sound installations.
Flexion	No	BendShort, BendMini, Bend Micro	Bend your fingers and control your lights. Goes from 0° to 180° (larger flex angle possible). BendMicro, BendMini and BendShort have different lengths.
Humidity	Yes	Hot&Humid	Let's get steamy, huh ! Measures both temperature and humidity. Can you handle temperatures from 0° upto 60° C (32° to 140° F) and a relative humidity from 10 % all the way to 95 % ?
Illumination	Yes	Flash	Detects rapid light changes or light flashes, including infrared, within a narrow field of view. Create a light beam switch using the SeeLaser or SeeIR that triggers when you cross it or use it as a continuous controller to sweep your filters. Detects upto 1000 Lux (5.0 mW/cm2) within a 20°-wide cone field of view.
Illumination	Yes	Light	Responds to white light from a wide viewing angle. Put fish in a bowl with lights below and let the fish shadows play (fish not included). Detects upto 10,000 Lux (50 mW/cm2) within a 180°-wide cone field of view.
Inclination	No	Tilt2D, TiltOn	The Tilt2D senses inclination in two dimensions simultaneously. Attach this sensor to your head to find out if you still can walk straight Saturday night at 4 am (or whether you're actually balancing on your head). Bonus: it is identical to the GForce2D so can sense acceleration and deceleration too ! Tilt2D senses a full 360° in two tilt axes, TiltOn only detects whether something is tilted or not (ie. on/off detection). It is a low-res tilt sensor. Triggers at 3° tilt (in one direction).
Magnetism	Yes	Magnetic	This sensor will show you the mysteries of magnetism. Range more than ± 1000 Gauss.

Interaction	Env.	Actuator	Applications
Movement	No	MoveOn	Detects movement within a range of 3 m. Be there not or be I-CubeXed.
Proximity	Yes	Close	A touchless sensor. Re-construct the front panel of Star Trek's USS Enterprise. Works from 25 mm (1.0") to 175 mm (6.9"). Sensitive to ambient lighting conditions !
Proximity	No	ReachClose	A sensor for waving at your gear. Leave your fans in awe of your magic majestic gestures. Reaches up to 80 cm (31") distance. Insensitive to ambient lighting conditions.
Proximity	Yes	Reach	One of our most popular sensors which work along the principle of the Theremin. Put your hands into its electromagnetic field while mapping it to Pitch Bend and create spooky movie music. Ranges upto 15 cm (5.9").
Rotation	No	Orient	Where do you want to go ? No, this is not some Microsoft gadget. Find east, west, south, north with this sensor.
Rotation	No	Turn	Tweak tweak tweak those sounds. Comes with funky black knobs. Perfect for your own front panel display. Performance oriented. Turn from 0° to 300°.
Temperature	Yes	Hot, Hot&Humid	Our "Mood Ring" sensor. Let your own body heat play your sequences or be adventurous and let the number of people in a room increase the heat. Warning: does not change color! Detects from -40° to 100° C (-40° to 212° F). The Hot&Humid also measures humidity.
Weight	No	TapTile, TapOn	For sensing walking, jumping and yes.. tapping. Can be covered to hide the tile. Put it on the dance floor or underneath your door mat. Senses from 45 to 1000 N (4.5 to 100 Kg, 10 to 227 lbs). Tapon just detects whether pressure is applied (ie. on/off detection), while the TapTile measures weight. It is the low-res, compact version of the TapTile. Suitable for control freaks who think knob, button, slider, foot switch, ... Requires 7 mm (0.3") travel or 20 N (2 Kg, 4.54 lb) weight to trigger.

Interaction	Env.	Actuator	Applications
Illumination	No	See, SeeIR, SeeLaser	An LED which provides visual feedback. Use it to monitor your MIDI messages or as a hi-tech Christmas tree decoration. Available in a green as well as (invisible) infrared. The SeeLaser is a laser LED actuator which works excellently in conjunction with the Flash sensor to make trigger beams that control your interactive music piece. Possibly the most unlikely way a diamond thief will find out about the captive powers of the I-CubeX. The SeeIR can also be used in this way with the Flash to make invisible beams (of shorter lenght though than the SeeLaser).
Motion	No	Switch	A low power control signal switcher. Advance your slide projector with each MIDI signal. Turn on your fan, your lights, your appliances, your fog machine, your micro wave. Handles at most 200 V DC at 1 A.

The above list of sensors and actuators is subject to change without warning. For information on our latest sensors and other products, contact us directly or check our web site at

http://InfusionSystems.com

Building your own sensors

Warning: Infusion Systems Ltd is not liable for any personal , Digitizer, or sensor damage due to the use or mis-use of custom (user-)built sensors.

Before constructing or testing your custom sensor, read the following points.

Things you'll need:

1. a HackCable (see our catalogue) - custom sensor connector
2. a multimeter
3. a soldering iron
4. a basic understanding of electronics
5. your sensor

Important things to keep in mind:

1. Your custom sensor's voltage range must be between 0 to 5 Volt. Any output voltage above 5 Volt may result in permanent damage to the Digitizer.
2. Your sensor should not draw more than 30 mA of current.
3. Test your sensor for correct voltages and current drain with your multimeter.

4. Connect your sensor's power input (+) to the HackCable's red (top, power) wire.
5. Connect your sensor's ground (-) to the HackCable's black (bottom, ground) wire.
6. Connect your sensor's signal output to the HackCable's white (middle, signal) wire.

7. We strongly recommend against using your own power supply (to power your sensor).

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