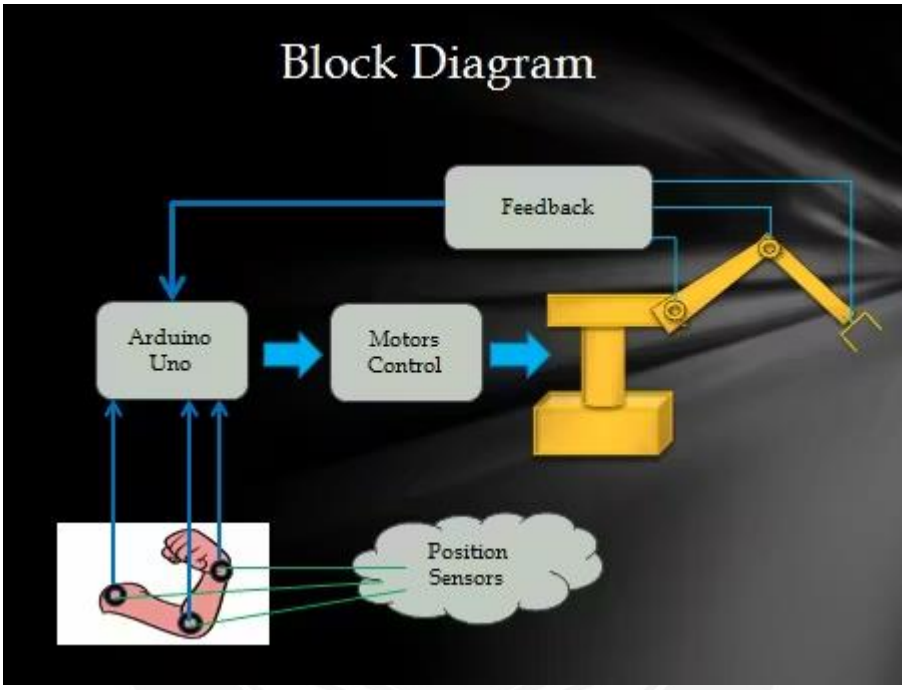
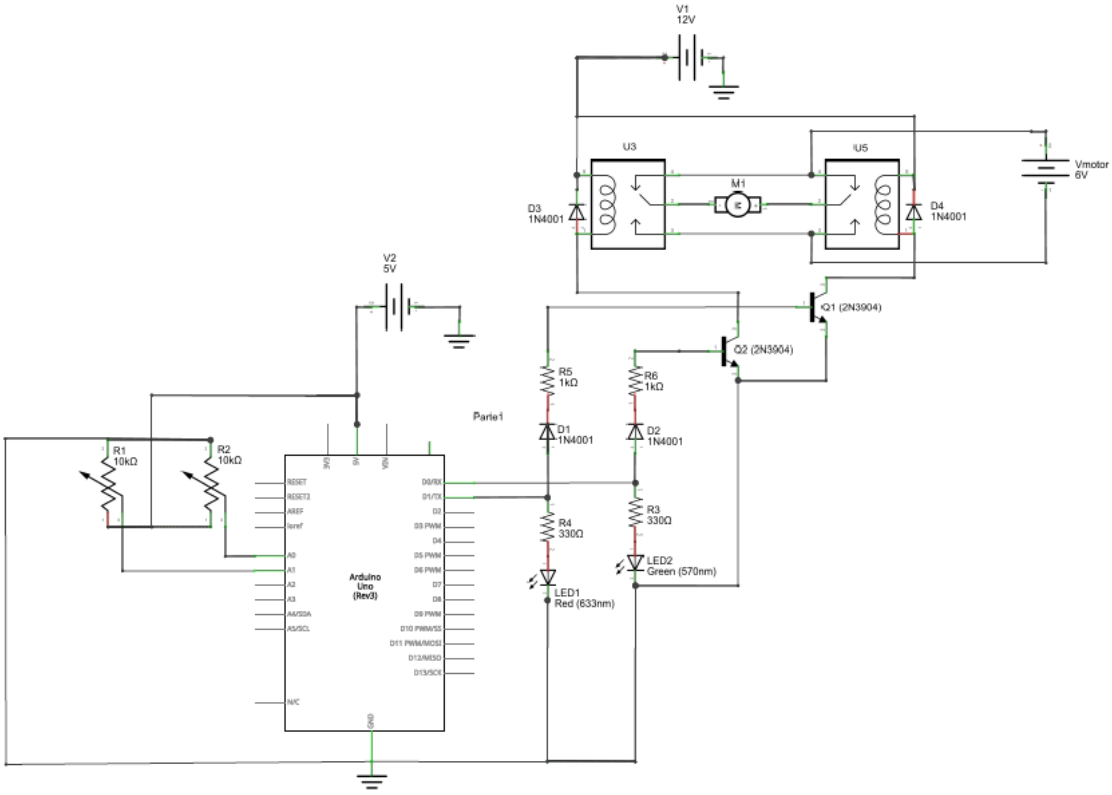
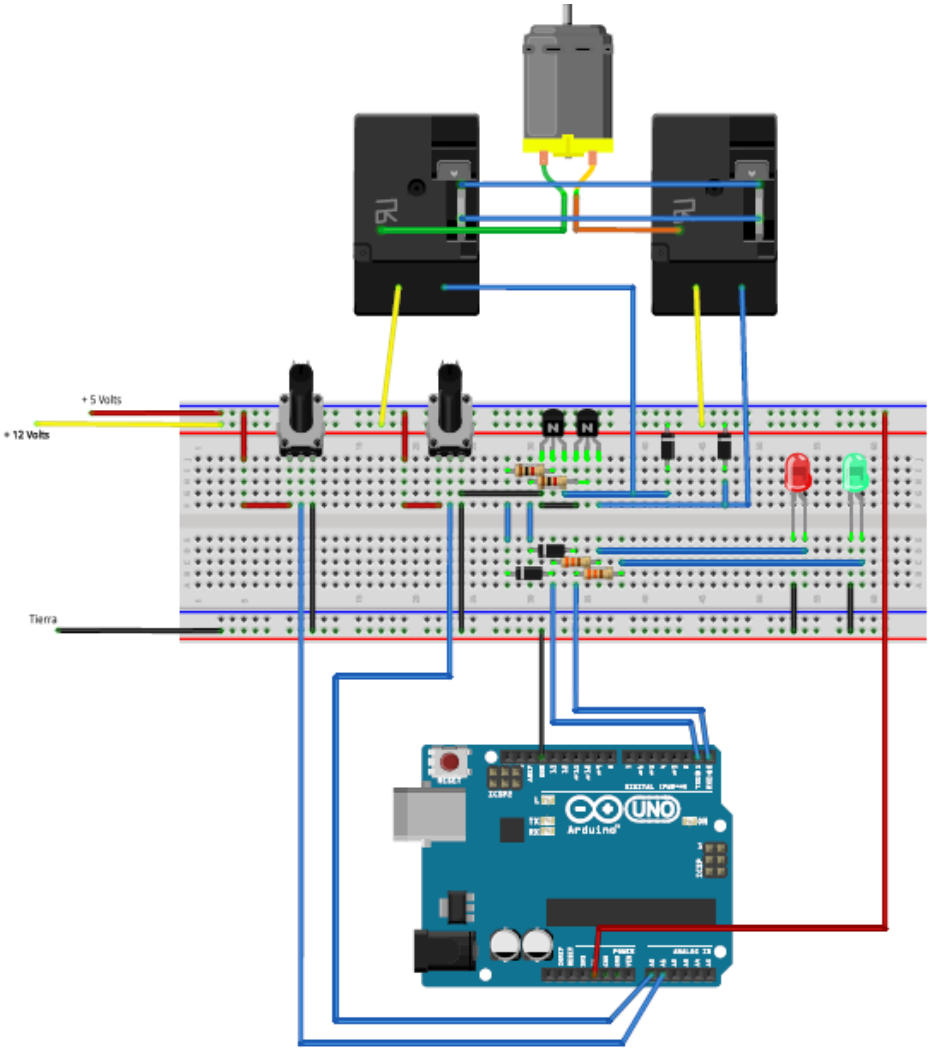
1.13 ROBOTIC ARM POSITIOING SYSTEM

