

# A LOW COST ADVANCED COLOR-SENSING ROBOT

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**Abstract** - To make everything easier and cost effective is a prime concern in our day-to-day life and the microcontroller-based robot presented here is an MATLAB based control system which works on the principle of image processing. It can be controlled only by a particular colored object of which position is changed in front of camera. Camera is working as a sensor in this project.

The design analysis of 'A LOW COST ADVANCED COLOR-SENSING ROBOT' has been presented in this paper. This system comprises of a small electronic unit with a camera which is located in front of operator. When a person change the position of red color object in front of camera then computer sends commands to our robot which moves according to that position.

In our project we have designed a robot for which the variation in horizontal and vertical axis of tracked object generate control signal which is send to the controller. The captured images of the object are processed using software MATLAB. Depending on the change in position of object, proper commands are given to the robot. This project is in aimed to design and develop a mobile robot which can move according to the position of a moving object. Here, we use the camera to capture image of the object and these frames are processed to track the object. The features of the object such as the color, shape, size can be monitored for tracking the object.

**Key Words:** Image Processing, Robot, MATLAB.

## 1. INTRODUCTION

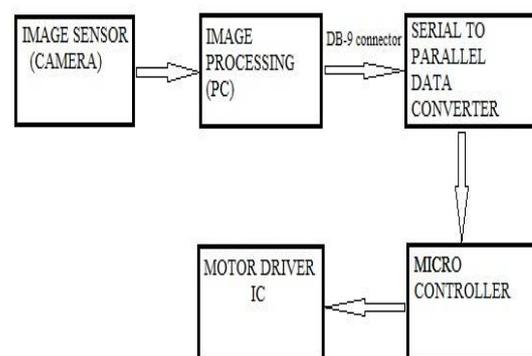
A camera is one of the most powerful and accurate sensors if you know how to process the images taken by it for the information you want. You can process subsequent images and extract a variety of information using image-processing techniques. MATLAB is a very powerful tool

and plays an important role in image processing. Image processing is converting an image into digital form and performing some mathematical operations on it, in order to get an enhanced image or to extract some useful information out of it. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.

MATLAB-based project where images taken by the camera are processed for colors and the position of a red-colored object is extracted out of the image. Based on the position of the red colored object in the image, different data are sent via COM port. The serial data are received by the robot and corresponding movement is done. You can change the code for any color that you find suitable. This project can be used for various industrial applications such as controlling heavy load-lifting machines with some object of a specific color in your hand.

Colored object can be held in your hand, which instructs the robot to move right, left, forward or backward as per the position of your hand.

### 1.1 BLOCK DIAGRAM



The project contain 2 sections:

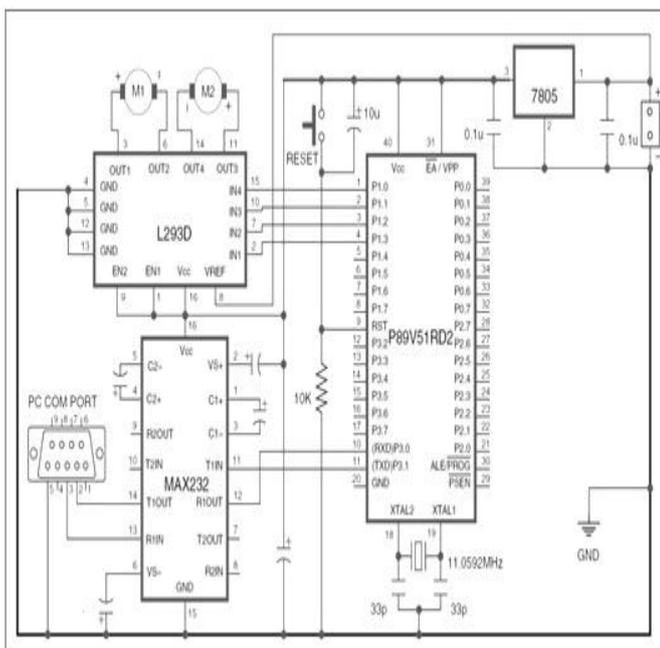
1. Image Processing

The application running on the computer interprets the position of the colored object and sends corresponding commands to the robot through the serial port.

**2. Robot (Receiver end)**

It uses microcontroller to receive serial data from the computer through driver IC. The received data is analyzed by the microcontroller and the motors are controlled through motor-driver.

