SENSING FOR VISUALIZATION

A Wiring and Processing workshop to read and visualize data

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Sensing for Visualization is an introduction to analog sensors and interactive graphics visualization. It includes circuit designs and programs to get started capturing data from the outside world. Reading data from our environment can be useful to create sensible interfaces that respond to our presence.

The analogue sensors covered in this workshop will be: photocell, potentiometer, switch and accelerometer. This sensors respond to light variations, touch, movement and orientation. Using inexpensive microcontrollers (Wiring/Arduino), electronic components and open software, you can prototype circuits to read meaningful data from the environment.

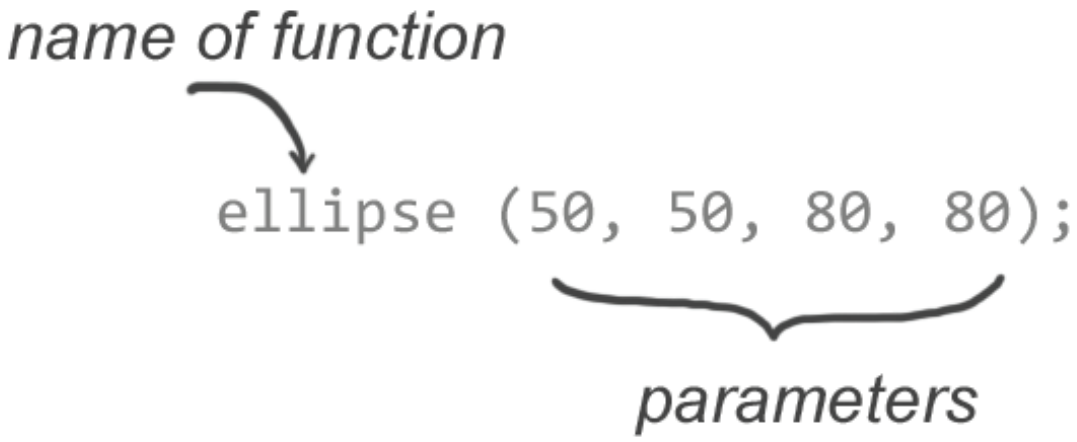
1.Functions

Before we start using the Wiring analog inputs, lets review some of the programming elements. In Processing, the syntax is almost identical to Java, but processing adds special features related to **graphics** and **interaction**.

1. Download the Processing IDE visiting
   www.processing.org/download
   At the bottom of the page, choose to download
   Processing 1.5.1 (Stable release)

2. Install program and open it

You can type commands to easily draw images on the computer screen by using predifined graphic functions such as ellipse() and rect(). Each function is conformed by its name and parameters. This processing function below draws an ellipse on the screen using the points (50,50) as center and a dimension of 80 by 80.

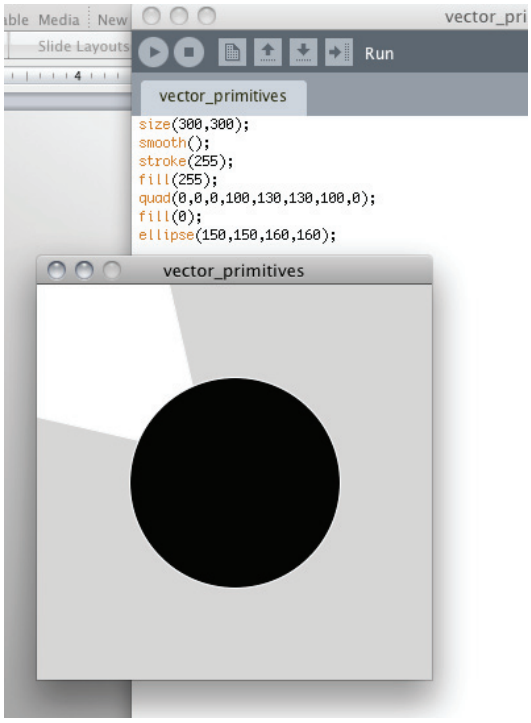


You don't need to memorize all the processing functions, but you will become familiar as you use them. The most helpful part is that you can find the meaning of the specific syntax in the Processing's reference (http://processing.org/reference/). From the reference we learn that:

ellipse(x, y, width, height);

2.Variables

The parameters from our functions can be changing numbers instead of fixed ones. These results can be used to create interactive systems that respond to a user's input. Taking in consideration that each parameter can be a variable that changes in time, we can alter graphics characteristics such as the size, the position, the color among many other properties.



