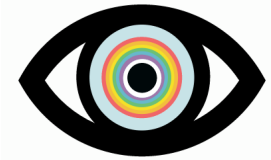


Aim of the project :

Compare the precision and accuracy in the detection of variabilities between different colors between a biological sensor (Human eye) and an electrical sensor (RGB sensor).



Bio-Lumos
biosensor 2017

Problematics :

- Does the precision in the detection of variabilities between different colors for a biological sensor depend on the wavelength of these colors ?
- Does the precision in the detection of variabilities between different colors for an electrical sensor depend on the wavelength of these colors ?
- What are the differences in terms of precision and accuracy in the detection of variabilities between different colors between a biological sensor and an electrical sensor ?

Variables :

Independent variables :

- Type of sensor (biological / electrical)
- Wavelength

Measures and dependant Variable :

- Précision and accuracy in the detection of color variabilities.

Protocol :

Human eye

Duration : 10-15 mins / subject

Introduction :

- The subject is introduced in a dark room and have to sit on a chair facing a computer screen 1m30 in front of him (in order to limitate the bias related to the different height of subjects).
- He signs a paper in order to agree with the terms and conditions of the experiments and to confirm that he is not colorblind and has no epileptic background.
- The rules of the test are explained and we proceed to a test with 10 pairs in order to make sure that the subject has understood the rules.

Colours :

→ they are selected with different proportion of green pixels components.

Colour 1	#ff6400	~ 605 nm	255 red	100 green	0 blue
Colour 2	#ff5A00	~ 607 nm	255 red	90 green	0 blue
Colour 3	#ff5000	~ 608 nm	255 red	80 green	0 blue
Colour 4	#ff4600	~ 610 nm	255 red	70 green	0 blue

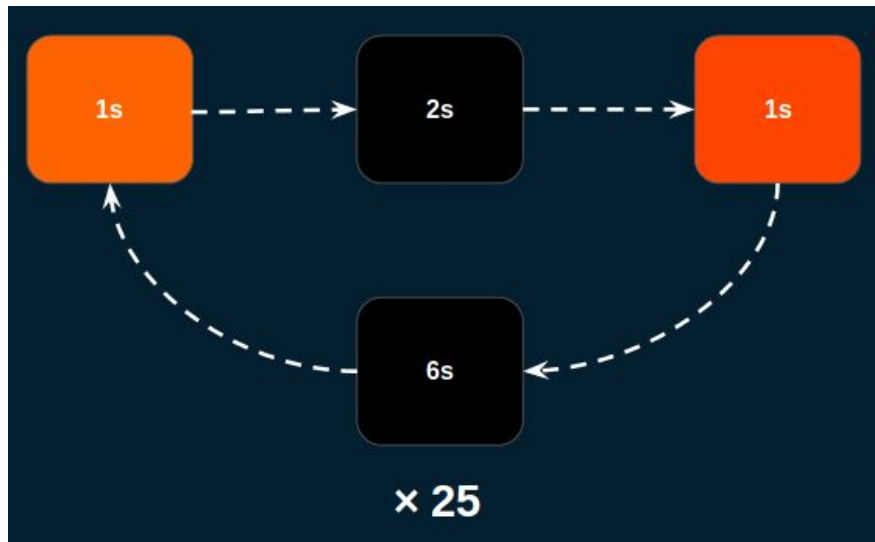
<http://encycolorpedia.com/>

Experiment :

- 1 seconds of first color
- 2 second black screen
- 1 second of second color
- 6 second of black screen , the subject evaluate and tell us if he perceived “same” or “different” colors. (a “I don’t know” is tolerable one or two times)

Repeat sequence (32 times)

There is a break of 10-15s between the 18th pair and the 19th pair where the subject can close his eyes to rest). 16 combinations are possible and we choose randomly the different pairs.

**Controls :**

We introduced the same pairs many times and reversed as a control and randomly choose the order in which they were presented.

Details :

- Screen luminosity : constant
- Conserve the same screen angle & position in the chair

Material :

- Computer (high screen resolution)
- Formular
- Chair
- Dark room
- ~30 people
- Meter

Ethical norms

- + No flash with high intensity
- + Take in account epilepsy and other kind of illness that could put the subject in danger during the experiment

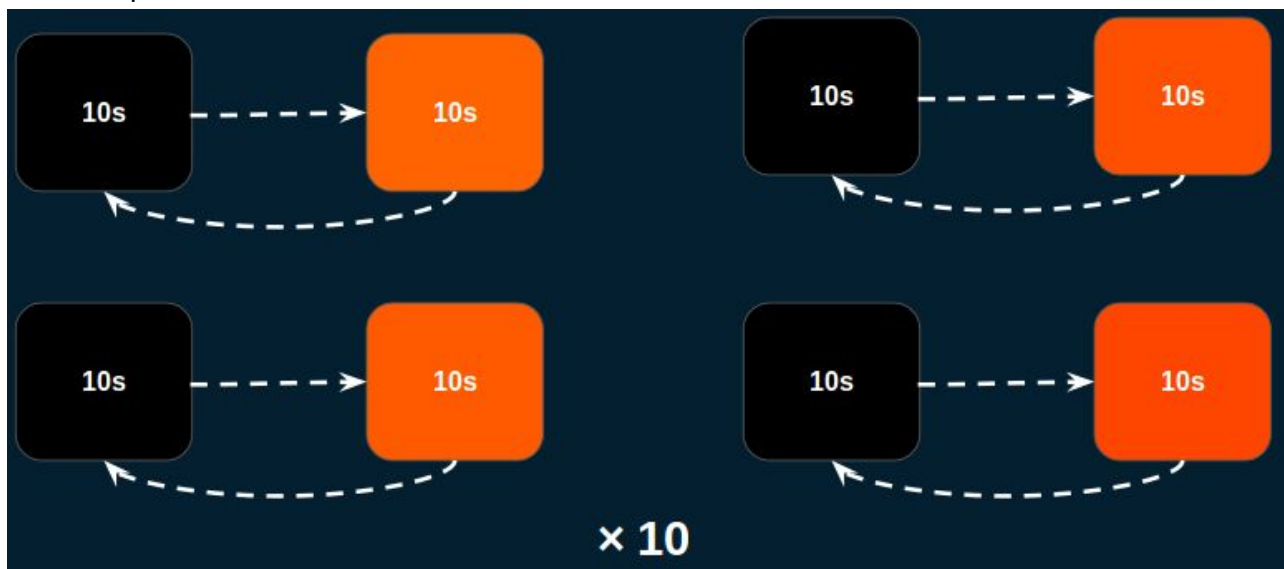
Problems that occurred :

