Project 11: Electronic Gradienter

In this chapter, we will be putting together the data collected by the accelerometer and import them into "Processing", a visual art software sketchbook which Arduino IDE is based on, to plot a 3D model showing the gesture of 101 in real time.

COMPONENTS LIST

No further component is needed in this chapter.

HARDWARE CONNECTIONS

No hardware connection is needed in this chapter.

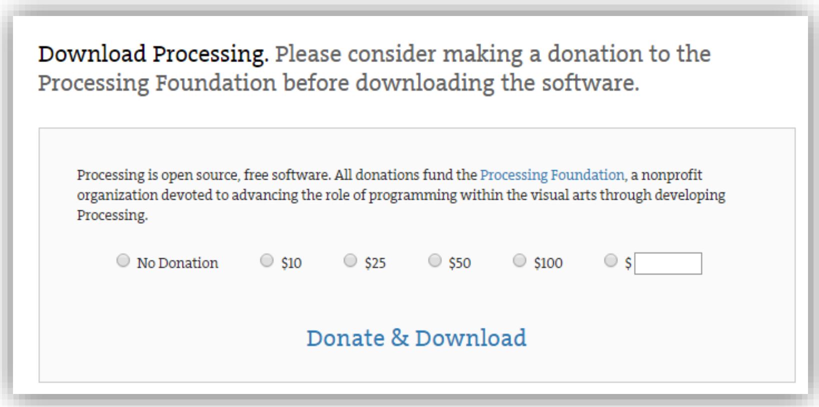
Build an electronic gradienter

In this section, we will introduce the "Processing", a wire communication based software that converts real-time data into 3D graphics. Due to the limitation of the space, we will not go deep into but just show you how to import data and plot our object. However, it is strongly recommended to learn more if building visual interactive projects is of your interest.

Download Processing

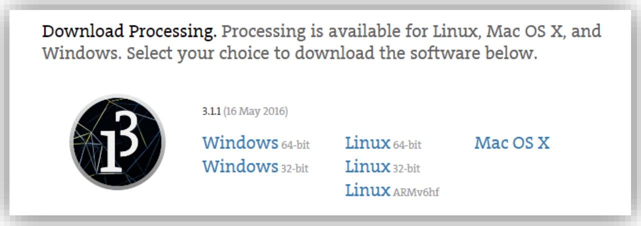
Go to the link below and follow the guide to start download.
https://processing.org/download/

Same as Arduino IDE, Processing is a free open-source software. You may choose the amount of donation of you want then click "Donate & Download" to go to the download page. Download the right version of Processing that is compatible with your operation system. This following part will be based on Windows 64-bit.

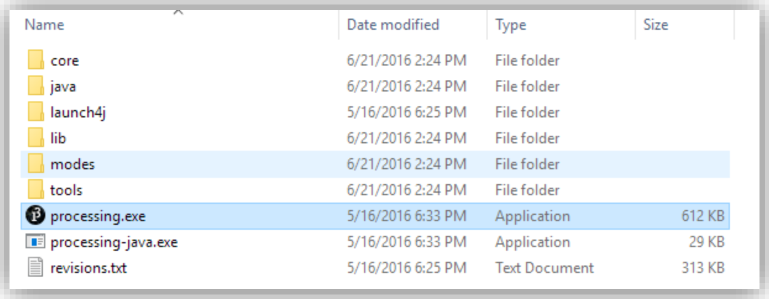


Download Processing. Please consider making a donation to the Processing Foundation before downloading the software.

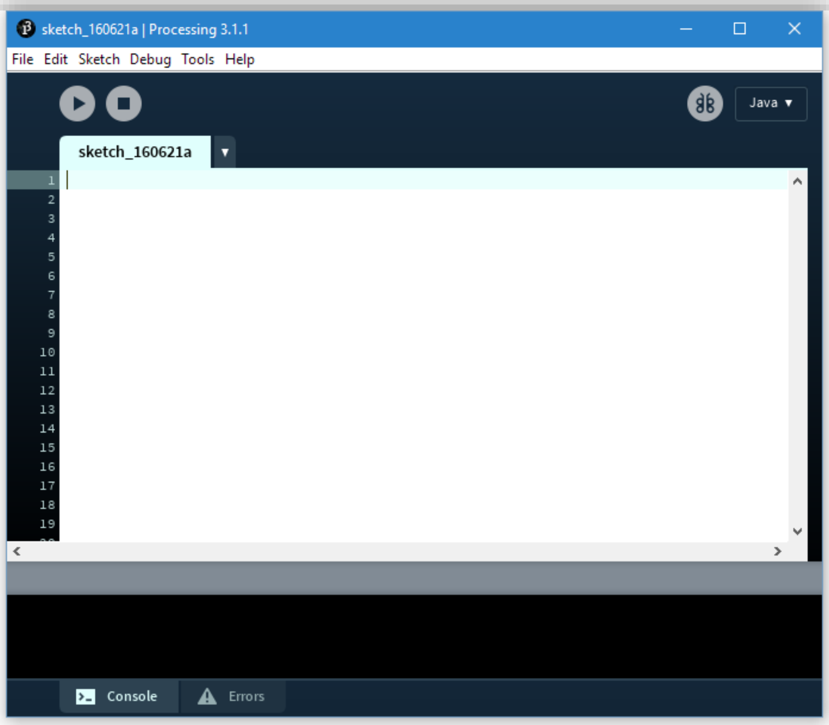
Processing is open source, free software. All donations fund the Processing Foundation, a nonprofit organization devoted to advancing the role of programming within the visual arts through developing Processing.


