A Mini Project Report

On

COLOUR SORTING MACHINE

Submitted in partial fulfillment of the requirement for the award of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS & COMMUNICATION ENGINEERING

from

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD, KUKATPALLY, HYDERABAD

by

VENKAT SAI KIRAN CHIGURUPATI	**18C11A0480**
RUPA SRI VUDATHA	**18C11A0456**
CHANDRA REKHA NOMULA	**19C15A0402**
RAMU KODARU	**19C15A0413**

Under the supervision of

Mr.K.SRINADH M.Tech.

Assistant Professor

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ANURAG ENGINEERING COLLEGE

(Autonomous)

(Accredited by NBA, New Delhi &Approved by AICTE, New Delhi &
Affiliated to JNTUH, Hyderabad)

ANANTHAGIRI (V&M), SURYAPET (Dt). T.S. India -508206

Ph: 08683- 272555, 272456, 272454

www.anurag.ac.in

2021-2022

ABSTRACT

Sorting of object is an essential mechanical process in which difficult work is quite required. Chronic manual arranging makes consistency troubles. Machines can perform mainly dreary assignments superior to human beings. Laborer exhaustion on manufacturing the structures can result in decreased execution and troubles in retaining up objects fine. An employee in the end may forget about to recognize the colour of item, but a machine in no way. On this basis a method has been implemented for sorting of objects using TCS3200 sensor based on colour.

LIST OF FIGURES

LIST OF ACRONYMS AND ABBRIEVATION

IDE	-	Integrated Design Environment
ASSIST	-	Automatic System for Surface Inspection and Sorting of Tiles
LCD	-	Liquid Crystal Display
SCADA	-	Supervisory Control and Data Acquisition
PLC	-	Programmable Logic Controller

1. INTRODUCTION

Machines can perform highly repetitive tasks better than humans. Worker fatigue on assembly lines can result in reduced performance and cause challenges in maintaining product quality. An employee who has been performing an inspection task over and over again may eventually fail to recognize the colour of product. Automating many of the tasks in the industries may help to improve the efficiency of manufacturing system. The purpose of this model is to design and implement a system which automatically separates products based on their colour. This machine consists of three parts: conveyor belt, colour sensor, and dc motor. The output and input of these parts was interfaced using ATMEGA 328 microcontroller to reduce human efforts on mechanical maneuvering different types of sorting machines are being developed. These machines are too costly due to the complexity in the fabrication process. A common requirement in the field of colour sorting is that of colour sensing and identification. 1.1. colour Sensing and Identification Colour sensor systems are increasingly being used in automated applications to detect automation errors and monitor quality at the speed of production line. They are used in assembly lines to identify and classify products by colour. The objectives of their usage include to check the quality of products, to facilitate sorting and packaging, to assess the equality of products in storage, and to monitor waste products. Consequently, there is an abundance of colour sensors and the choice is often application-driven. Low cost and simple colour sensors are preferred over sophisticated solutions for less demanding applications where the top priority is cost and power consumption

1.1 Introduction to colour sensor

This experiment setup has been designed specifically for detecting the colour based on frequency. The LCD panel directly displays the frequency of RGB colour present in each colour. Combination of RGB colours gives the different colour. Thus Arduino RGB Colour Detector using TCS3200 Colour Sensor is a wonderful project for students who want to have fun with too many colours. In this project, we will be **"Interfacing TCS3200 Colour Sensor with Arduino"** for designing a simple colour detector. Experimental Set-Up has been designed specifically for detecting the frequency of RGB colour. The LCD panel directly displays the frequency of RGB colour.

1.2 Motivation

Colour sensor systems are increasingly being used in automated applications to detect automation errors and monitor quality at the speed of production line. They are used in assembly lines to identify and classify products by colour. The objectives of their usage include to check the quality of products, to facilitate sorting and packaging, to assess the equality of products in storage, and to monitor waste products. Consequently, there is an abundance of colour sensors and the choice is often application-driven. Low cost and simple colour sensors are preferred over sophisticated solutions for less demanding applications where the top priority is cost and power consumption. Colour names can be used and conjure reasonably consistent perceptions. There have eleven basic colour names that have been identified such as white, gray, black, red, yellow, green, blue, orange, purple, pink, and brown. Most or all colours can be described in terms of variations and combinations of these colours. Due to the fact that human colour vision is accomplished in part by three different types of cone cells in the retina, it follows that three values are necessary and sufficient to define any colour. Colour theory describes that there are three values that can be thought of as coordinates of a point in three-dimensional space, giving rise to the concept of colour space. Hue, saturation, luminance is one such colour co-ordinate system, or colour space.

1.3 Objective

Bickman, et al described in the article about automated colour-sorting using optical technology that has evolved from early designs intended to remove ceramic contaminants. The system configuration is similar to automated ceramic removal equipment, but colour-sorting equipment used a different light source. Automated systems can generally be instructed to remove any one or a combination of the three glass colours. Industrial applications require some sort of automated visual processing and classification of items placed on a moving conveyor. Bozma and Yal-cin state that items may be randomly positioned and oriented while moving on a conveyor. A camera located above the conveyor views the items orthographically. Boukouvalas et al describes an integrated system developed for the detection of defects on colour ceramic tiles and for the colour grading of defect-free tiles.

1.4 Methodology

This machine uses a mechanism which uses a colour sensor to sort coloured product. We are connecting Arduino uno to a controller circuit. To this circuit a colour sensor is attached. This colour sensor is to detect the colour. After the colour is detected, a signal is sent to the Arduino uno to sort and display colour. LCD is used to display colour which is been sorted. Where LCD is connected to controller circuit. A combination of all these colours gives a different colour. There is various software available which directly converts the combination of RGB frequency into the desired colour. The set up is absolutely self-contained and requires no other apparatus. It is totally implemented based on shading by using TCS3200 Shading sensor with associated with Arduino Unospeed. According to Publication named "Automatic colour sorting machine using TCS3200colour sensor and ATMEGA328Microcontroller "manual sorting of products involves many risks, in order to reduce those risks sorting process has become automatic process.

1.5 Organization of Thesis

- **Chapter 1** Provides introduction to system, objective, motivation and methodology.
- **Chapter 2** A brief review of literature towards available models.
- **Chapter 3** Discusses about components used in our proposed architecture.
- **Chapter 4** Give details of implementation of the proposed methods.
- **Chapter 5** Provides complete analysis of designed product.

