

Wind Instrument Building

AMRO'22 - Debug

Marije Baalman & Enrique Tomas

June 17

Overview

- Pick a kite
- Build your own sensors
- Receive data on your laptop or smartphone
- Fly the kite
- Listen to the kites roar, squeek and make other sounds

On the first day of the workshop we will fly some kites and use *conductive foil* and *copper tape* to create sensors that are affected by flying the kite.

- For example, we can make a pressure sensor, that measures the pressure of the wind on the kite.
- Or we can create a tail for the kite that can measure the turbulation of its own movement.

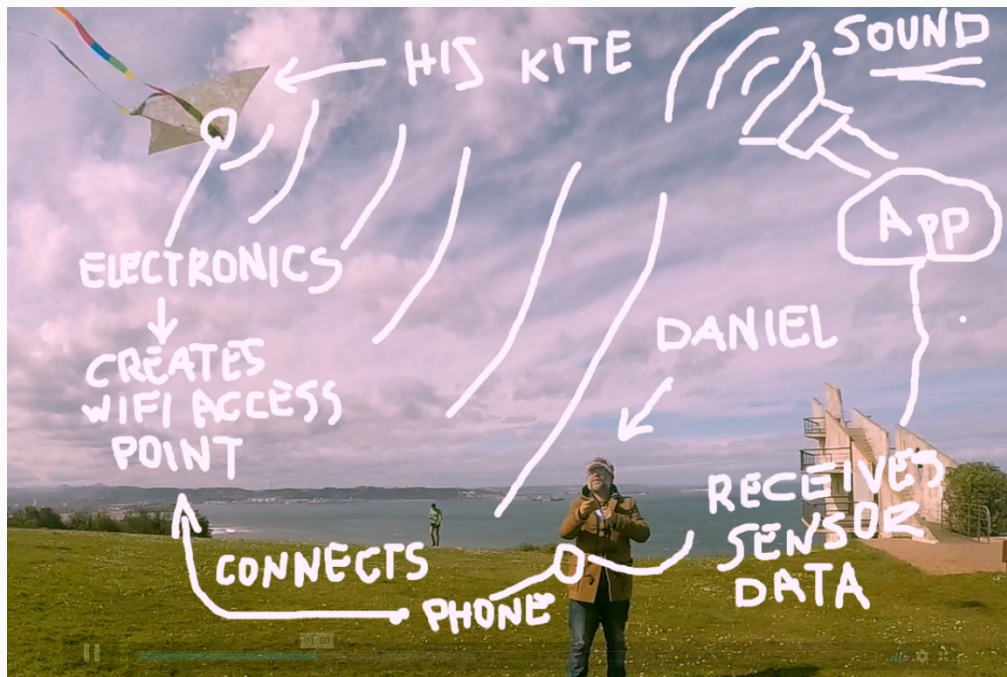
We will create these sensors, measure their resistance with multimeters, and solder wires and resistors to connect them to a sensor board.

We will attach the sensors to an Olimex ESP32-S2 board, that creates a WiFi point, and sends out data as OSC data.

You can view this data in Processing, SuperCollider or PureData, and use it to map it to sound or visuals.

Tomorrow, we will showcase our results by flying the kites, and listening to how they sound!

Setup concept



Introductions

About Marije

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- Active since 2001 making electronic music performances and since then have also created several installations.
- Working in different collaborations with other artists.
- From sound now also using other media such as light.
- Moving towards more conceptual work.

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Engaged in the open source community since around 2002. Contributions to SuperCollider, co-organised the LAC2007 in Berlin, open source hardware *Sense/Stage MiniBee*.

- <https://marijebaalman.eu>
- <https://nescivi.eu>

Composing Interactions

An Artist's Guide to Building Expressive Interactive Systems



About Enrique

<http://ultranoise.es/>



Round of introductions

- who are you?
- what is your background?
- what do you hope to learn during the workshop?
- which experience do you bring to the workshop?