[https://youtu.be/XZ63bZIfIoc]

This project involves the realization of a prototype that mimics the movements of the human arm. The idea is to replicate the movement of our arm and that every move we make will be reflected in the robotic arm. Consider the block diagram shown, which represents the entire project:







SOFTWARE PROGRAM:

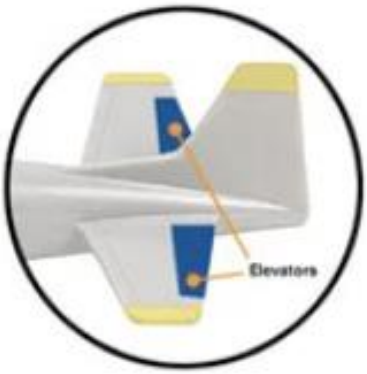
```
int POT1 = A0;     // select the input pin for the potentiometer 1
int POT2 = A1;     // select the input pin for the potentiometer 2
int X = 0;       // select the pin for the motor control (FORWARD)
int Y = 1;       // select the pin for the motor control (REVERSE)
int sensorValue1 = 0;  // variable to store the value coming from POT1
int sensorValue2 = 0;  // variable to store the value coming from POT2
void setup()
{ // declare X AND Y as an OUTPUT:
  pinMode(X, OUTPUT);
  pinMode(Y, OUTPUT); }
void loop()
{  // read the values from the POTS:
  sensorValue1 = analogRead(POT1);
  sensorValue2 = analogRead(POT2);
  // compare sensor values:
  if (sensorValue1 <= sensorValue2 + 50 || sensorValue1 >= sensorValue2
{ digitalWrite(X, LOW);
  digitalWrite(Y, LOW);   }
  if (sensorValue1 < sensorValue2 - 51)
{ digitalWrite(X, LOW);
  digitalWrite(Y, HIGH);   }
   if (sensorValue1 > sensorValue2 + 51)
{ digitalWrite(X, HIGH);
  digitalWrite(Y, LOW);    }  }
```

1.14 AUTOPILOT SYSTEM

An autopilot is a system which is used to control the path/trajectory of the vehicle without constant "hands-on" control by a human operator being required.