2. LITERATURE REVIEW

Colour Sorting Machine", Components used to sort colours is Arduino UNO, Colour Sensor, and LCD. In this, they used colour sensor to segregate three colours into three different bins. Once the object is detected using colour sensor it will coordinate with the Arduino uno respectively. By using this methodology, we can save money, time and it also includes less manpower. According to Publication named, "colour Sorting Machine", There are many ways to identify which colour it is like by using image processing etc., but nowaday's technology is increasing and we are used to choose the best easiest quickly done alternative. The integrated system developed under the ASSIST project (automatic system for surface inspection and sorting of tiles) is used for the detection of defects on colour tiles and for the colour grading of defect-free tiles. Many have proposed advanced solutions for the sorting of recyclable packaging towards process automation. Mattone et al had explained about a technique for detecting and classifying objects. Most of the authors prefer to use 2D Vision techniques to separate the objects from the known belt background and to get some of their geometrical parameters. So, publisher used the simple components to build the colour sorting model. Components used are Arduino Uno, colour sensor and LCD. By using these components model is built and accuracy rate has also increased. According to Publication named, "Arduino Based Colour sorting machine using TCS3200 colour sensor", In this to increase the speed and the process microcontroller is used along with colour sensor. ATMEGA 328 microcontroller controls the entire process and gives instructions accordingly. In this, three colours are sorted.

2.1 Existing Method

At present times, colour sorting is done using LEDs, an LDR, O/P Amps and an Arduino UNO. This device had an effect in success due to its low efficiency. LDR does not read every colour correctly. This project might not be directly applicable to human retina.

2.2 Proposed Method

The proposed method uses RGB colour sensor TCS3200 which is so efficient. Using the colour sensor, it shows approximately the right colour.

3. SYSTEM DESIGN

3.1 Block Diagram of colour sorting machine

It consists of power supply and colour sensor as an input to arduino. The target colour is placed at the sensor. The output of arduino is given to LCD.

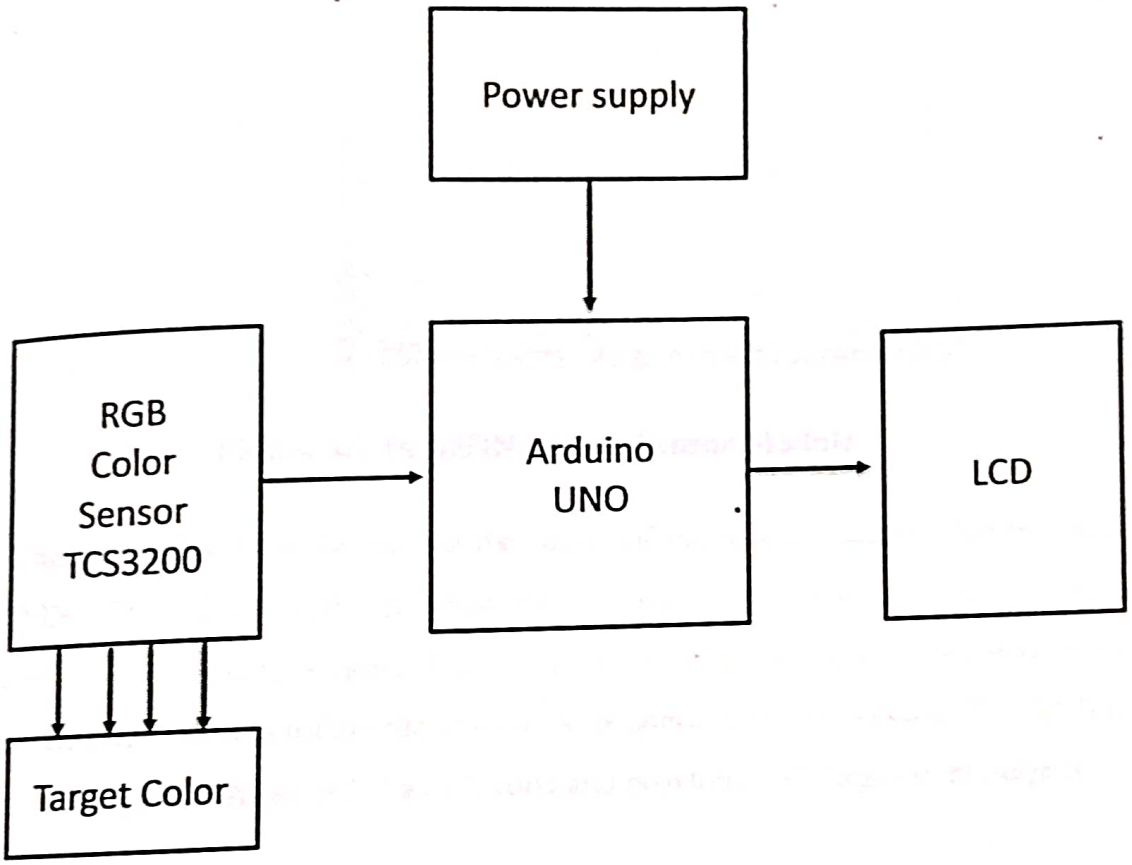


Figure.3.1 block diagram of colour sorting machine

TCS3200 Colour Sensor Module

At the heart of the module is an inexpensive RGB sensor chip from Texas Advanced Optoelectronic Solutions TCS3200. The TCS3200 Colour Sensor is a complete colour detector that can detect and measure an almost infinite range of visible colours.

