

Robotic Arm with Color Sensor

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Abstract

A robot can program normally for human hands. This robot is one of the embedded system designs which is interfaced the arduino program with the robot arm chassis. This system is mainly used Arduino UNO, color sensor, three servo motors and robot arm chassis to implement the color classification robotic arm. The color sensor is used in the robotic arm to classify the color of the object. The position of the boxes to keep the objects according to the degree of the motor which is defined in the program. Thus the moment of the robot arm depends on the detected color. The main objective of the project is to detect the color of the object and to pickup this object. And then, the robot arm takes it and keeps it to the specified box. Red, Green and Blue colors can be classified because TCS3200 is used in this system. This robot factory can be used industries, factories, supermarkets etc.

1. Introduction

The robot system consists of various building blocks like sensor to enable co-operation by physical means and enables the robot to react to forces applied to the robot by the human partner. A robotic arm is usually a machine that can program with human-like functions. This system is an embedded system. This speeds up the speed of the coloration procedure, which is faster and more efficient. Provides accurate color separation processes; Reducing the cost of the color separation process will optimize the productivity of an industry. The system comprise of color sensor, stepper and servo motors and arduino. Color sensor detects the specified color of the object. The significance of a project can be estimated from its current utilization and future prospect of advancements. The robotic arm picked the object according to the color sensor and place into dustbin. This thought touched us when we noticed that we often use litter twice a day.

1.1. Objectives

The objectives of the system are

- To reduce the man power in the real world and save human life
- To be ability to work in any hostile environment
- To understand the intelligence level of robots
- To understand the basic configuration of robot

2. Operation of the Block Diagram

The robotic arm of a robot that is capable of resembling a human arm is called a robotic arm. The robotic arm is really modernized. In this system, use one arduinouno and 995 servo motor 3 pieces. Eezybotarm MK2 robotic arm is used. Color sensor 1 pieces and 3 potential meters are used. Buzzer, Switch, and LED are also used. If the robotic arm is used effectively, it can see the advanced technology. The system's block diagram is presented in Figure 1.

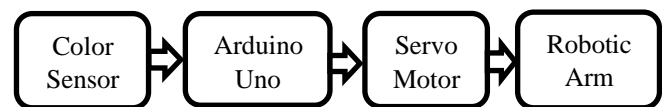


Figure 1. Block Diagram of the System

3. Implementation of the System

This system is one of the embedded systems. The software program and hardware circuit are interfaced to design this robotic arm with color sensor. There are two parts in this system, i.e. hardware implementation and software implementation.

3.1. Hardware Implementation

In this system, Arduino UNO is specially used to run the circuit, especially, A0, A1 and the A2 pin of the arduino are connected to the middle pin of the potentiometer. The other two pins of the other potentiometers are related to the voltage. The ground switch is linked to the voltage and the pin of the led pin is linked to the ground and the positive connects to the resistor and the resistor 13 pin connects to the tcs3200 color sensor. The color is red and the robot selects the object and puts it into the rubbish bin. The color is green and the robot selects the object and puts it into the rubbish bin. The color is blue and the robot selects the object and puts it into the rubbish bin. If the color is other, the robot does not work. The circuit design of the system is presented in Figure 2.