Download Processing. Processing is available for Linux, Mac OS X, and Windows. Select your choice to download the software below.

3.1.1 (16 May 2016)



Name	Date modified	Type	Size
core	6/21/2016 2:24 PM	File folder	
java	6/21/2016 2:24 PM	File folder	
launch4j	5/16/2016 6:25 PM	File folder	
lib	6/21/2016 2:24 PM	File folder	
modes	6/21/2016 2:24 PM	File folder	
tools	6/21/2016 2:24 PM	File folder	
processing.exe	5/16/2016 6:33 PM	Application	612 KB
processing-java.exe	5/16/2016 6:33 PM	Application	29 KB
revisions.txt	5/16/2016 6:25 PM	Text Document	313 KB


sketch_160621a | Processing 3.1.1
File Edit Sketch Debug Tools Help
Java
sketch_160621a
Console
Errors

To get started, we need first upload code to 101 to set it sending gesture data through serial port. Also, we need code for Processing to set it receiving data and converting into 3D plot.

CODE

Code for Arduino IDE

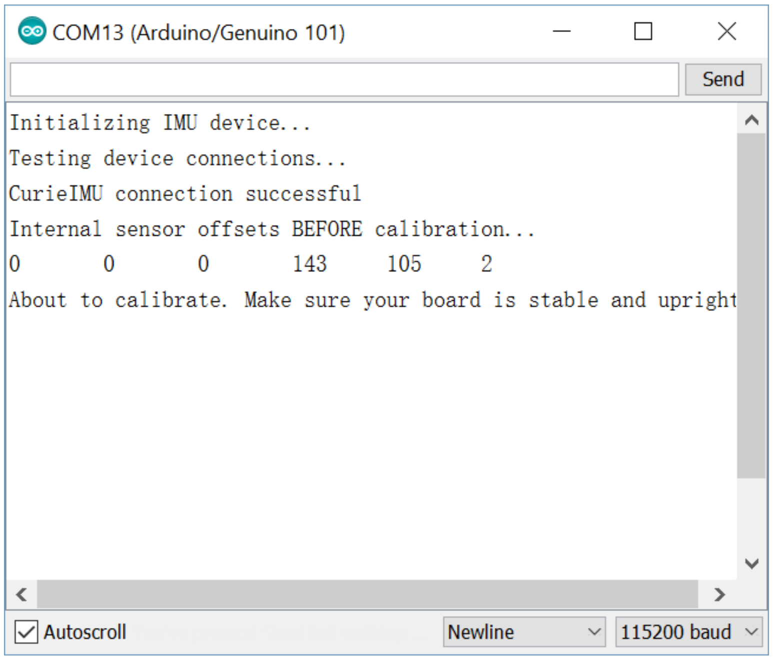
```
#include "CurieIMU.h"
#include "math.h"
int16_t ax, ay, az;         // accelerometer values
int16_t gx, gy, gz;         // gyrometer values

const int ledPin = 13;      // activity LED pin
boolean blinkState = false; // state of the LED

void setup() {
  Serial.begin(9600); // initialize Serial communication
  while (!Serial);    // wait for the serial port to open

  // initialize device
  Serial.println("Initializing IMU device...");
  CurieIMU.begin();

  // verify connection
  Serial.println("Testing device connections...");
  if (CurieIMU.testConnection()) {
    Serial.println("CurieIMU connection successful");
  } else {
    Serial.println("CurieIMU connection failed");
  }

  // use the code below to calibrate accel/gyro offset values
  Serial.println("Internal sensor offsets BEFORE calibration...");
  Serial.print(CurieIMU.getXAccelOffset());
  Serial.print("\t"); // -76
  Serial.print(CurieIMU.getYAccelOffset());
  Serial.print("\t"); // -235
  Serial.print(CurieIMU.getZAccelOffset());
  Serial.print("\t"); // 168
  Serial.print(CurieIMU.getXGyroOffset());
  Serial.print("\t"); // 0
  Serial.print(CurieIMU.getYGyroOffset());
  Serial.print("\t"); // 0
  Serial.println(CurieIMU.getZGyroOffset());


  Serial.println("About to calibrate. Make sure your board is stable
and upright");
  delay(5000);

  // The board must be resting in a horizontal position for
  // the following calibration procedure to work correctly!
  Serial.print("Starting Gyroscope calibration...");
  CurieIMU.autoCalibrateGyroOffset();
  Serial.println(" Done");
  Serial.print("Starting Acceleration calibration...");
  CurieIMU.autoCalibrateXAccelOffset(0);
  CurieIMU.autoCalibrateYAccelOffset(0);
  CurieIMU.autoCalibrateZAccelOffset(1);
  Serial.println(" Done");

  Serial.println("Internal sensor offsets AFTER calibration...");
  Serial.print(CurieIMU.getXAccelOffset());
  Serial.print("\t"); // -76
  Serial.print(CurieIMU.getYAccelOffset());
  Serial.print("\t"); // -2359
  Serial.print(CurieIMU.getZAccelOffset());
  Serial.print("\t"); // 1688
  Serial.print(CurieIMU.getXGyroOffset());
  Serial.print("\t"); // 0
  Serial.print(CurieIMU.getYGyroOffset());
  Serial.print("\t"); // 0
  Serial.println(CurieIMU.getZGyroOffset());

  Serial.println("Enabling      Gyroscope/Acceleration      offset
compensation");
  CurieIMU.setGyroOffsetEnabled(true);
  CurieIMU.setAccelOffsetEnabled(true);

  // configure Arduino LED for activity indicator
  pinMode(ledPin, OUTPUT);
}

void loop() {
  // read raw accel/gyro measurements from device
  CurieIMU.getMotion6(&ax, &ay, &az, &gx, &gy, &gz);
  double unitx, unity;
  unitx= double(ax)/sqrt(ax*ax+ay*ay+az*az);
  unity= double(ay)/sqrt(ax*ax+ay*ay+az*az);
  double pitch, yaw,roll;

  yaw = 0;
  pitch = -asin(unity/sqrt(1-unitx*unitx)) ;
  roll = atan(unitx/sqrt(1-unitx*unitx));

  Serial.print(float(yaw));
  Serial.print(","); // print comma so values can be parsed
  Serial.print(float(pitch));
  Serial.print(","); // print comma so values can be parsed
  Serial.println(float(roll));
  delay (10);


}
```

