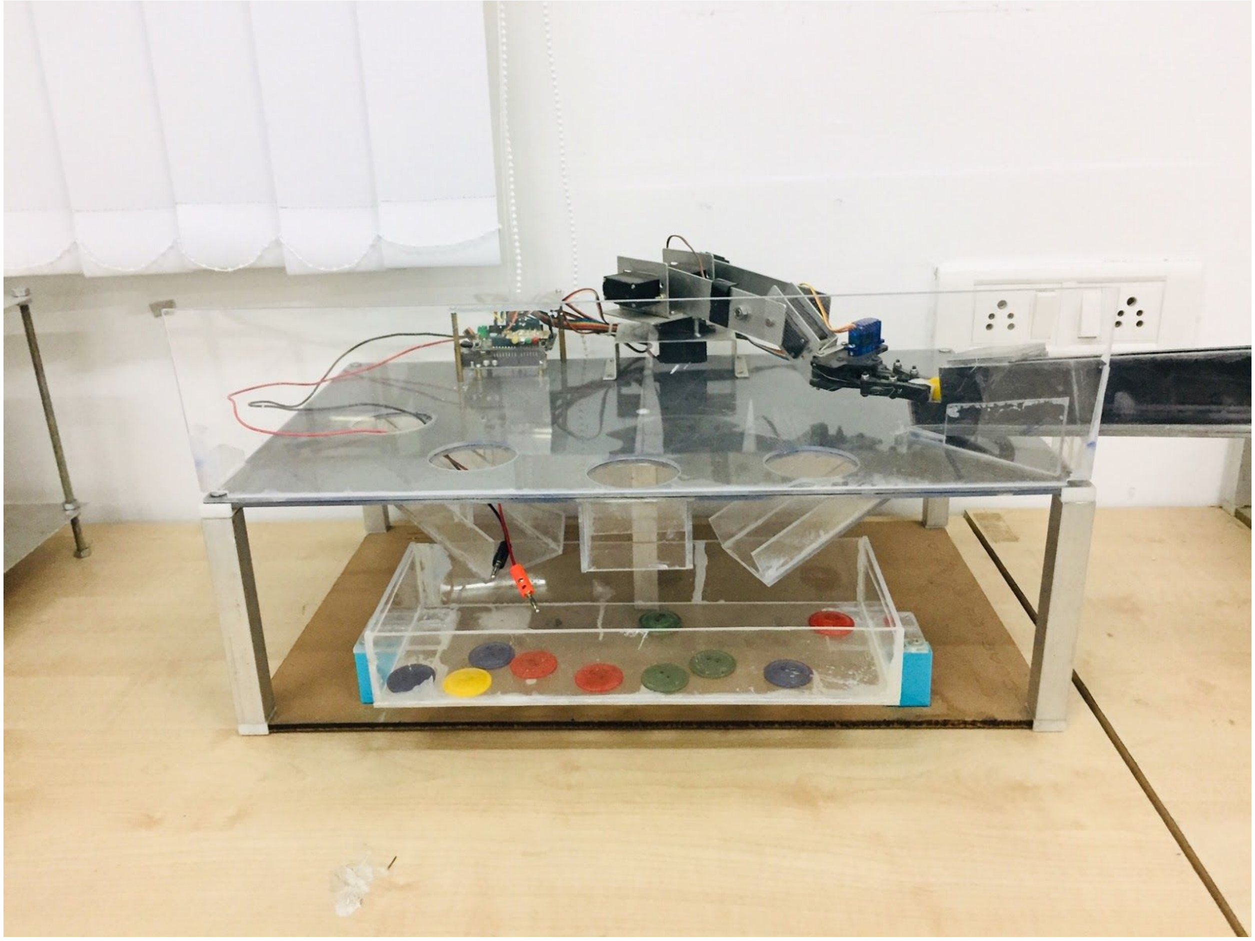
COLOR SORTING ROBOTIC ARM



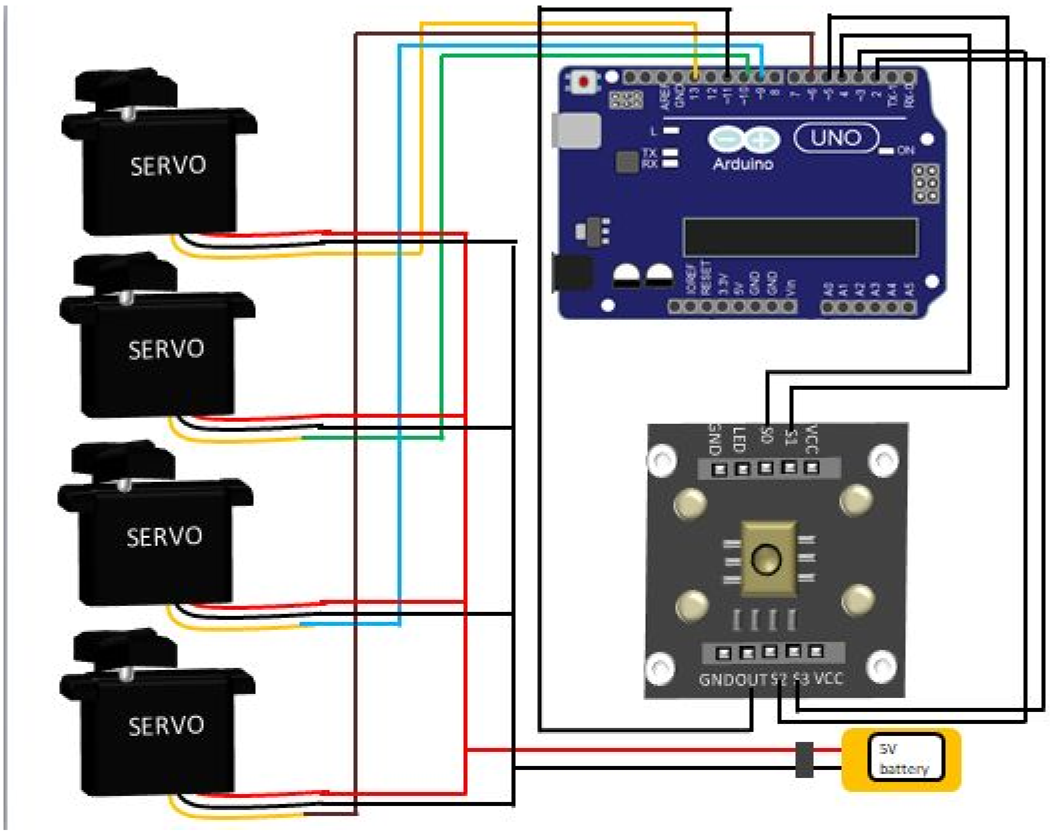
Introduction: The term robot comes from the Czech word *robota,* which means, “Forced labour.” While robots are of various types, the most common manufacturing robot is the Robotic Arm, which is a electronically-programmed mechanical arm, which performs the functions of the human arm. Robotic arms are usually made up of two or more segments, connected by articulated joints. The robotic arm has the equivalent of a shoulder, an elbow, a wrist and the hand (or gripper).

