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# AUTOMATIC COLOR SORTER USING TCS3200

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## ABSTRACT

**Introduction:** Object sorting has become an essential-criterion in all the industries across the world. Automated industries employ several methods for establishing perfect object classification. In this fast-moving modern era, even every small-scale industry is in need of a system for sorting the goods they produce.

**Objective:** Objective of this study was to classify objects based on color using the sensor TCS3200 in a perfect way.

**Materials and Methods:** Color based object sorting is an effective way to distinguish the objects using some comparatively convenient techniques. This paper introduces two efficient methods for classifying objects based on color. The first technique implies electrical actuation using DC servo motors and the second method used pneumatic actuation for sorting. Both the methods use TCS3200 as the primary sensor for classification of objects.

**Results:** Both the methods proved to be effective by accurately recognizing the input objects and classifying them in an excellent way as instructed.

**Conclusion:** These methods can be implemented to any kinds of industrial sorting irrespective of the size and shape of the objects. These most cost-effective and user-friendly ways to separate objects based on color.

**Keywords:** RGB Technology, Sorting, Actuation, Servo motor, Controllers, Pneumatics.

## INTRODUCTION

In our daily life, our vision is filled with colorful objects around us. Most industries across world manufacture several products under various sectors. In general, a lot of industries produce different products under one division. Those products are required to be organized, and the best way to organize them is based on the color of the goods produced. Several methods are available for sorting objects based on color, here some of the proven effective methods have been discussed.

## MATERIALS AND METHODS Sensor Analysis

TCS3200: It is a color sensor which is capable of detecting any number of colors as

possible. This sensor uses RGB technology for Identifying the color of the object introduced to it. This sensor is available as a module.

On the center of this module, an eye like structure is available. If we look at that portion on a microscopic scale, RGB grids could be seen. These grids correspond to the RGB matrix and each grid contain three sensors to measure the intensity of red, green and blue light received respectively.

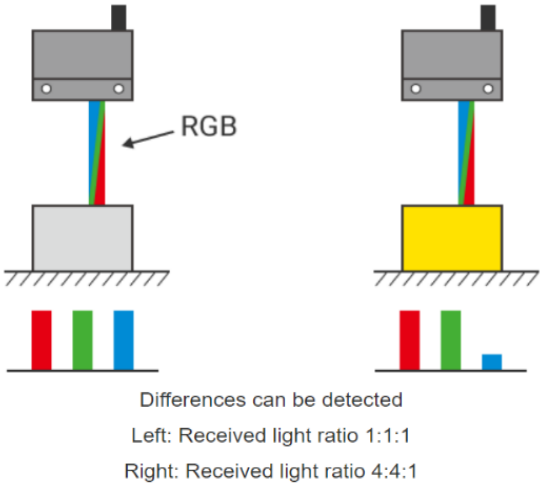


**Figure-1: RGB detection representation**

As we are generally familiar that every color that is visible to us can be scaled on the amounts of red, green and blue color they contain. Thus, measuring the RGB values of a specific color of the object, determines the final color of the object.

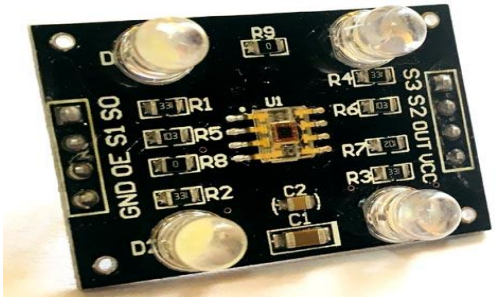


**Figure-2: TCS3200 Module**

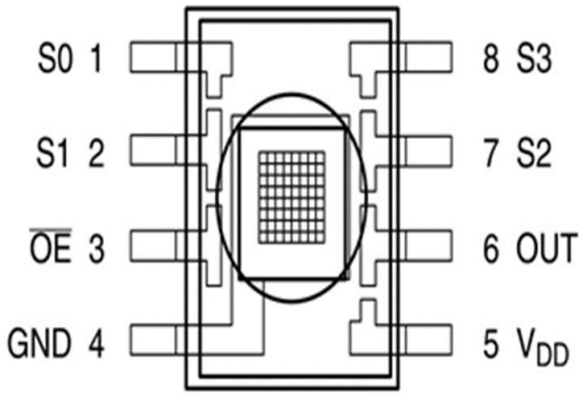


**Figure-3: Internal section of TCS3200**

This sensor is provided with filters, which can be screened for the detection of specific colors. In that note, to detect white color, no filter mode is used. Thus, TCS3200 is known as programmable color sensor.