Keep it concise :)

Wind Instruments



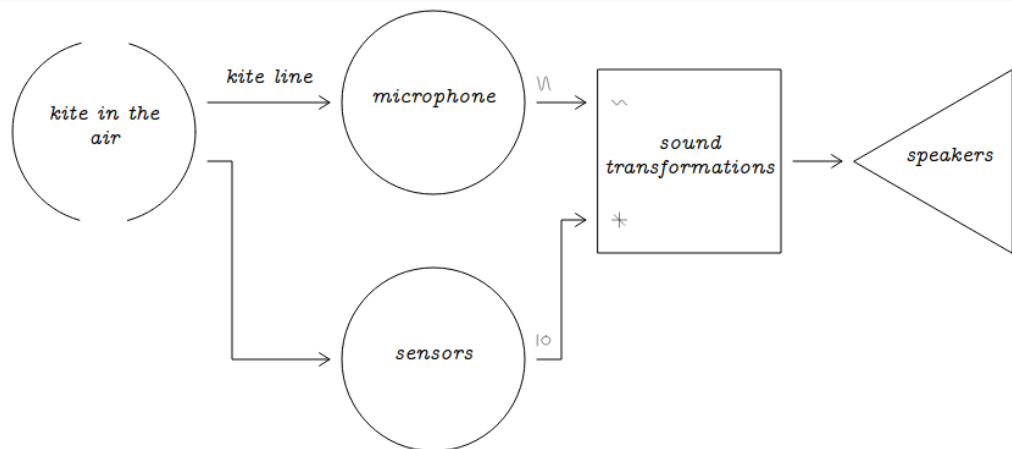
Video link

V.L.I.G. (vliegen, liggen in gedachten)

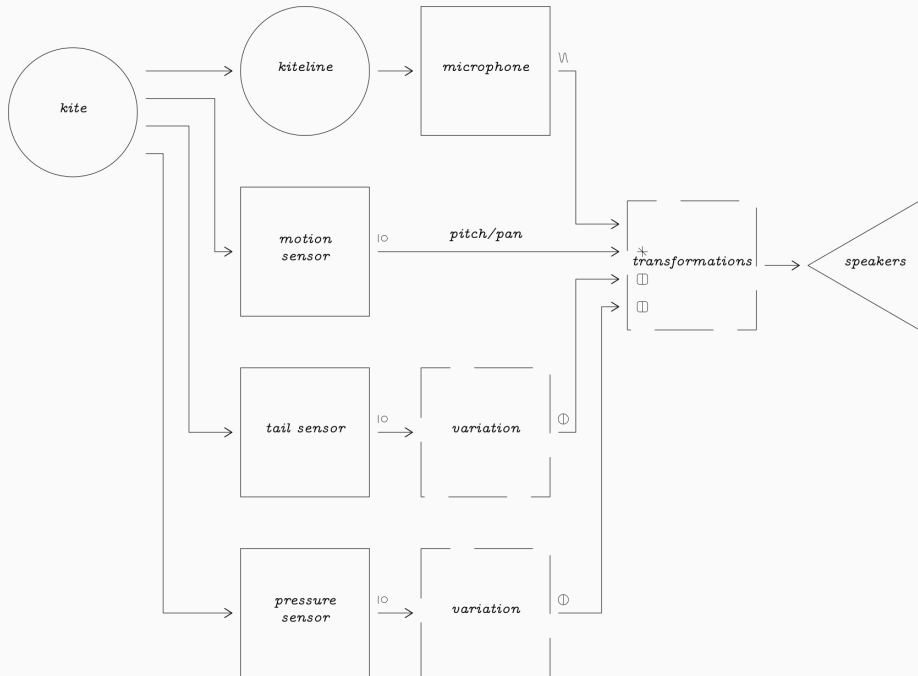
(flying, lying in thought)

Current exhibition at Siou-Long Cultural Park in Tainan (Taiwan)





V.L.I.G. - detailed concept

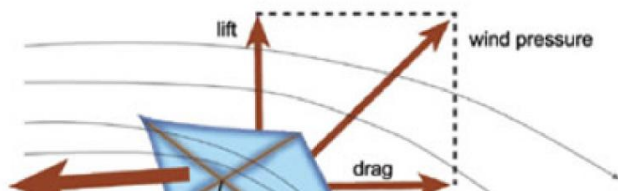
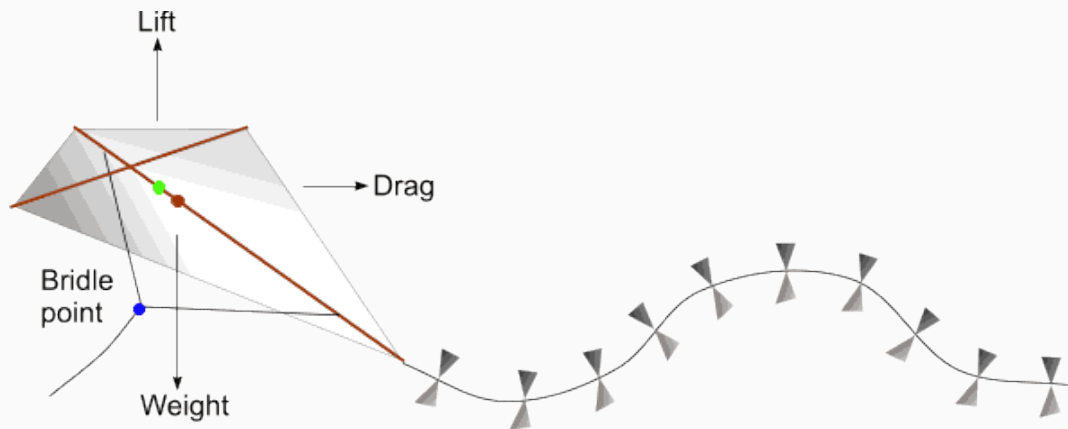


