Automatic Color Sorting Machine Using Arduino Mega Microcontroller

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Abstract— **In this digital world, color processing gives us a greater impact in different industries to solve the consistency issue of continuous manual sorting. This paper will be a new approach to recognize and sort the objects continuously and keep them in a designated location. Nowadays, image or colors processing attract massive attention as it leads to possibility of widening scope of application in different field with the help of modern technology. A color sorter is researched, designed and created with Arduino Mega microcontroller, TCS230 color sensor, servo motor and other electronic components. This work involves sensors that sense the object's color and sends the signal to the Arduino. The microcontroller sends signal to circuit which drives the various motors to allow the object and place it in the specified location. Based upon the detection, the hole moves to the specified location, releases the object and comes back to the original position. The system has the ability to sort the object according to their colors into respective color station in minimum time.**

Keywords— **Arduino Mega, Servo Motor, Color Sorting, TCS 230 Color Sensor, Programming**

I. INTRODUCTION

The color sorting machines is used for sorting mainly RGB colors. This paper describes a working prototype designed for automatic sorting of objects based on the color. The color sorting machine using Arduino is a fascinating and renowned project for techniques, which would like to combine electronics, machine building and programming. The color sorting machine is fully automated with the help of Arduino Mega. Block diagram of system is as shown in Fig 1.
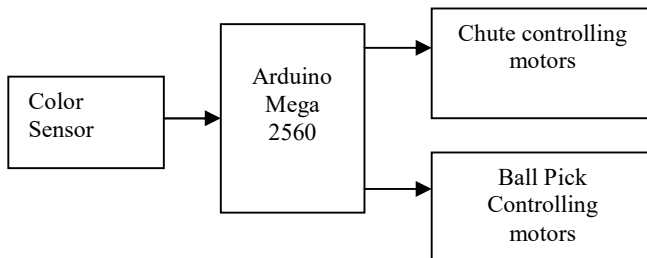

Fig. 1 Block diagram of color sorter system

This color sorting machine separates different colored objects and classifies them into respective cups. Sorting of products is a very difficult industrial process. Continuous manual sorting creates consistency issues[1].. This paper describes a working prototype designed for automatic sorting of objects based on the color.

TCS230 sensor was used to detect the color of the product and the Arduino was used to control the overall process. The identification of the color is based on the frequency analysis of the output of TCS230 sensor. The experimental results promise that the prototype will fulfill the needs for higher production and precise quality in the field of automation.

The color sorter machine is mostly used in foods production factories such as sorting grain (agricultural products), production of coffee, nuts, and oil crops, diamond industry that is measured by the color sorter and used as a measurement of its purity.

II. REQUIRED COMPONENTS LIST

In this system commonly required the following components.

- Arduino MEGA 2560
- Servo Motors
- TCS230 Color Sensor

A. Arduino MEGA 2560

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. Students are confronting the Arduino for the first time.

To determine the state of switches and other sensors, the Arduino is able to read the voltage value applied to its pins as a binary number. The interface circuitry translates the sensor signal into a 0 or +5 V signal applied to the digital I/O pin.
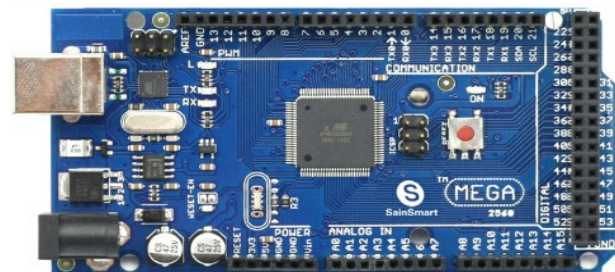

Fig. 2 Arduino Mega 2560

For advanced Arduino users; there are lots of resources. Arduino Mega 2560 is shown in fig 2.If the pin is at 0 V, the program will read it as a 0 or LOW. If it is at +5 V, the program will read it as a 1 or HIGH. If more than +5 V is applied, so be careful.

Interacting with the world has two sides. First, the designer must create electronic interface circuits that allow motors and other devices to be controlled by a low (1-10 mA) current signal that switches between 0 and 5 V, and other circuits that convert sensor readings into a switched 0 or 5 V signal. Second, the designer must write a program using the set of Arduino commands that set and read the I/O pins.The Arduino also has six analog input pins for reading continuous voltages in the range of 0 to 5 V from sensors such as potentiometers.