**Object Sorting based on Color**

**Method 1: (Electrically Actuated Color Sorter)**

This method implies TCS3200 color sensor, dc servo motors and an Arduino Uno microcontroller for sorting objects. When the desired object is passed through the sensor path, the sensor detects the particular color and sends the signal to the microcontroller, which then instructs the servo motors to separate the objects based the detected color.

The range of the colors of the object to be sorted has to be calibrated with the sensor and should be fed in the code for better performance. The sensor is capable of detecting the color of the object within one second or less, which makes this method much suitable for industrial object sorting, packaging and inspection.

## Circuit

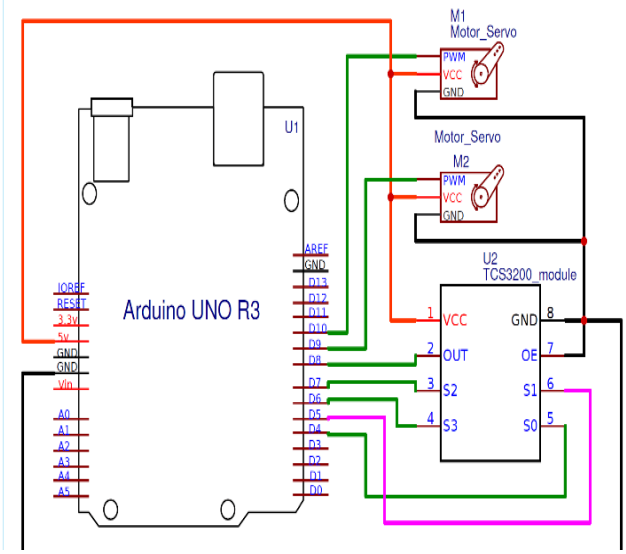


**Figure-4: Circuit Simulation of method 1 in proteus software**

The first servo motor (M1), takes the object and places it in the sensor detection range. After detecting the color, the second servo motor (M2), helps in sorting the object and placing it to the corresponding section allotted for the particular color.

## Code Snippets

The code used to instruct Arduino UNO, carries out the process of color sorting in an elegant stepwise manner. The code used has been attached here.

```
frequency = pulseIn(sensorOut, LOW);
int R = frequency;
Serial.print("Red = ");
Serial.print(frequency);//printing RED color freque
Serial.print("   ");
delay(50);
```

The above snippet demonstrates the identification of color frequency

```
// activating green photodiodes to read
digitalWrite(S2, HIGH);
digitalWrite(S3, HIGH);
// Reading the output frequency
frequency = pulseIn(sensorOut, LOW);
int G = frequency;
Serial.print("Green = ");
Serial.print(frequency);
```

The above code snippet indicates the activation of photodiodes of the colors to read

```
//Readings are different for different setup
//change the readings according your project and readings detected
  if(R<22 & R>20 & G<29 & G>27){
    color = 1; // Red
    Serial.print("Detected Color is = ");
    Serial.println("RED");
```

The above code snippet shows the setting of color calibrations according to the objects to be sensed.Servo motor operation is looped. A switch case function is utilized for the servo motor to drop the sorted objects.

```
void loop() {
  //initial position of servo motor
  pickServo.write(115);
  delay(600);

  for(int i = 115; i > 65; i--) {
    pickServo.write(i);
    delay(2);
  }
```

The above snippet indicated the declaration of initial position of the servo motor.

## Code Description

First, the libraries are included and the servo variables are defined, and then the pin numbers of the sensor are defined. The servo motors M1 and M2 are designated as pick servo and drop servo. The motor moves after some delay to the detector region and waits for the detection. This delay will be less than or equal to one second.

The sensor detects the color and sends out the corresponding frequency. Based on the detected color, the drop servo motor moves to a certain angle programmed and places the objects to their allotted sections. Detect Color() function is used to measure frequency and compares the color frequency in order to find the conclusion of theobject's color.

**Applications of Method 1**

Many food industries could imply this system for sorting the packed goods they produce based on color. This system is relatively cheap, and thus could be employed in small scaled industries in need of object separation based on color, as well.

