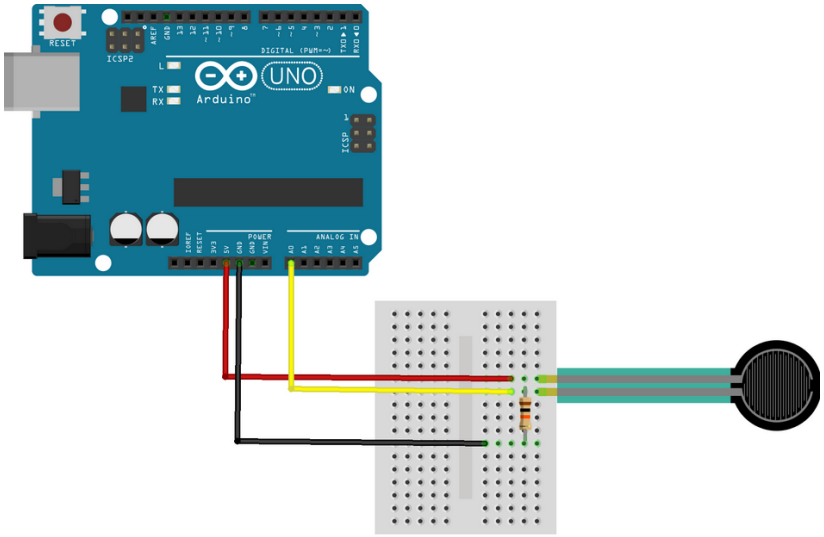
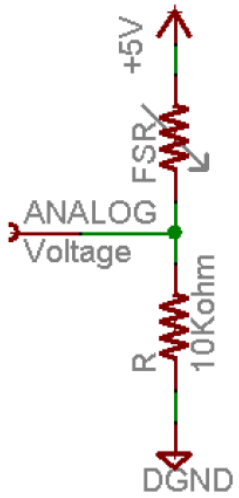
Assignment TP1: Rapid Prototyping

This assignment is realized by David Feng (10250) and Kenza Kettani (10279).





We have chosen a force sensitive resistor (FSR) as the sensor in this circuit and we used a 10 KOhm resistance.

1. Measurement setup:
   After the construction of the circuit, it is necessary to stack several elements to have a sufficient weight. We have chosen a EWA2 loud speaker, Xiao MI Note 3 smartphone, an ashtray and a cup. The measures are taken once all these elements are in place.
   To have a stable measurement, we added a counter (3s) before taking measurements in the Arduino program and a delay of 200ms between each measurement.

2. We use the program that we created before in the exercise 6. And we use the processing software to save the data.
   100 measurements are stored in a data file. The measurements correspond to the analog read from the port COM3.

   Its mean value is 0.039 N. And its random error is 0.038 N.

To calculate the force, we must calculate first the fsrVoltage, the fsrResistance and the fsrConductance.

$fsrVoltage = data1 * \frac{5000}{1023}$ The Vinput is equal to 5000 mV.

$fsrResistance = (5000 - fsrVoltage) * \frac{10000}{fsrVoltage}$ We multiply by 10 000 because we used a 10 KOhm as resistance.

$fsrConductance = \frac{1000000}{fsrResistance}$ We measure in micromhos.

Then we have to estimate the force by estimation. If the fsrConductance value is less than 1000 micromhos, then the force will be equal to fsrConductance/80. Else, the force will be equal to (fsrConductance – 1000)/30.

3. We repeat the same measurement setup by using a second sensor exchanged with another group.
   Its mean value is 0.046 N. And its random error is 0.045 N.

