Experiment Plants :

Material

- ❏ 2 Pots of Venus flytrap
- ❏ Osmotic water (to keep the plant alive)
- ❏ 1 tube, transparent and graduated
- ❏ 1 iPhone 5s
- ❏ 9 fake flies (same size, 3 different densities) printed with a 3D printer **MakerBot Replicator 2X**
    - ❏ 10% density (0.14 g, 0.13 g, 0.15 g)
    - ❏ 50% density (0.19 g, 0.19 g, 0.20 g)
    - ❏ 90% density (0.22 g, 0.23 g, 0.22 g)

Controls

- Perform the experiment without dropping anything on the trap. #negative
- Check that the trap close and re-open when facing a stimuli #positive

Protocol

- ❖ Place the tube over a trap, orient it so the trap is open upwards vertically as well as the tube.
- ❖ Grab the fake fly then place over the tube and make sure the fake fly is at the desired distance from the trap.
- ❖ Start filming, drop the fake fly from 10,6 cm high. Once it hits the trap and it has closed, you can stop filming.

Repeat : 3 times for each one of the 9 fake flies

Results :

To extract data, view video frame-by-frame (at 30 FPS). Determine the frame number at which the fly is dropped(1), the one at which the fly touches the plant(2), then the one when the plant begins to move(3). Calculate ((3)-(2))-(1), then multiply this number by the frame rate to obtain the reaction time of the plant.

Ethical norms

We must avoid using weights that could damage the plant.

Problems that occurred and bias :

- ❖ We had to hold with our fingers the fake fly at the top of the tube and place the tube over the plants without touching them, so the distance between the fake fly and the plant and the way we drop it weren't very precise.
- ❖ The plants and the tube weren't all oriented the same way.
- ❖ The precise response time is hard to determine because the moments when the fake fly touches the plant and when the plant starts to close are sometimes located between two frames of the video.
- ❖ Occasionally, the fly did not trigger any reaction. We considered the stimulus as improper and did not take these events into account with our data.

- It is possible that the plants had a slower reaction time due to the fact that they didn't have a proper vernalization phase at this time of the year.
- Maybe the age the plants, the number of hairs touched by the fake fly and the way it falls affected their response time, after some bibliographic research we found that :
  - "The time it takes for the trap to reopen depends on the size of the insect, temperature, the age of the trap, and the number of times it has gone through this process." (http://botany.org/bsa/misc/carn.html)
  - "The amount of time the trap takes to close varies greatly with temperature, light, plant health and other factors [...] and The amount of time it takes to complete digestion is dependent on the size of the insect, the age of the trap, and temperature"(https://www.flytrapcare.com/venus-fly-trap-information)
  - Depending on different sources, at least two hairs has to be stimulated or the same hair has to be stimulated 2 times between 20 and 30 seconds in order to create a reaction from the flytrap.

Experiment Piezo sensor :

Material

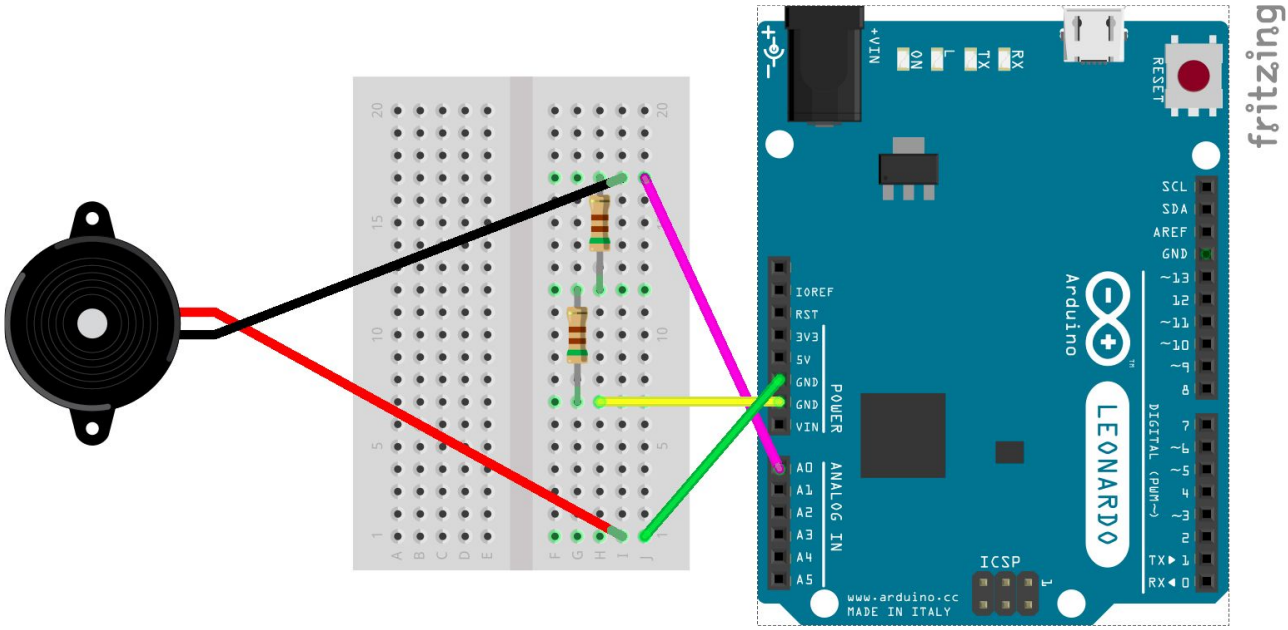
- ❏ The same : tube, fake flies, iPhone 5s
- ❏ Piezo sensor
- ❏ Bread board & wires
- ❏ 2 * 510kΩ resistor