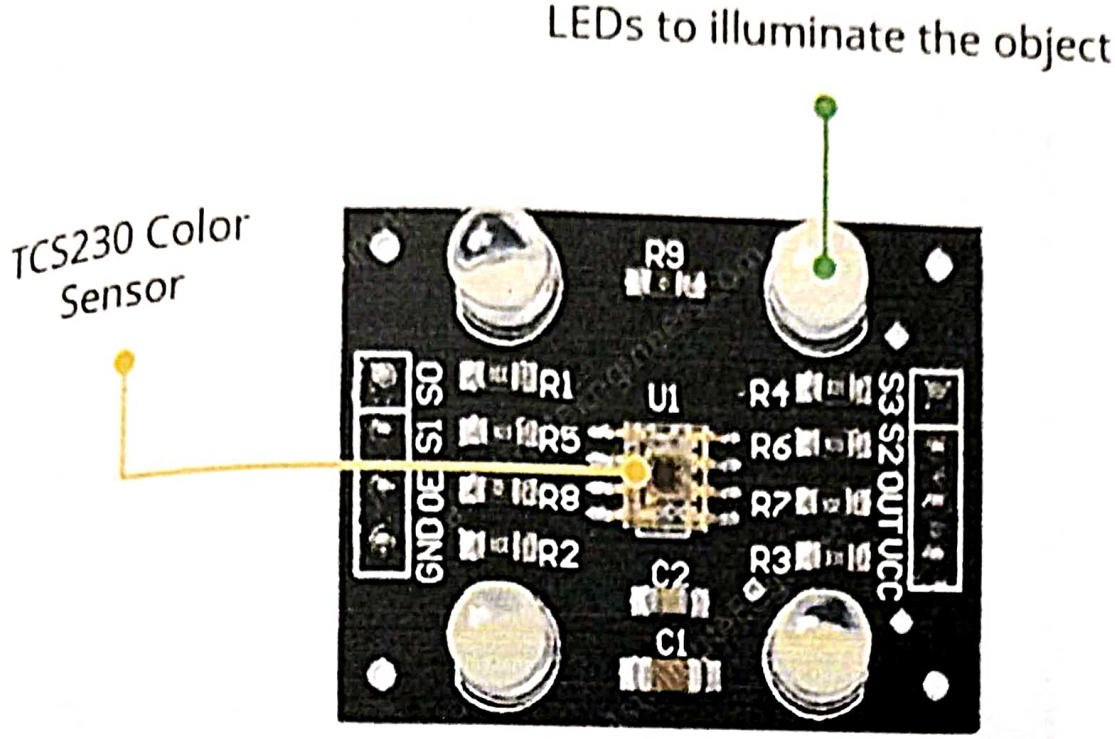


Figure.3.2 TCS3200 Colour Sensor Module

The sensor itself can be seen at the center of the module, surrounded by the four white LEDs. The LEDs light up when the module is powered up and are used to illuminate the object being sensed. Thanks to these LEDs, the sensor can also work in complete darkness to determine the colour or brightness of the object. The TCS3200 operates on a supply voltage of 2.7 to 5.5 volts and provides TTL logic-level outputs.

TCS3200 Operation

The TCS230 detects colour with the help of an 8 x 8 array of photodiodes, of which sixteen photodiodes have red filters, 16 photodiodes have green filters, 16 photodiodes have blue filters, and remaining 16 photodiodes are clear with no filters.

If you look closely at the sensor, you can actually see these filters.

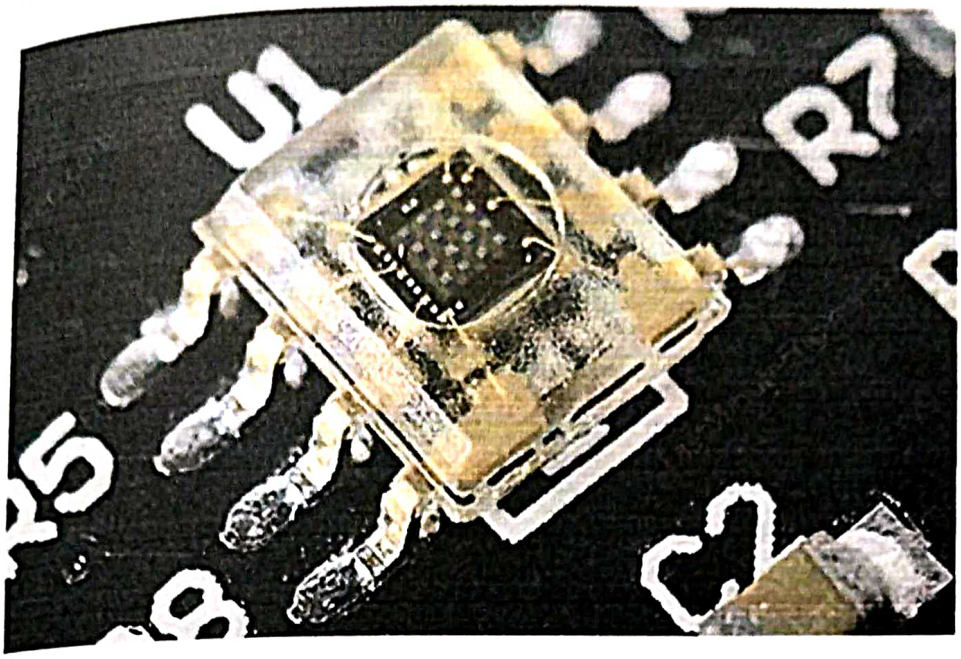


Figure.3.3 TCS3200 Operation

Each 16 photodiodes are connected in parallel, so using two control pins S2 and S3 you can choose which of them to read. So for example, if you want to detect only red colour, you can select 16 red-filtered photodiodes by setting the two pins to LOW according to the table.

Similarly, you can choose different types of photodiodes by different combinations of S2 and S3.

Table.3.1 different combinations of S2 and S3

S2	S3	Photodiode type
LOW	LOW	Red
LOW	HIGH	Blue
HIGH	LOW	Clear (No filter)
HIGH	HIGH	Green

An internal current-to-frequency converter converts readings from photodiodes into a square wave whose frequency is proportional to the intensity of the chosen colour. The range of the typical output frequency is 2HZ~500KHZ.

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 2%, 20% or 100%. This frequency-scaling function allows the sensor to be used with a variety of microcontrollers and other devices.

Table.3.2 different scaling factor by different combinations of S0 and S1

S0	S1	Output frequency scaling
LOW	LOW	Power down
LOW	HIGH	2%
HIGH	LOW	20%
HIGH	HIGH	100%

You can get different scaling factor by different combinations of S0 and S1. For the Arduino most applications use the 20% scaling.

TCS3200 Colour Sensor Module Pinout

The figure 3.4 shows the pinout of a common TCS3200 module.

