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1. INTRODUCTION

1.1 Importance of Project:

A product sorting machine is a device that sorts products based on their attributes such as size, weight, shape, color, and material. These machines are important in a variety of industries, including manufacturing, food processing, and logistics, where sorting products accurately and efficiently is crucial to meeting production targets, ensuring product quality, and minimizing waste.

Here are some of the key benefits of using a product sorting machine:

Increased efficiency: Sorting products manually can be time-consuming and labor-intensive, especially when dealing with large volumes of products. A product sorting machine can sort products at a much faster rate, allowing for increased efficiency and throughput.

Improved accuracy: Manual sorting is prone to errors, which can result in products being misplaced or damaged. Product sorting machines can sort products with high accuracy, ensuring that each product is placed in the correct location or container.

Reduced labor costs: Sorting products manually requires a significant amount of labor, which can be expensive. By using a product sorting machine, companies can reduce labor costs and reallocate those resources to other areas of the business.

Increased safety: Sorting products manually can be hazardous, especially when dealing with heavy or sharp objects. Product sorting machines can reduce the risk of injury to workers by automating the sorting process.

Better product quality: Product sorting machines can sort products based on quality criteria, such as defects or damage. This ensures that only high-quality products are passed on to the next stage of production or shipped to customers.

Overall, a product sorting machine can help companies to increase productivity, reduce costs, and improve product quality, making it an important investment for many industries.

1.2 Problem Definition:

Many manufacturing and processing industries rely on the sorting of products based on color to ensure product quality and consistency. However, manual sorting can be time-consuming, labour-intensive, and prone to errors. A color sorting machine can automate the sorting process, increasing efficiency, accuracy, and reducing labour costs. The problem is to design and develop a color sorting machine that can accurately and efficiently sort products based on their color, while minimizing waste and maximizing throughput.

1.3 Aim and Objective:

The aim of the color sorting machine project is to design and develop a machine that can accurately and efficiently sort products based on their color, while minimizing waste and maximizing throughput.

The objectives of a color sorting machine project could include the following:

1. Design a machine that can sort products based on their color and take a count of each color product.
2. Develop a sorting mechanism that can accurately identify, and sort products based on their color.
3. Incorporate sensors and software algorithms that can detect and count the product of different color.
4. Optimize the sorting process to minimize waste and maximize throughput, improving the overall efficiency of the production line.
5. Create a user-friendly interface that allows operators to easily monitor and adjust the sorting process.
   Overall, the objective of a color sorting machine project is to create a reliable, efficient, and cost-effective solution for automating the product sorting process and improving the quality and consistency of the products produced in various industries.

2. FUNDAMENTALS OF PROJECT

2.1 Literature Survey:

Basically, there are two types of color sorting machines available in the market and they are as follows:

- **Chute-type color sorter:** Chute-type color sorter has a vertical sliding chute which can drive all material moving. The largest currently in the market is the 16-chute color sorter. It has a larger output, and the price is relatively low when compared to belt color sorter. It offers wide sorting range and can sort almost all grains seed such as rice, wheat, corns and so on. The drawback is that the sorting range would not contain the fragile materials and it also cannot sort lighter materials.
- **Belt-type color sorter**: Belt-type Color Sorter is horizontal in structure. This type of machine can transfer the material through its belt. Product stays relatively static as it moves horizontally on the belt. Hence it can be used in sorting light, fragile materials. The only drawback is that it is usually very costly to purchase.

Other than these the machines which are using opto electronics principle as well as IOT based having image processing are also used.

Overall, a literature survey of a color sorting machine project would provide a comprehensive overview of the current state of the art in color sorting technology, helping to identify gaps and opportunities for further research and development.

Fig.1 Belt type color sorter.

Fig.2 Chute type color sorter.

2.2 Basic Theory:

The basic theory behind a color sorting machine project is to use color as a primary criterion for sorting different objects or products. The color sorting machine is designed to detect and sort objects based on their color using various sensors and sorting mechanisms. The project involves developing a system that can accurately and efficiently sort different types of products based on their color, while minimizing waste and maximizing throughput.

The color sorting machine project typically involves the following steps:

- Product feed: The product to be sorted is fed into the machine via a hopper.
- Color detection: The color of the product is detected using a color sensor, such as the TCS3200 color sensor. The sensor detects the color of the product and converts it into an electrical signal that can be processed by the microcontroller.
- Signal processing: The microcontroller, typically an Arduino board, processes the electrical signal from the color sensor using software algorithms. The algorithms analyse the color data and determine the appropriate bin or location for the product to be sorted.
- Sorting mechanism: The sorting mechanism is responsible for physically moving the product to the appropriate bin or location based on the color data provided by the microcontroller. This can be done using stepper motors.

- Feedback system: A feedback system is typically included in the color sorting machine project to provide real-time information to the user about the sorting process, such as count for each color product. This can be in the form of an OLED display.

The basic theory of a color sorting machine project is to create a reliable and efficient system that can sort products based on their color, reducing the need for manual sorting and improving the quality and consistency of the sorting process. The project typically involves a combination of hardware and software components that work together to accurately and efficiently sort products based on their color.

