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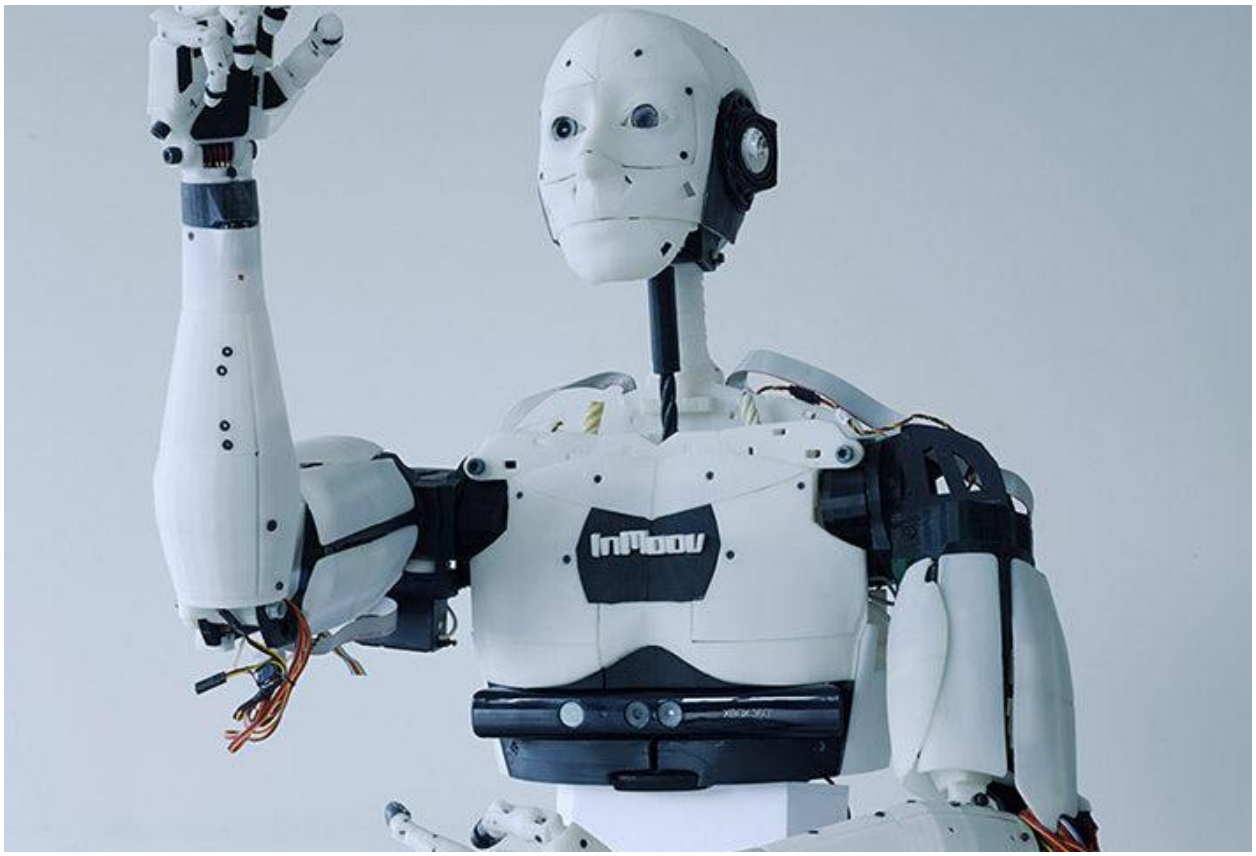
RACAI Z-34 Project

This document is the summary of four months of work



The goal of this project was to discover the capacity of artificial intelligence and to understand all the mechanisms of this beautiful and complex thing, which one generally follows us all our life but does not make us interested. During four months, we worked on the robotic arm of the open source project “Inmoov”, we built the arm with the robot’s plan and tried to control it with an artificial intelligence.

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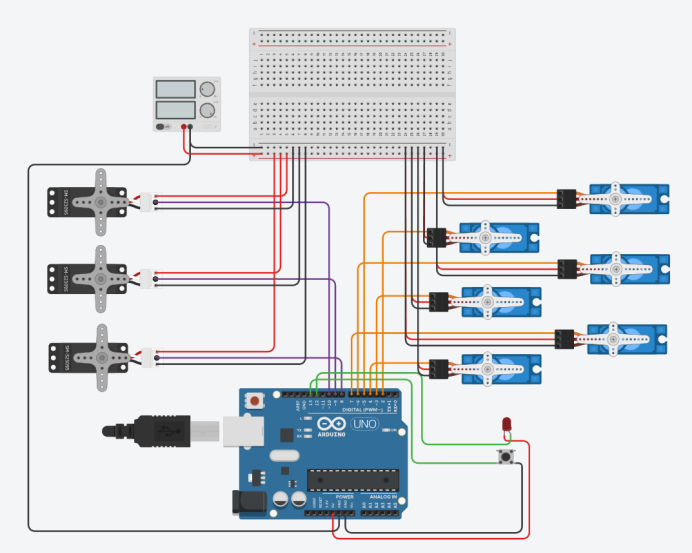
The initial goal of the project