Color variables (values range from 0-255)

tint(R,G,B,Alpha);
fill(R,G,B,Alpha);

3.Wiring + Processing

To allow your Wiring board read variable data in processing, you must first complete the following steps:

1. Download the Wiring IDE visiting www.wiring.org.co/download

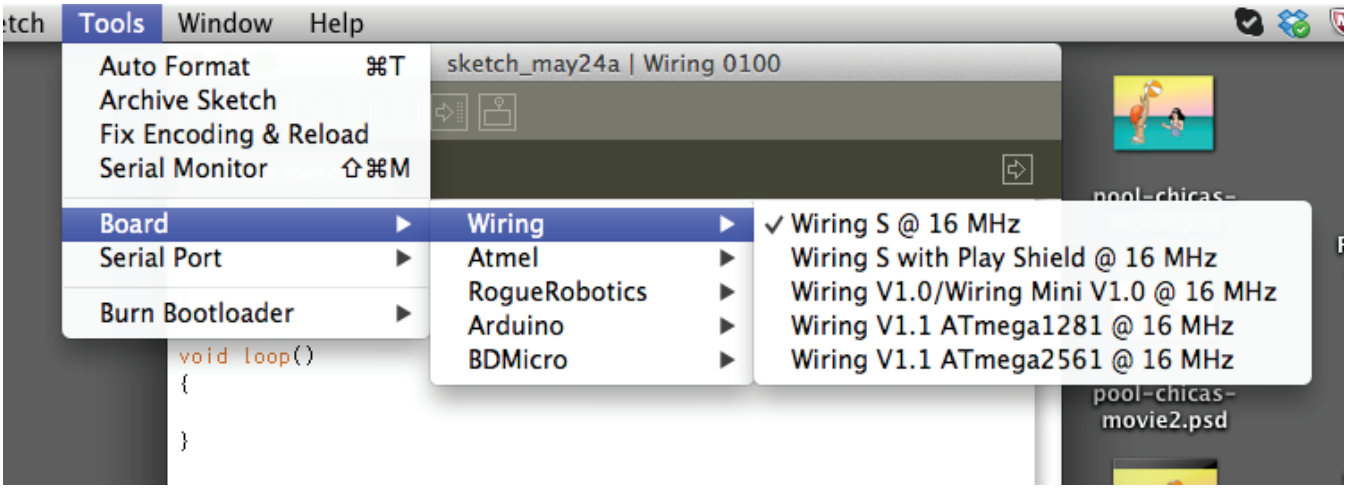
2. Install the FTDI Drivers first and then the application

3. Run the Wiring IDE for the first time and plug in your board to the USB port

4. In the tool bar go to: Help / examples /Core / Firmata/ examples/ StandardFirmata

5. Chose your board and Serial port (should be the one starting wity usb

6. Click on the “Upload to Wiring Hardware” button



7. Close the Wiring and Processing IDEs

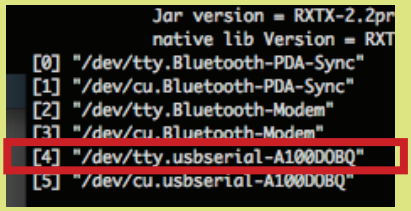
8. Install the wiring library for processing in the processing/libraries folder. The library and examples can be downloaded in: http://wiring.org.co/reference/libraries/FirmataProcessing/

