Color Responsive Robocam Using Image Processing

G.Padmanabha Sivakumar[a], *Saket malladi [b]

EIE Department, SCSVMV Deemed to be University, Kanchipuram, Tamilnadu-631561, India.

A B S T R A C T

Color detection of an object is one of the most efficiently used methods for sensing and following of an object. This process is done using image processing. This method employs the detection of moving object based on RGB color space and decides the action based on the color detected. A digital camera is used for image acquisition and image processing to detect the color, whereas a microcontroller-based robot is used for performing the assigned task. In certain places, where the human involvement in any work is risky, the use of such robot is feasible. The basic purpose of building this robot is to follow the appropriate object or instruction and to detect any immediate threat that the environment might pose. In order to develop the model, (x-bee) wireless module, along with Arduino module and image processing to recognize and classify the images, convert it into histograms containing hexadecimal data and matching it with the classification report from the datasets and presenting an understandable output.

Keywords: X-bee, Image processing, Color detection.

1. Introduction

Image processing is a technique for processing of images using mathematical operations. It makes use of any form of signal processing for which the input is an image, a series of images, or a video, e.g. a photograph or video frame. The output of image processing may be either an image or a set of characteristics or parameters related to the image that is extracted. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Images are also processed as three-dimensional signals where the third-dimension being time or the z-axis. Image processing usually refers to digital image processing but optical and analog image processing also are possible. The detection and classification of local structures (i.e. edges, corners, and T-Junctions) in color images is important for many applications such as image segmentation, image matching, object recognition, visual tracking in the fields of image processing and computer vision. There has been an increasing interest in the usage of robots in spaces where humans reside and safe navigation by effective sensing becomes an important issue. Here, we are describing a prototype to detect objects that exist in front of an autonomously navigating robot by analysing images using a camera. Although moving object detection and obstacle avoidance have been actively studied in the fields of computer vision and intelligent robotics, analysing the real time video of the object captured is still challenging. Keeping the above considerations in mind, a fast and simple masking method for color detection in a small search region specified is proposed.Color detection of an object is one of the most efficiently used methods for sensing and following an object. This process is carried out using image processing technique. This method employs the detection of moving object based on RGB color space and decides the action based on the color detected.A digital camera is used for image acquisition and image processing to detect the color whereas a microcontroller-based robot is used for performing the assigned task. The basic idea behind this project is to decrease the risk of human life and also effectively utilize man power in the industries.The concept of color detection is, as the name suggests, a part of image processing that involves differentiation between objects based on their color. For example, if we are processing an image with a number of colored objects, and we want to process only the ones of a particular color, then color detection methods basically return a binary image where only the portions with relevant color are white, while the rest is black. This reduces the information of the image to only the relevant portions, which make it easier to process for various operations.

Color Responsive Robocam is a color detecting and responsive robot which can be used in places where human involvement is risky. The robot performs a motion based on the designated task for each color. The detection of color is done using a RGB filter and the robot responds to the color detected by performing a set action for the particular color. In this prototype the tasks are defined only for red, green, yellow and blue colors and the robot performs actions based on these colors. In certain places where human involvement is dangerous, the use of such robot is feasible. The basic idea behind building this robot is to follow the appropriate object or instruction and to detect any immediate threat that the environment might pose.

1.1 Literature Survey

Research shows that the risk for human lives is high in industries and factories which deal with high temperature and high voltage tasks. There are several other work places wherein certain kind of tasks might pose a threat to the lives of the workers. Detecting such threats by hu mans is not advisable as it might be dangerous. Such threats can be usually associated with certain colors. Also, many small scale industries use a lot of man power for various tasks. In such places, using this color tracking robot will be helpful. It reduces the consumption of time as well.

Recently, there has been increasing interest in using mobile robots within spaces where humans reside and hence, safe navigation by effective sensing becomes an important issue. Here, we describe a method to detect moving objects that exist in front of an autonomously navigating robot by analyzing images using a camera mounted on the robot. Although moving object detection and obstacle avoidance have been actively studied in the fields of computer vision and intelligent robotics, respectively, analyzing the images of a moving object is still challenging. Keeping the above considerations in mind, a fast and simple masking method for color detection in a small search region specified is proposed.

