Robot control using hand gestures

Uma B. Barahate

PG Student
Savitribai Phule Women's Engineering College,Aurangabad,Maharashtra,India.

Prof.P.R.Thorat

Principal
Savitribai Phule Women's Engineering College,Aurangabad,Maharashtra,India.

Abstract- In this paper we have implemented a wireless robot control through hand gesture recognition based on perceptual color space. In the recent days gesture controlled devices are getting more attention. There are different types of gesture controlling techniques. Hand gesture recognition system received great attention in the recent few years because of its manifoldness applications and the ability to interact with machine efficiently through human computer interaction The essential aim of building hand gesture recognition system is to create a natural interaction between human and computer where the recognized gestures can be used for controlling a robot or conveying meaningful information.

In gesture recognition technology, a camera reads the movements of the human body and communicates the data to a computer that uses the gestures as input to control applications. This is a new approach of controlling a robot by merely showing hand gestures in front of the camera. A web camera captures a gesture shown in front of it for a time period and processes it to determine the command from the gesture. The command is then executed by generating proper control signals.

We developed hand gesture based system that controls the robot.

Keywords –
Hand Gesture, Gesture recognition, wireless robot, LabVIEW.

I. INTRODUCTION

Including gestures with Human-Computer Interaction (HCI) could be an extremely beneficial development. The general problem is quite challenging due a number of issues including the complicated nature of static and dynamic hand gestures, complex backgrounds, and occlusions. The goal of this project is to develop a program implementing real time gesture recognition. At any time, a user can exhibit his hand doing a specific gesture in front of a video camera linked to a computer. However, the user is not supposed to be exactly at the same place when showing his hand. It has to do it as fast as possible, given that real time processing is required. We propose a fast algorithm for automatically recognizing a limited set of gestures from hand images for a robot control application. Hand gesture recognition is a challenging problem in its general form. We consider a fixed set of manual commands and a reasonably structured environment, and develop a simple, yet effective, procedure for gesture recognition. This paper is consisting of the two important parts software development and hardware development. Software- for getting the status of the gesture .Hardware -for applying the gestures.

The software consists of the different phases of conversion of the different hand gestures in to the signals or commands for the robot and hardware consist of details of the transmitter and receiver of the project.

II. RELATED WORK

Color-based target recognition is inherently difficult, due to variation in the apparent color of targets under varying imaging conditions. A number of factors might lead to the problem, namely, the color of incident daylight, surface reflectance properties of the target, illumination geometry, and viewing geometry [1]. There have been numerous studies in the literature dealing with varying color in highly constrained environments, such as color constancy algorithms [2], but are generally not applicable to outdoor images. Buluswar and Draper [3] developed color models for illumination and surface reflectance for use in outdoor machine vision. Stachowicz and Lemke [4] presented a color recognition method to compress the color information in an image into a small feature space that still contains enough information to separate one image from another. Liu *et al.* [5] provided an approach combining multiple color models to make color-based object recognition stable under varying imaging conditions. Another idea is to establish a supervised learning mechanism based on neural network for color measurement [6].This approach offers good performance and is more convenient to be implemented in human-robot interaction. The ability to quickly and correctly recognize hand gestures plays an important role in human-robot interaction applications. Numerous

approaches have been applied to interpreting hand gestures. More recently, combining color space transformation and color thresholding method to classify each pixel in an image into one of a discrete number of color classes has increased noticeably [7]. This approach offers good performance and is more convenient to be implemented in human-robot interaction. The ability to quickly and correctly recognize hand gestures plays an important role in human-robot interaction applications. Numerous approaches have been applied to interpreting hand gestures. In literature [8]-[10], several hand geometry based systems are proposed for measuring a hand shape to extract its features, including lengths and widths of fingers, and hand contour, for recognition. The main objective of this work was the developing of a control system for a robot, based on gesture recognition.

III. SYSTEM DEVELOPMENT

In this project, we propose a gestures recognition method to recognize a number of well-defined hand gestures representing a limited set of commands that the humans can give to the mobile robot. A web camera will be attached to a computer which will acquire live feed of gestures done by the operator. The operator will give a gesture of thumbs up. Now when the thumb is pointing in left direction, the command is 'move left', when one figure, the command is 'move forward' when two figures, the command is 'move reverse' etc. The frames captured by the camera are in RGB format. Convert RGB image into Gray scale image. We then applying threshold value for one color the gray image are converted to binary image. In binary image the threshold color turns black & the background becomes white. Now using final output i.e binary image compare with trained images. We can find the match image. Thus then we give command to the robot in this way.