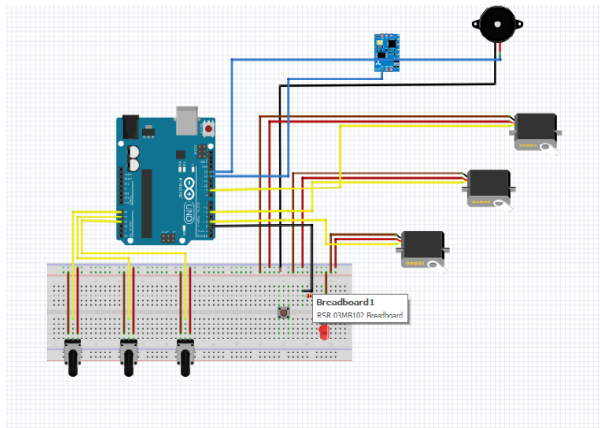


Figure 2. Circuit Diagram of the System

3.2. Software Implementation

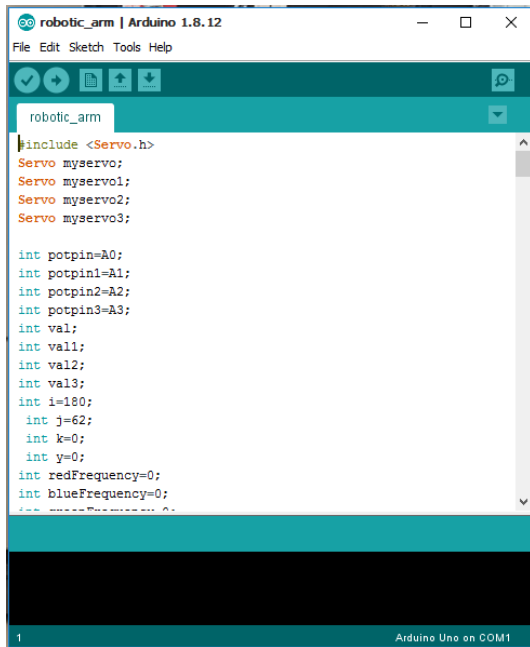


Figure 3. The Simulation of the Arduino IDE

In this system, Arduino 1.8.12 simulator is used for software implementation. It is the best solution for developing code for Arduino UNO devices. It runs the operating system, numerical computing, graphical applications, etc. are used for programming in various domains. Programming mode on C is used for software implementation. Figure 3 is illustrated the simulation of the Arduino IDE.

3.3. Methodology

Color sorting robotic arm system selects the specified color object and placed it at a desired location. Firstly, when object is determined by the robot, the gripper of the robot will pick the object and place it to the specified color differentiating station. The sensor has a current-to-frequency converter that reads

photodiodes' reading into photodiodes' into square waves with a frequency proportional to the brightness of the selected color. This frequency is then, read by the Arduino.

The arm picks the object and drops it to the placedefined by programming of controller. The arm rotates to the specific angle (135°, 90°, 45°). This selection of frequency and color is shown in following Tables 1 & 2. The selection of output frequency ports are made by S₀ and S₁, while the control pins S₂ and S₃ are used to select the color read by the photodiode.

Table 1: Frequency Selection

S ₀	S ₁	Output Frequency Scaling (f ₀)
L	H	2%
L	L	Power Down
H	H	100%
H	L	20%

Table 2: Color Selection (photodiode Type)

S ₂	S ₃	Photodiode Type
L	H	BLUE
L	L	RED
H	H	GREEN
H	L	Clear (no filter)

4. System Design

Firstly, the robot stays in initial state and color sensor reads the color. If the color is red, the robot picks the object and rotates 135 degrees and goes to the box for red object. Else go to stop. If the color is green, the robot picks the object and rotates 90 degrees and goes to the box for green object. Else go to stop. If the color is blue, the robot picks the object and rotates 45 degrees and goes to the box for blue object. Else go to stop. If the color is red, the robot picks the object and places it into the red dustbin. If the color is green, the robot picks the object and places it into the green dustbin. If the color is blue, the robot picks the object and places it into the blue dustbin. If the color is other, the robot does not work. The flowchart of the system is as depicted in Figure 4.