B. Servo Motors for Arduino

Unlike dc motors, with servo motors you can choose the position of motor shaft at a specific position (angle) using control signal. The motor shaft will hold at this position as long as the control signal not changed. This is very useful for controlling robot arms, unmanned airplanes control surface or any object that you want it to move at certain angle and stay at its new position. Servo motors may be classified according to size or torque that it can withstand into mini, standard and giant servos. Usually mini and standard size servo motors can be powered by Arduino directly with no need to external power supply or driver. Usually servo motors come with arms (metals or plastic) that are connected to the object required to move (see figure below to the right).

C. Motor Control using Arduino

Standard servo motor control using Arduino is extremely easy. This is because the Arduino software comes with a sample servo sketch and servo library that will get you up and running quickly firstly, connect the black wire from the servo to the Gnd pin on the Arduino and connect the red wire from the servo to the +5V pin on the Arduino and then the third wire (usually orange or yellow) from the servo is connected to a digital pin on the Arduino.
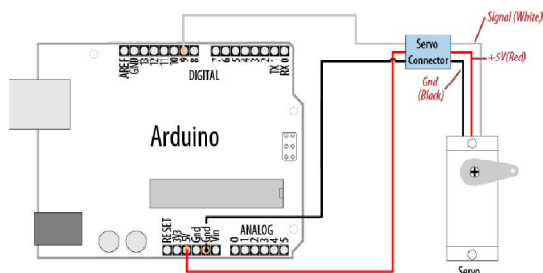

Fig. 3 Using Servo Motor with Arduino

D. TCS230 Color Sensor

In this paper, it will need to learn how to detect colors using Arduino and the TCS230/TCS3200 Color Sensor.

1) Working of TCS230 Color Sensor

The TCS230 senses color light with the help of an 8x8 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, the researcher can read the square wave output and get the results for the color. If it takes a closer look at the sensor, it can know how it detects various colors. The photodiodes have three different color 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.
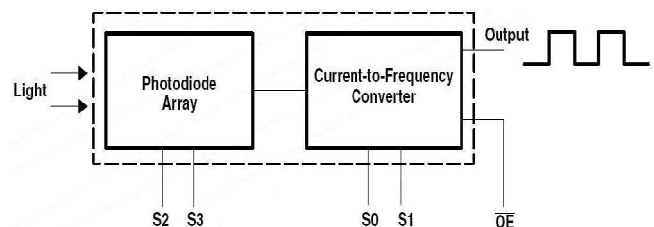

Fig. 4 TCS230 Color Sensor[2]

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. The sensor has two more control pins, S0 and S1 which are used for scaling the output frequency.
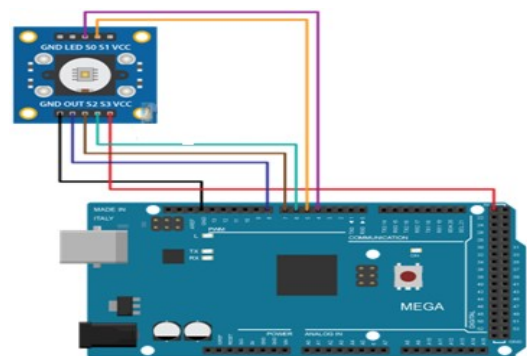

Fig. 5 Color Sensor with Arduino

TCS230 Color Sensor is used with this color sorting machine. This sensor acts as a perfect color sensor for the color sorting Machine. The TCS230 Color sensor's PCB module includes a TAOS TCS230RGB color sensor chip, white LEDs (4 Numbers) and LED control circuit with some basic components.

Features of TCS230 Color Sensor are a programmable high resolution color light to frequency converter sensor. It provides a programmable color and full scale output frequency and can directly control with the Microcontroller.

In this color sorter, it is essential need to know about Infrared Object Detection Sensor. This Medium Range Infrared sensor offers simple, user friendly and fast obstacle detection using infrared; it is non-contact detection. The

implementations of modulated IR signal immune the sensor to the interferences caused by the normal light of a light bulb or the sun light. The sensing distance can be adjusted manually.