Code for Processing

```
import processing.serial.*;
Serial myPort;

int newLine = 13; // new line character in ASCII
float yaw;
float pitch;
float roll;
String message;
String [] ypr = new String [3];

void setup()
{
  size(600, 500, P3D);

  /*Set my serial port to same as Arduino, baud rate 9600*/
  myPort = new Serial(this, Serial.list()[0], 9600); // if you have
only ONE COM port active
  //myPort = new Serial(this, "COM5", 9600);  // if you know the 101
COM port

  textSize(16); // set text size
  textMode(SHAPE); // set text mode to shape
}

void draw()
{
  serialEvent();  // read and parse incoming serial message
  background(255); // set background to white

  translate(width/2, height/2); // set position to centre

  pushMatrix(); // begin object

  rotateX(pitch); // RotateX pitch value
  rotateY(-yaw); // yaw
  rotateZ(-roll); // roll

  drawArduino(); // function to draw rough Arduino shape

  popMatrix(); // end of object

  // Print values to console
  print(pitch);
  print("\t");
  print(roll);
  print("\t");
  print(-yaw);
  println("\t");

}

void serialEvent()
{
  message = myPort.readStringUntil(newLine); // read from port until
new line (ASCII code 13)
  if (message != null) {
    ypr = split(message, ","); // split message by commas and store
in String array
    yaw = float(ypr[0]); // convert to float yaw
    pitch = float(ypr[1]); // convert to float pitch
    roll = float(ypr[2]); // convert to float roll
  }
}
void drawArduino() {
  /* function contains shape(s) that are rotated with the IMU */
  stroke(0, 90, 90); // set outline colour to darker teal
  fill(0, 130, 130); // set fill colour to lighter teal
  box(300, 10, 200); // draw Arduino board base shape

  stroke(0); // set outline colour to black
  fill(80); // set fill colour to dark grey

  translate(60, -10, 90); // set position to edge of Arduino box
  box(170, 20, 10); // draw pin header as box

  translate(-20, 0, -180); // set position to other edge of Arduino
box
  box(210, 20, 10); // draw other pin header as box
}
```