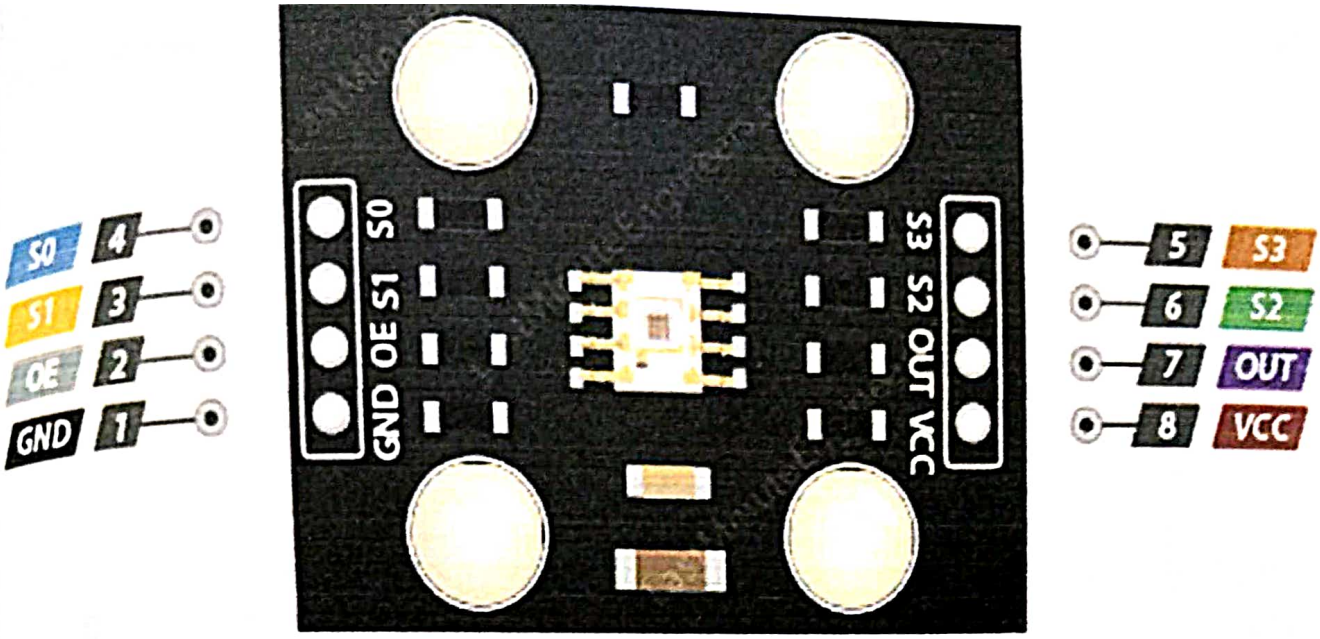


Figure.3.4 pinout of a common TCS3200 module

GND is a ground pin.

OE is the Output Enable pin. This pin is rarely used and on most modules is permanently enabled. If not already enabled then pull it LOW.

S0 & S1 pins are used to select the frequency scaling.

S2 & S3 pins are used to select the colour array.

OUT pin is a TTL level square wave.

VCC pin supplies power to the module. Connect it to the 2.7V to 5.5V power supply.

Wiring TCS3200 Colour Sensor to Arduino UNO

Hooking up the TCS 230 to an Arduino is very simple. Every pin is used except the Output Enable pin, and the module is powered safely from the 5-volt output of the Arduino.

Below is the hookup for the experiments with the TCS3200:

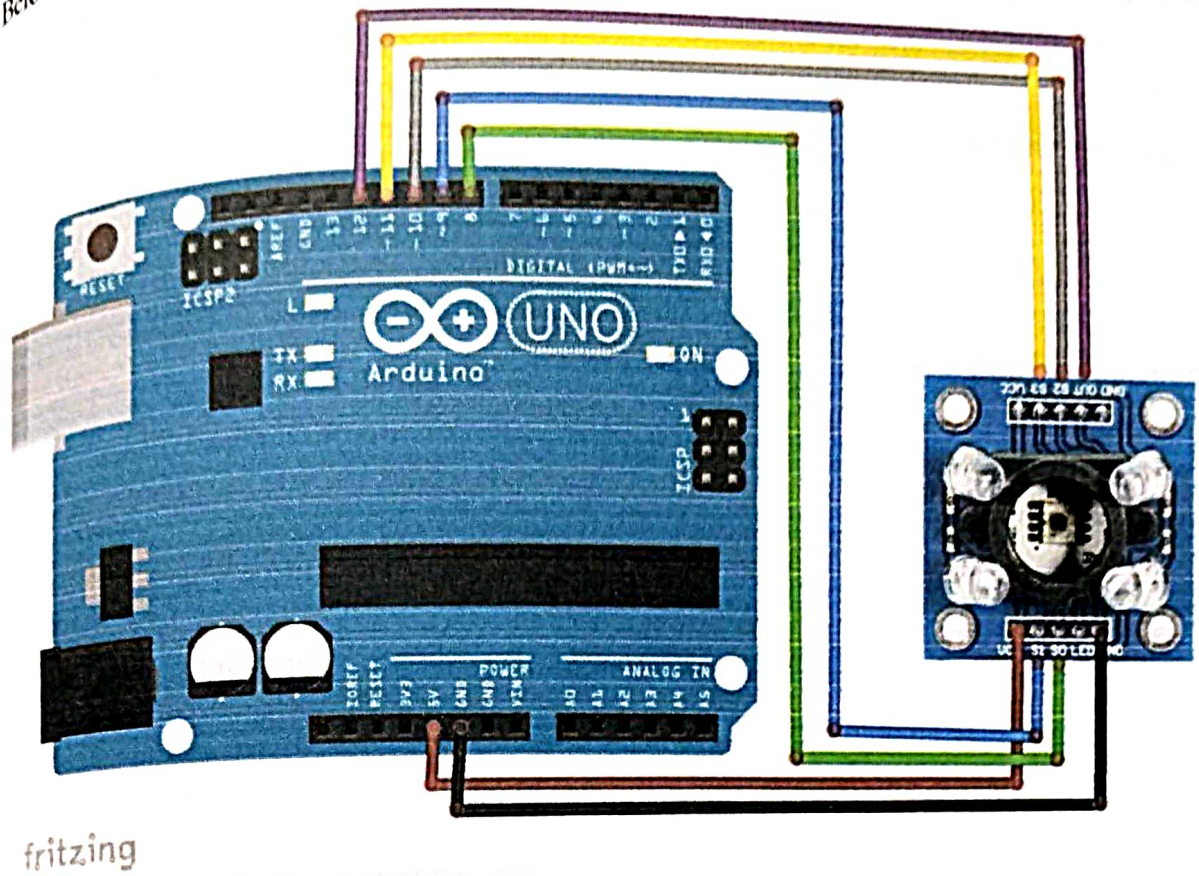


Figure.3.5 TCS3200 Colour Sensor to Arduino UNO

None of the pins used on the Arduino are critical because the module does not require any pin-specific features, so if you want to use different pins you can do so safely. Just be sure to change the pin numbers in the code to reflect any changes to the wiring. Once your sensor is connected to the Arduino it's time to write some code!

Calibrating the Sensor

We will actually use two sketches to work with the TCS230 colour sensor.

1. The first sketch (calibration sketch) will help us to obtain the raw data from the sensor.
2. The second sketch (main Arduino sketch) will use the raw data previously received to display RGB values for the colour being sensed.

Note that both sketches will use the same hardware hookup.

Following is the calibration sketch. This sketch addresses the TCS3200 sensor colour-by-colour and reads the pulse width of the output pin. The output is then displayed on the serial monitor.

Once you upload the sketch you will get such readings. Record the readings you get at both extremes.

ARDUINO UNO

setup( ): A capacity present in each Arduino sketch. Run once before the loop( ) function. Frequently used to set pinmode to info or yield. The setup( ) function resembles like:

```
void setup( ){
        //code goes here
        }
```

input: A pin mode that admissions data.

output: A pin mode that sends data.

HIGH: Electrical sign present (5V for Uno). Additionally ON or True in boolean rationale.