Beep Beep Vuela workshop video

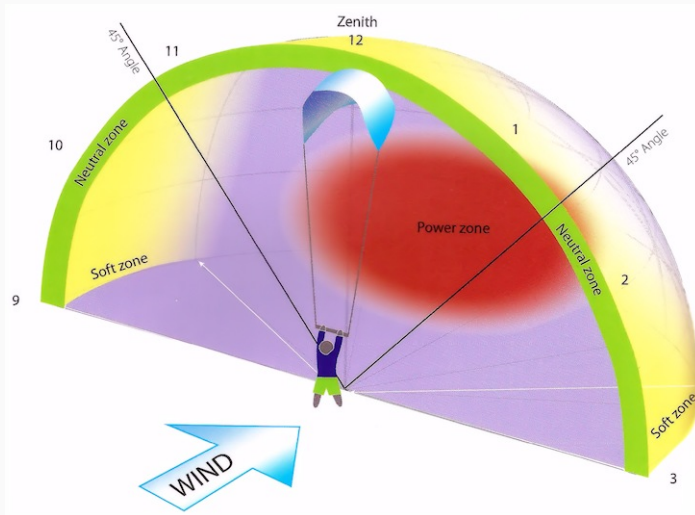


Kites, air, forces and knots

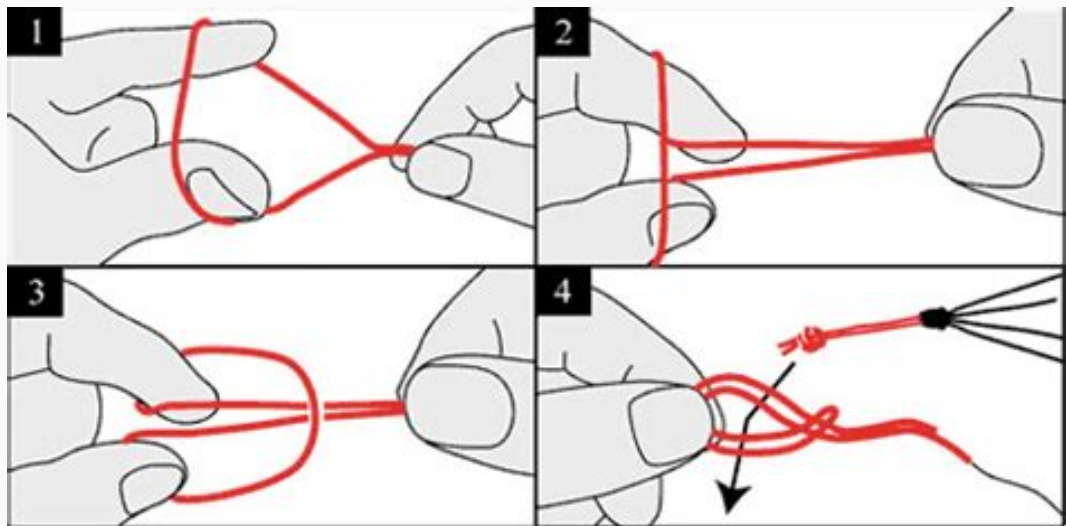
Air and forces



Wind window



Useful knot to know



Making sensors

What is a sensor?

Sensors transform or transduce one form of energy into another.

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For example:

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Most often a sensor is used to measure a physical quantity, and transform it into an electronic signal.

Self-made sensors: conductive materials and resistance

Using conductive materials, you can create your own sensors.

