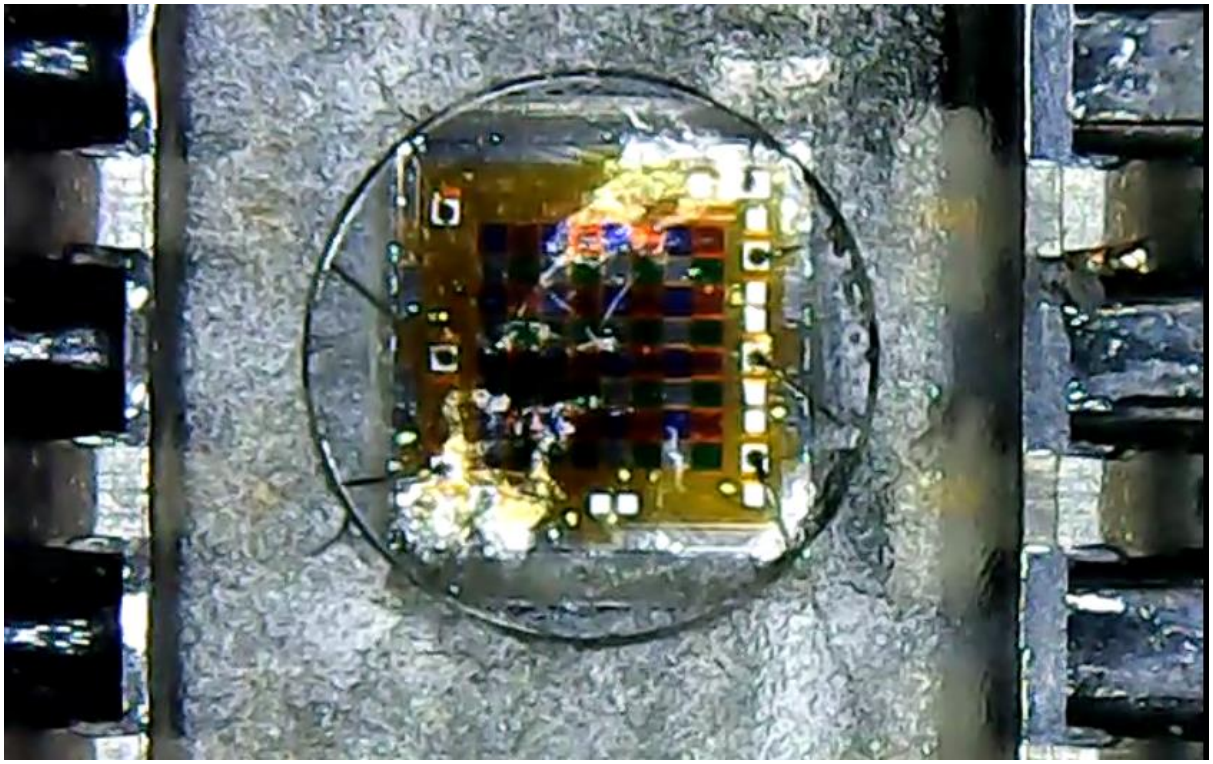
Color Sensor

Introduction

Color sensors are applied to measure, detect the color of the surfaces. These sensors have a wide range of applications in industrial, medical and security systems.

