

Color Sorting Robotic Arm

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Abstract - The paper presents a robotic arm with a smart approach to implement sorting of objects on the basis of color. Here, we have a robotic arm which sorts small spherical objects after which it picks and places them in different boxes. The color detection is done by color sensors which use light intensity to frequency conversion method. In our system the TCS34725 (color sensor) is interfaced with the Arduino board. The robotic arm is controlled by a microcontroller based system which further controls DC servo motors through a motor driver L293D. This is a low cost system with simplest concepts to implement sorting effectively saving manual time and work.

1. INTRODUCTION

In the era of robotics and automation, all the industries are becoming automated for faster development and growth. A robot is an electro-mechanical machine which reduces human efforts and increases efficiency. It is a real time machine which completes its given tasks in given time, with the help of computer programming.

The paper presents the design and development of a robotic arm with the application of color sorting of spherical objects using advanced sensors. Basically the robotic arm is programmed to pick the spherical object from one place and drop accordingly into the respective colored box. Here, the color sensors are used to sense the color of the object to be picked and dropped, and the voltage i.e. the intensity of the color sensed is converted into frequency which is given as input to the microcontroller. The microcontroller enables motor driver circuit which drives the motors of the robotic arm to grip the objects and drop them in the specified location according to the color.

2. PROPOSED SYSTEM

2.1 BLOCK DIAGRAM OF THE SYSTEM

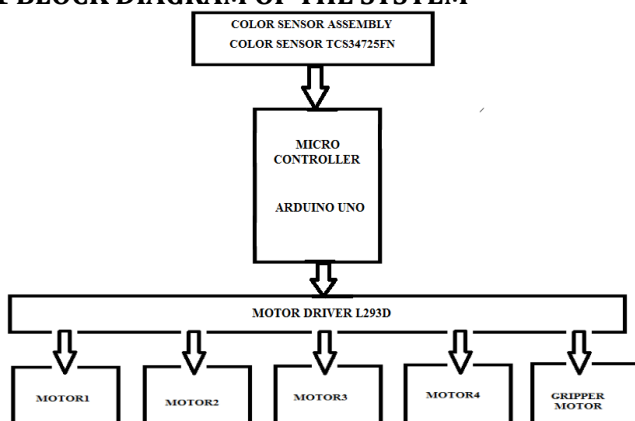


Fig -1: Block system overview

2.2 WORKING

The sorting criterion of the system is color and so a photodiode is used as a color sensor. The sensor color detection is based on the RGB color model which includes a wide range of colors. The microcontroller is an integral part which controls the rest of the blocks of the unit. The output of the photo sensor is given as input to the microcontroller which analyzes the intensities & controls the functions of rest of the blocks of the system.

After sensing the color of the object, picks the object using a gripper. This requires controlling the gripper motor. The controller now moves the arm to the dropping location where the gripper motor is again controlled to drop the object.

Motor driver is used to interface motors with the microcontroller unit since the o/p voltage of the microcontroller unit is very less than that required for driving the motors. The whole system operates on 3 servo motors & 1 stepper motor.

2.3 COLOR SENSING

The color sensor detects primary RGB colors and then checks for reflected color intensities which convert the intensity value into 8 bit value for each primary color. The RED color object reflects RED color with high intensity similarly for GREEN and BLUE. The three primary RGB colors are mixed to create remaining colors. After knowing fixed values of primary color it is easy to determine the color of tested object. The corresponding light intensity is reflected on sensor, and each color is having a particular value accordingly sensor will produce the output.

2.3 PICK AND PLACE CONTROL

Pick and place control operation is operated with the help of 3 servo and 1 stepper motor. The PWM pulses are taken from servo motor for varying and maintaining the position. The operation of stepper motor is to rotate the arm in specified angle. The mechanical part consists of Aluminum gripper and arm is made up of 2mm aluminum compressed sheet which will help to reduce the weight of model. The color of the object is sensed by sensor, picks the object using a gripper. This requires controlling the gripper motor. The controller now moves the arm to the dropping location where the gripper motor is again controlled to drop the object.

3. HARDWARE & SOFTWARE DISCRPTIONS

3.1 ARDUINO

Arduino is open source platform based on Atmel's and atmega168 microcontroller. it is used for building electronic products. It consist of hardware as well as software which is nothing but IDE, with the help it we can write and upload the programme from computer to physical board. Arduino has 14 digital input as well as output pins in which 6 for PWM o/p and 6 analog inputs. It has USB connection for power jack, ICSP header and crystal oscillator. Arduino requires external voltage source about 7-12v.it has flash memory, EPROM to store the programme in memory. The digital read pin will read the digital value of the given pin similarly Digital write pin will write the digital value of the given pin. Pin mode will set the pin to I/O mode. Analog read and write pin reads and writes the value of pin respect.