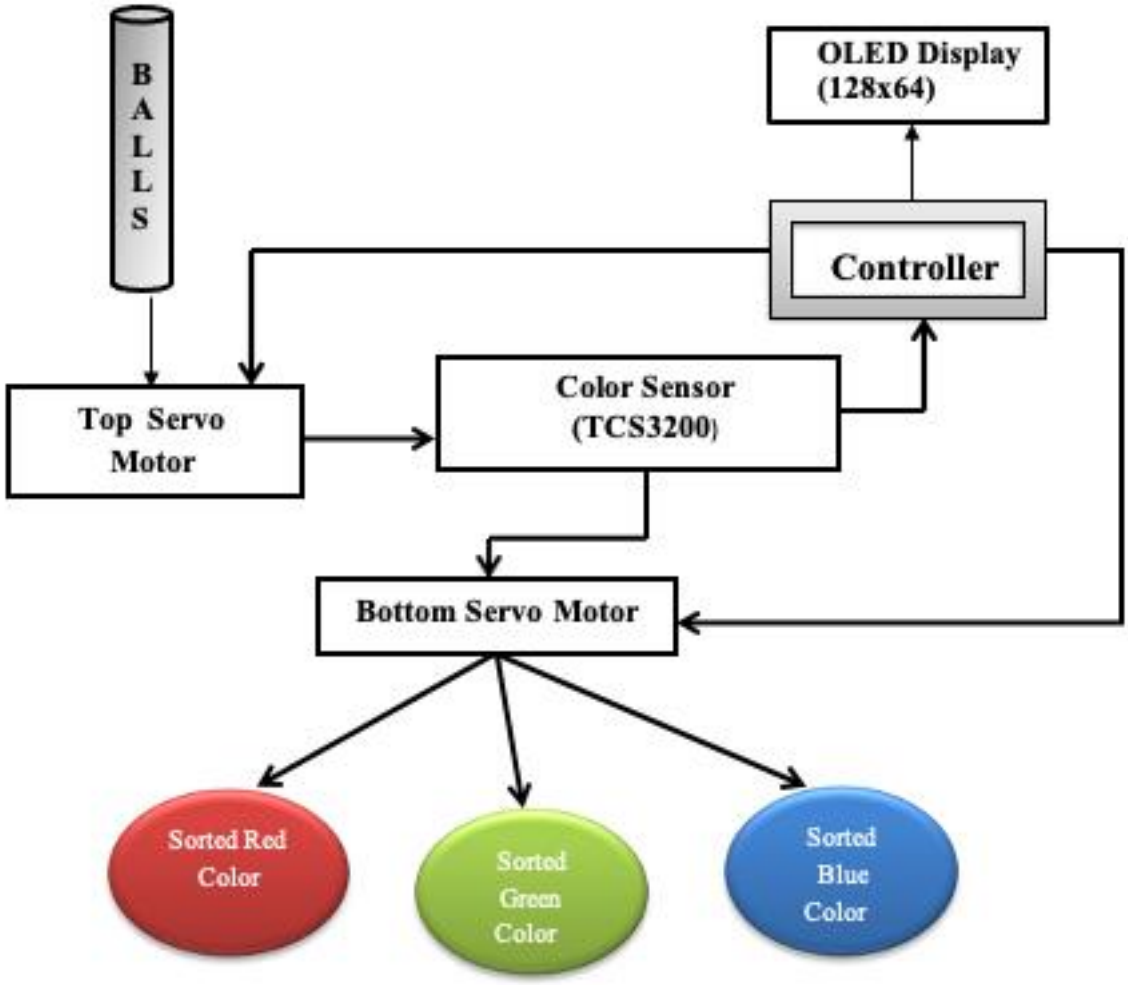

Fig 3. System Flow of the Color Sorting Machine.

3. PROJECT PROPOSAL

3.1 System Specifications:

The system specifications of a color sorting machine project can vary depending on the specific requirements of the project. However, here are some general specifications that are commonly used in color sorting machine projects:

- Product type: The color sorting machine should be designed to sort a specific type of product based on its color, such as grains, nuts, or seeds.
- Throughput: The throughput of the color sorting machine is the rate at which the machine can sort products. It is typically measured in terms of products per minute (PPM) or kilograms per hour (Kg/hr).
- Accuracy: The accuracy of the color sorting machine is the degree to which the machine can correctly identify, and sort products based on their color. The accuracy is typically measured as a percentage of correctly sorted products.
- Sorting speed: The sorting speed of the color sorting machine is the time it takes for the machine to sort a single product based on its color. It is typically measured in milliseconds.
- Sorting resolution: The sorting resolution of the color sorting machine is the degree to which it can differentiate between different shades of colors. A higher resolution means the machine can distinguish between a greater range of colors.
- Sorting mechanism: The sorting mechanism is the physical mechanism used to sort the products based on their color. It can be a conveyor belt, a pneumatic system, or stepper motors.
- Power supply: The power supply of the color sorting machine should be sufficient to run all the components of the system, including the microcontroller, color sensor, sorting mechanism, and feedback system.
- User interface: The color sorting machine should have a user interface that is easy to use and provides real-time feedback about the sorting process. This can include an LCD display or other visual and auditory signals.
- Dimensions: The dimensions of the color sorting machine should be appropriate for the space in which it will be installed and the volume of products that need to be sorted.

These are some of the system specifications that can be considered when designing a color sorting machine project. The specific requirements will vary depending on the application and the type of product that needs to be sorted.