LOW: No electrical sign present (0V). Additionally OFF or False in Boolean rationale.

Digital Read: Get a HIGH or LOW perusing from a pin previously proclaimed as an info.

Digital Write: Assign a HIGH or LOW an incentive to a pin previously pronounced as an output .

Analog Read: Get an incentive between or including 0 (LOW) and 1023 (HIGH). This permits you to get readings from simple sensors or interfaces that have multiple states.

Analog Write: Assign an incentive between or including 0 (LOW) and 255 (HIGH). This allows you to set output to a PWM esteem rather than simply HIGH or LOW.

PWM: Stands for Pulse-Width Modulation, a strategy for copying a simple sign through an advanced pin. An incentive between or including 0 and 255. Utilized with analogWrite.

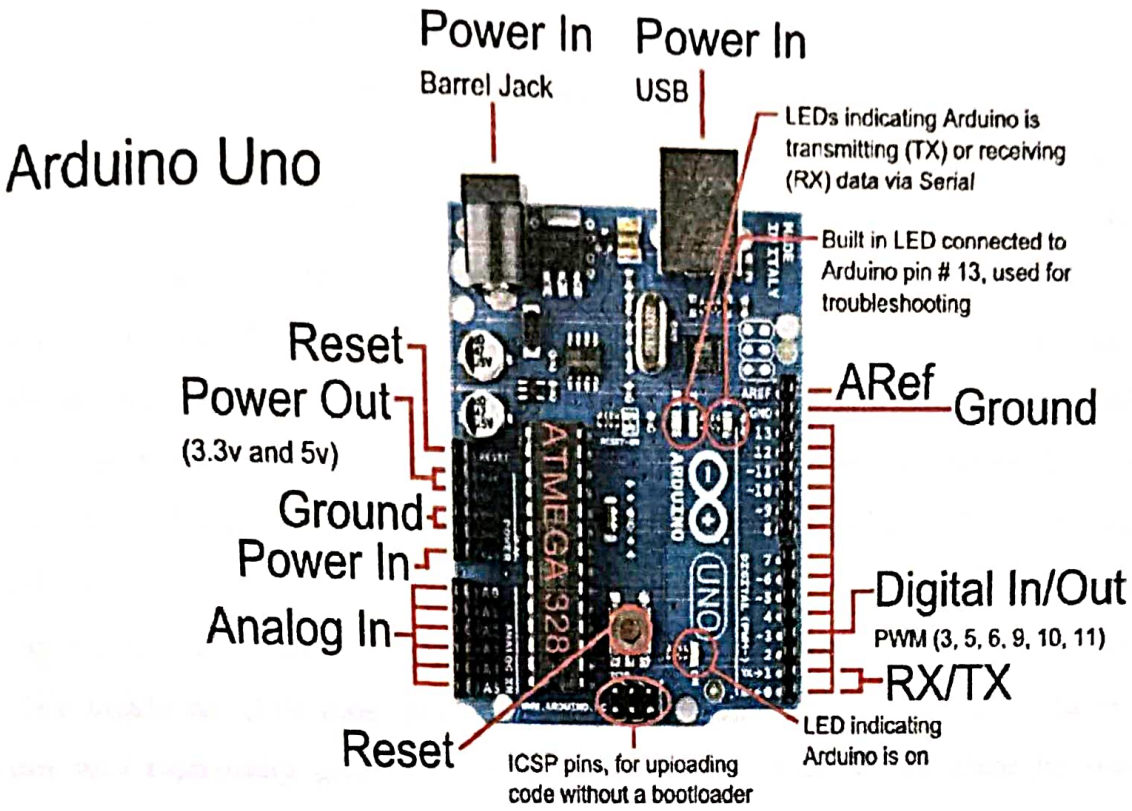


Figure.3.6 ARDUINO UNO

These boards below use the identical micro-controller, just in a very different package. The Lily pad is meant to be used with conductive thread rather than wire and therefore the Arduino Mini is solely a smaller package without the USB, Barrel Jack and Power Outs.