The aim of this project is to make students learn how to develop a mechanical robotic arm and also make it programmable for different tasks. In this project, a robotic arm with four degrees of freedom is designed and programmed using Arduino Uno board. The arm is capable of picking up coloured discs, sensing the colour (like red, blue, green and yellow) and dropping them in their designated containers.

List of components required-

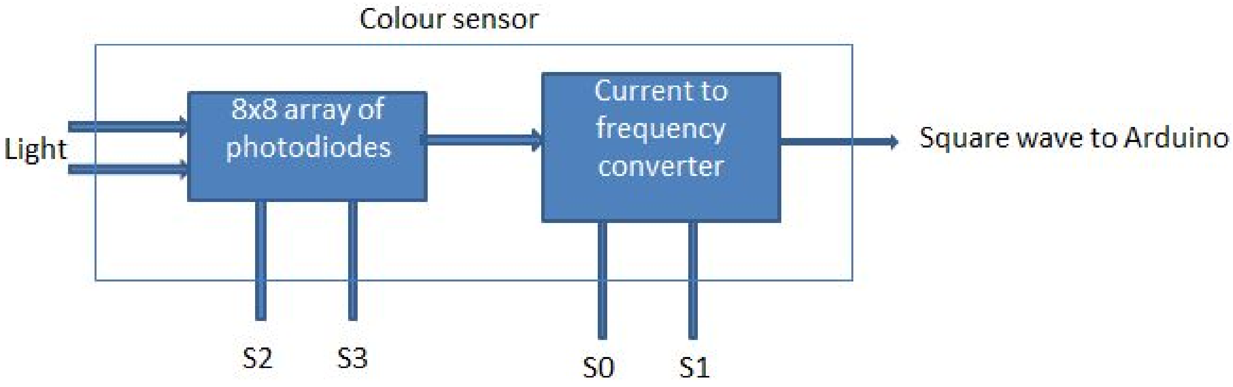
1. Servo motors
2. Arduino Uno microcontroller
3. Colour sensor
4. Power supply (5v 3 amp minimum)