9. Open Processing1.5.1

10. Copy and paste the following code to verify that Processing is controlling the board through the firmata:

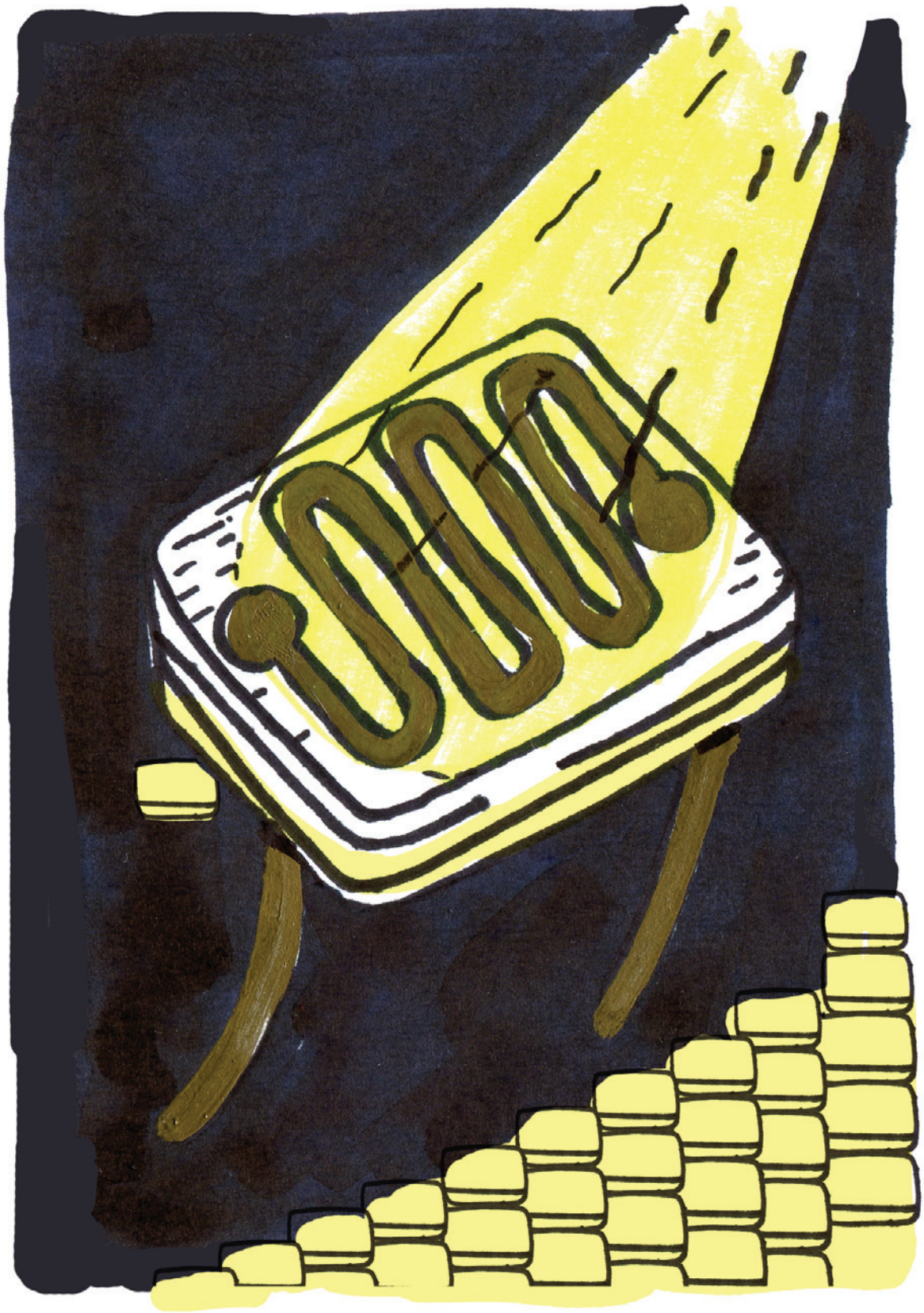
```
import processing.serial.*;
import Wiring.*;
Wiring wiring;

void setup() {

  println(Wiring.list());
  wiring = new Wiring ( this, Wiring.list()[4], 57600);
  wiring.pinMode(15, wiring.OUTPUT);
}

void draw(){

  wiring.digitalWrite(15, Wiring.HIGH);
  delay(3000);
  wiring.digitalWrite(15, Wiring.LOW);
  delay(2000);

}
```