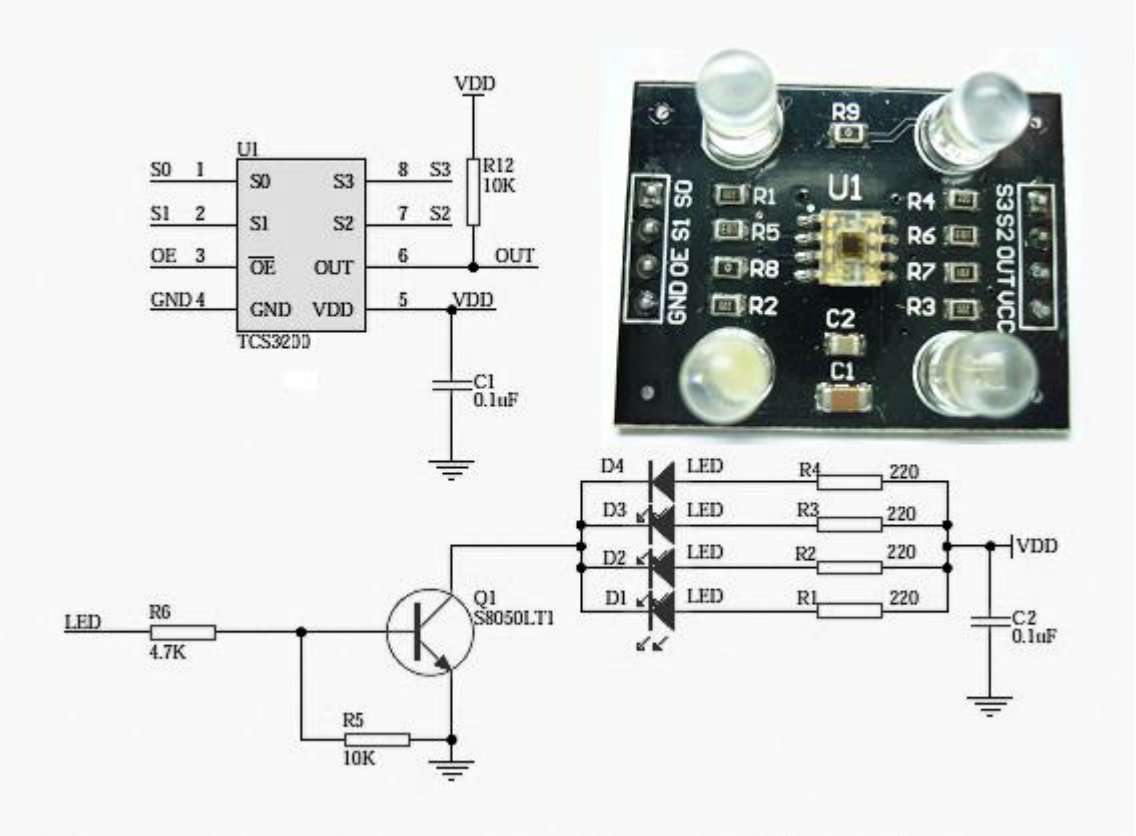
These sensors are used in certain specific applications such as analyzing the color of coffee beans during roasting, measuring highly reflective surfaces and lustrous metals, measuring self-luminous and transparent surfaces such as foil, glass or plexiglass, and other inline color measurement applications. Other applications include the recognition of anti-reflection coating on lenses, color detection of kitchen fronts, color and intensity tests of vehicle lights and many industrial applications.

The specific color sensor that we will be using is the TCS3200. It outputs a series of digital pulses with the frequency varying depending on the light intensity.



The way it works is that it has an array of sensors on the chip. Note that the different colors – red, green, blue and clear (some bluish tint). These are actually “filters” on the light sensors on the chip so you can target the intensity of a specific color (see above image of the chip taken from a microscope)

Interfacing with the Chip



The board has 8 pins which are also directly connected to the 8 pins of the chip. There are also 4 LEDs onboard. These LEDs illuminate the surface to be detected. In theory, the light reflected will be proportional to the red, green and blue components of the surface color. However, note that ambient lighting may also affect the sensor reading so it may be a good idea to create a cover around the sensor like this one

S0	S1	OUTPUT FREQUENCY SCALING (f_o)
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

There are 4 control pins on the board: S0 S1 S2 and S3.

S0 and S1 are pins that control the output of the sensor. “Scaling” simply means that the output frequency will be scaled down to 20% or 2% of the output. This is particularly useful for slower microcontroller. However, for normal cases, using 100% of the output will suffice.

Pins S2 and S3 controls which portion of the sensor to activate. For example, if we want to detect the level of color GREEN then we have to apply logic HIGH or 5 volts to pins S2 and S3 of the sensor. Selecting the CLEAR portion will only measure the intensity of the light not specific to any color. We can try this :

GND - GND
OE – leave unconnected
S1 – 5V
S0 – 5V
S2 - GND
S3 - GND
OUT – OSCILLOSCOPE / METER
VCC – 5V

DO NOT FORGET to power off your arduino when wiring and make sure to always double check before powering up (the numbers in the image above denotes the pins to be connected to Arduino)

Upload the code to the Arduino (see github for the downloadable version)

```
#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);
```

```
  digitalWrite(S0,HIGH);
  digitalWrite(S1, HIGH);

  Serial.begin(9600);
}
void loop() {

  digitalWrite(S2,LOW);
  digitalWrite(S3,LOW);

  frequency = pulseIn(sensorOut, LOW);

  Serial.print("R= ");
  Serial.print(frequency);
  Serial.print("  ");
  delay(100);

  digitalWrite(S2,HIGH);
  digitalWrite(S3,HIGH);

  frequency = pulseIn(sensorOut, LOW);

  Serial.print("G= ");
  Serial.print(frequency);
  Serial.print("  ");
  delay(100);

  digitalWrite(S2,LOW);
  digitalWrite(S3,HIGH);

  frequency = pulseIn(sensorOut, LOW);

  Serial.print("B= ");
  Serial.print(frequency);
  Serial.println("  ");
  delay(100);
}
```

Lets go through the code very quickly.

The first few lines are to select which pins we have connected the sensor to.

The variable “frequency” is where we store the frequency reading from pin 8 which we have connected to the output of the sensor

Lines 22 to 29 is when we select a color by modifying S2 and S3 then getting the sensor reading. Line 25 is where we get our sensor reading.

We repeat this algorithm until we get the values for colors RED, GREEN and BLUE.