Arduino

Code : This sketch reads a piezo element to detect a knocking sound. It reads an analog pin and compares the result to a set threshold. If the result is greater than the threshold, it writes "knock" to the serial port, and toggles the LED on pin 13.

```
// these constants won't change:
const int ledPin = 13;      // led connected to digital pin 13
const int knockSensor = A0; // the piezo is connected to analog pin 0
const int threshold = 100;  // threshold value to decide when the detected sound is a knock or not


// these variables will change:
int sensorReading = 0;      // variable to store the value read from the sensor pin
int ledState = LOW;         // variable used to store the last LED status, to toggle the light

void setup() {
  pinMode(ledPin, OUTPUT); // declare the ledPin as as OUTPUT
  Serial.begin(9600);       // use the serial port
}

void loop() {
  // read the sensor and store it in the variable sensorReading:
  sensorReading = analogRead(knockSensor);

  // if the sensor reading is greater than the threshold:
  if (sensorReading >= threshold) {
    // toggle the status of the ledPin:
    ledState = !ledState;
    // update the LED pin itself:
    digitalWrite(ledPin, ledState);
    // send the string "Knock!" back to the computer, followed by newline
    Serial.println("Knock!");
  }
  delay(100);  // delay to avoid overloading the serial port buffer
}
```

Setup : We didn't used the LED for our setup and replace the 1MΩ resistor with two 510kΩ resistor



Source : http://www.arduino.cc/en/Tutorial/Knock (created 25 Mar 2007 by David Cuartielles, modified 30 Aug 2011 by Tom Igoe)

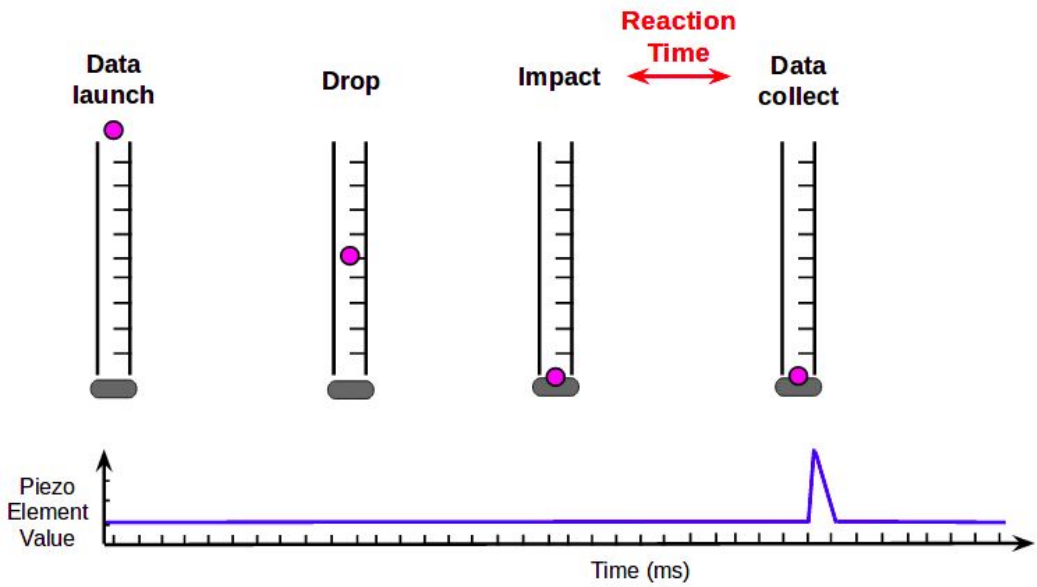
Controls

- Perform the experiment without dropping anything on the sensor. #negative
- Check that the sensor gives values when facing a stimuli #positive

Protocol

- ❖ Place the tube over the sensor, orient it so the sensor is facing upwards vertically as well as the tube.
- ❖ Grab the fake fly then place over the tube and make sure the fake fly is at the desired distance from the sensor.
- ❖ Start filming and recording the sensor data.
- ❖ Drop the fake fly from 10,6 cm high and wait for the sensor to record.
- ❖ Use the frame by frame video to determine when the fake fly hit the sensor and when the sensor starts to give values. Use the measurements to determine when it responded and determine response time accordingly.

Repeat : 3*3 fake flies, 3 times each



Results

To extract data, view video frame-by-frame (at 30 FPS). Determine the frame number at which the fake fly is dropped(1), the one at which measuring begins(2)*, the one at which touches the sensor(3). Calculate (3)-(1), then multiply this number by the frame rate to obtain the time at which the sensor was touched. Also calculate (2)-(1) and multiply by the frame rate to obtain the time at which the measures started. Use the difference between this value and the previous one to determine the time it took for the fly to touch the sensor after measuring.

*When the sensor data is graphed, mark the time at which the sensor was touched and evaluate how long it took for it to react by locating the spike in the graph and calculating the time interval between these two values.

Problems that occurred and bias :

- We had to hold with our fingers the fake fly at the top of the tube so the distance between the fake fly and the sensor and the way we drop it weren't very precise.
- The precise response time is hard to determine because the moments when we launch the data and the moment the fake fly touches the sensor are sometimes located between two frames of the video.