3.2 System Block Diagram:

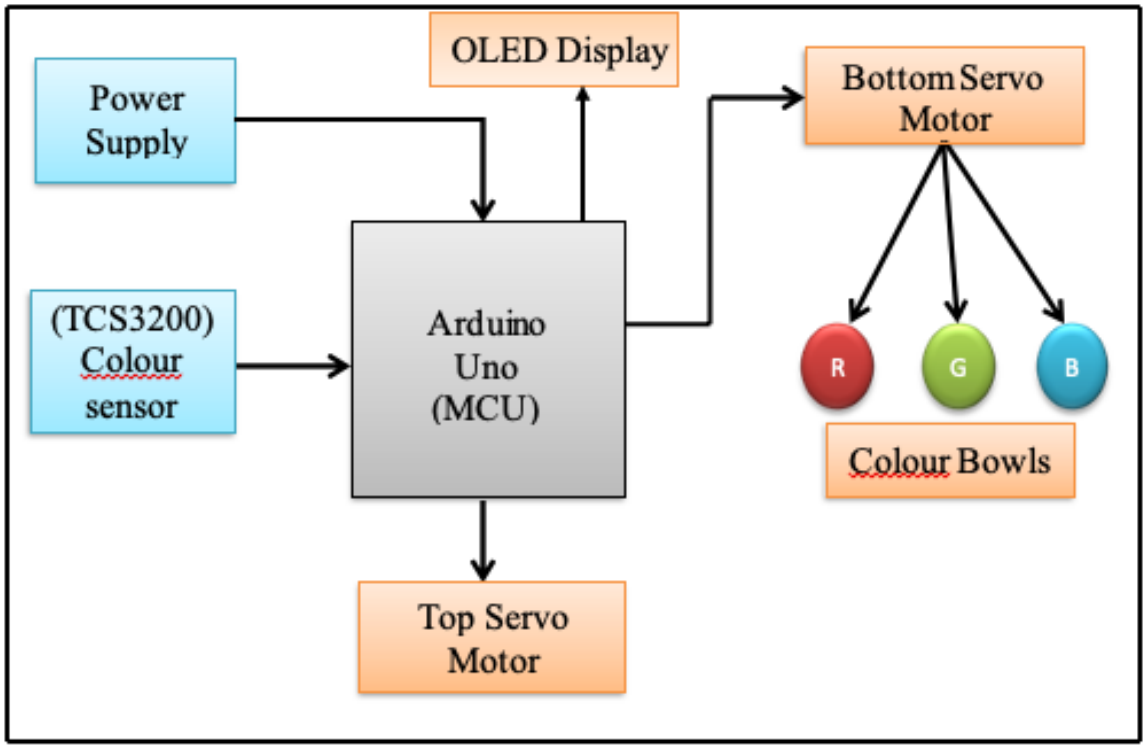

Fig.4 Block Diagram of Color Sorting Machine.

Description:

Basically, there are two input units, two output units and a microcontroller i.e., controller unit. Input units are shown with blue block, output units are shown with orange block and controller unit in grey block.

Input Units:

- Color Sensor (TCS3200): This sensor uses its inbuilt filters and send the data in the form of frequency to the microcontroller (Arduino Uno).
- Power Supply: A 5V Power Supply here used to provide power to the sensor, motors, and the microcontroller.

Output Units:

Both the outputs here are nothing but the two tiny servo motors (SG90) which are used to bring the ball under the sensor and other to sort the ball with respect to its color.

3.3 Method of Implementation:

The implementation of a Color Sorting Machine project can be divided into several steps. Here are the general methods of implementation.

- **Identify the product:** The first step is to identify the type of product that needs to be sorted. The product's physical properties, such as size, shape, and texture, will

determine the type of color sensor, sorting mechanism, and other components needed.

- **Select the color sensor:** The next step is to select a color sensor that is suitable for the product being sorted. The TCS3200 color sensor is commonly used in color sorting machine projects, but other sensors may be more appropriate depending on the application.
- **Choose the microcontroller:** A microcontroller, such as the Arduino board, is used to process the electrical signals from the color sensor and control the sorting mechanism. Choose a microcontroller that is compatible with the color sensor and has sufficient processing power.
- **Design the sorting mechanism:** The sorting mechanism is responsible for physically moving the product to the appropriate bin based on the color data provided by the microcontroller. The mechanism can be designed using stepper motors, pneumatic systems, or conveyor belts.
- **Write the software:** Write the software algorithms to analyse the color data and determine the appropriate bin or location for the product to be sorted. The software should be compatible with the microcontroller and color sensor.
- **Assemble the hardware**: Assemble the color sorting machine by connecting the color sensor, microcontroller, sorting mechanism, power supply, and feedback system.
- **Test the machine:** Test the machine to ensure that it accurately sorts the products based on their color. Adjust the software algorithms and hardware components as necessary to improve the machine's accuracy and efficiency.
- **Deploy the machine:** Deploy the color sorting machine in the production line or other appropriate location and provide training to the operators as necessary.

These are the general methods of implementation for a color sorting machine project. The specific steps may vary depending on the product being sorted and the requirements of the application.

3.4 Task Vs Time Schedule:

ACTIVITY	**DURATION**
Research about Project	1 Jan – 20 Jan
Component Gathering	20 Jan – 31 Jan
Individual Testing Of Components as per requirement	1 Feb – 15 Feb
Software Development	16 Feb – 10 March
Hardware Assembly	11 March – 25 march
Final Testing	26 March - 5 April
Making of Final model	6 April – 15 April
Preparing Project Report	15 April – 30 April

4. Planning Resources

4.1 Hardware:

There are total four main components used in this experiment and they are as follows.