- Retinal Fatigue
- Poor Color Memory
- Not the same time of break

Electronic sensor :

Experiment :

- In the same room and the same conditions with the same computer and same screen luminosity and computer positioning,, we place the sensor approximately at the same height.
- ~10 seconds of black screen
- ~10 seconds of colored screen
- Repeat 10 times for each of the same 4 colours than the ones we used in the first experiment



Controls :

We use the black screen as a negative control.

Details :

- Screen luminosity : constant
- Temperature : constant (the sensor is sensible to temperature).
- Conserve the same screen angle & position in the chair

Material :

- Same Computer, room, table, meter
- something to hold the sensor
- Arduino board + 6 cables
- RGB sensor (TCS3200)
- Another computer to collect data

Montage : (from howtomechatronics.com that provided us the code too)

Code :

/* Arduino Color Sensing Tutorial ** by Dejan Nedelkovski, www.HowToMechatronics.com **/

```
#define S0 4
#define S1 5
#define S2 6
#define S3 7
#define sensorOut 8

int frequency = 0;

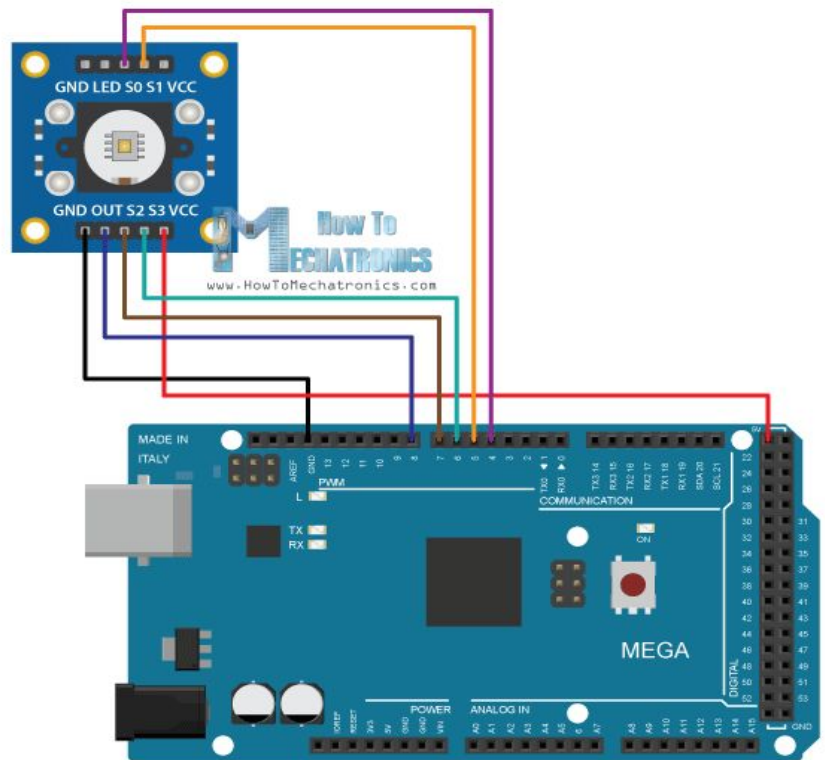
void setup() {
  pinMode(S0, OUTPUT);
  pinMode(S1, OUTPUT);
  pinMode(S2, OUTPUT);
  pinMode(S3, OUTPUT);
  pinMode(sensorOut, INPUT);

  // Setting frequency-scaling to 20%
  digitalWrite(S0,HIGH);
  digitalWrite(S1,LOW);

  Serial.begin(9600);
}

void loop() {

  // Setting Green filtered photodiodes to be read
  digitalWrite(S2,HIGH);
  digitalWrite(S3,HIGH);
  // Reading the output frequency
  frequency = pulseIn(sensorOut, LOW);
  // Printing the value on the serial monitor
  Serial.print("G= "); //printing name
  Serial.print(frequency); //printing RED color frequency
  Serial.print(" ");
  delay(100);
}
```



Problems that occurred and bias :

- We didn't succeed to build our own board because of technicals problems (no USB recognition) from the arduino board even when trying with several computers, board, cables etc... Finally Another group : Nina G., Lara N. And Adrien V. Led us their sensor that we used during the experiment.
- The RGB sensor was fixed to the back of the computer that collected the data and the scotch was not strong enough to hold it at the same exact place during the experiment.
- The sensor gave us absurd results when it was placed at the same distance than the human subjects so we did the measurements at 29,7 cm from the screen.
- We didn't take in account the little adaptation time of the sensor when we switched from black screen to orange screen.