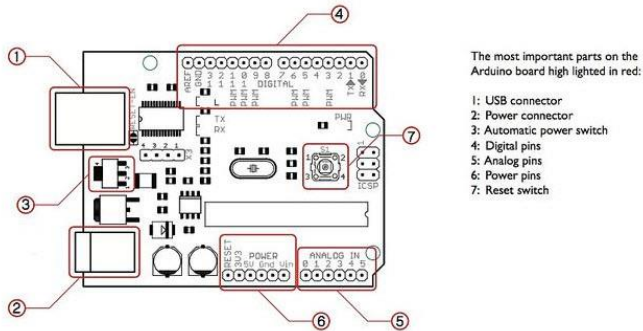


Fig -2: Arduino board

3.2 COLOR SENSOR

The color sensor used to sense the color of object is TCS34725FN. It detects the light intensity of RGB color and accordingly gives a digital output. It has integrated IR blocking filter which measures color correctly. TCS34725FN has high sensitivity and about 3.1 m wide dynamic range which makes it an ideal sensor for various color intensities. Four analog to digital converters are present in color sensor.

3.3 ROBOT ARMS & MOTORS

The Robotic arm is a 4 axis arm and has a gripper at the front to grip the object and pick it. The arm can go left and right and also up and down keeping the gripper parallel to the ground surface. Servo motors are used at the joints. Basically, servo motors are DC motors which have precise angular motion control. PWM pulses acts as input to the Servo Motors for varying and maintaining the position. The stepper motor helps in rotating the arm base. The microcontroller does not provide enough current to the DC motors. So these motors are connected to the Arduino

microcontroller by motor-driver IC, L293D. A motor driver IC is used for current enhancement.

Axis Capabilities: Mechanical Assembly	Maximum Angle(°)	Speed (Degree/sec)
Waist	180°	0-27°
First Arm	180°	0-27°
Second Arm	180°	0-27°
Third Arm	180°	0-27°
Forth Arm	180°	0-27°

Fig -2: Axis capabilities

3.4 IR PHOTOTRANSISTOR

An Infrared (IR) phototransistor is a transistor circuit which can receive and detect infrared light and is activated by only infrared light. It has only two terminals connected, the emitter and base. The base terminal is left open so that the transistor circuit is activated by the photons from light striking it. In this system, the phototransistor serves the purpose of differentiating the object from the surface.

3.5 COMPARATOR LM324

The LM324 has four operational amplifiers with high gain and frequency compensated internally. Its operation is to compare the two input voltages and output the greater one.

3.6 ARDUINO SOFTWARE

Arduino 1.8.4 is integrated development environment which will write as well as upload the programme on board. It operates on windows, Mac OS X and Linux operating system. The Arduino programme is written in Java language. The software used to write programme consists of libraries and instruction set. It consists of code editor window, compiler, and error detection mechanism. The Arduino compiler will compile the code upload on the board with single click.

4. APPLICATIONS

The system has a number of applications in various fields, as it provides color sorting of objects. This project is successful if it separates different objects according to their color. It is a sensor based system which sorts an object according to its color and then performs the pick and place functions for the object. An application to the system is also object detection and color recognition, which are the two main steps in the sensing part. For human beings it is a tiresome task to sort the objects with

efficiency and high quality, which leads in lack of accuracy in the job.

The system has an important application in the agriculture field. Here the different types of fruits can be sorted and segregated and then pick and place function can be performed to place them in their respective places. Products like grains, apples, lemons, oranges, almonds, bananas, grapes, and different kind of fruits are sorted efficiently. Also in industries sorting of various objects and tools is an important application.

5. CONCLUSIONS

The paper presents the design and development of a pick and place robotic arm with the application of color sorting of spherical objects using advanced sensors. The different colors are identified by the advanced color sensor TCS34725FN. After the color is identified the objects are picked and dropped by the gripper in the respective position in an efficient manner. Finally, this is a low cost system with simplest concepts which saves manual time and work.

REFERENCES

- [1] Gooldy Katal, Sahil Gupta, Shitij Kakkar, "Design And Operation Of Synchronized Robotic Arm" , Internationale Journal of Research in Engineering and Technology, Volume: 02 Issue: 08Aug2013
- [2] Naathaniel Pinckney, "YouBot arm," paper KUKA 2010
- [3] Trinesh, T. M. and Vijayaavithal Bongale, "Detection and Distinction of Colors Using Color Sorting Robotic Arm in a Pick and Place Mechanism" Vol. 4, No. 6, June 2015
- [4] Dhaanoj M1, Reshma K V2, Sheba V3, Maarymol P4, "COLOUR SENSOR BASED OBJECT SORTING ROBOT USING EMBEDDED SYSTEM", Vol. 4, Issue 4, April 2015