Observing the reaction of *C.elegans* when exposed to UV light and compared them to UV sensor

The aim of this project

The aim of this project is to compare the precision of biological sensor and electronic sensor on seven days. Our biological sensor is C.elegans and the electronic sensor is the adafruit uv sensor. We would like to see to what extent are C.*elegans* precise to detect the different intensities of UV light compared to the precision of the UV sensor. In this project we are focus on 390 nm that belong to UV light.

We choose C.elegans because negative phototaxis behaviors are observed when we put light on them. Moreover they move quickly, we can observe them easily because they measure 1 mm and there are more sensitive to UV light than another wavelight.

We brought the uv sensor adafruit and the LED UV on internet and they arrived 3 days later.

Preparing the plates

The preliminary step of the experiment is to prepare the media the *C.elegans* will grow in. The growth medium used in this experiment is called Nematode Growth Medium (NGM).

Below is what you will need to prepare the medium :

- NaCl
- Agar
- Peptone
- 5 mg/mL cholesterol on ethanol
- 1M KPO4
- 1M MgSO4
- 1M CaCl2

And here is how you should prepare your medium :

- In a 2 liter erlenmeyer, mix together 3 grams of NaCl, 17 grams of agar, 2,5 grams peptone and 975 mL of water.
- Cover the top of the erlenmeyer with aluminium foil and autoclave for 50 minutes.
- Put the erlenmeyer in a 55°C water for 15 minutes in order for it to cool down.
- Add 1 mL of 1M CaCl2, 1 mL of cholesterol in ethanol, 1 mL of 1M MgSO4 and 25 mL of 1M KPO4.

- Blend all of the chemical together.

N.B ~ the medium was prepared by Adrien MARCK, who also provided us with the C.elegans. We needed to warm the medium during 5 minutes in the microwave. The medium was made in june 2016 and there was strange things inside.

- Under the hood, pour 20 mL of NGM in each plates (20 in our experiment).
- Allow the medium to cool down at room temperature.
- Label your plates, parafilm them and put them in a fridge.

Observing the reaction of C.elegans to UV light

First of all, we need to put the *C.elegans* at the middle of our plate. We decided to use 15 *C.elegans* per plates. In order to do so, we will take each of them, one by one, and transfering them carefully with a hoop

- Put le LED at the bottom of the construction, UV light going through the hole at the bottom of the montage.
- Put the plate on top of the montage.
- Put the montage underneath the binocular microscope, centered on the *C.*elegans.
- Turn the UV light on and observe how the *C.elegans* react.
    - Here we will observe how long they take to leave the area lightened by the UV light. In order to do so, we will draw a circle delimiting said area. We delimited 4 differents area.
    - We film the C.elegans with

We will be doing the experiment with 5 different conditions. We test with a 395 nm UV light 5 different intensities and replicate each of them 4 times.

The different intensities are :