Cosmetic industries (mostly MNC's), and also pharmaceutical industries could use this system for packaging and inspection.

**Method 2: (Pneumatic Color Sorter) Operation**

This method utilizes pneumatic actuators, valves and compressors along with the TCS3200 color sensor and a microcontroller. In this method, the sensor is placed above the pneumatic actuator. So, when the object is passed through the sensor, it sends signals to the controller which then commands the pneumatic actuator to function, hence the pneumatic cylinder extends and pushes the object corresponding to the color detected into the allotted rack. In case of lighter objects, instead of cylinders, pneumatic valves releasing compressed and pressurized air can be used, so that the objects are blown off to their respective sections. Plc also functions as an effective controller for this method.

In this method also, a servo motor is used for conveyor driving, so that the objects are taken in front of the sensor. The microcontroller is fed with the same code by altering just the second servo motor portion by the pneumatic section.

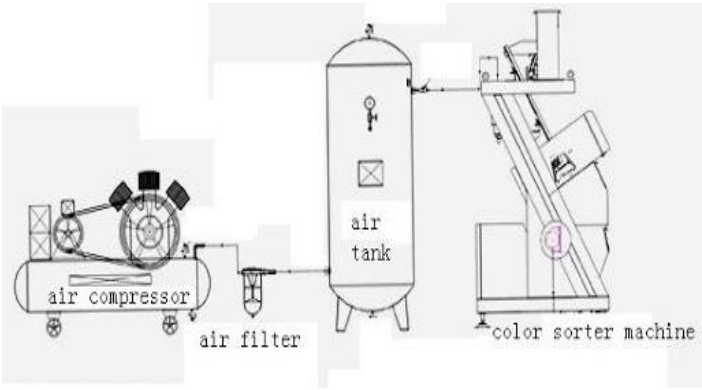


**Figure-5: A reference Pneumatic Color sorting system**

**Applications of Method 2**

This method facilitates the elimination of contaminants in food industries, granaries, and other such industries. This method could be of a vital use to color pencil manufacturing industries to sort them by using pneumatic air. As contaminants, dust particles and also products like pencils are all light weighted, these objects can be easily sorted out with the help of pneumatic color sorter system.

**Survey**

A survey has been conducted among nearly hundred machine tool industry workers and students of the related field regarding the methods preferred for object sorting based on color and its advantages:

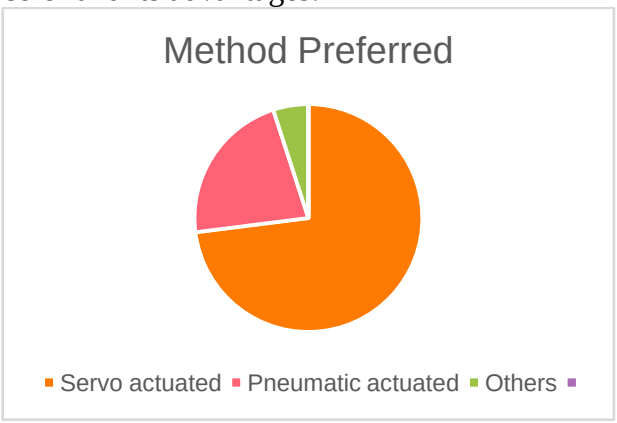


**Figure-6: Pie-chart demonstrating survey results**

## RESULTS

In the electrically actuated type sorter, the process was quicker and accurate. The input objects were precisely identified by the sensor as they reach under it and then the servo actuators operated immediately and sorted the object by moving as per the instructions provided by the controller. Overall, this method was efficient for smaller objects. In the pneumatic color sorter also, the sensors were able to detect the corresponding-colored objects quickly and the pneumatic actuators responded as soon as they received signals from the controller. This method was effective for larger light weighted objects.

## CONCLUSION

Object separation is an unavoidable part in most of the industries. Separating them based on their color is the most advantageous as well as cost effective method. These methods can be implemented to any kinds of industrial sorting irrespective of the size and shape of the objects. Depending upon the nature of the industrial system to which this is employed, the sorting systems can be designed accordingly.

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**Conflict of Interest:** Nothing to declare

**Contribution of Authors:**

BG conceived the idea, conducted main research, collected data and made the write-up.

BB edited and proofread the draft and made the final draft.

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