Circuit diagram:



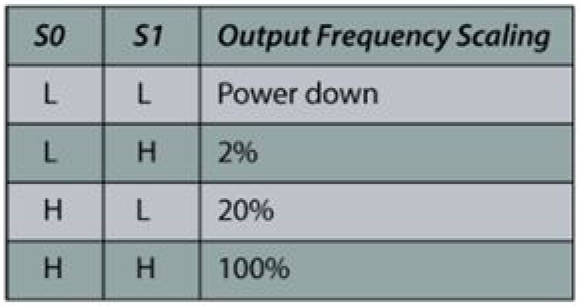
TCS3200 (colour sensor) interface with arduino:

The TCS3200 sensor senses light of different colours with the help of an 8 x 8 array of photodiodes. Then using a Current-to-Frequency Converter, the readings from the photodiodes are converted into a square wave with a frequency directly proportional to the light intensity. Finally, using the Arduino Board we can read the square wave output and get the results for the colour.

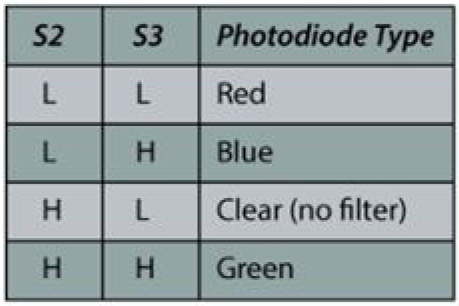


If we take a closer look at the sensor we can see how it detects various colours. The photodiodes have three different colour filters. Sixteen of them have red filters, another 16 have green filters, another 16 have blue filters and the other 16 photodiodes are clear with no filters.

Each 16 photodiodes are connected in parallel, so using the two control pins S2 and S3 we can select which of them will be read. So for example, if we want to detect red colour, we can just use the 16 red filtered photodiodes by setting the two pins to low logic level according to the table.



S0	S1	Output Frequency Scaling
L	L	Power down
L	H	2%
H	L	20%
H	H	100%



S2	S3	Photodiode Type
L	L	Red
L	H	Blue
H	L	Clear (no filter)
H	H	Green

The sensor has two more control pins, S0 and S1 which are used for scaling the output frequency. The frequency can be scaled to three different preset values of 100 %, 20 % or 2%. This frequency-scaling function allows the output of the sensor to be optimized for various frequency counters or microcontrollers.