The project is divided in to two parts software for getting the status of the gesture and hardware for applying the gestures.

Software Structure

3.1 Flow of System -:

3.3.1 Algorithm-:

The algorithm for the software development can be given as follows Algorithm for the program which converts the gestures to commands for the robot is as follows:
1) Capture a frame from camera. It's in RGB format.
2) Convert this RGB image to Gray Scale image.
3) Convert this image to binary image by applying threshold value.
4) Filter binary image.
5) Find out the match.
6) If match occurs then go to the next step.
   Else give the previous command to robot.
7) Give the commands to robot.

3.1.2 Flowchart of the System-:
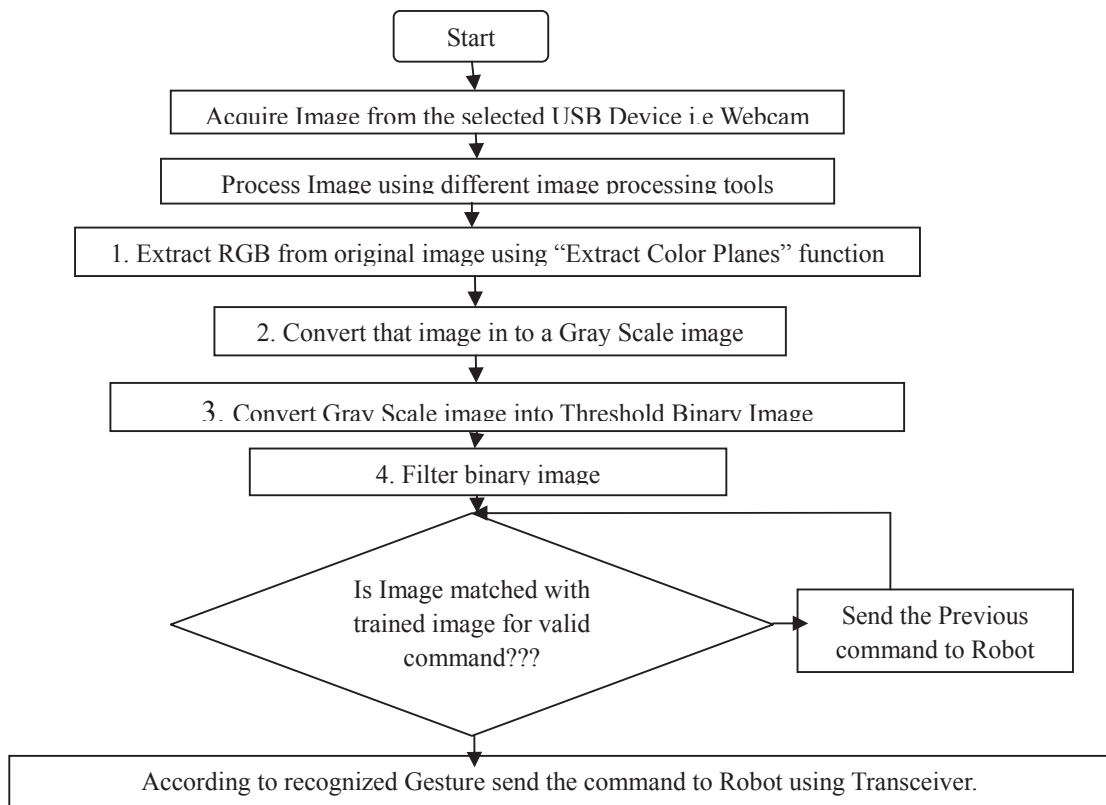Flow chart for recognizing gesture & give commands to the robot.

Start

Acquire Image from the selected USB Device i.e Webcam

Process Image using different image processing tools

1. Extract RGB from original image using "Extract Color Planes" function

2. Convert that image in to a Gray Scale image

3. Convert Gray Scale image into Threshold Binary Image

4. Filter binary image

Is Image matched with trained image for valid command???

Send the Previous command to Robot

According to recognized Gesture send the command to Robot using Transceiver.