- 0
- 255
- 200
- 150
- 100

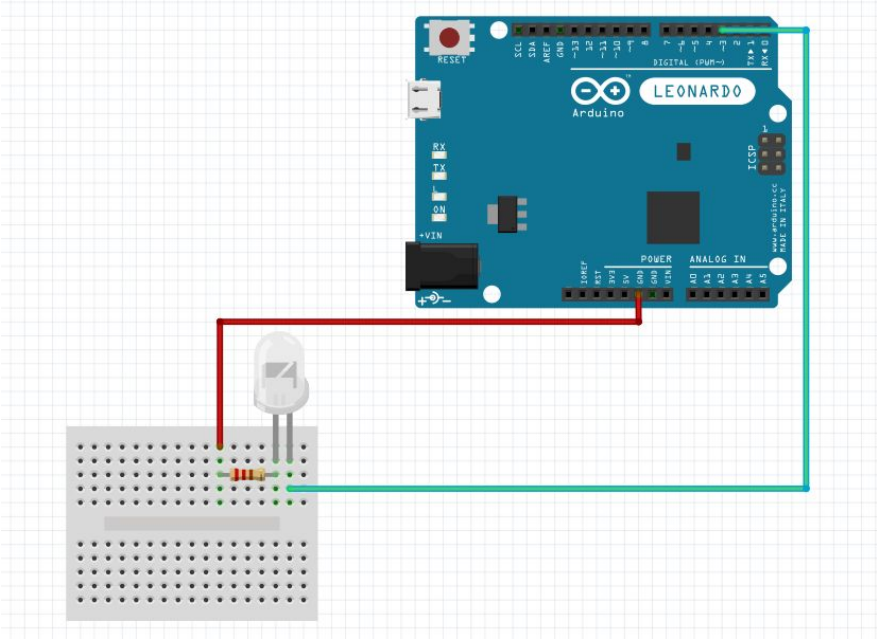
and the two controls are

- Positive : intensity maximal : 255
- Negative : No UV light

The different intensities we determine with arduino (the arduino gives values between 0 to 255 AU)

Designing the Arduino

- LED intensity with arduino



We did this montage with :