1. Arduino Uno:

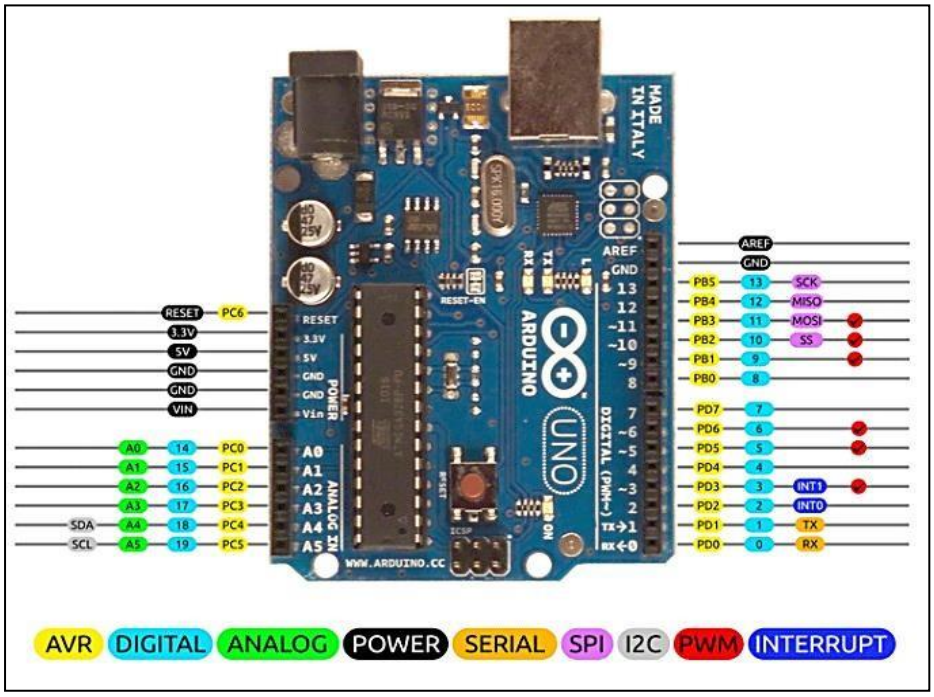

Fig.5 Arduino Uno with Pin Description

- Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller.
- Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.
- Software used for Arduino programming is Arduino IDE (Integrated Development Environment).

Pin Description:

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 – 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

Arduino Uno Technical Specifications:

Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
DC Current on 3.3V Pin	50 mA

Flash Memory	32 KB (0.5 KB is used for Bootloader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

2. Colour Sensor Module (TCS3200):

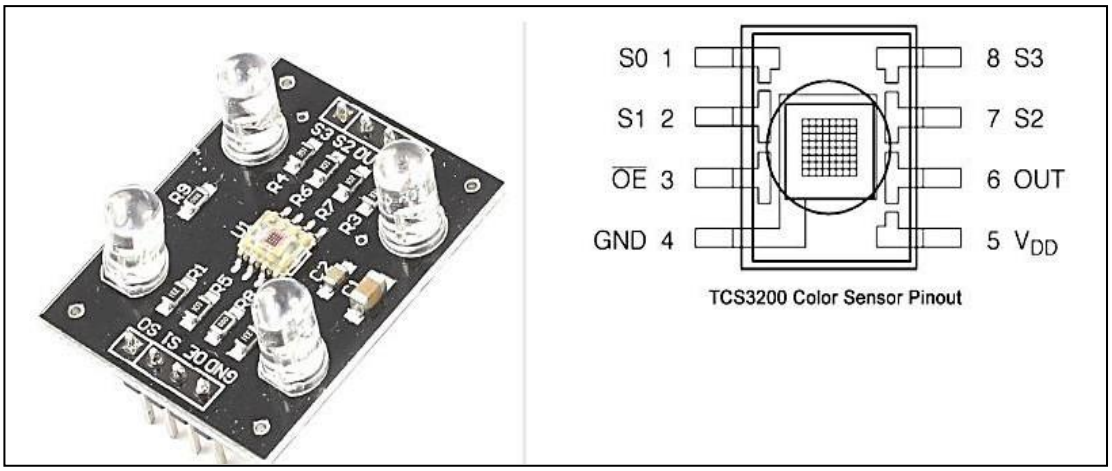

Fig.6 Color sensor TCS3200 and Pinout

- This Arduino compatible TCS3200 color sensor module consist of a TAOS TCS3200 RGB sensor chip and 4 white LEDs.
- The main part of the module is the TCS3200 chip which is a Color Light-to- Frequency Converter.
- The white LEDs are used for providing proper lighting for the sensor to detect the object color correctly.
- This chip can sense a wide variety of colors and it gives the output in the form of corresponding frequency.
- This module can be used for making color sorting robots, test strip reading, color matching tests etc.

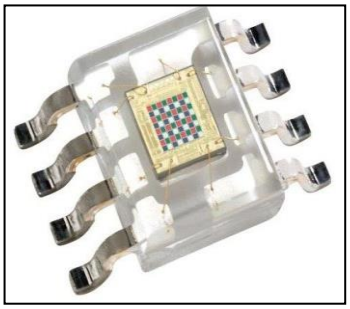

Fig.7 TCS3200 Chip

- The TCS3200 chip consist of an 8 x 8 array of photodiodes
- Each photodiode have either a red, green, or blue filter, or no filter.
- The filters of each color are distributed evenly throughout the array to eliminate location bias among the colors.
- Internal circuits include an oscillator which produces a square-wave output whose frequency is proportional to the intensity of the chosen color.

Pin Configuration:

PIN NAME	**PIN NUMBER**	**DESCRIPTION**
GND	4	Power supply ground. All voltages are reference to the ground.
VCC	5	Supply voltage
OE	3	Enable for FO (Active low)
OUT	6	Output frequency (fo)
S0, S1	1, 2	Select lines for output frequency scaling
S2, S3	7,8	Select lines for photodiode type.

Frequency Scaling:

S0	**S1**	**OUTPUT FREQUENCY SCALING(F0)**
L	L	Power down
L	H	2%
H	L	20%
H	H	100%

Filter Selection:

S2	**S2**	**PHOTODIODE TYPE**
L	L	RED
L	H	BLUE
H	L	CLEAR (NO FILTER)
H	H	GREEN

- The sensor has four different types of filter covered diodes. In the 8 x 8 array of photodiodes, 16 photodiodes have Red filters, 16 have Blue filters, 16 have Green filters and the rest 16 photodiodes are clear with no filters.
- Each type can be activated using the S2, S3 selection inputs. Since each photodiodes are coated with different filters each of them can detect the corresponding colors.
- For example, when choosing the red filter, only red incident light can get through, blue and green will be prevented. By measuring the frequency, we get the red light intensity. Similarly, when choose other filters we can get blue or green light.