III. OVERVIEW OPERATION OF COLOR SORTER

Color Sorter machine can be divided by three main sections:

- Main Control Board
- Input Devices
- Output Devices

A. Main control board

The main control board of color sorter machine is Arduino Mega 2560 and it accepts the signals from the input devices and produces the output signals to the output devices.
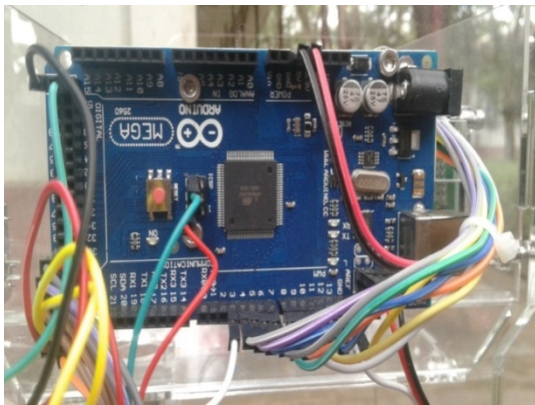

Fig. 6 Main Control Board

B. Input devices

The main input devices of the color sorter machine are color sensor and infrared object detection object sensor. The color sensor senses colors of the colored objects, glass balls and produces the signals for Arduino Board as input signals. The infrared object detection sensor senses the glass ball that is present or not below the color sensor. If the object is not present below the color sensor, informs the Arduino board there is no object there.

C. Output devices

The output devices of the machine are gear motor, servo motor and LCD display. The gear motor controls the position of glass ball and drives the motor until to reach location of glass ball if it not reach right place according to output signal from the Arduino board. The servo motor will choose the colored cup by rotating the tube of the machine. The LCD display shows the output result of the color sensor.

D. Steps by Step Operation

The glass balls are placed into the upper cup of the machine to enter tube and the gear motor is rotating step by Step to reach the right position. When a ball reaches its position, the gear motor rotates for next one. The color sensor senses the glass

ball for the second state between two conditions such as extra LED light ON and OFF. In extra LED light 'OFF' conditions, the output values of the color sensor are high number that shown 1 to 256 representation number and low number in the LED 'ON 'condition. For example, when the LED is ON, the output values are 30(Red), 26(Green) and 34(Blue) and 5(Red), 8(Green) and 7(Blue) in OFF state.

When there is an object in front of sensor it produces frequency which is proportional to the color of the object and the selected photo diode configuration in such a way that it provides maximum frequency for the respective color to the respective photo diode. Hence sensor gives maximum frequency for red colored object when red filter is selected, and in the same way other colored object are also sensed by corresponding filters. The objects will finally fall to the corresponding cup[3].

Fig. 7 LCD Displayed Right Color

If the green ball reaches, the main control classifies the color under the signal is sent by the color sensor and shows the output on the LCD display like shown in Fig 7 and produces the signal for servo motor.

In final state, as in Fig 8, the servo motor chooses the right cup to put the object by rotating arm. This process is been doing again to the first step.

Fig. 8 Put into Right Color Cup

E. Programming

There are two Arduino programs for color sorter that there are color math program and color sorter program.

1) Color Math

The color sorter machine needs to specify default color value for current location and light condition. If you not specify value, the machine can't classify the color. The Color Match program is used for default color recording the object and records the color under the two conditions LED ON and OFF.

2) Color Sorter

This program is written by Arduino programming language. This program is main control program for color sorter machine. The recorded values form the color math program is filled to the color sorter program. The program has three parts; they are define the pins, initiation the pin such as input or output and looping the program.

F. Flow Chart for Color Sorter

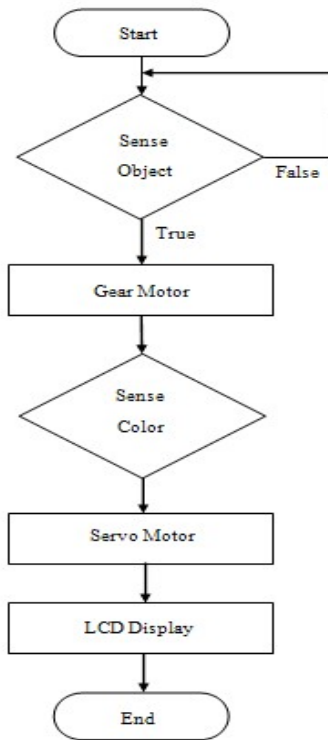The flow chart is easy way to understand the programming language and compose by sample blocks and round rectangle.

Fig. 9 Flow chart of the color sorter machine

IV. TEST AND RESULTS

This system has been developed as a sorting machine using Arduino for automatic color sorting, taking into consideration three colors namely Green, Yellow and Blue. So the results are shown as the following figures step by step involved in the process.