The computer needs to know which port the board is using. Fill in the right number that fits your USB connection port. You will see when you run the program the first time



The above program controls the timing of the LED (15) that is included in the Wiring S board

4.Reading Analog Data



Photocell

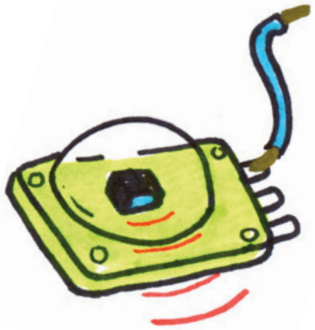
Analog Sensors

Depending on your choice to interface with the environment, you can use different sensors. The photocell is sensitive to light, the potentiometer is a knob, and the accelerometer responds to it's inclination. In all these cases, the user is manipulating data, and the data can be meaningful for creating user experiences. We assume that environment variables can be also computer variables or parameters, and therefore used to manipulate values in the screen.

Button Switch

Every sensor has a different behavior, but when we read physical data in the computer we will have numbers. These numbers can be used as parameters of a computer program. The numeric values that the computer can read is an interval between 0 – 1023. We will use this interval as a range of variability.

Potentiometer

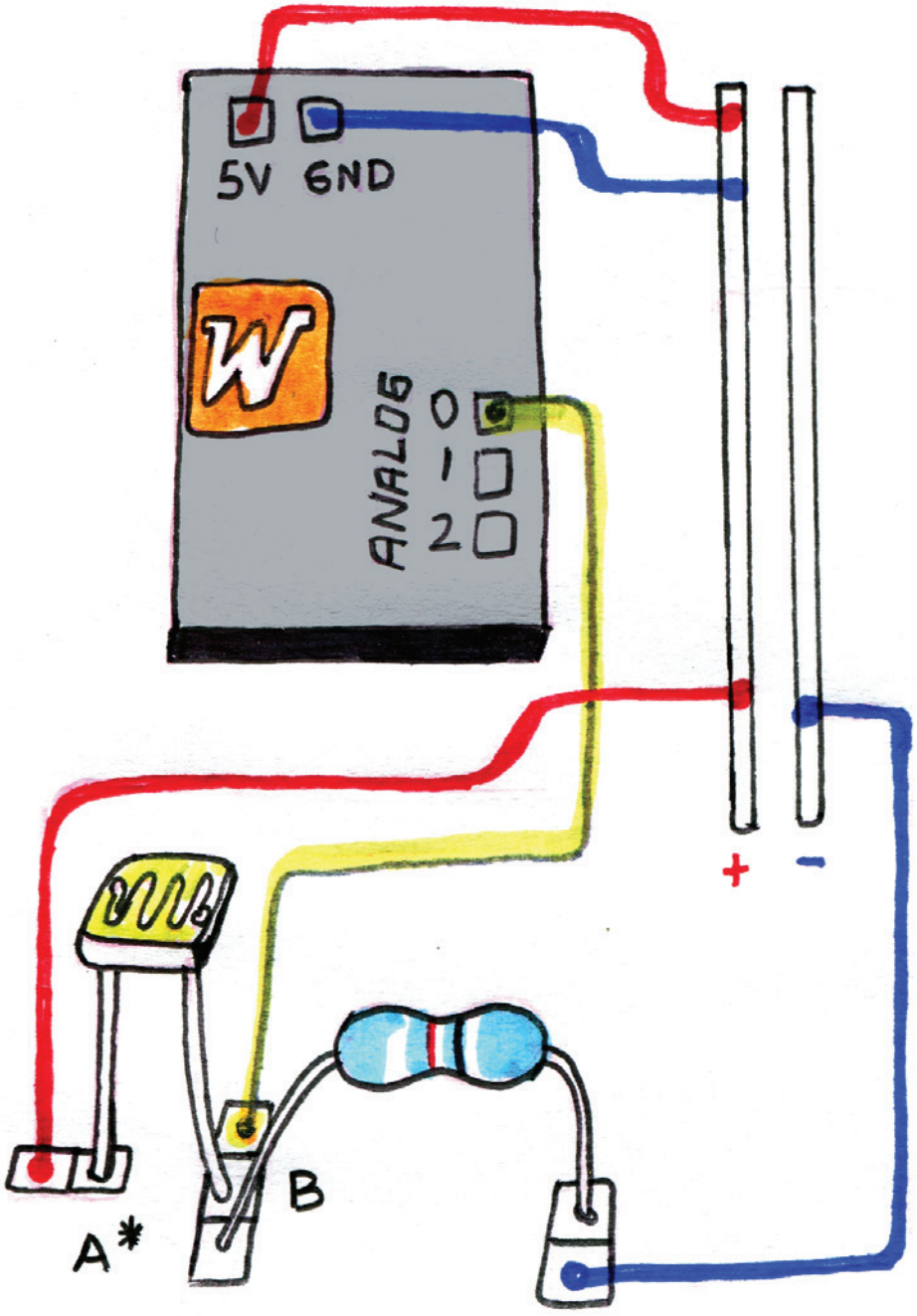


PIR motion sensor

Jumper wires

5.Visualizing one variable

Build the circuit below:

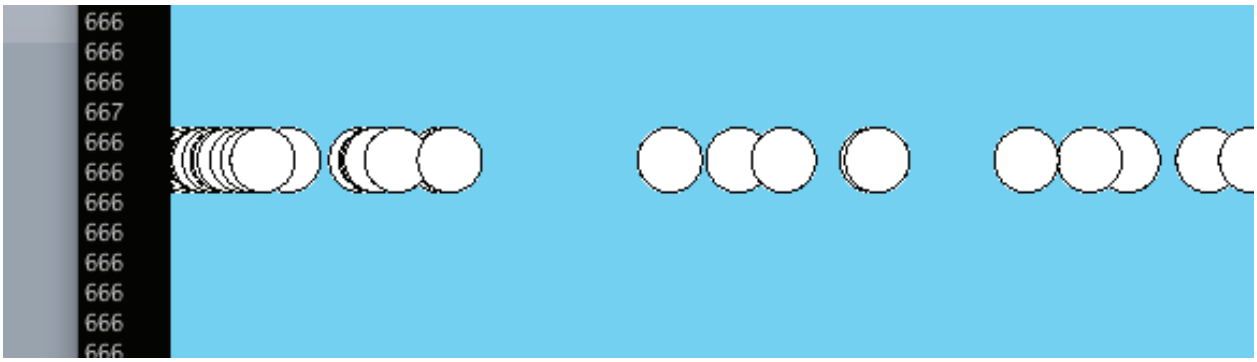


* You may replace the connection A-B with a potentiometer or a switch

Copy and paste the following code in processing:

```
import processing.serial.*;
import Wiring.*;

Wiring wiring;
int val;

void setup() {

  size(720,500);
  frameRate(10);

  println(Wiring.list());
  wiring = new Wiring ( this, Wiring.list()[4], 57600);
  wiring.pinMode(0, wiring.INPUT);
}

void draw(){
  background(150);
  val=wiring.analogRead(0);
  ellipse(val,250, 10,10);
  println(val);
}
```

The variable “val” is the numeric value captured by the photocell. The function *wiring.analogRead(0)* means that wiring reads the analog port #0 on your board. The function *pritln();* allows us to se the true numeric value of “val.” Now the ellipse moves along the x-axis of the screen because of *ellipse(val,250, 10,10);*



6.Calibration

Using the function map(); we can adjust the range of the maximum and minimum values of our sensor. Depending on the context it won't always be 0-1023.