Arduino

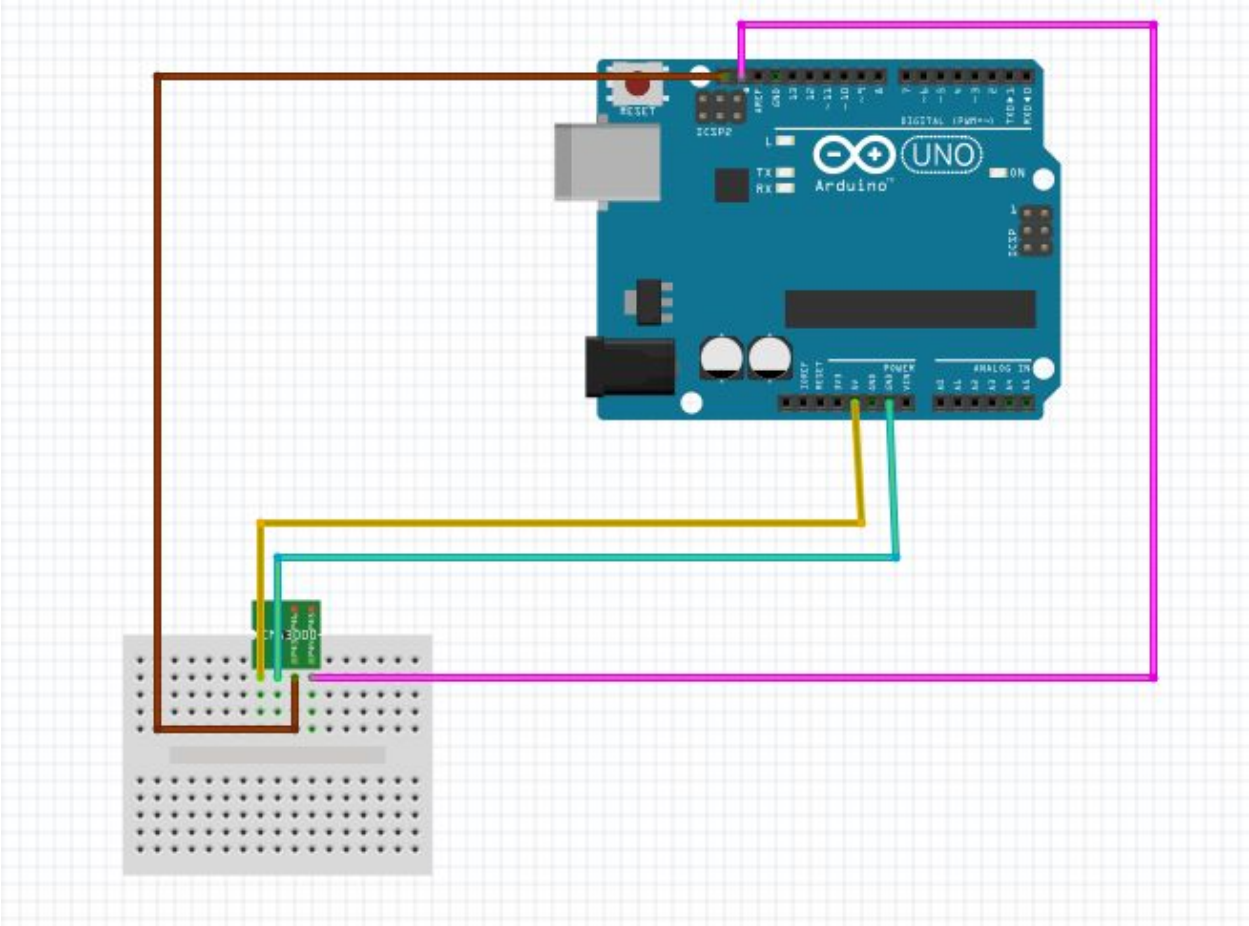
UV.LED

Resistor

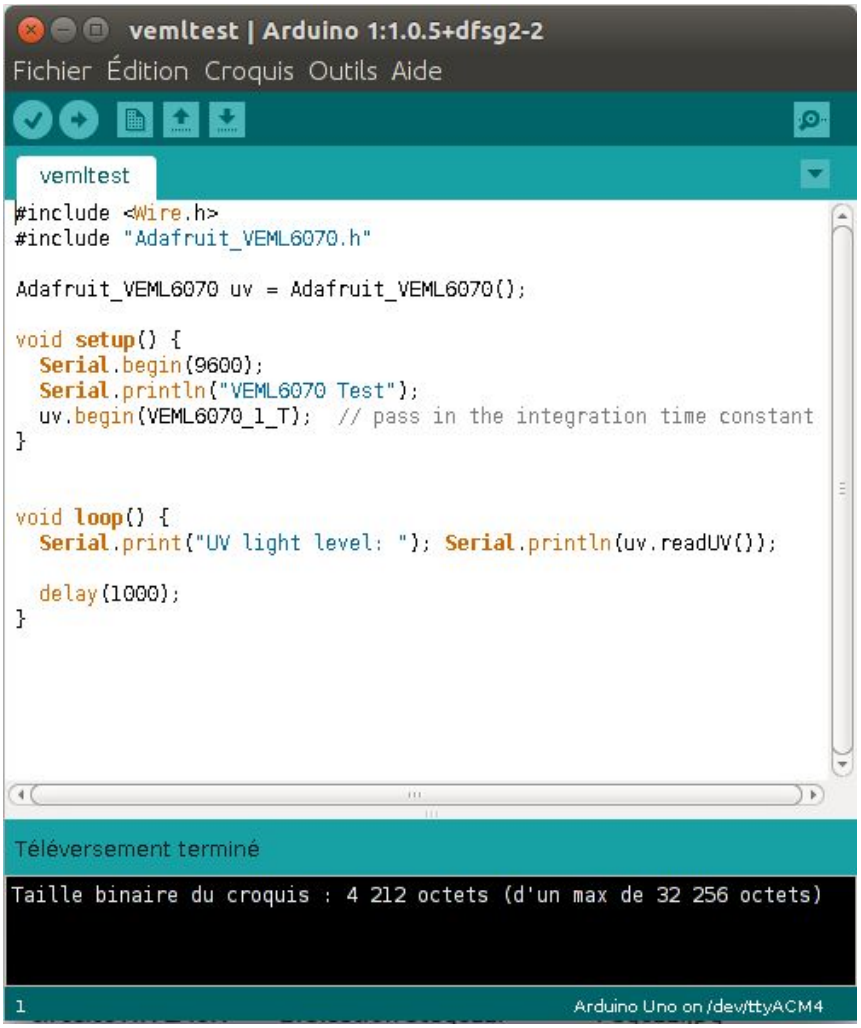
We open arduino and we use the code blink (which is in the library) that we modify to obtain different intensity of the LED without blinking. This is the code we use :

- Measuring UV intensity with adafruit uv sensor

For this montage we need the adafruit uv sensor, a arduino(here we use the arduino UNO), a breadboard.