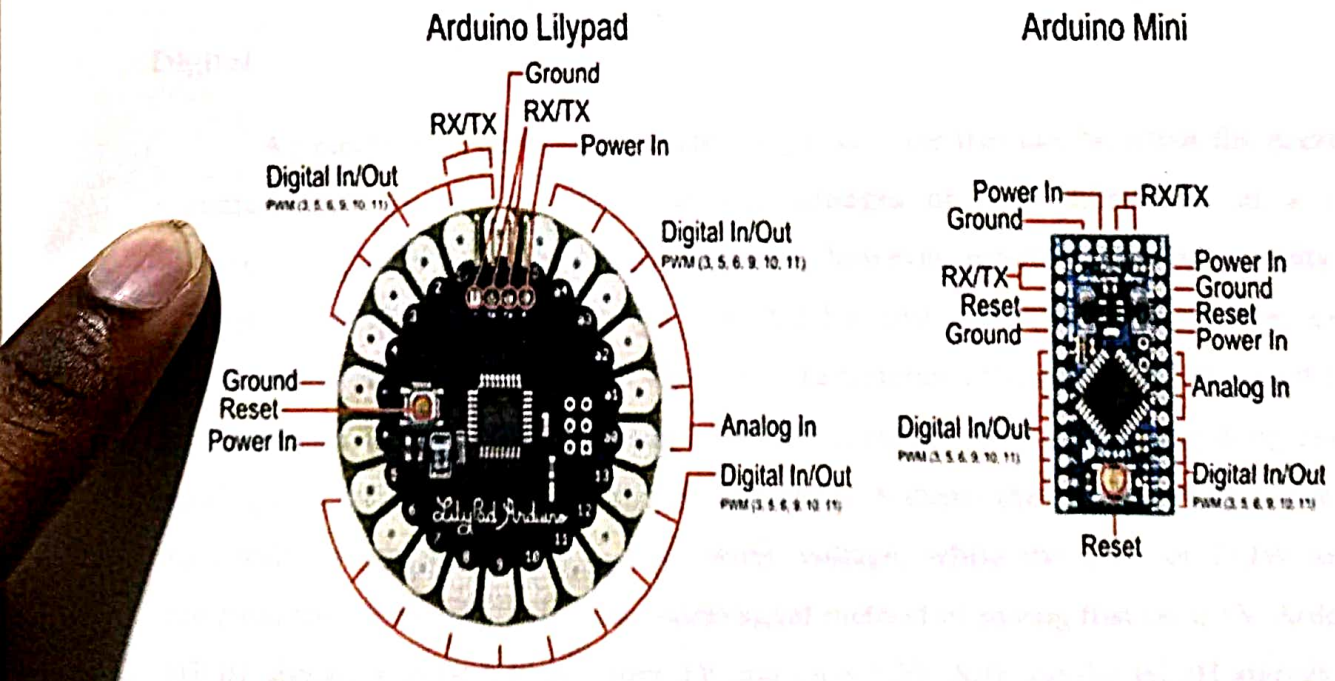


Figure.3.7 Barrel Jack and Power Outs

It relies upon what you might want to attempt to do with it truly. There are two unique purposes laid out above for the resistor, we are going to reexamine both. On the off chance that you need to utilize the obstruction as a sensor perusing gadget first you might want to get a handle on the most voltage permitted by the simple data sources you're utilizing to peruse the sign. On an Arduino this is frequently 5V. In this way, as of now we as a whole know the most worth we need for V out. The Vin is exclusively the amount of voltage effectively present on the circuit before it arrives at the essential resistor. you should be prepared to locate the most extreme voltage your sensor outputs by relying on the Datasheet, this can be the most measure of voltage your sensor will let through given the voltage in of your circuit. Presently we've precisely one variable left, the value of the subsequent resistor. Explain for R2 and you'll have all the parts of your obstruction sorted out! We tackle for R1's most noteworthy worth in light of the fact that a more modest resistor will essentially give us a more modest sign which can be clear by our simple sources of info. Controlling a simple Reference is actually equivalent to perusing a sensor aside from you need to figure for the Voltage Out worth you need to use as the simple Reference.

The entirety of the electrical signs that the Arduino works with are either Analog or Digital. it's critical to get a handle on the distinction between these two sorts of sign and the best approach to control the information these signs speak to.

Digital

An electronic sign communicated as paired code that can be either the presence or onattendance of current, high and low voltages or short heartbeats at a specific ecurrence. People see the world in simple, however robots, PCs and circuits utilize Digital. A computerized signal is a sign that has just two states. These states can shift contingent upon the sign, however basically characterized the states are ON or OFF, never in the middle. In the realm of Arduino, Digital signs are utilized for everything except for Analog Input. Contingent upon the voltage of the Arduino the ON or HIGH of the Digital sign will be equivalent to the framework voltage, while the OFF or LOW sign will consistently rise to 0V. This is an extravagant method of saying that on a 5V Arduino the HIGH signals will be a little under 5V and on a 3.3V Arduino the HIGH signals will be somewhat under 3.3V. To get or impart Digital signs the Arduino utilizes Digital pins # 0

- # 13. You may likewise arrangement your Analog In pins to go about as Digital pins. To set up Analog In pins as Digital pins utilize the order:

Pin Mode (pin Number, esteem);

Where pin Number is an Analog pin (A0 – A5) and worth is either INPUT or OUTPUT. To arrangement Digital pins utilize a similar order yet reference a Digital pin for pinNumber rather than an Analog In pin. Computerized pins default as info, so truly you just need to set them to OUTPUT in pin Mode. To peruse these pins utilize the order:

Digital Read (pin Number);

Where pin Number is the Digital pin to which the Digital segment is associated. The digital Read order will restore either a HIGH or a LOW sign. To impart a Digital sign to a pin utilize the order:

Digital Write (pin Number, esteem);

Where pin Number is the quantity of the pin imparting the sign and worth is either HIGH or LOW.

The Arduino additionally has the ability to yield a Digital sign that goes about as an Analog sign, this sign is called Pulse Width Modulation (PWM). Computerized Pins # 3, # 5, # 6, # 9, # 10 and #11 have PWM capacities. To yield a PWM signal utilize the order:

Analog Write (pin Number, esteem);

Where pin Number is a Digital Pin with PWM capacities and worth is a number between 0 (0%) and 255 (100%). For more data on PWM see the PWM worksheets or S.I.K. circuit 12.

Things to remember about digital:

- Digital Input/Output utilizes the Digital pins, however Analog In pins can be utilized as Digital
- To get a Digital sign use: digital Read (pin Number);
- To impart a Digital sign use: digital Write (pin Number, esteem);
- Digital Input and Output are in every case either HIGH or LOW

The entirety of the electrical signs that the Arduino works with are either Analog or Digital. It is critical to comprehend the distinction between these two kinds of sign and how to control the data these signs speak to.

SOFTWARE TIPS

While bootloadingna Atmega8 chip with Arduino 0010, there is an order (- i800) that makes bootloader defer 10 minutes. Thus, in the event that you need to utilize bootloader, use order line rather than IDE, eliminating "– i800" order and adding "– F" order, or use Arduino 0007 IDE. To transfer draws Arduino 0010 turns out great.

ARDUINO S3v3 NEW FEATURES

- full viable with Shield Boards (Version 2 is the main Arduino Board not viable with Shield Boards as a result of ICSP header wrong position, and tall parts);
- AVcc LP channel to lessen commotion level on ADC;
- auto reset include;
- auto reset empower/impair jumper, to dodge not wanted resetting;
- arduino Diecimila viable reset pin;
- pin13 locally available drove, with current limiter resistor;
- TX and RX locally available leds;
- power drove with suitable current limiter resistor (less 20mA of comsumption);
- jumper to impair sequential correspondence and to empower RX outer draw down resistor, to evade "RX skimming blunder". This element permits to utilize computerized pin0 and pin1 as an ordinary pin, when sequential correspondence isn't required;
- all comparative segments (diodes, semiconductors, leds, capacitors) has a similar board direction (to commits simpler to mount with less errors);
- no wires between cushions, more space between wires, bigger wires, bigger cushions (better for drawing, binding and penetrating, with no shortcircuits, patching extensions or open wires in erosion);
- just 3 wire spans;
- electrolytic capacitor (in sequential to TTL circuit) changed to bipolar sort (to keep away from rearranged voltage issue when sequential link isn't associated);
- All jumpers are correct point type, to permit Shield Boards use.

ARDUINO IDE

Download Arduino Integrated Design Environment (IDE) here (Most late form: 1.6.5): https://www.arduino.cc/en/Main/Software

This is the Arduino IDE whenever it's been opened. It opens into a clear sketch where you can begin programming right away. To begin with, we ought to arrange the board and port settings to permit us to transfer code. Interface your Arduino board to the PC through the USB link.

LCD 16×2 Pin Configuration and Its Working

Nowadays, we always use the devices which are made up of LCDs such as CD players, DVD players, digital watches, computers, etc. These are commonly used in the screen industries to replace the utilization of CRTs. Cathode Ray Tubes use huge power when compared with LCDs, and CRTs heavier as well as bigger. These devices are thinner as well power consumption is extremely less. The LCD 16×2 working principle is, it blocks the light rather than dissipate. This article discusses an overview of LCD 16X2, pin configuration and its working.