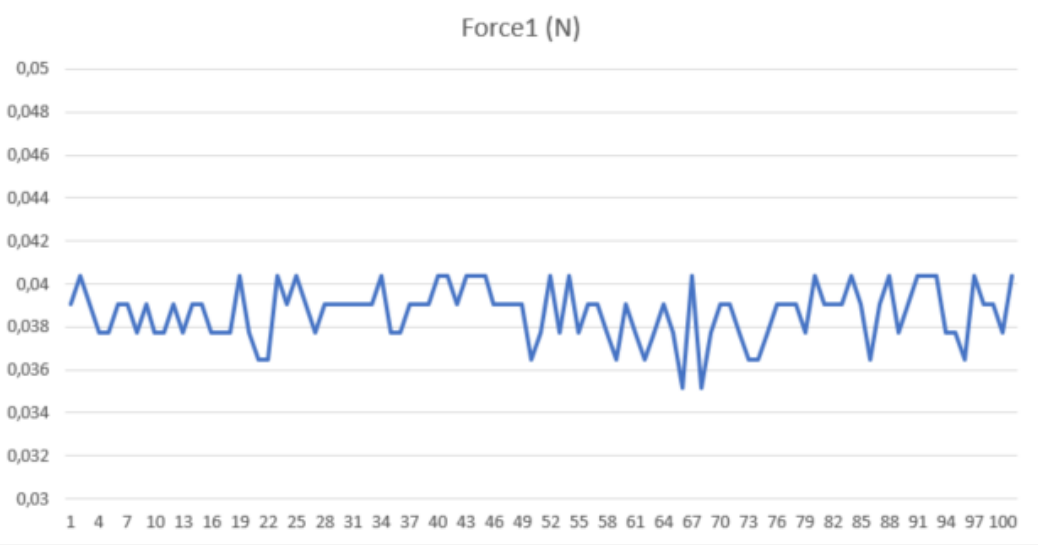
   To calculate the random error (sigma), this formula is used: $\sigma = \sqrt{\left(\frac{1}{N-1} * \sum(xi - m)^2\right)}$

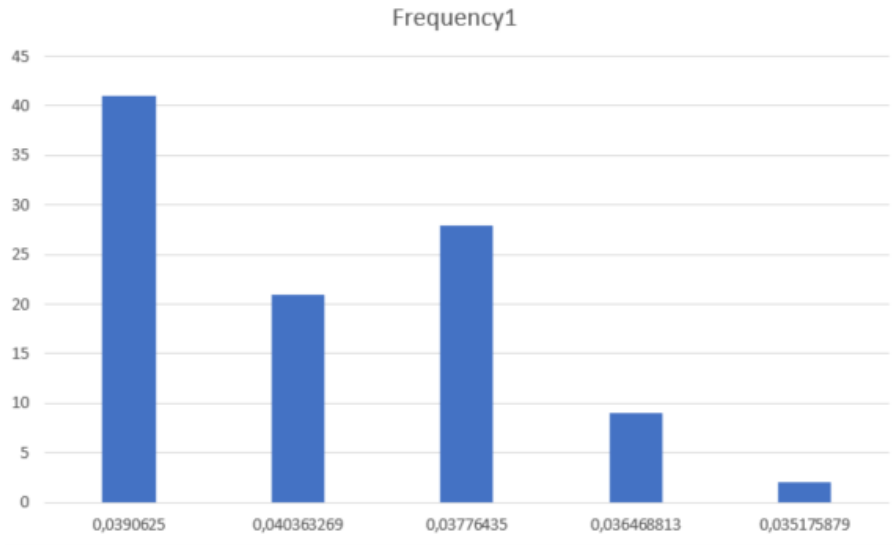
4. The systematic error as difference of the 2 mean values is abs (0.039 – 0.046)=0.007N.

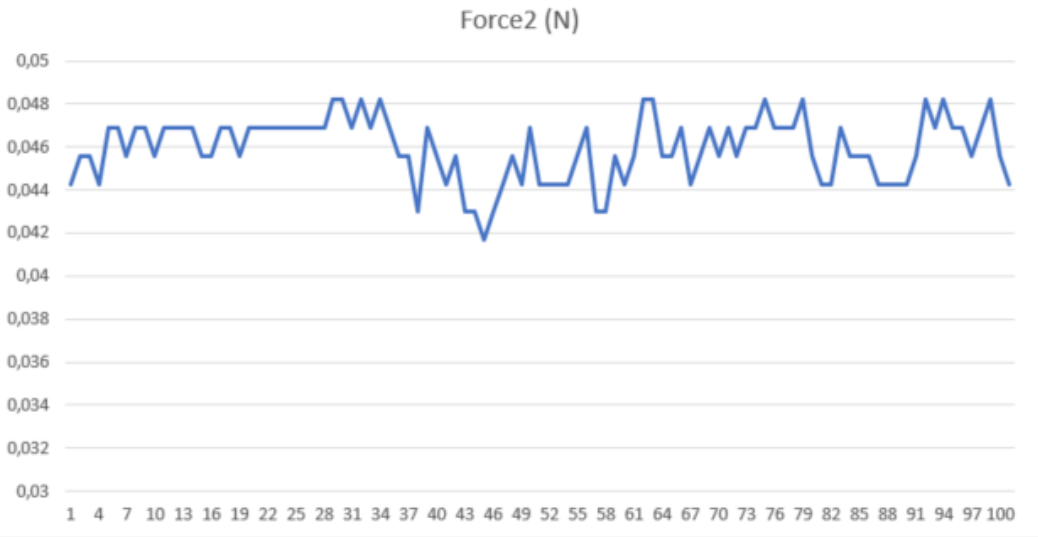
The Force1 and the frequency1 correspond to our FSR. And the Force2 and the frequency2 correspond to the second FSR.