At the beginning of the project Z-34, we wanted to work on the robotic arm of the Inmoov open source project. In the first time, we wanted to control it with the artificial intelligence used by **"*computer vision*"** of the **"*OpenCV*"** library. Then contrôle the robot with muscular activity's sensors.

The goal was to learn how the human's arm works and to propose a new way to control a robot. There isn't need for a controller, just to come in front of the camera.

In the second time, the goal of the Myoware (muscular activity sensor) was to raise to another level communication and interactions man-machine.

Electronic schematic



The electronic circuit is rather simple and minimalist, it is composed of nine servomotors, an Arduino Uno V3 and an external power supply of 30A 5V. You can also find a button and a LED for the control button

Operating algorithm

```
#include <Servo.h>

// The forarm
Servo thumb;
Servo index;
Servo major;
Servo ring;
Servo annular;

Servo wrist;

//The biceps
Servo elbow;
Servo rotShoulder;
Servo upShoulder;

int Elbow[] = {15,50,80};
int RotShoulder[] = {50,90,180};
int UpShoulder[] = {0,95,180};

//The speed action button
const short int LED = 12;
const short int BUTTON = 13;
unsigned long currentTime;
boolean ETA = 0;
int button;
int i;
int j;

// The list of all the fingers
Servo hand[]={thumb, index, major, ring, annular};
//The list of the arm joint
Servo biceps[] = {elbow, rotShoulder, upShoulder};

void setup() {
  //Initialisation of the pins of the hand motors
    for(i=0; i<5;i++){ hand[i].attach(i+2);}
    for (i=0; i<5; i++) {hand[i].write(170);}

    wrist.attach(7); wrist.write(20); // to initialize the wrist

    // Action button
    pinMode(LED, OUTPUT);
    pinMode(BUTTON, INPUT_PULLUP);

    //Biceps
    //Initialisation of the pins
    for(i=0; i<3; i++){ biceps[i].attach(i+8);}

      // Initialisation of HS 805 BB+ position
      elbow.write(20); rotShoulder.write(90);
      upShoulder.write(90);

      rotShoulder.write(RotShoulder[0]); delay(3000);
      rotShoulder.write(RotShoulder[2]); delay(6000);
      rotShoulder.write(RotShoulder[1]); delay(3000);

      upShoulder.write(UpShoulder[0]); delay(4000);
      upShoulder.write(UpShoulder[2]); delay(6000);
      upShoulder.write(UpShoulder[1]); delay(4000);

      elbow.write(Elbow[0]); delay(4000);
      elbow.write(Elbow[2]); delay(4000);
      elbow.write(Elbow[0]); delay(4000);
```

```
void loop() {
  button = digitalRead(BUTTON);
  if (millis() - currentTime > 500){
        currentTime = millis();
        ETA =! ETA;
        digitalWrite(LED,ETA);
     }
  if (button== LOW){
    digitalWrite(LED, LOW);
    thumbUP();
    }
  }

     void demo(){
        coucou();
        delay(2000);
        style();
        delay(2000);
        like();
        delay(2000);


      }
     void style(){
      elbow.write(90);

      for (i=0;i<5;i++){
          hand[i].write(170);
          delay(100);
        }
        delay(2000);
        for (i=0;i<5;i++){
            hand[i].write(70);
            delay(100);
        } }

    void like(){
        for (i=0;i<5;i++){
            hand[i].write(60);
            delay(100);
        }
        major.write(180);
```

```
void coucou(){
    elbow.write(Elbow[2]);
    rotShoulder.write(RotShoulder[2]);
    upShoulder.write(50);
    delay(3000);
    for (i=0;i<5;i++){
      hand[i].write(60);
      delay(100);
    }
    for (i=0;i<4;i++){
        wrist.write(0);
        delay(500);
        wrist.write(40);
        delay(500);
    }

     wrist.write(20);
}

void thumbUP(){
  elbow.write(80);
  rotShoulder.write(RotShoulder[1]);
  upShoulder.write(UpShoulder[1]);
  for ( i=1; i<5; i++){
    hand[i].write(170);
    delay(500);
  }
  thumb.write(50);
  wrist.write(60);
```

The time and the planning of the project

Planning initial

In our initial planning, we planned to assemble the robot in 4 seances and then start to work on the computer vision and finish it at 6 seances. We also planned to work on the muscular activity controller.