Sperry Corporation developed the first autopilot in 1912. The autopilot was connected to gyroscopic head indicator & attitude indicator (artificial horizon) to be hydraulically operated by elevators & rudder.

The autopilot is the central component of every automatic flight system. This auto-stabilization mechanism is designed to keep the aircraft in stable flight along one or more of its three axes: Pitch, Yaw and Roll.



Components of an AFCS (Automatic Flight Control System)

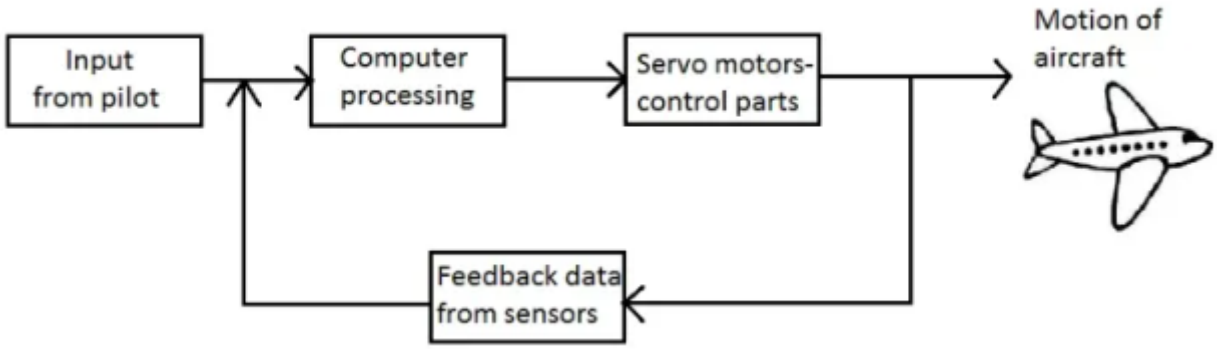
3 LEVELS OF AUTOPILOTS

1. Single-axis autopilots controls the aircraft in roll axis only with the help of ailerons aka “wing levelers”.
2. Two-axis autopilots can control an aircraft in pitch axis as well as roll axis with the help of ailerons & elevators.
3. The three-axis autopilot systems are capable of controlling an aircraft in all the 3 axes- roll, pitch & yaw with the help of all three – ailerons, elevators & rudder.

Presently, autopilots get the inputs from dozens of sensors located in different parts of plane (accelerometer, pressure sensor & various gauges) and controls those sensors with servo motors & links. AFCS is able to maintain/control the trajectory/path of the flight.

Example:

Let us consider a case in which the pilot wants to fly at a constant height in the same direction keeping the speed constant.



1. The pilot sets a value for wings to maintain the position of the flight.
2. Somehow, a wing will dip if there are change in directions of wind (or weather changes or type of air)
3. Position sensors or gyroscopes notes down the change & sends to the computer system.
4. The computer compares the input value with the new value recorded by the sensors.
5. The computer sends a signal which turns the servo motors (servos) on.

6. The servos adjust the ailerons (in this case) accordingly until the new value gets equal to the input value(until the aircraft maintain the height as previous)
7. As soon as the values get equal, it again sends a signal to servos to turn it off.

In simple words, if the aircraft dips 5m, the ailerons will adjust their angles & gain a height of 5m so that the height remains constant during the flight.

The heart of a modern automatic flight control system is a computer with several high-speed processors. To gather the intelligence required to control the plane, the processors communicate with sensors located on the major control surfaces. They can also collect data from other airplane systems and equipment, including gyroscopes, accelerometers, altimeters, compasses and airspeed indicators.

The processors in the AFCS then take the input data and, using complex calculations, compare it to a set of control modes. A control mode is a setting entered by the pilot that defines a specific detail of the flight. For example, there is a control mode that defines how an aircraft's altitude will be maintained. There are also control modes that maintain airspeed, heading and flight path. These calculations determine if the plane is obeying the commands set up in the control modes. The processors then send signals to various servomechanism units. A servomechanism, or servo for short, is a device that provides mechanical control at a distance. One servo exists for each control surface included in the autopilot system. The servos take the computer's instructions and use motors or hydraulics to move the craft's control surfaces, making sure the plane maintains its proper course and attitude.

Modern autopilots have evolved so significantly that they can not only execute a flight plan but also are capable of performing automated landings under the supervision of a pilot.