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For example:

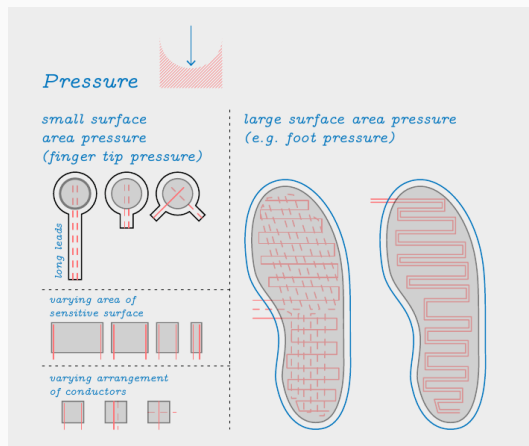
- a pressure sensor - by layering conductive materials: as they are pressed together the layers make more contact and the electronic resistance between them changes.

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Making a pressure sensor

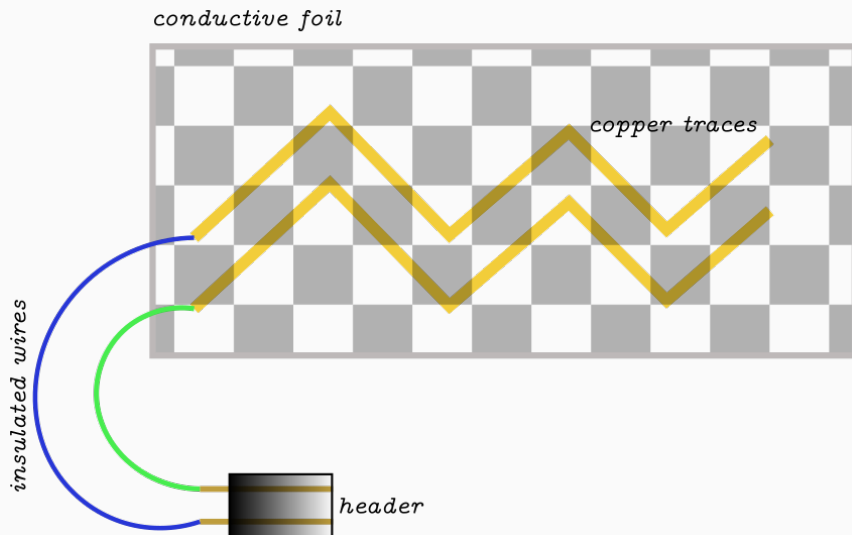
- copper tape
- conductive foil

For the connections:

- insulated copper wires
- copper tape
- header pins

Construction with copper tape

- stick two traces of tape to the kite fabric
- add a layer of conductive foil, that is loosely at the back of the kite surface



- Pre-tin the wires, by letting some solder into it
- Pre-tin the copper tape, by letting some solder into it
- Pre-tin the header, by putting some solder onto each pin

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- Solder the wire onto the copper tape
- Solder the wire onto the header

- Tape the copper tape onto the foil
- Tape the copper tape onto the thread

Alternately, you can also solder directly onto the conductive thread

*Warning: if you put the copper tape onto the foil **before soldering**, the foil will melt when you try to solder*



Making a kite tail sensor

Kite tail



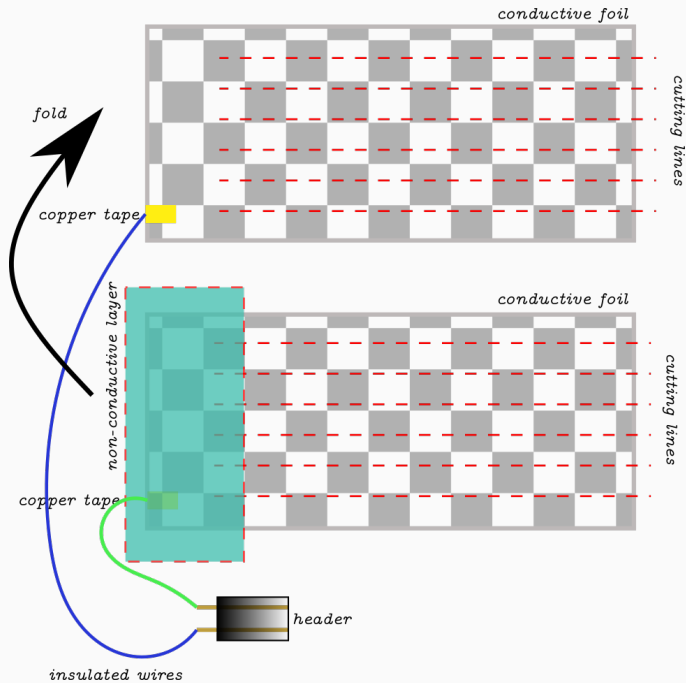
- conductive foil

For the connections:

- insulated copper wires
- copper tape
- header pins

- determine the length of the tail
- cut two large pieces of conductive foil, that have the length of the tail and a good width
- determine the length of the tail stripes
- put some insulating material at the top between the two layers, and on the outside of the layers
- make long cuts in the material to create the stripes, but make sure that the layer at the top stays connected
- fold the tail up
- sew or tape the tail so that it stays in the desired shape
- attach a piece of wire so that you can connect it to the kite.