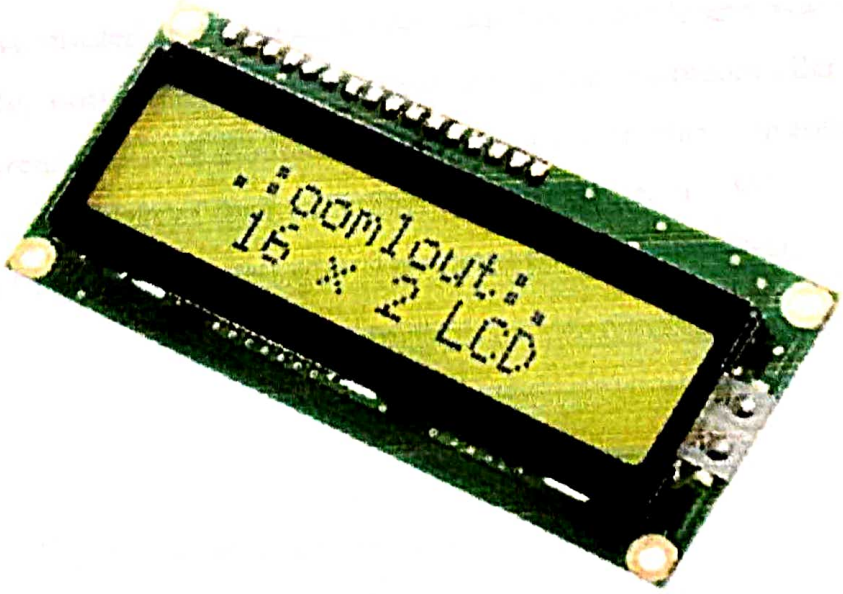


Figure.3.8 16X2 LCD

LCD 16×2 Pin Diagram

The 16×2 LCD pinout is shown below.

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
- Pin2 (VCC/Source Pin): This is thė voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.
- Pin15 (+ve pin of the LED): This pin is connected to +5V
- Pin 16 (-ve pin of the LED): This pin is connected to GND.

4. IMPLEMENTATION

4.1. Proposed System

Our project is PLC and SCADA based automatic Colour sorting machine divided into four cycles namely: Object Detection, Conveyor starting, Sensory Detection and Sorting mechanism. Our project involves reducing the industrial cost employed in installation and functioning of multiple conveyor belt systems in different industries like Food Processing Industry, Medicine Industry etc. for sorting of different colour objects. This is achieved by setting up a single conveyor belt which carries objects and then the PLC module along with the sensor module which detects the objects and then the objects are sorted accordingly. With this the operational costs, labour costs and installation costs are reduce in manifold by minimal increase of the inputs for the PLC. The ease of use is provided by SCADA.

4.2 System Process Flow

Working Explanation:

The TCS3200 senses colour light 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.

To TCS3200, then choose a colour filter, it can allow only one particular colour to get through and prevent another colour. For example, when choosing the red filter, the only red incident light can get through, blue and green will be prevented. So we can get the red light intensity. Similarly, when choosing other filters we can get blue or green light.

TCS3200 has four photodiode types. Red, blue, green, and clear, reducing the amplitude of the incident light uniformity greatly so that to increase the accuracy and simplify the optical. When the light project to the TCS3200D we can choose the different types of photodiode by different combinations of S2 and S3. Look at the form as follows.

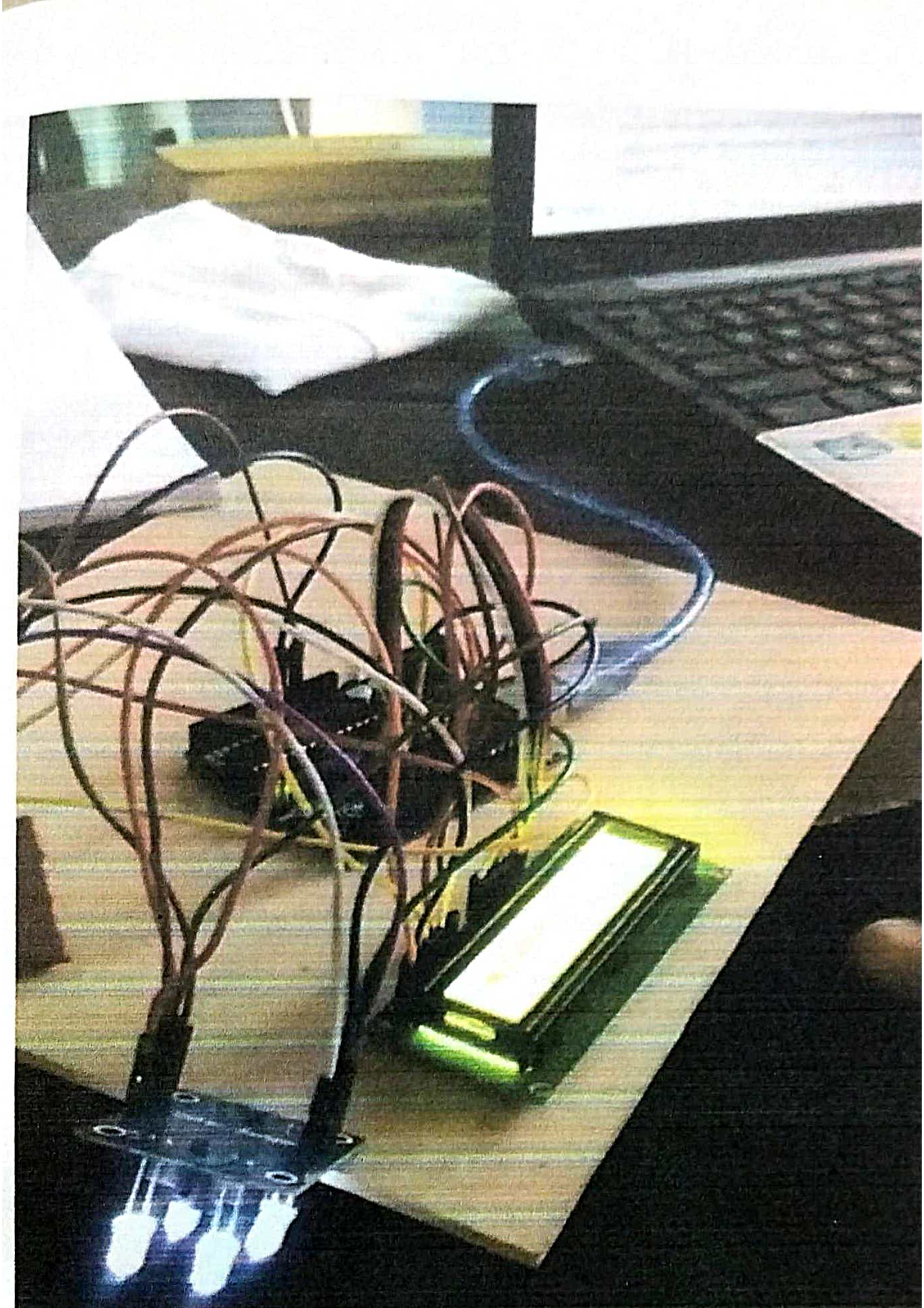
TCS3200 can output the frequency of a different square wave (occupies empties compared 50%), different colour and light intensity correspond with a different frequency of the square wave. There is a relationship between output and light intensity. The range of the typical output frequency is 2HZ~500KHZ. We can get different scaling factors by different combinations of S0 and S1.

