Detection & Distinction of Color using Color Sorting Robotic Arm in a Pick & Place Mechanism

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1. Introduction

Color sorting Robot is one of the useful, costless and fastest systems in Industrial applications to reduce manual working time and provides less human mistake when manual system is undertaken. The importance of robotics in 21st century is increasing day by day to reduce human mistakes in their daily tasks because of their ability to do much difficult tasks; the automotive industry fully operates with robots completing tasks on time without any mistake. The "Rancho Arm" was designed in 1963 to assist handicapped persons. Revolution in the robotics has opened the way to help the handicapped people so that they can reclaim the use of lost limbs. By 1969 more robotics arm were developed and controlled through computer such as Stanford arm was robotics arm this respect.

The proposed system is an embedded system which will increase the speed of color sorting procedure, provide the accurate color sorting process, decrease the cost of color sorting process and optimize the productivity of an industrial object. The system comprises of color sensor, stepper & servo motors and controller. Color sensor detects the specified color of the object and controller reads this from the data at its input ports. In this system we will use colored balls as an object.

The controller conveys its decision to the station that been programmed. Since a controller is used as a heart of the system, it makes the set up low cost and effective nevertheless. Industry utilization and manufacturing also defined the significance of this project.

2. Relevance

The objective of this project is to design an efficient, controller based system that pick up right colored object e.g. colored balls and put it down at right place to optimize the productivity, minimizing the cost of the products and decreasing human mistakes. The controller used is a controller having high speed performance, low cost. It communicates with color sensor and various motor modules in real time to detect the right colored object (balls) and to control the arm movement. The simple architecture reduces the manufacturing and maintenance costs. The design is quite flexible as the software can be changed according to specific requirements of the user. This makes the proposed system to be an economical, portable and a low maintenance solution for industrial applications.

3. Literature Review

The paper "DESIGN AND DEVELOPMENT OF COLOUR SORTING ROBOT"of author LIM JIE SHEN, IRDA HASSAN describes a new approach for continuous recognition and sorting of objects into desired location. A color sorting robot is researched, designed and created with Arduino Uno microcontroller, TCS3200D Color Sensor, SG90 Tower Pro Servo Motor and other electronic components. The system has the ability to sort the object according to their colors into respective color station in minimum time[XI].

The paper "Position Control of Pick and Place Robotic Arm" of author Shweta Patil, Sanjay Lakshminarayan describes design of an efficient, microcontroller based system that pick up right color of objects and put it down at right place to optimize the productivity, minimizing the cost of the products and decreasing human mistakes[IX].

In the paper "color sorting based object sorting robot using embedded system" of author Dhanoj M, Reshma K , Sheeba , Marymol P represents an application to sort colored objects with a robotic arm which picks different colored cubes and sorts them placing in different cups. The detection of the particular color is done by a light intensity to frequency converter method. The robotic arm is controlled by a microcontroller based system which controls DC servo motors.

The paper "Automated colored object sorting application for robotic arms" represents an application to sort colored objects with a robotic arm. The color recognition is made using image recognition with a webcam. The robotic arms are widely used in the industry, but most of them are used in a PTP (Point To Point) trajectory, the moves are learned previously by the robotic arm. Very few robots in the industry are programmed to be smart, or to make decisions.

4. Proposed Work

4.1 Objective

- Developing pick and place application using controller and color sensor.
- To write color recognizing and color sorting code.
- To integrate color recognizing, sorting with controller.
- To test the code and troubleshoot with the efficiency of the system.

4.2 Scope

- **Agricultural Industry:**
  Color sorting robotic arm can be used in agricultural industries to sort the fruits and vegetables depending upon their color.
- **Pharmaceutical industry**:
  To separate different medicines color sorting robots are used in pharmaceutics.
- **Food and Beverages:**
  In beverages industry to separate different juice bottles color sorting robot is helpful.