Construction



- Pre-tin the wires, by letting some solder into it
- Pre-tin the copper tape, by letting some solder into it
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- Solder the wire onto the header
- Tape the copper tape onto the foil

*Warning: if you put the copper tape onto the foil **before soldering**, the foil will melt when you try to solder*

Circuit to measure the resistance

Measuring resistance



Voltage divider

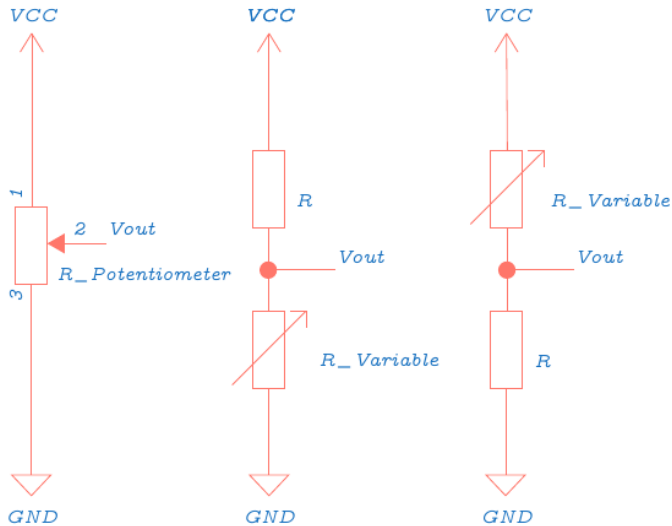


Figure 5.17 — Electronic circuits for the voltage divider. The left image is a potentiometer or slider, on the middle and right are

voltage dividers for a variable resistor in series with a fixed, static resistor.

Calculating the best resistance for the second resistor

The voltage that can be measured can be calculated with the formula:

$$V_{out} = \frac{R}{R + R_{variable}} V_{cc}$$

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The best resistor to use with your resistive sensor can be calculated with the following steps:

- Measure the value of the resistance of the sensor when fully pressed:

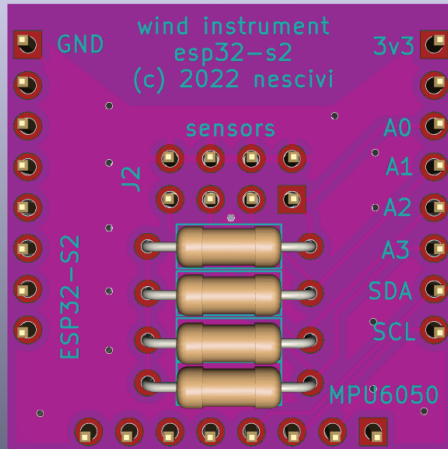
$R_{pressed}$

- Measure the value of the resistance of the sensor without pressure on it:

R_{free}

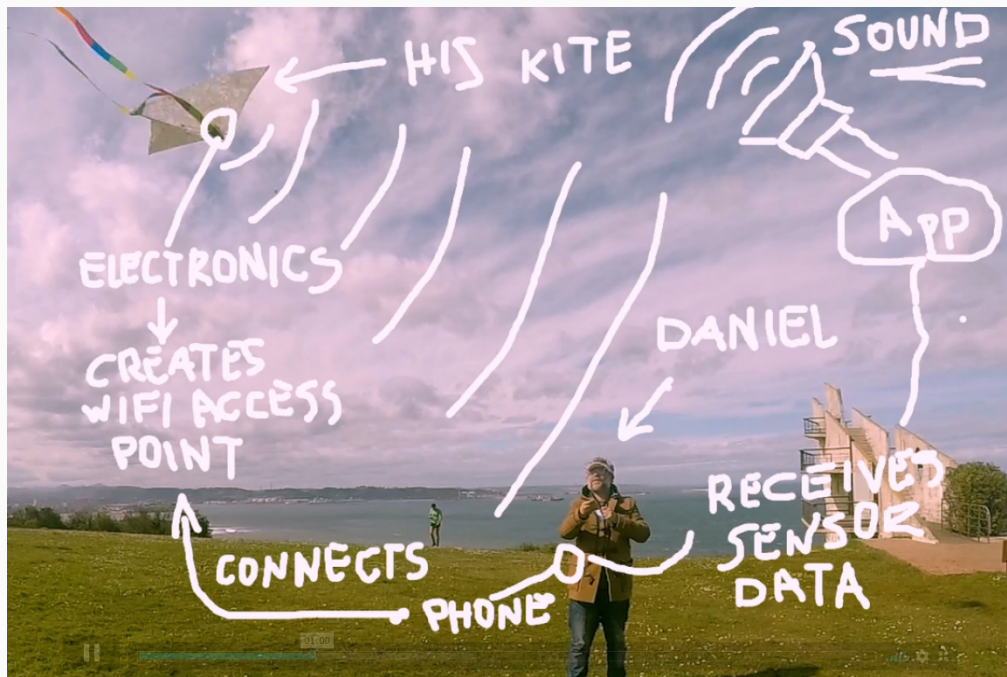
- Multiply the two values measured: $R_{pressed} * R_{free}$
- Take the square root of this: $\sqrt{R_{pressed} * R_{free}}$
- Take a fixed resistor that has a resistance value close to this calculated value.

Soldering the resistor onto the PCB



Receiving data

Setup

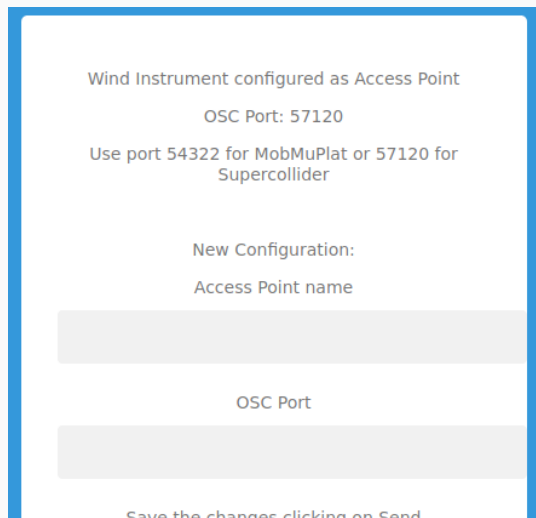


<https://github.com/sensestage/wind-instrument-building>

- drawings: sensor construction drawings
- kicad/esp32-shield/esp32-shield: pcb shield design
- esp32: folder with the firmware and software for this workshop
 - esp32: firmware files for the board, we use `wind-instrument-kike-v1`
 - supercollider: files with code to run in SuperCollider to view and sonify data
 - MobMuPlat: files with code to run in Pd or on the smartphone to sonify data

Configuration via the browser

- Connect to the WiFi of your sensor board (e.g. Wind-Instrument-1)
- With the browser go to `http://192.168.0.1`
- Configure a unique name for your sensor board
- Change the UDP port to send data to
 - 57120 for SuperCollider
 - 57322 for MobMuPlat



Wind Instrument configured as Access Point

OSC Port: 57120

Use port 54322 for MobMuPlat or 57120 for Supercollider

New Configuration:

Access Point name

OSC Port

Save the changes clicking on Send

- `'/analog'` - 4 float values for self-made sensors: between 0 and 1
- `'/accelero'` - accelerometer (MPU6050) 3 axes: between -2 and 2
- `'/gyro'` - gyroscope (MPU6050) 3 axes: between -600 and 600
- `'/angles'` - orientation (calculated from the MPU6050): between -180 and 180 degrees

MobMuPlat is an open source environment that allows to create GUI interfaces for the smartphone, and run Pd patches in the background.

- install MobMuPlat in your smartphone and its development package from <http://danieliglesia.com/mobmuplat/>
- download all source code from the wind-instrument-building repository
- copy all files from “MobMuPlat” to your smartphone mobmuplat folder
- connect your phone to the kite access point and run mobmuplat examples

<https://github.com/sensestage/wind-instrument-building/esp32/MobMuPlat>

- view data
- process data
- map to sound

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Quarks:

- SenseWorld
- DataNetwork
- adclib

<https://github.com/sensestage/wind-instrument-building/esp32/supercollider>

<https://marijebaalman.eu>

- iii - instrument inventors initiative
- Some images are taken from the book *Composing Interactions*
- the research for the book *Composing Interactions* was funded by Creative Industries Fund NL