Dash has found that, the pixel based color features of the object are enhanced by diminishing the background color using Gaussian filter. Most tracking methods can be classified into two major types, namely, probabilistic filtering algorithms and deterministic localization algorithms. Here, some improvement in color based tracking has been proposed and employed to track a moving object. The object state has been taken as the object position, speed and the appearance condition of the object. From the simulation results it is observed that the proposed algorithm is an efficient methodology for object tracking in many challenging situations.

In the research of Chen and Diao , results from motion and color analysis are fused and a region-growing technique based on the Gaussian distribution of its RGB information is performed to further refine the moving object's image. Results are shown to demonstrate the accuracy of our method. According to Fernandez-Sanchez et al [3], background subtraction (BGS) method based on the Gaussian mixture models usingcolour and depth information is done. For combining colour and depth information, the probabilistic model based on Gaussian distribution is used. The prototype depicted in this report utilizes these study outcomes for better results. Thus, this technique will help to robustly detect regions of interest as pre-processing in high-level image processing stages.

2. EXISTING METHODOLOGY

Detecting and locating object in digital image has become one of the most important applications for industrial use to ease user and save time. The techniques have been developed years ago but improvement of it is still required in order to achieve better results. The techniques used to detect a colored object are color processing which use primary filtering to eliminate the unrelated color or object in the image. Besides, sha pe detection is used where the process requires edge detection. Circular Hough Transform (CHT) technique will determine the candidates and find the circular pattern with the given radius within an image by collecting the maximum voting. The program should automatically detect the desire object and count the total number of it.

A paper on Color based Edge detection techniques presents a review on different methods of color-based edge detection. Edge detection has found to be most important step in many critical vision applications. It results in the black and white (binary) image where each object is differentiated by lines (either black and white). Edges are basically the area in the image where sharp changes exist. It has been found that most of the exi sting techniques have neglected the use of colors while detecting the edges but in many applications a region can be categorized based upon the color. This paper has shown that the most of the existing techniques fails in case of images with complex background.

Edge detection plays a significant role in vision processing. Edge recognition is the name for a set of mathematical methods which target at classifying points in an image at which the image intensity varies sharply or, has discontinuities. The points at which digital image intensity turns sharply are stereotypically ordered into a set of line segments called edges. The similar problem of discovering discontinuities in 1D signal is identified as step detection and the problem of discovering signal discontinuities over the time is called as change detection. Edge detection is essential instrument in vision processing, machine vision and digital image processing, mainly in the areas of feature recognition. The problem is to find edges in an image, so the first step is the process of scene reconstruction. The edges can be used later for segmentation of the image into objects. The most straightforward edge detection can be done by using thresholds: pixels with gray level above some threshold are considered to be in one group and all the other pixels in the

second. The edges should appear when you cross the border between the groups. This technique works in very straightforward domains, but by no means can provide as an edge detector in the real world. More sophisticated approach uses linear operators to find edges. For example, if you relate a gradient operator on the image and only then relate the threshold technique, the result that you get is much better. Gradient operator s are not the only method that can be used for edge detection. There are a lot of linear operators (e.g. Laplacian) that can serve this purpose.

Basic geometric shape and primary color detection using image processing on MATLAB gives an approach to identify basic geometric shapes and primary RGB colors in a 2-dimensional image using image processing techniques with the help of MATLAB. The basic shapes included are square, circle, triangle and rectangle. The algorithm involves conversion of RGB image to grey scale image and then to black and white image. This is achieved by thresholdingconcept; the area of the minimum bounding rectangle is calculated irrespective of the angle of rotation of the object and ratio of thi s area to area of the object is calculated and compared to the predefined ratio to determine the shape of the given object. The dominant color pixels present helps to determine the color of the object. The practical aspects of this include reducing the manual labor in industries used to segregate the products and providing real time vision to the robots.

A paper based on Improved Method of Color Image Edge Detection Based on One Order Gradient Operator suggests that in order to research the problem of the gray edge and leaving out some edges during detecting the color edges, the color contrast enhancement algorithm is designed such that it depends on decomposing the interrelated color component of the color images based on RGB color model. And the edge detection improved method is proposed based on the above algorithm. Namely, the components edges are computed by the gradient operators after the components are enhanced and the color image edges are composed. The experimental results show that the color edges are detected through the proposed method and the algorithm has the advantage of keeping more edge details than the other ways. Because the algorithm is an improved method of pixel processing based on three components of RGB color model, it needn't transform one color model to the other color model, so it is a simpler method.