Features and Specifications:

- Voltage : (2.7V to 5.5V)
- Interface: : Digital TTL
- Working temperature : -40oC to 85oC
- Size : 28.4x28.4mm (1.12x1.12")
- High-resolution conversion of light intensity to frequency
- Programmable color and full-scale output frequency
- No need of ADC (Can be directly connected to the digital pins of the microcontroller)
- Input Power down feature

3. Servo Motor (SG90):

Fig. 8 Servo Motor.

Wire Configuration:

Wire Number	Wire Colour	Description
1	Brown	Ground wire connected to the ground of system
2	Red	Powers the motor typically +5V is used
3	Orange	PWM signal is given in through this wire to drive the motor

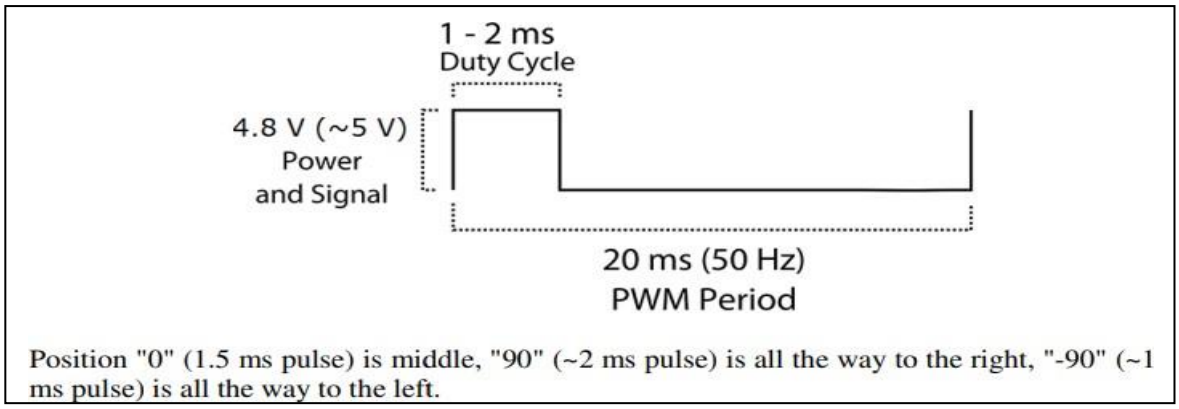

Fig. 9 PWM signal of the Servo Motor.

Specifications:

- Weight: 9 g
- Dimension: 22.2 x 11.8 x 31 mm approx.
- Stall torque: 1.8 kgf·cm
- Operating speed: 0.1 s/60 degree
- Operating voltage: 4.8 V (~5V)
- Dead band width: 10 µs
- Temperature range: 0 ºC – 55 ºC

4. OLED Display (128X64):

Fig. 10 OLED Display.

An OLED display with a resolution of 128x64 has 8192 pixels, which can display text, images, and other visual information. The display has 128 columns and 64 rows of pixels, which can be individually controlled to create a wide range of graphics and text.The pin configuration of the OLED display can vary depending on the specific model and manufacturer.

Pin Description:

- GND: Ground pin for power supply.
- VCC: Power supply pin for the display (typically 3.3V or 5V).
- SCL: Serial clock pin for communication with the microcontroller.
- SDA: Serial data pin for communication with the microcontroller.
- RES: Reset pin for resetting the display.
- DC: Data/Command pin for selecting between data and command modes.
- CS: Chip select pin for selecting the OLED display.

Technical Specifications:

Display Technology	OLED (Organic LED)
MCU Interface	I2C / SPI
Screen Size	0.96 Inch Across
Resolution	128×64 pixels
Operating Voltage	3.3V – 5V
Operating Current	20mA max
Viewing Angle	160°
Characters Per Row	21
Number of Character Rows	7

5. Regulated 5V Power Supply:

A 5V regulated power supply was made by using IC 7805, transformer (1A), capacitors and diodes. This power supply is used to power the other three components of the project.

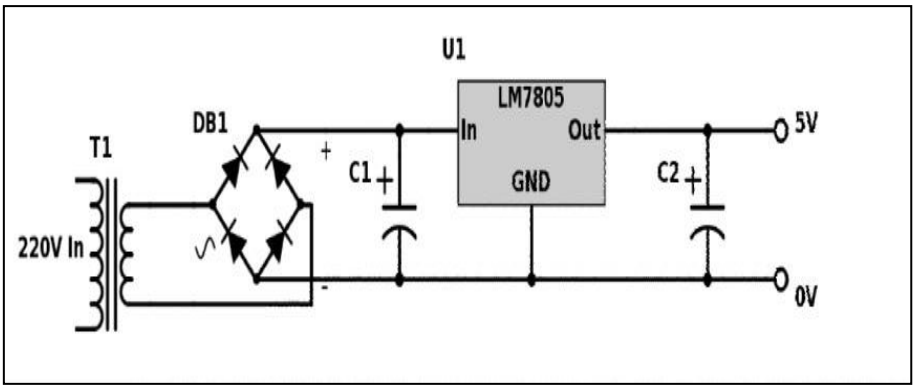

Fig. 11 Circuit Diagram Of 5V Regulated Power supply.