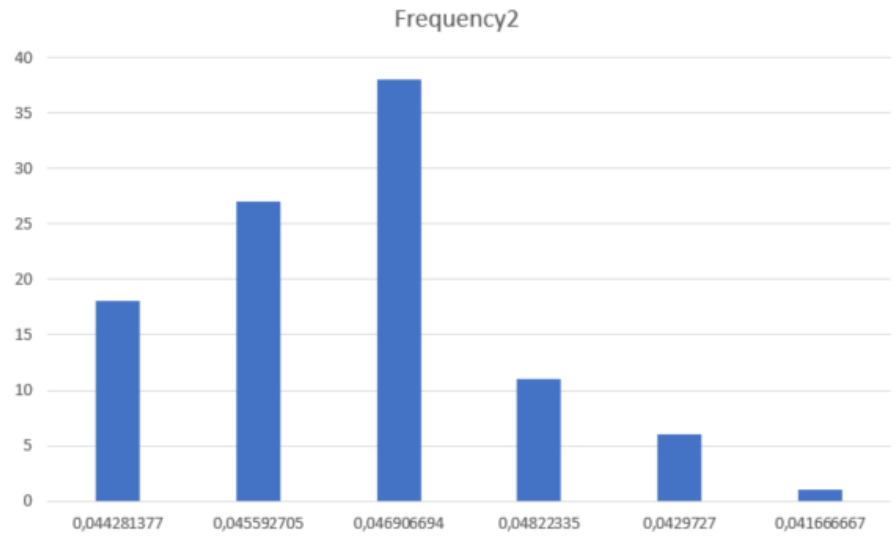
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	data 1	data 2			data 1	data 2		difference1	difference1^2	σ1		difference2	difference2^2	σ2
2	31	35		mean value	31	36,63		1,08595E-05	1,1793E-10	0,03868136		-0,00212344	4,50901E-06	0,04598576
3	32	36						0,040363269	0,001629194			0,04559271	0,002078695	
4	31	36						0,0390625	0,001525879			0,04559271	0,002078695	
5	30	35						0,03776435	0,001426146			0,04428138	0,00196084	
6	30	37						0,03776435	0,001426146			0,04690669	0,002200238	
7	31	37						0,0390625	0,001525879			0,04690669	0,002200238	
8	31	36						0,0390625	0,001525879			0,04559271	0,002078695	
9	30	37						0,03776435	0,001426146			0,04690669	0,002200238	