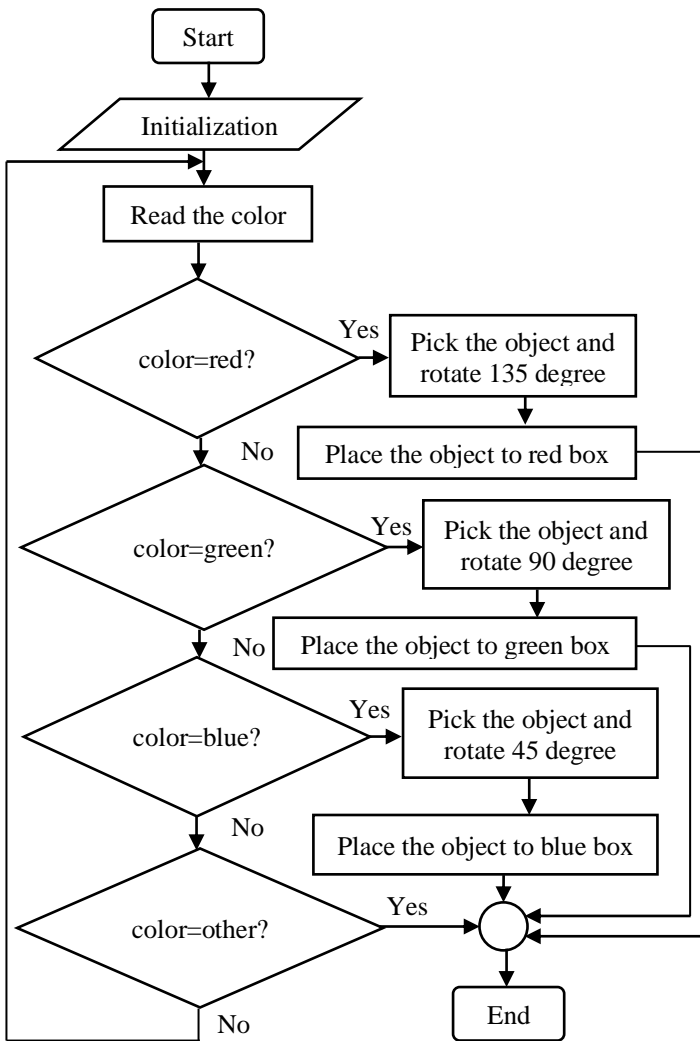


Figure 4. Flowchart of Robotic Arm

4.1. Mechanical Design of Robotic Arm

The arm is the main part of the robotic arm. It includes three parts: shoulder, elbow and wrist. They are all joints. The shoulder is at the bottom of the arm. Normally connected to a controller; It can move forward or backward. The elbow is in the middle and allows the upper section of the arm to move forward or backward independently of the lower section. Finally, the wrist is at the very end of the upper arm and attaches to end effector. The end effector is operated by a robotic hand. It is often composed of two claws, through sometimes three, that can open or close on command. It can also spin on the wrist, making material and equipment easy.

4.2. Implementation Setup

This system presents the design, development and construction of a robotic arm, which pickup, take and keep this object to specified box for each color. This main objective of the project is to detect the color of the object and to pick up this object. And then the robot arm takes it and keeps it to the specified box. The color sensors TCS3200 show almost stable response in various sunlight conditions. This color sensor can detect the RGB color (red, green, blue). A blue object is placed in front of the sensor at different distances. Two measurements should be saved: when the object is placed far from the sensor and when the object is close to it. The blue frequency (B) should be the lowest compared to the red (R) and green (G) frequency reading the serial motor. When the blue is placed in front of the sensor, the blue frequency (B) values oscillate between 59 and 223. Then, save the upper and bottom frequency limits for the blue color, because they will be needed later. Repeat this process with green and red objects and write down the upper and bottom frequency limits for each color. The frequency values to RGB are between 0 and 255. The frequency values are zero when the different colors objects are placed in front of the sensor.

A servo motor is a DC motor integrated with a gear train and some control logic so that it is easier to use. They have a limited rotation, typically 180 degrees. A servo motor has a 3-pin interface with power, ground and control input. The control input is usually a 50Hz pulse-width modulated signal. In typical servo motor with 180 degrees of rotation, a pulse width of 0.5ms drives the shaft 0 degree, 1.5ms to 90 degree, and 2.5ms to 180 degree. The system is operation with open loop. If a closed loop control is included, a better resolution can be obtained. The system responses are little bit slower than expected. It can improve by using a more advanced color sensors and arduino boards the robotic arm picked the object to the detected color by color sensors and place into the respective box. The picking and sorting speeds are comparable to the ideal human picker but with advanced quality monitoring and the ability to work without a rest or a break, 24 hours a day, 7 days a week. The schematics diagram of the color classification robotic arm design is as shown in Figure 5.



Figure 5. The Prototype of the Robotic Arm

5. Conclusions

The objectives of this system has been achieved which was developing the hardware design and software program to control the color classification robotic arm. The robotic arm has been development successfully as the movement of the robot can be controlled precisely. According to the robotic arm control method is expected to overcome the problem such as placing or picking object fasting degree of the motor. The robot helps people with tasks that would be difficult, unsafe or boring for a real person to do alone. Red, Green and Blue colors can be classified because TCS3200 is used in this system. This robot factory can be used industries, factories, supermarkets etc.

6. Limitations and Further Extensions

The robotic arm can classify for any three colors, red, green and blue because it is used the TCS3200 color sensor. This robotic arm can be extended by using advantaged boards modules to be an autonomous robotic arm. It can be extended as carrying and performing human-robot handovers. It can handle dangerous objects such as chemicals and hotplates. It can signal for example using the robotic arm to gesture to a coworker for assistance. Robot arms are used in conjunction with people in manufacturing facilities to use or assist in improving the quality of life of elderly people with disabilities. It can balance the user by grasping and bracing using objects in the environment and again use the external wheel to go anywhere.

References

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