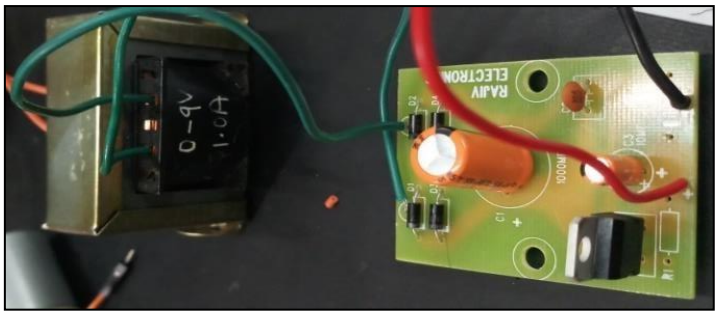

Fig. 12 Power supply.

4.2 Software:

Algorithm:

1. Start Process.
2. Get color ball at position 115.
3. Bring the color ball under the sensor at position 65 using Top Servo Motor.
   3.1 Sense the color using Red, Green and Blue Filters.
   3.2 Switch to the Case 1 or 2 or 3 according to the Color detected by the sensor.
4. Rotate the Bottom Servo Motor according to the case 1 or 2 or3.
5. Rotate the Top Servo Motor further at position 29 to drop the ball on slide attached to the Bottom Servo Motor.
6. Whenever the case 1 or 2 or 3 execute according to it the counting of ball is done.
7. Bring the Top Servo Motor back to the position 115 to get the next color ball.
8. Repeat the process from 3rd step again.

Program Code:

```
#include <Servo.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>

#define SCREEN_WIDTH 128 // OLED display width, in pixels
#define SCREEN_HEIGHT 64
#define S0 1
#define S1 2
#define S2 3
#define S3 4
#define sensorOut 5
Servo topServo;
Servo bottomeServo;
int frequency = 0;
int color = 0;
Adafruit_SSD1306 display(SCREEN_WIDTH, SCREEN_HEIGHT, &Wire, -1);
void setup()
{
```

```
{
  Serial.begin(115200);

  if(!display.begin(SSD1306_SWITCHCAPVCC, 0x3C)) // Address 0x3D for 128x64
  {
    Serial.println(F("SSD1306 allocation failed"));
    for(;;);
  }
  delay(2000);
  display.clearDisplay();

  display.setTextSize(1);
  display.setTextColor(WHITE);
  display.setCursor(50, 0);
  // Display static text
  display.println("Colour");
  display.setCursor(50, 10);
  display.println("Sorting");
  display.setCursor(50, 20);
  display.println("Machine");
  display.setTextColor(BLACK,WHITE);
  display.setCursor(0, 35);
  display.println("Red");
  display.setCursor(50, 35);
  display.println("Green");
  display.setCursor(100, 35);
  display.println("Blue");
  display.display();
  pinMode(S0,OUTPUT);
  pinMode(S1,OUTPUT);
  pinMode(S2,OUTPUT);
  pinMode(S3,OUTPUT);
  pinMode(sensorOut, INPUT);
  digitalWrite(S0,HIGH);
  digitalWrite(S1,HIGH);
  topServo.attach(6);
  bottomeServo.attach(7);
  Serial.begin(9600);
}
void loop()
{
topServo.write(115);
delay(500);
for(int i=115; i>60; i--)
{
  topServo.write(i);
delay(5);
}
delay(1000);

color=readColor();
delay(100);
switch(color)
{
  case 1:
  bottomeServo.write(25);
  Serial.println("RED");
  break;
  case 2:
  bottomeServo.write(100);
```

```
  Serial.println("GREEN");
  break;
  case 3:
  bottomeServo.write(175);
  Serial.println("BLUE");
  break;

  case 0:
  break;
}
delay(1000);

for(int i=60; i>25; i--)
{
  topServo.write(i);
  delay(5);
}
delay(200);

for(int i=25; i<115; i++)
{
  topServo.write(i);
  delay(5);
}
color=0;
}
//Custom Function - readColor()
int readColor()
{
  digitalWrite(S2, LOW);
  digitalWrite(S3, LOW);
  frequency = pulseIn(sensorOut , LOW);
  int R = frequency;
  Serial.print("R= ");
  Serial.print(frequency);
  Serial.print(" ");
  delay(20);
  digitalWrite(S2, HIGH);
  digitalWrite(S3, HIGH);
  frequency = pulseIn(sensorOut, LOW);
  int G = frequency;
  Serial.print("G= ");
  Serial.print(frequency);
  Serial.print(" ");
  delay(50);
  digitalWrite(S2, LOW);
  digitalWrite(S3, HIGH);
  frequency = pulseIn(sensorOut, LOW);
  int B = frequency;
  Serial.print("B= ");
  Serial.print(frequency);
  Serial.println(" ");
  delay(50);
  if(R<G & R<B)
  {
    color = 1;  // Red
    for (int i = 1; i <= 20; i++)
    {
```

```
    display.setTextColor(WHITE);
    display.setCursor(0, 50);
    display.println(i);
    display.display();
    delay(2000);
    display.fillRect(0, 50, 20, 30, BLACK);
    display.display();
    }
  }
  if(G<R & G<B)
  {
    color = 2; // Green
    for (int i = 1; i <= 20; i++)
    {
    display.setTextColor(WHITE);
    display.setCursor(60, 50);
    display.println(i);
    display.display();
    delay(2000);
    display.fillRect(60, 50, 20, 30, BLACK);
    display.display();
    }
  }
  if(B<R & B<G)
  {
    color = 3;  // Blue
    for (int i = 1; i <= 20; i++)
    {
    display.setTextColor(WHITE);
    display.setCursor(105, 50);
    display.println(i);
    display.display();
    delay(2000);
    display.fillRect(105, 50, 20, 30, BLACK);
    display.display();
    }
  }
return color;
  }
```