Arduino Sketch:

```
#include <Servo.h>
Servo Base;  // create servo object to control a servo
Servo Shoulder;  // create servo object to control a servo
Servo Elbow;  // create servo object to control a servo
//Servo WristUpDown;  // create servo object to control a servo
//Servo WristRotate;  // create servo object to control a servo
Servo Gripper;  // create servo object to control a servo

int value[36] =
{159,170,58,120,159,175,58,120,159,175,58,160,159,146,58,160,129,146,58,160,129,166,58,160,129,166,58,120,129,146,58,120,159,146,58,120};
int a = 0;// block start address
int stepno = 1;
int buffer = 0;
int offset = 5; // initiallize for green
//int b = 0;// accumulative start address
int OutPut= 11;//naming pin11 as output
unsigned int rPulseWidth = 0;
unsigned int bPulseWidth = 0;
unsigned int gPulseWidth = 0;
```

```
 //const int inputPinA = 0; //  Pins 0 & 1 are connected to push buttons.
// const int inputPinB = 1;
//int pot_input[0];
int pot_input[2] = {0};
void setup()
{
  Serial.begin(9600);
  Base.attach(13);  // attaches the servo on pin 2 to the servo object
  Shoulder.attach(10);  // attaches the servo on pin 3 to the servo object
  Elbow.attach(9);  // attaches the servo on pin 4 to the servo object
//  WristUpDown.attach(8);  // attaches the servo on pin 5 to the servo object
//  WristRotate.attach(7);  // attaches the servo on pin 6 to the servo object
  Gripper.attach(6);  // attaches the servo on pin 7 to the servo object

 // Initiallized ARM positions on power on ///
  Base.write(161);
  Shoulder.write(146);
  Elbow.write(58);
  Gripper.write(120);
/////////////////////////////////////////

                pinMode(5, OUTPUT);//Sensor S0
                pinMode(4, OUTPUT);//Sensor S1
                pinMode(3, OUTPUT);//Sensor S2
                pinMode(2, OUTPUT);//Sensor S3
                pinMode(11, INPUT);//Sensor OUT

                digitalWrite(5,HIGH);//setting frequency selection to 20%
                digitalWrite(4,LOW);

                pinMode(A1, OUTPUT);//GND
                pinMode(A2, OUTPUT);//Yellow LED
                pinMode(A3, OUTPUT);//Blue LED
                pinMode(A4, OUTPUT);//Green LED
                pinMode(A5, OUTPUT);//Red LED

                digitalWrite(A1, LOW);// for GND
                digitalWrite(A2,LOW);
                digitalWrite(A3,LOW);
                digitalWrite(A4,LOW);
                digitalWrite(A5,LOW);
colour_sense();
Serial.print(offset);
}

void loop()
{
  Serial.println(offset);
   //offset = buffer;
   //colour_sense();



    //pot_input[0]=analogRead(0);
    //pot_input[1]=analogRead(1);
    //pot_input[0]= map( pot_input[0],0,1023,15,-15);
    // pot_input[1]= map( pot_input[1],0,1023,15,-15);

    //value[a]=(value[a] + pot_input[0]);
    //value[a+1]=(value[a+1] + pot_input[1]);

for (int count=0;count<200;count++)
{
 if (stepno >= 5 && stepno <= 8)
  {
    Base.write(value[a] + offset);
    Shoulder.write(value[a+1]);
    Elbow.write(value[a+2]);
    Gripper.write(value[a+3]);
    delay(10);
  }
  else{
    Base.write(value[a]);
    Shoulder.write(value[a+1]);
    Elbow.write(value[a+2]);
    Gripper.write(value[a+3]);
    delay(10);
  }
```

```
      }
  a=a + 4;
  stepno++;
  if (a>=36)
  {
    a=0;
    stepno = 1;
    offset = buffer;
    colour_sense();
  }
//colour_sense();
}

void colour_sense()
{
   digitalWrite(3,LOW);
                digitalWrite(2,LOW);//setting for RED color sensor
                rPulseWidth = pulseIn(OutPut, LOW);//read pulse width
                if (rPulseWidth > 10000)
                { rPulseWidth = 10000;
                }
                //rPulseWidth = (256-rPulseWidth);
                 rPulseWidth = map(rPulseWidth, 0,10000,255,0);

                delay(300);

                digitalWrite(3,LOW);
                digitalWrite(2,HIGH);// setting for BLUE color sensor
                bPulseWidth = pulseIn(OutPut, LOW);// read pulse width
                 if (bPulseWidth > 10000)
                { bPulseWidth = 10000;
                }

                bPulseWidth = map(bPulseWidth, 0,10000,255,0);

                delay(300);


                digitalWrite(3,HIGH);
```

```
            digitalWrite(2,HIGH);// setting for GREEN color sensor
            gPulseWidth = pulseIn(OutPut, LOW);// read pulse width
             if (gPulseWidth > 10000)
            { gPulseWidth = 10000;
            }

             gPulseWidth = map(gPulseWidth, 0,10000,255,0);
            delay(300);

            if ((rPulseWidth > gPulseWidth) && (gPulseWidth > bPulseWidth) &&
((rPulseWidth + gPulseWidth + bPulseWidth) > 600))// test for yellow
            {
              buffer = -55;// Yellow
              digitalWrite(A2, HIGH);
              digitalWrite(A3,LOW);
              digitalWrite(A4,LOW);
              digitalWrite(A5,LOW);
          }

            else if ((rPulseWidth > bPulseWidth) && (bPulseWidth > gPulseWidth))// &&
((rPulseWidth + gPulseWidth + bPulseWidth) > 500))// test for red

             {
              buffer = 15;// Red
              digitalWrite(A2,LOW);
              digitalWrite(A3,LOW);
              digitalWrite(A4,LOW);
              digitalWrite(A5,HIGH);
      }

      else if ((bPulseWidth > rPulseWidth) && (bPulseWidth + gPulseWidth))// test for
blue

       {
        buffer = -35;// blue

        digitalWrite(A2, LOW);
              digitalWrite(A3,HIGH);
              digitalWrite(A4,LOW);
              digitalWrite(A5,LOW);
      }

            else
      { buffer = 5;// green
      digitalWrite(A2, LOW);
              digitalWrite(A3,LOW);
              digitalWrite(A4,HIGH);
              digitalWrite(A5,LOW);
      }
            }
```