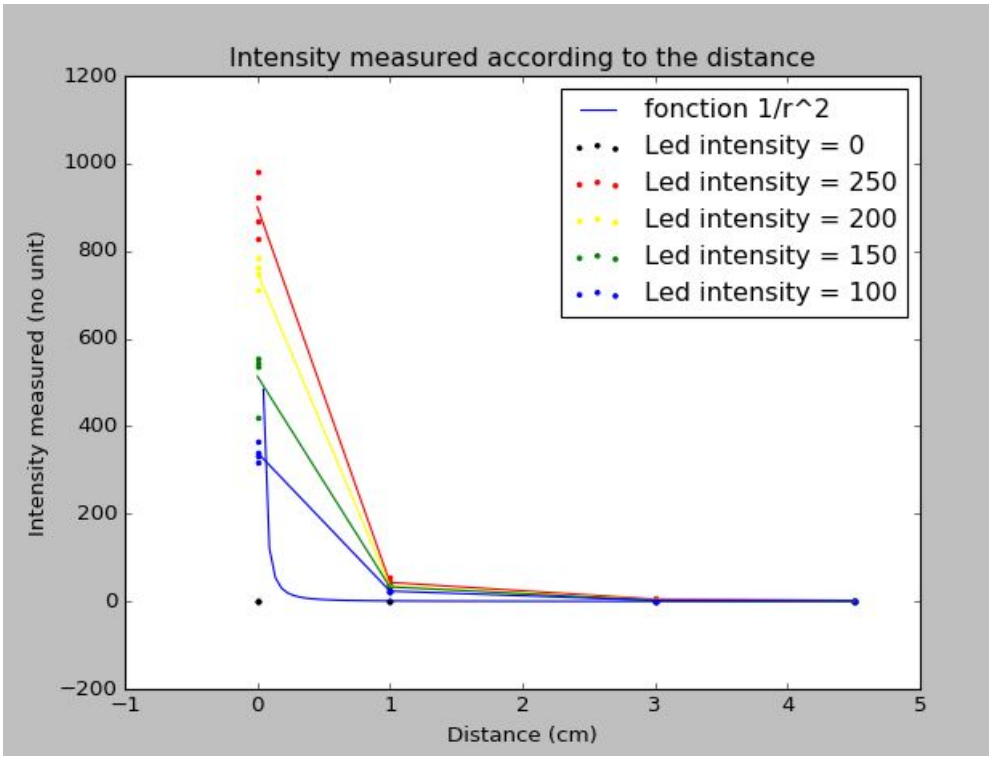


We download the library of the sensor and we use the code they propose. This is the code we use :



The output of the sensor gives values between 0 to 65535 AU.