4.3 Miscellaneous:

Here are some miscellaneous aspects of a color sorting machine project that may be worth considering:

- **Safety:** When designing a color sorting machine, it is important to consider safety measures to protect operators from injury. For example, the sorting mechanism should be enclosed to prevent accidental contact, and emergency stop buttons should be installed in case of malfunction.
- **Maintenance:** Regular maintenance is necessary to keep the machine functioning properly. This may include cleaning the color sensor, lubricating the moving parts of the sorting mechanism, and checking for loose connections.
- **Cost:** The cost of building a color sorting machine can vary depending on the components used and the complexity of the design. It is important to consider the cost-benefit ratio to determine if the investment is worthwhile.
- **Calibration:** Calibrating the color sensor is an important step in ensuring accurate sorting. The sensor should be calibrated periodically to account for changes in lighting conditions and other factors that may affect color accuracy.
- **Integration:** Integrating the color sorting machine into an existing production line or system may require additional hardware or software components. It is important to consider these factors during the design phase to ensure a seamless integration.
- **Flexibility:** The color sorting machine should be designed to accommodate different types of products and colors. The software should be flexible enough to adjust to different sorting criteria, and the sorting mechanism should be adjustable to accommodate different product sizes and shapes.

These are just a few miscellaneous aspects to consider when designing and implementing a color sorting machine project.

4.4 Budget:

COMPONENTS	**COST**
Arduino Uno	600
Color Sensor (TCS3200)	350
2 Stepper Motor (SG90)	280
OLED Display (128X64)	200
5 volt Power Supply	150
Connecting Wires	60
Other Decoration Material	400
TOTAL AMOUNT	**2,040**

5. Experimentation and Results

5.1 Test procedure:

1. Turn on the power supply.
2. Put the colored ball randomly in the tube.
3. Check whether the red color is sorted to the left hand side.
4. Check whether the green color is sorted to the middle.
5. Check whether the blue color is sorted to the right hand side.
6. Also check the count related to color on OLED Display.
7. Turn off the power supply.

5.2 Observations/Testing:

1. **Testing Color sensor to extract the R, G, B values and print the color on serial monitor.**