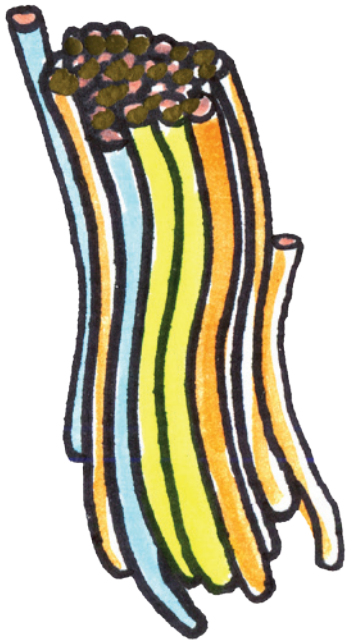
Output range desired

value= map(val, 0, 1023, 0, width);

Input range from analog read

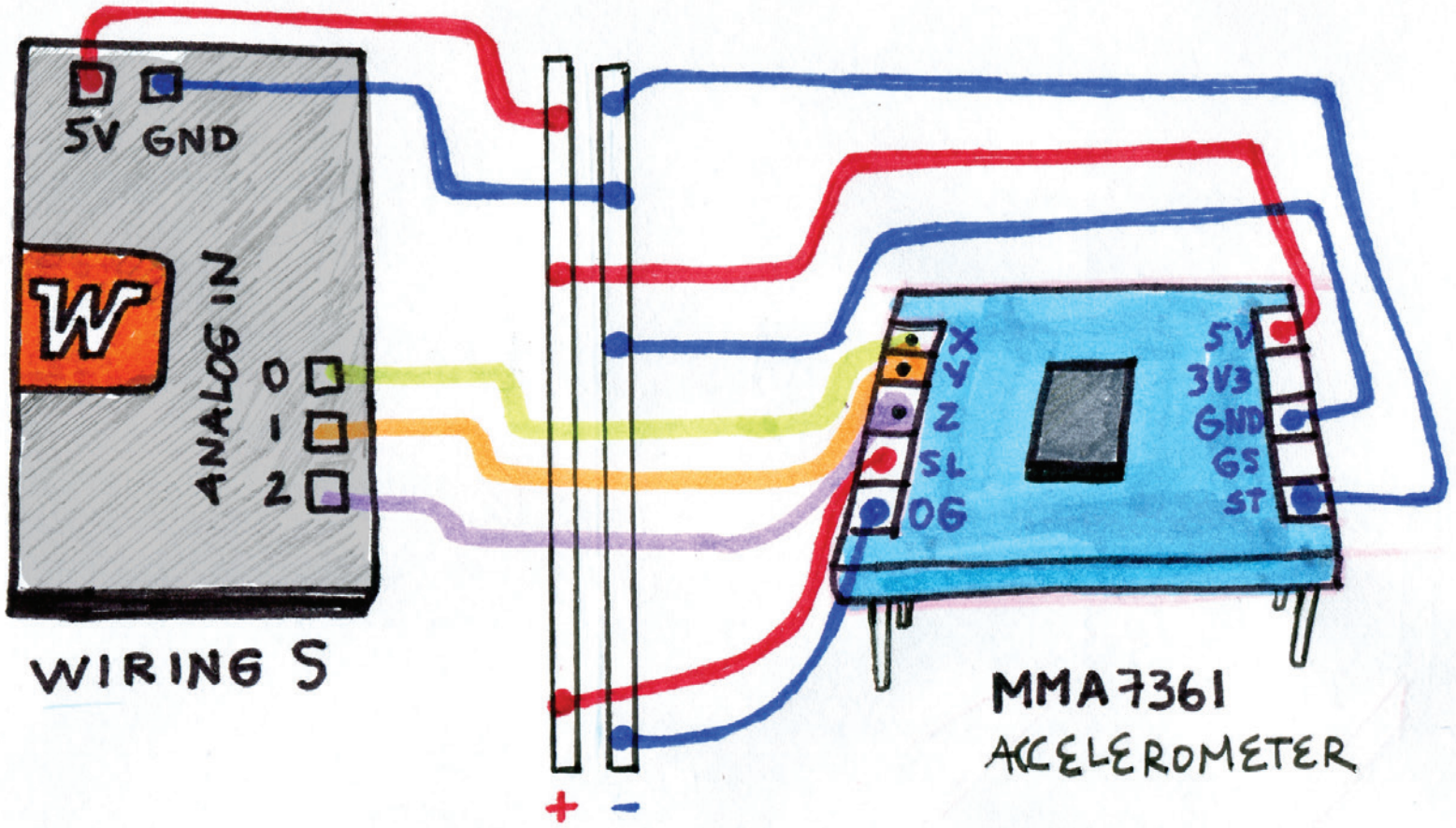
The desired range can be the size of the screen for example, therefore we use the variable *width*. The new code with the *map();* function added will be:

```
import processing.serial.*;
import Wiring.*;

Wiring wiring;
int val;
float value;

void setup() {

  size(720,500);
  frameRate(10);
  println(Wiring.list());
  wiring = new Wiring ( this, Wiring.list()[4], 57600);
  wiring.pinMode(0, wiring.INPUT);
}
void draw(){
  background(150);
  val=wiring.analogRead(0);
  value=map(val, 0, 1023, 0, width);
  ellipse(value,250, 10,10);
  println(val);
}
```