5. RESULTS

5.1 Analysis

We have developed a sorting machine using ATMEGA 328 for automatic colour sorting, taking in to consideration of some colours. We consumed two months to produce the prototype with the expense of Rs.2000. You may note that the green object and the red object lying in different sections of the container placed on the second conveyor belt.

Dimensional Analysis The prototype is designed for sorting objects of any shape but having fixed sizes of 1cm. We can of course change this parameter by adjusting the aluminum frame of the colour sensor. But one may note that it usually results in a change in the light ambience forcing us to do further frequency analysis of the sensor output for test colours. The prototype will get more complicated as we increase the number of colours that have to be detected. The placement of the object on the first conveyor belt is very crucial. It must be so placed that the centre of the object and that of the sensor should be aligned with the same vertical plane, so that perfect detection takes place.



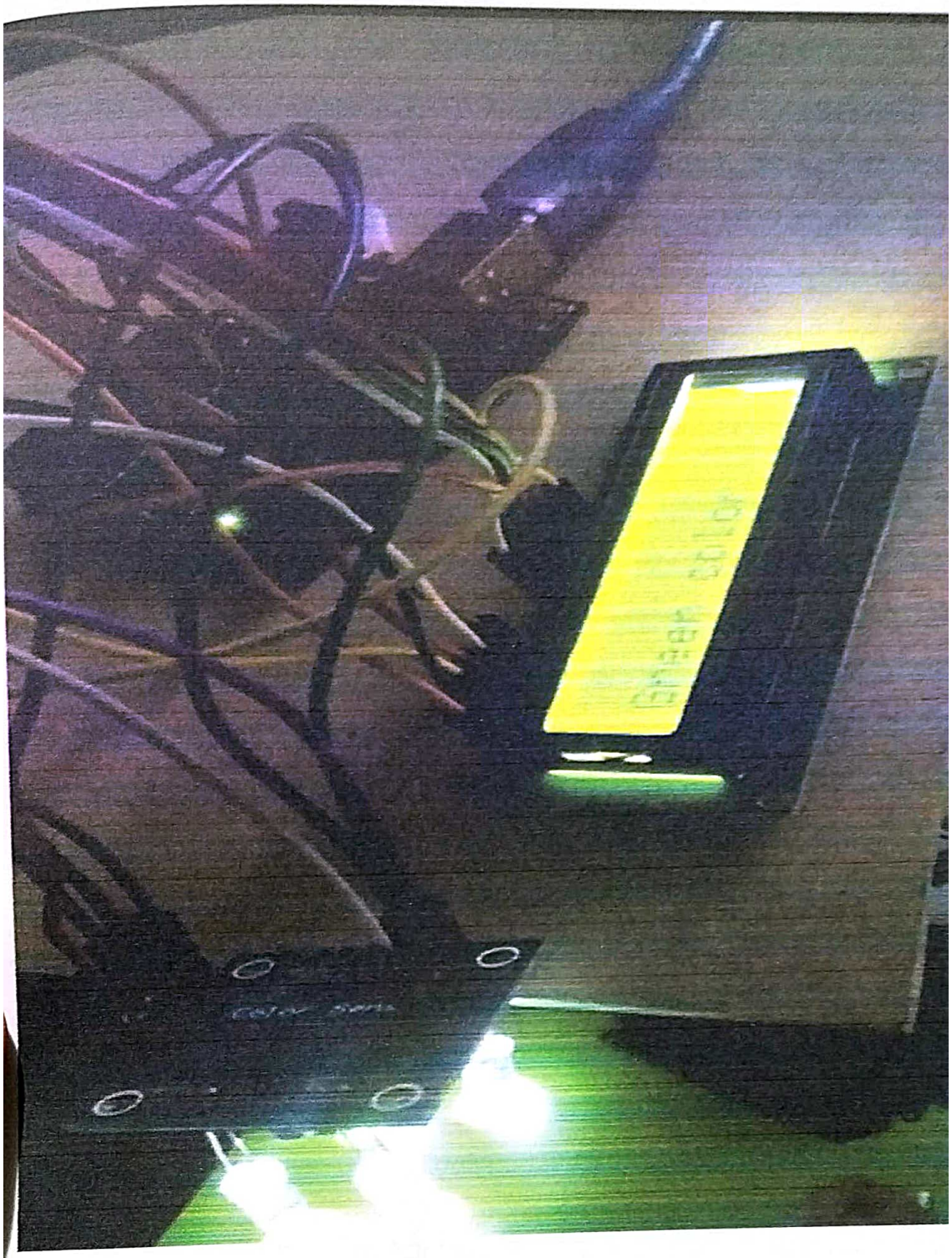


Figure.5.2 Lcd Displaying the Output Colour

6. CONCLUSION

We have developed a sorting machine using ATMEGA 328 for automatic colour sorting. We consumed two months to produce the prototype with the expense of Rs.2000. You may note that the green object and the red object lying in different sections of the container placed on the second conveyor belt. This project of automatic colour sorting is excellent one because of its working principle and wide implementation. By applying the idea of this project an industry can easily sort the required product according to its color. Through it has some limitation, but by having done some modification this concept can be implemented in wide range of application.

7. FUTURE SCOPE

It is very useful in wide varieties of industries along with the help of ATMEGA 328 and SCADA, especially in the packaging section. Automatic sorting machine enhances efficiency, practicality, and safety of operators. It ensures remarkable processing capacity as well as peerless performance including colour detection. Of course we need to add high speed DC motors and sensors with appreciable response to speed up the system for industrial application. The model can be improved by making some changes in the program and components. Some suggestions are given below.

- We can add a load cell for measurement and control of weight of the product
- We can also add a counter for counting the number of products
- Speed of the system can be increased accounting to the speed of production
- The system can be used as a quality controller by adding more sensors .
- The sensor can be changed according to the type of product
- The DC motor can be replaced with stepper motor
- The ATMEGA 328 can be replaced with PLC