Analysis of the data



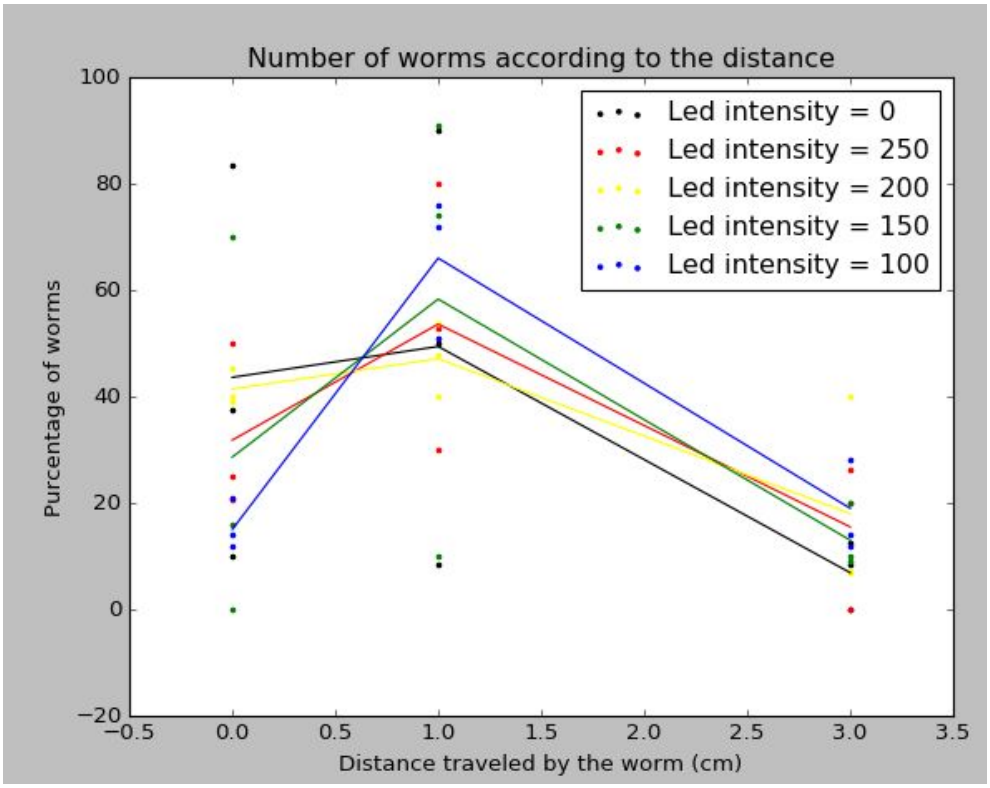
For the UV sensor, we first plotted the intensity measured according to the distance.

One point is one replicate and the curve is the mid of this replicate for each intensity. The code for this graph is in the folder “UVsensor_mesure”. It contains a python code which read several text file. The text file contains the data measured for each intensity.

We expected to have curves which look like the formula of intensity decreasing with distance (1/r^2). Unfortunately, we didn’t have enough data between 0 and 1 cm to fit the surve.

However, for each intensity, the curves seem decreasing really fast like the 1/r^2 function.

Negative control (no led on) stay on 0, proving that there is no other light which interferes with the sensor. The values recorded by the UVsensor decrease according of the intensity of the led, what is logical.



For the *C.elegans,* we plotted the number of worms according to the distance. The number of worms is in percentage because we didn't manage to transfer the same number of worms on the different plates.

The code can be found in the folder "worms_mesure".

0cm is the center of the plate, which is call "zone 1". If worms reached 1cm, they are in zone 2. If they reached 3cm, it's zone 3.

We can see that for the negative control (led off), worms move away from the center. We expected to have the majority of worms stay at the center because they didn't need to escape from the light. It's certainly due to the light of the binocular loup.

For the other intensity, when the led is on, we expected to have a x^2 function because contrary to the UV sensor, worms are phototaxis negatif. Here, the majority of worms move towards zone 2. If they was following a x^2 function, the majority of worms would be find in zone 3.

There are several bias in our experimental design whose can explain this results. First, a gradient of temperature in the plates. We just take them off of the fridge. So the the temperature at the border of the plate which decrease slowly than at the center. *C.elegans* are very sensitive to temperature, and they certainly prefered the temperature in zone 1 and 2. The light of the binocular loup is also a biais. The

disposition of the lamp illuminated mainly zone 3, and worms don't like light. There are also the time of experiment. Maybe, worms just hadn't enough time to reach zone 3.

Conclusion

There are some similarities between UV sensor and *C.elegans.* Both are sensitive to UV light. However, there is an obvious difference in their precision to measure the intensity of light.

UV sensor is more reliable than *C.elegans* to know the intensity of UV light. We can see that difference in comparing the 2 graphs. As we expected, graph 1 shows a trend close to 1/r^2 function. Contrary to that, the graph 2 doesn't show the x^2 function expected.

C.elegans are also influenced by other parameters like food in the media, light of the day, temperature, or interaction with other worms. This parameters differentiate worms from UV sensor. UV sensor are just influenced by the light of the day too.

Bibliography

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Video

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Other resources

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».https://cdn-learn.adafruit.com/downloads/pdf/adafruit-veml6070-uv-light-sensor-breakout.pdf.

« LED clignotante - Projet Arduino ».

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