7.Accelerometer

Can you create a program that reads 3 variables at the same time? How would you alter your visualization? Use the same code adding new variables.

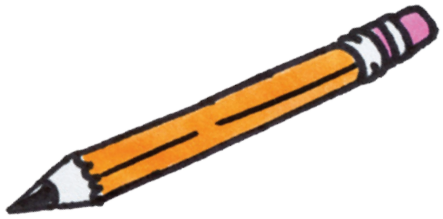


8.Programming Objects

Another of the element that may play importance while using graphics is the concept of a programming "object." A programming object is related to real objects in the sense that they have specific charactersitscs.

Say a pencil...

- Is yellow
- It's 7 inches
- Has an eraser



In the same way, every "object" in programming has different properties. You can change the size, position, hue and many other properties by applying variables to each individual object.

In programming we can "call" the characteristics (or properties) of the objects and use them as variables. Objects can be movies, bitmaps vectors, sounds, etc. For raster graphics, we use the PImage object:

```
PImage b; //creates the object
b = loadImage("mar.png"); // assigns a file to that image object

image(b, 0, 0); // the function image draws "b" in the screen point (0,0)
```

We can also explore more in the reference to learn about the properties of the image object. In the case of the image, the syntax explains:

image(img, x, y, width, height, opacity)

To access the object's properties we use "." To refer to that object for example the width of image b is noted as "*b.width*"
Experiment in processing bringing images and modifying their properties using the following code. Remember to save image in the "data" folder of the same sketch.

```
PImage a; //creates the object a

void setup() {
  size(800, 600);
  a = loadImage("name of your image.png");
 }

void draw() {
  image(a,400, 300, a.width*val, a.height*val);
  }
```

Can you change the size of an image using the potentiometer or accelerometer?
The expression *a.width*val* takes the original width of the image and multiplies the size by the value of the variable "val"

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Thanks to Hernando Barragán for his work developing Wiring. He revolutionized the practice of electronic art and made physical computing more approachable. Wiring-based hardware has become ubiquitous for hobbyists and engineers alike. At school in Colombia, Hernando taught us that programming is a lot of fun.
The Wiring website includes extensive documentation and examples of this project. For more information visit www.wiring.org.co