Firstly, the result will show checking the glass ball as shown in Fig 10 .The infrared detection object sensor checks the object that present or not.
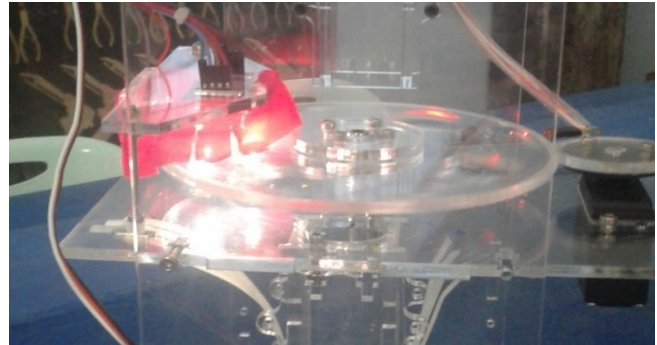

Fig. 10 Checking the Glass Ball

At the second stage, it senses the glass ball color by TCS230 color sensor. In this stage, when the glass ball reached under the sensor, the sensor starts reading it.
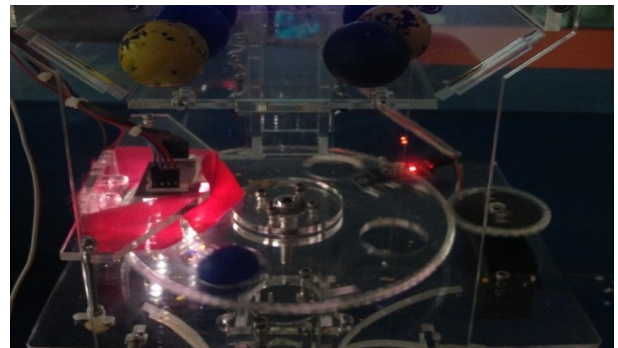

Fig. 11 Sensing the Glass Ball Color

After sensing the color of ball, the result of color sensor is displayed on LCD. While the blue colored ball reached, the LCD will display 'BLUE' as shown in Fig 12.

Fig. 12 Displaying the Glass Ball Color

Finally, this final result is the putting the right glass ball color by servo motor. In this stage, as shown in Fig 13, the arm of sorter using servo motor puts the glass ball into the right cup according to the result from the sensor.

Fig. 13 Putting the Glass Ball by Servo Motor

V. CONCLUSION

The system can work successfully and can sort the object depending on their color. Hence this color sorting system is a smart color sorter that can recognize color balls and placed them at the correct location. There are existing sorters using PIC microcontroller but they can't easily be many created using Arduino programming. The real contribution of this system is that it is able to shorten the time needed to sort the color hence making this system more efficient than the existing one. This sorter is not only reduces manual efforts, time consumed, but also prevents the choosing wrong color of color blind people who can't be able to choose right color. Thus a cost effective mechatronics system can be designed using the simplest concepts and efficient result can be observed.

It is very useful in wide varieties of industries along with the help of PLC 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 color detection. Of course it will need to add high speed DC motors and sensors with appreciable response to speed up the system for industrial application.

REFERENCES

[1]. Kunhimohammed C. K, Muhammed Saifudeen K. K, Sahna S, Gokul M. S and Shaeez Usman Abdulla, Dept. of Applied Electronics and Instrumentation, M.E.S.College of Engineering, Kuttipuram, "Automatic Color Sorting Machine Using TCS230 Color Sensor And PIC Microcontroller"International Journal of Research and Innovations in Science and Technology, Volume 2:Issue 2:2015
[2]. www.rhydolabz.com,TCS230 Color Sensor User Manual
[3]. J. M. Low, W. S. Maughan, S. C. Bee and M. J. Honeywood, Sortex Limited, London "Sorting by colour in the food industry"
[4]. https://sites.google.com/a/umn.edu/me2011/:
[5]. https://arduino.cc/en/Main/ArduinoBoard.
[6]. https://arduino.cc/en/Guide/HomePage
[7]. http://programmingelectronics.com>how to use arduino
[8]. www.pdfgenicom/compacsort.com/sorters
[9]. www.google.com/arduino.cc/main/software
[10]. www. pdfgenicom/servo-tutorial
[11]. "Automatic Material Handling System Using Pick & Place Robotic Arm & Image Processing", Mr. Deepak L RAJNOR1 A.S Bhide, Professor.