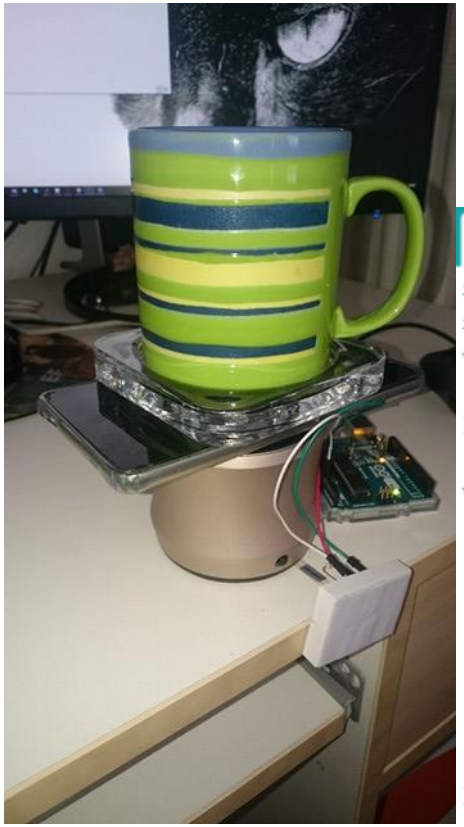
O	P	Q	R	S	T	U	V	W	X	Y	Z
	fsrVoltage1 (mV)	fsrResistance1 (Ohm)	fsrConductance1 (microMhos)	Force1 (N)	Force1meanvalue (N)		fsrVoltage2 (mV)	fsrResistance2 (Ohm)	fsrConductance2 (microMhos)	Force2 (N)	Force2meanvalue (N)
	151,5151515	320000	3,125	0,0390625	0,03905164		171,0654936	282285,7143	3,542510121	0,04428138	0,046404819
	156,402737	309687,5	3,229061554	0,04036327			175,9530792	274166,6667	3,647416413	0,04559271	
	151,5151515	320000	3,125	0,0390625			175,9530792	274166,6667	3,647416413	0,04559271	
	146,627566	331000	3,021148036	0,03776435			171,0654936	282285,7143	3,542510121	0,04428138	
	146,627566	331000	3,021148036	0,03776435			180,8406647	266486,4865	3,752535497	0,04690669	
	151,5151515	320000	3,125	0,0390625			180,8406647	266486,4865	3,752535497	0,04690669	
	151,5151515	320000	3,125	0,0390625			175,9530792	274166,6667	3,647416413	0,04559271	
	146,627566	331000	3,021148036	0,03776435			180,8406647	266486,4865	3,752535497	0,04690669	
	151,5151515	320000	3,125	0,0390625			180,8406647	266486,4865	3,752535497	0,04690669	
	146,627566	331000	3,021148036	0,03776435			175,9530792	274166,6667	3,647416413	0,04559271	


Force1 (N)
0,05
0,048
0,046
0,044
0,042
0,04
0,038
0,036
0,034
0,032
0,03
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79 82 85 88 91 94 97 100


Frequency1
45
40
35
30
25
20
15
10
5
0
0,0390625
0,040363269
0,03776435
0,036468813
0,035175879


Force2 (N)
0,05
0,048
0,046
0,044
0,042
0,04
0,038
0,036
0,034
0,032
0,03
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79 82 85 88 91 94 97 100


Frequency2
40
35
30
25
20
15
10
5
0
0,044281377
0,045592705
0,046906694
0,04822335
0,0429727
0,041666667



TP1_arduino

```
int SensorPressurePin = A0; // select the input pin for the pressure sensor
int count = 100;
void setup() {
  Serial.begin(9600);
}

void loop() {
  delay(3000);
  while(count != 0){
    int SensorValue = analogRead(SensorPressurePin);
    Serial.println(SensorValue);
    count = count - 1;
    delay(200);
  }
  Serial.println("finish");
}
```

tp1 | Processing 3.3.7

Fichier Modifier Sketch Dépanner Outils Aide

tp1

```
1  import processing.serial.*;
2
3  Serial myPort;  // Create object from Serial class
4  String val;     // Data received from the serial port
5
6  PrintWriter output;
7
8  void setup() {
9    String portName = Serial.list()[0];
10   myPort = new Serial(this, portName, 9600);
11   output = createWriter( "data1.txt" );
12 }
13
14 void draw()
15 {
16   if (myPort.available() > 0 ) {
17         val = myPort.readString();
18         output.println(val);
19     }
20 }
21
22 void keyPressed() {
23   output.flush(); // Writes the remaining data to the file
24   output.close(); // Finishes the file
25   exit(); // Stops the program
26 }
```

tp1 | Processing 3.3.7

Fichier Modifier Sketch Dépanner Outils Aide

tp1

```
1  import processing.serial.*;
2
3  Serial myPort;  // Create object from Serial class
4  String val;     // Data received from the serial port
5
6  PrintWriter output;
7
8  void setup() {
9    String portName = Serial.list()[0];
10   myPort = new Serial(this, portName, 9600);
11   output = createWriter( "data2.txt" );
12 }
13
14 void draw()
15 {
16   if (myPort.available() > 0 ) {
17         val = myPort.readString();
18         output.println(val);
19     }
20 }
21
22 void keyPressed() {
23   output.flush(); // Writes the remaining data to the file
24   output.close(); // Finishes the file
25   exit(); // Stops the program
26 }
```