**1.2 CIRCUIT DIAGRAM**



It uses microcontroller P89V51RD2 to receive serial data from the computer through driver IC MAX232. The received data is analyzed by the microcontroller and the motors are controlled through motor-driver IC L293D. The power supply for the robot comes from a 9V battery which is regulated to 5V by regulator 7805.

The USB port of the computer is connected to the robot through USB-to-serial converter. Controlling commands to the robot are sent via serial port and the signal levels are converted into 5V TTL/CMOS type by MAX232. These signals are directly fed to microcontroller for controlling motors M1 and M2 to move the robot in all directions. EN1 and EN2 are connected to Vcc to keep L293D always enabled.

The application running on the computer interprets the position of the colored object and sends corresponding commands to the robot through the serial port. If the operator stands in front of the computer's camera, holds a red-colored object in his hand and raises his hand up, the MATLAB application running in the computer interprets

the position of the colored object and sends data to the serial port. The robot is programmed to move forward if it receives from the serial port.

**Color detection algorithm:** In color-detection algorithm, the primary-color (red, green and blue) objects can be detected easily. The algorithm used for color detection actually works in separate steps.

1. Extracting frames: From the video alternate frames are extracted and are further processed.

2. Extracting color components: Each frame contains three basic color matrices R,G and B. depending on the color of the object to be tracked, we are extracting one color matrices or a combination of matrices.

3. RGB to grey scale conversion: Each frame is converted to grey scale. It will reduce memory usage and increases the processing speed.

4. Noise Elimination: Noise elimination is performed to filter noises caused by reflections or motion blurs. For noise elimination is performed by median filtering operation. Median filter is used to remove "salt and pepper" noise while preserving useful details. Noises due to change in background or illumination condition may misidentify some of background pixels to be as foreground.

5. Elimination of small objects: This is to remove object below a certain pixel size which may otherwise cause malfunction. MATLAB provides special function for this operation.

6. Subtracting background: The grey scale matrices obtained in step RGB to grey scale conversion is subtracted from color component matrices.

**2. INTRODUCTION TO MATLAB**

MATLAB software is an interactive environment used by millions of engineers and scientists worldwide. It lets you explore and visualize ideas and collaborate across disciplines including signal and image processing, communications, control systems, and computational finance.

The MATLAB system consists of four main parts:

**(a) THE MATLAB LANGUAGE**

This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both "programming in the small" to rapidly create quick and dirty throw-away programs, and "programming in the large" to create complete large and complex application programs.

**(b) HANDLE GRAPHICS**

This is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete Graphical User Interfaces on your MATLAB applications.

**(c) MATLAB MATHEMATICAL FUNCTION LIBRARY**

This is a vast collection of computational algorithms ranging from elementary functions like sum, sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix eigen values, Bessel functions, and fast Fourier transforms.

**(d) MATLAB APPLICATION PROGRAM INTERFACE (API)**

This is a library that allows you to write C and Fortran programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.

**3. COMPONENTS/DEVICES**

COMPONENTS/DEVICES	ALTERNATE COMPONENTS/DEVICES
IC1 -P89V51RD2 microcontroller	-PIC,Arduino,AVR microcontroller
IC2 -L293D motor driver	-SN754410 , LB1836M
IC3 -MAX232level converter	-CD4066B CMOS
IC4 -7805,5V regulator	-ICL 7663
Resistors -10-kilo-ohm	-Series and parallel combination of different resistors and capacitors.
Capacitors - 0.1µF	
-10µF	
-1µF	
-33pF	
11.0592MHz -Crystal Oscillator	-Frequency Synthesizer chip MC145181
100 rpm dc motor	
USB to Serial connector	
Software Tools: -MATLAB	-OpenCV
-Image Acquisition Tool	
Box	

**4. CONCLUSION**

The project is designed, implemented and tested successfully. The response of system to different object movements was satisfactory. Still some advancement can be included to for system to improve performance.

Obstacle avoidance mechanisms can be included. This can be done by sensing the back ground images and processing it properly. Different active sensors such as infrared sensors and supersonic sensors are employed to measure the range in real time the obstacles and robot. A mobile robot with various types on sensors via ubiquitous networks can be introduced.

A mobile robot composed on TCP/IP network, wireless camera and several sensors in an environment can be constructed, and show obstacle avoidance and object tracking methods necessary with providing diverse services desired by the people.

**5. REFERENCES**

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