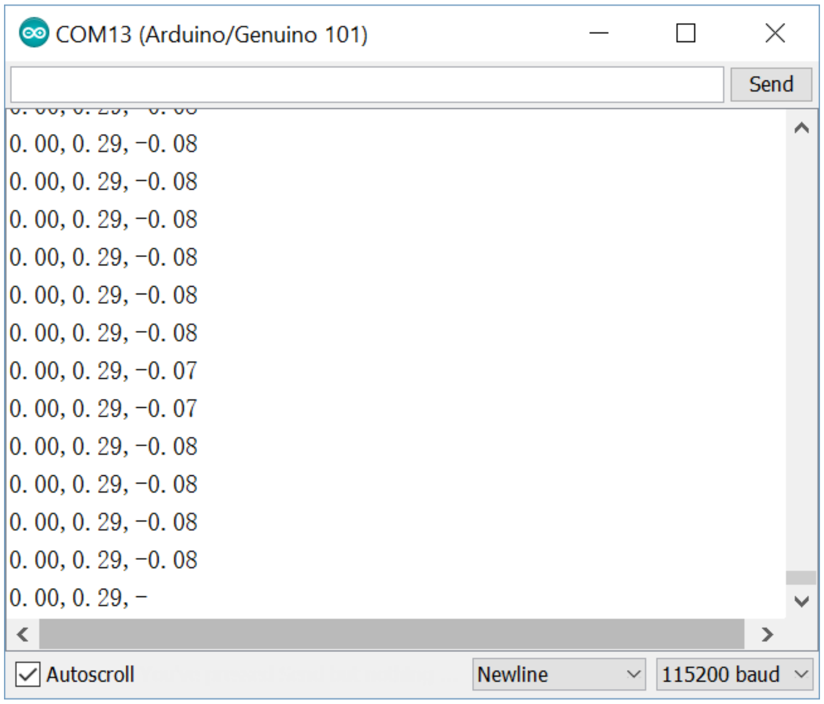
Instruction

Uploading the code for Arduino IDE into 101. Wait a few seconds till the system boots up. Select the COM port for 101 and open the serial monitor. 101 will run into a calibration procedure once the serial monitor is opened for the first time. Make sure the board is place in still on a flat surface. The entire procedure takes about 10 seconds.



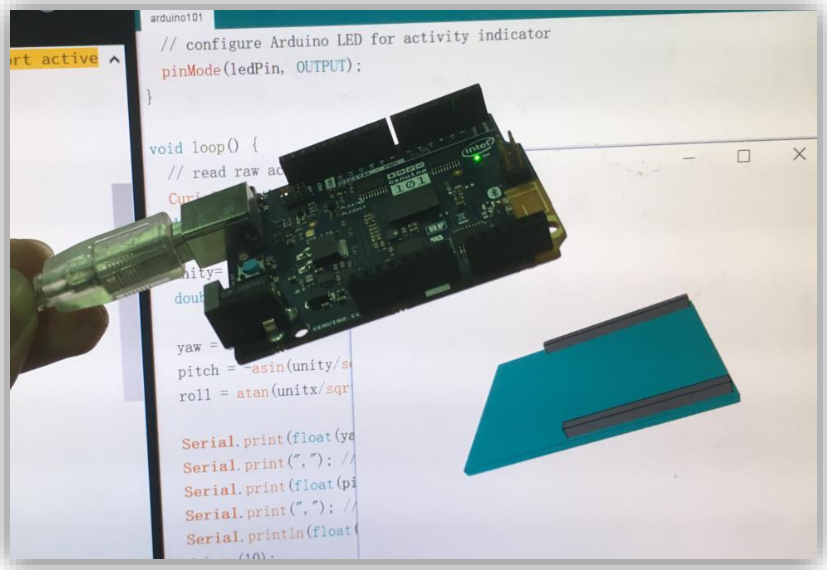
```
Initializing IMU device...
Testing device connections...
CurieIMU connection successful
Internal sensor offsets BEFORE calibration...
0       0       0       143     105     2
About to calibrate. Make sure your board is stable and upright
```

Once the calibration is done, 101 starts sending gesture data in the format of yaw, pitch, roll, each divided by comma. Since we will only use the measurements from the accelerometer, we won' t be able to know its yaw (the orientation of the board), but only pitch and roll (to which side and how much the board tilts).



```
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 07
0. 00, 0. 29, -0. 07
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -0. 08
0. 00, 0. 29, -
```

When the data comes out from the serial monitor, you can now close it and run the program that we copied into Processing (always close the first serial monitor when you switch to another, otherwise it may cause error), and a 3D plot of 101 will show up in the popped out window. Now, try to tilt your 101, if the 3D plot tilts in the same way then it' s good to go.



```
  // configure Arduino LED for activity indicator
  pinMode(ledPin, OUTPUT);
}

void loop() {
  // read raw ac
  yaw =
  pitch = -asin(unity/s
  roll = atan(unitx/sqr

  Serial.print(float(ya
  Serial.print(","); //
  Serial.print(float(pi
  Serial.print(","); //
  Serial.println(float(
```