Planning Final

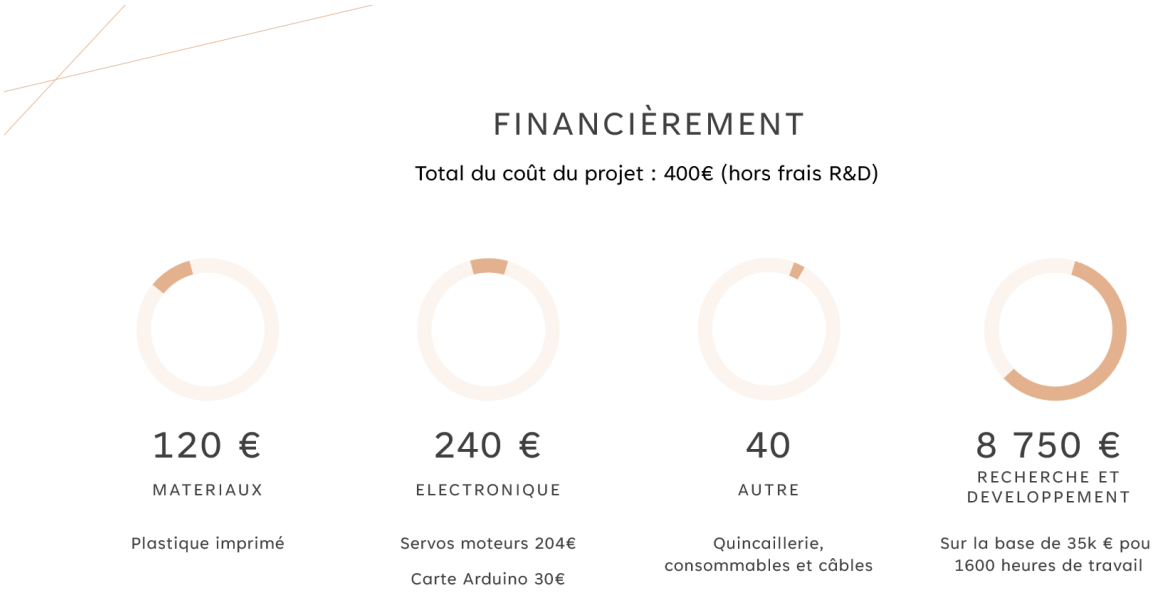
In our final planning, we spend almost all the seances for assembling the robot. At the end of the 7th seances we decided to present a functional robot instead of nothing because of the artificial intelligence which was not functional.

Différences

Before the start of the project we believed that the assemblage of the robotic arm will be easy and fast but we realized that it was not so easy and we spent a lot of time on it, especially because of many small problems which when added together represent a significant loss of time.

One of the significant problems that made us waste a lot of time was the printing of 3D pieces because sometimes the pieces were damaged so we needed to print them again.

Details of project costs*



For the research and development part, starting from a base of 35k € for 1600 hours of work, we arrive at a total of 4375€ per participant, multiplying this figure by two thus obtain the total cost for R&D.

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* The price of this project was estimated by amazon. It has been established for the purposes of this report and does not represent exactly the actual price of this project.

Problems encountered

The forearm

We started with the forearm construction until the 3rd seance. We encountered many problems during this part of the project. First of all, the principal part of the hand had a default inside it. We tried to resolve the obstruction, but finally we found another solution.

Then, the cables kept loosening, so we had to glue them permanently with strong glue. Even with the strong glue they kept loosening. The hand works but the problem is probably the wire

The elbow

About the shoulder, at first it was very difficult to calibrate it because of the potentiometer that we have moved.
Then we had a problem of functioning due to the bad distribution of the weight on the worm. To solve it, we put many elastic, but it was not enough.

Conclusion and objectives for the future

To conclude, this project allowed us to acquire a lot of new knowledge in electronics and it also allowed us to discover the organization and the functioning of a project. It was a project on which we worked in pairs, which was also an opportunity to develop our teamwork skills.

CE QUE CE PROJET NOUS A APPORTÉ

What we can learn from this is that our project was a very interesting but perhaps too ambitious one, but this will not prevent us from continuing this project in the future by building the other arm and then the head and even the bust of the RACAI Z-34.

We also want to work on EEG (brain wave) technology to control our robot without our hand. We could push the limits of the relation man-machine.

All the details of the Inmoov project

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