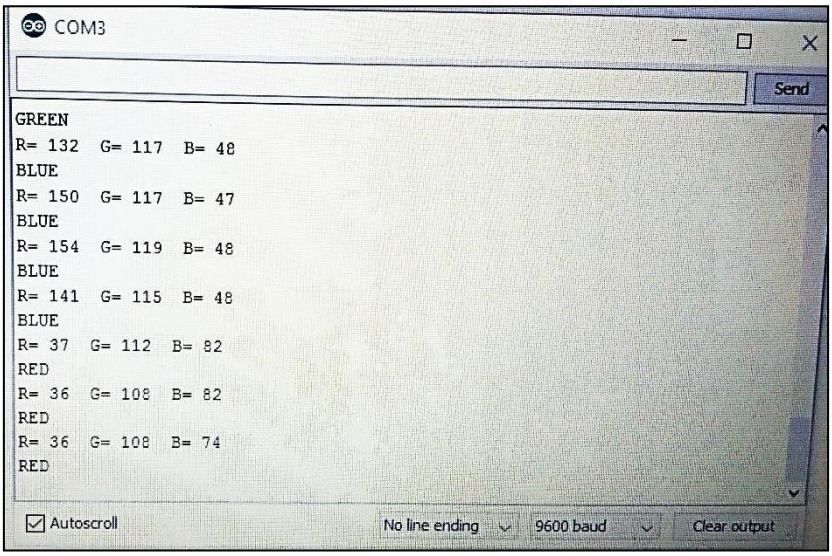

Fig.13 Output of the sensor on serial monitor

2. Testing Top Servo Motor:

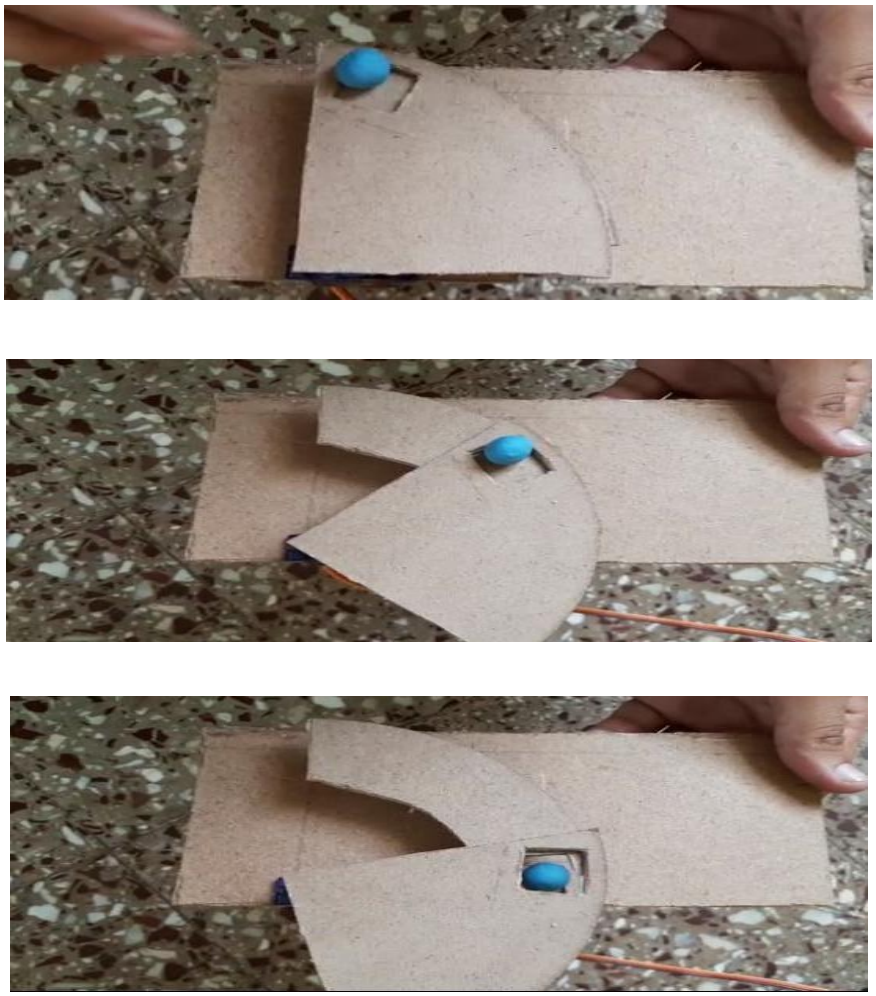

Fig.14 Testing Three Positions of Top Servo Motor

3. Testing Bottom Servo Motor:

Fig.15 Three Positions of Bottom servo Motor

4. Testing of OLED Display:

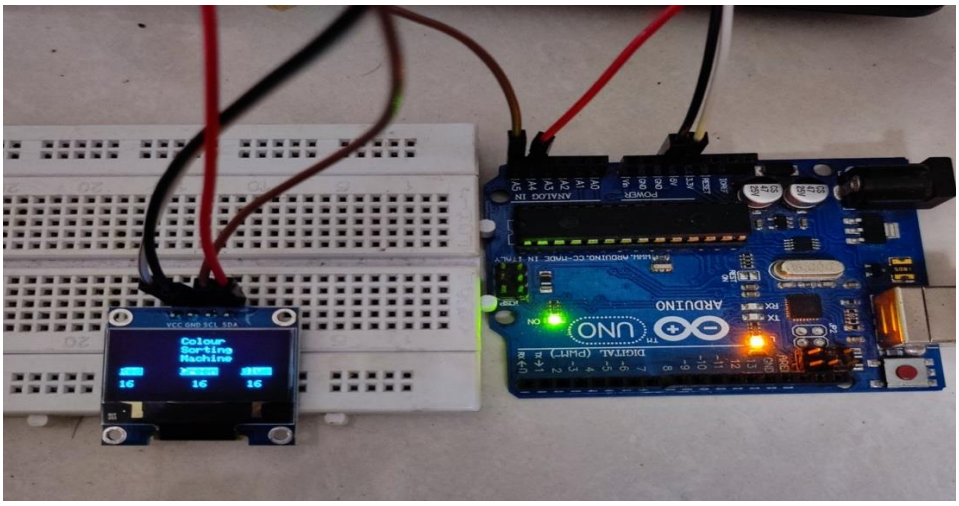

Fig.16 Testing of OLED display.

5. **Final Product:**

Fig.17 Color sorting machine Final Product

5.3 Result and Conclusion:

- The color sorting machine works perfectly for the three colors Red, Green and Blue.
- For further detection of other color we have to tabulate the RGB values of the specific color and those values should be entered in the condition for identifying colors in the program.
- This project is a small demonstration of how the color sorting machines can be used in various industries like mining, food processing industries, recycling, etc.
- This project can further be modified by using other sensor for sensing the exact specifications of the object such as weight, shape, etc.

6. Summary and Future Scope

6.1 Applications:

1. Grain (Agricultural Product) Industry.

Color sorters are mostly used in sorting grain (agricultural products). The rice sorting differences of rice (husked paddy) materials, using a high-resolution CCD optical sensor to separate stones, black rice, etc. It is the final step after polishing rice with a rice polisher. The second sorting market is in use for coarse cereals, such as wheat, corn, peanut, different kinds of beans, sesame seeds, etc. Sorting machines improve product quality and add social benefits.

2. Food Industry:

Color sorters are used for the food processing industry, such as coffee, nuts, and oil crops. The goal is the separation of items that are discoloured, toxic (such as ergot), not as ripe as required, or still with hull after dehulling such as sunflower seeds. Compared with manual sorting, machines save labour and time, have higher efficiency, and have lower processing costs. Throughputs have increased with the use of new CCD technologies. In fig.3 Grain sorting machine available in the market is shown.

3. Diamond and Mining Industry:

They are also used in the diamond industry. The transparency of the diamond is measured by the color sorter and used as a measurement of its purity, and the diamonds are mechanically sorted accordingly. This has an advantage over X-ray fluorescence methods of robotically detecting purity, since purer diamonds are less likely to fluoresce.

In demining sorting industry, It is also called sensor-based sorting technology. Optical color sorters (CCD color camera) combine X-ray sorting technology and NIR (near infrared spectrometry) to pick out the impurities of ore, minerals, stone and sand products, or separate ore into two or more categories. In fig.2 the color sorting machine used in mining industries is shown.

4. Recycling:

In the recycling industry, colour sorters can distinguish between colored and colourless PET and colored and colorless HDPE flakes, as well as being able to separate flakes by color before re-granulation. Plastic color separators are used to separate mixed-color plastic flakes or granules. Plastic type separators (Sensor-based sorting technology) are used to separate plastics with same colors but different materials. The industry recognized technology is use a chute color sorter to sorting plastic pellets, and a belt-type color sorter to sort plastic flake products.

Fig. 18 Colour sorting Machine used for Recycling

6.2 Future scope:

- 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 Servo motor can be replaced with better servo/stepper motor.
- The Arduino can be replaced with PLC.