2.1. Problem Formulation

The conventional color tracking robot using sensors can be programmed to detect and track only one color at a time. This makes the functioning of a robot confined to one single function. To overcome this, we can design a color following robot by using image processing technique to detect the colors. By this we can define the functionality of the robot for more than one color which makes the robot versatile. This prototype is designed so as to track the object by detecting its color and control the movements of the robot by allotting predefined tasks in the code. The functionality is basically defined for four different colors namely green, red, yellow and blue. The number of colors can also be increased by making changes in the program.

2.2 Motivation

Automatic moving object detection is essential for various computer vision applications like video surveillance systems. And also object tracking is a major aspect when it comes to work places with risky factors like high temperature, high pressure conditions. Color detection of an object is one of the most efficiently used methods for sensing and following of an object. This is an innovative system to detect the colors and track the object based on the predefined set of commands. It is a simple system which can be used without the continuous interference of the humans to guide the robot. Along with this, the robot also decreases human intervention in the work place to a greater extent.

2.3 Project Objective

Object tracking is a major aspect when it comes to work places with risky factors like high temperature, high pressure conditions. The main objective of this project is to design an innovative system to detect the colors and follow the object based on the predefined set of commands.

2.4 Scope of Project

The conventional color tracking robot using the sensors can be programmed to detect and track only one color. We are designing a color tracking robot by using image processing technique to detect the colors where we can define the functionality of the robot for more than one color. This prototype is to track the object by detecting its color and control the movements of the robot. By inculcating certain improvisations the robot can be used for surveillance purpose, segregation of items and variety of other applications.