5. Methodology

5.1 Design of Robotic Arm:

The design of the robotic arm includes four major parts: base, elbow, shoulder and wrist. Different parts of robotic arm with description shown in Figure 1. The robotic arm can be used to achieve the concept of degrees of freedom. Using the robot arm in straight position, rotating it from shoulder side, the robot can move in three different ways. The movement of the robot to up-and-down position is called pitch. The right and left movement is called yaw. Whole movement of the robot arm as a screwdriver is called roll.
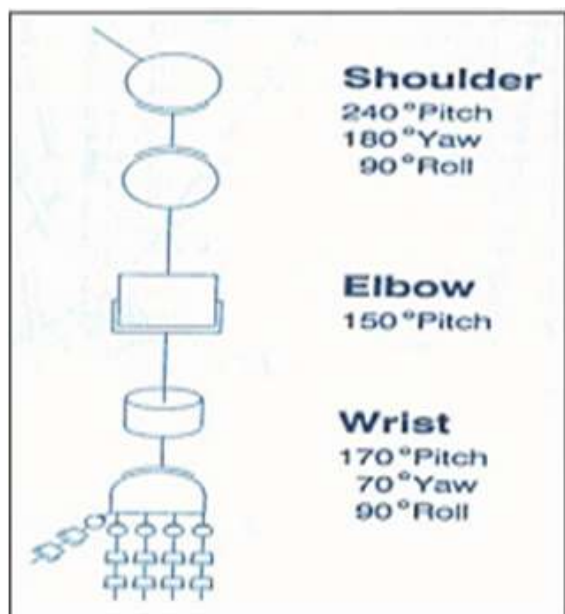

Figure 1: Parts of robotic arm

The wrist and shoulder will have three degrees of freedom and they are pitch, yaw and roll but elbow will have only pitch. Moving the robot arm from the elbow side only, holding the shoulder keeping in same position constantly, the elbow joint has equivalent pitch in the shoulder joint, giving the elbow with one degree of freedom. Now rotating wrist to straight position and motion less, we can easily bend the wrist to up and down position, side to side and it can easily twist.

5.2 Detection and distinction of color

The Color sensor is a programmable light-to-frequency converter, it can filter RGB (Red, Green, and Blue) data obtained from source light and convert it to a square wave form having 50% duty cycle with frequency proportional to light intensity. Digital inputs and digital outputs allow interfacing with a microcontroller directly. So color of the ball's light is calculated by RGB values. Color sensor will sense the color of cube and give data to the controller for further instructions.
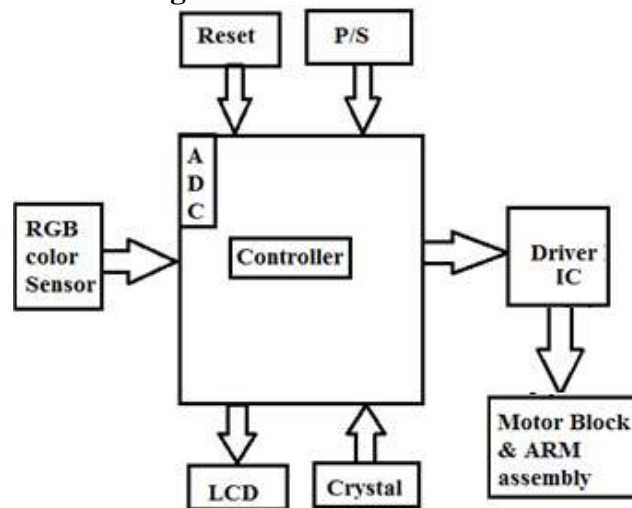
6. Block Diagram

Figure 2: Block Diagram

7. Proposed Steps

1) Design of power supply
2) Design of Robotic arm.
3) Interfacing of color sensor with controller module.
4) Interfacing of robotic arm with controller module.
5) Sense the color of the balls.
6) Pick and place it in particular container as per the color.

8. Facilities Available and Requirements

1) Controller
2) TCS3200D/ Updated color sensor as per requirements
3) Robotic arm with gripper Assembly
4) In circuit programming software
5) Single phase supply

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