2.5 Detailed Block Diagram:

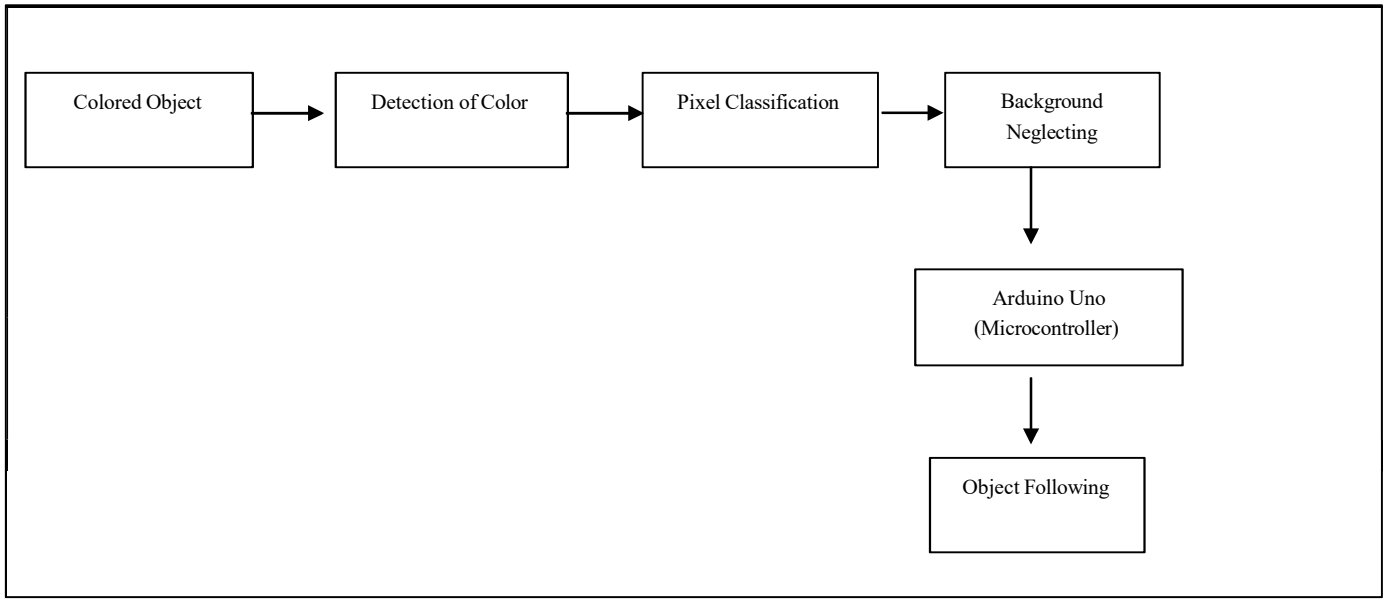


Fig.1.1 Detailed block diagram

- **Colored Object:** we are using four different colored objects in this project. The colors to which the bot responds are green, red, yellow and blue.
- **Detection of Color:** The above mentioned colors are detected by using real time video capturing through the camera.
- **Pixel Classification:** Once the video capturing starts, the color of the object that is within the 640*480 pixels rectangle are only detected.
- **Background Neglecting:** The video that is captured outside the 640*480 pixels rectangle is neglected by converting it to grey scale.
- **Arduino Uno (Microcontroller):** The microcontroller we use here is arduino uno ATmega328P. it controls the bot's motion.
- **Object Following:** Once the color is detected, based on the color functions are assigned to the bot. those functions will be performed. The functions are:
  - Green: the bot follows the green colored object until the front IR sensor gets triggered.
  - Red: the bot immediately stops and reverts back until the back IR sensor gets triggered
  - Yellow: the bot turns right and waits for the next color to be detected.
  - Blue: the bot turns left and waits for the next color to be detected.

3. Conclusion

In this way the proposed prototype executes its operations step wise. At each step the particular softwares responsible for that particular functionality support the entire working of the bot.

REFERENCES

- PranjnaParimita Dash, "Robust detection & tracking of object by particle filter using color information", 2013 Fourth International Conference on Computing, Communications and Networking Technologies (ICCCNT) 2013, pp. 1-6
- Ye-gang Chen, Xiao-rongDiao, "Moving Object's Detect in a Monocular Moving Camera", 2013 IEEE International Conference on Dependable, Autonomic and Secure Computing (DASC), 2013, pp. 399-403
- L. Maddalena and A. Petorisino, "A fuzzy spatial coherence-based approach to background/foreground separation for moving object detection, " in Neural Computing and Applications, vol. 19, March 2010, pp. 179-186

- SeungJong Noh and MoonguJeon, "A new framework for background subtraction using multiple cues, " in Asian Conference on Computer Vision, 2012
- Fernandez-Sanchez, E. J., Rubio, L., Diaz, J., and Ros, E. "Background subtraction model based on color and depth cues, " in Machine Vision and Applications, 25(5), 1211-1225, 2013
- P. Chiranjeevi and S. Sengupta, "New fuzzy texture features for robust detection of moving objects" , *IEEE Signal Process. Lett.* , vol. 19 , no. 10 , pp.603 - 606 , 2012
- InteckWhoang, FarhanAkram, JeongHeon Kim, Kwang Nam Choi, "Object Tracking Using Maximum Color Distance and Shape Density", *ICIG*, 2013, Image and Graphics, International Conference on, Image and Graphics, International Conference on 2013, pp. 369-373
- Color Feature Detection THEO GEVERS ISLA, Informatics Institute University of Amsterdam, Amsterdam, The Netherlands., JOOST VAN DE WEIJER LEAR, GRAVIR laboratory INRIA Grenoble, France.,HARRO STOKMAN ISLA, Informatics Institute University of Amsterdam Amsterdam, The Netherlands.
- https://www.arduino.cc/en/main/arduinoBoardUno
- https://www.scribd.com/doc/74318958/Datasheet-Arduino-Uno
- https://en.wikipedia.org/wiki/XBee
- https://www.arduino.cc/en/Main/ArduinoXbeeShield
- http://arduinobasics.blogspot.in/2014/09/relay-module.html
- G. Peace, Taguchi methods: A Hands-on Approach to Quality Engineering, Addison-Wesley Publishing Company (1995).
- L. Zhao, H. Kim and J. Kim, Optimal design of smart panel using admittance analysis, *Journal ofMechanical Science and Technology*, 21 (4) (2007) 642-653.