Figure 3.1 Flowchart of gesture recognition

Hardware Architecture
3.2 Introduction of Hardware

The hardware architecture of this project is consist of two basic parts namely Transmitter unit, Receiver unit. The block diagram of these parts is as shown in figure 4.1 and figure 4.2 respectively. On the transmitter side it is consist of PC with gesture recognition software connected to web camera which in turn connected to RF transceiver through RS232 whereas the receiver unit is consist of blocks like RF transceiver module, PIC16F877 , BO DC motor ,Relays ,5V regulated power supply.

A web camera will be attached to a computer which will acquire live feed of gestures done by the operator. The operator will give a gesture of thumbs up. Now when the thumb is pointing in left direction, the command is 'move left', when one figure, the command is 'move forward' when two figures, the command is 'move reverse' etc. These gestures are then given to pc with graphics software, which is then given to RF Tran's receiver through Rs232 .The RF Tran's receiver is then transmit these encoded signals in radio frequency transmission medium. RF Tran's receiver module on the receiver side will receive the signal from radio frequency medium and gives those signals to the controller so that the controller will generate the necessary signals for controlling various actions and driving the different applications.

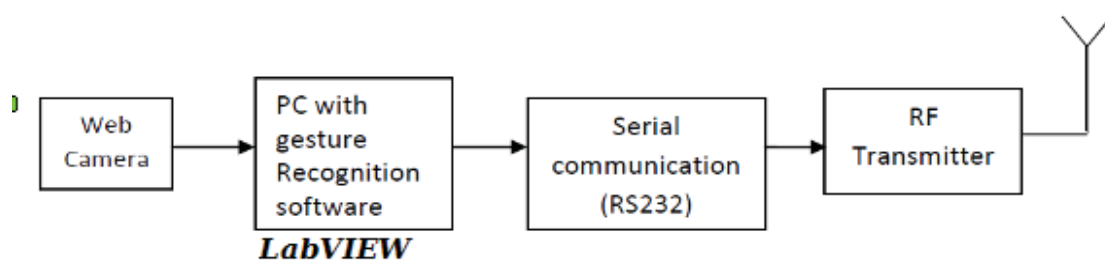*3.2.1 Transmitter and Receiver Block Diagram*

Web Camera → PC with gesture Recognition software **LabVIEW** → Serial communication (RS232) → RF Transmitter
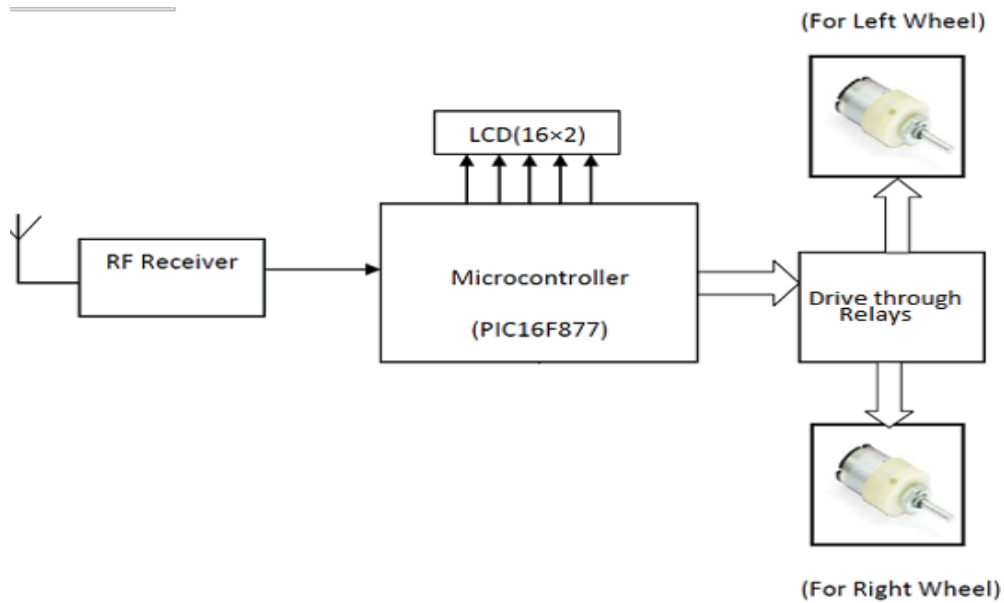
Figure 3.2 Block Diagram of Transmitter unit

Figure 3.3 Block Diagram of Receiver unit

IV. RESULT

According to hand gesture robot will move .Now in our project we used first finger for forward movement ,two fingers for reverse command,three fingers for right command etc. The figure 4.1 shows the output for forward command.
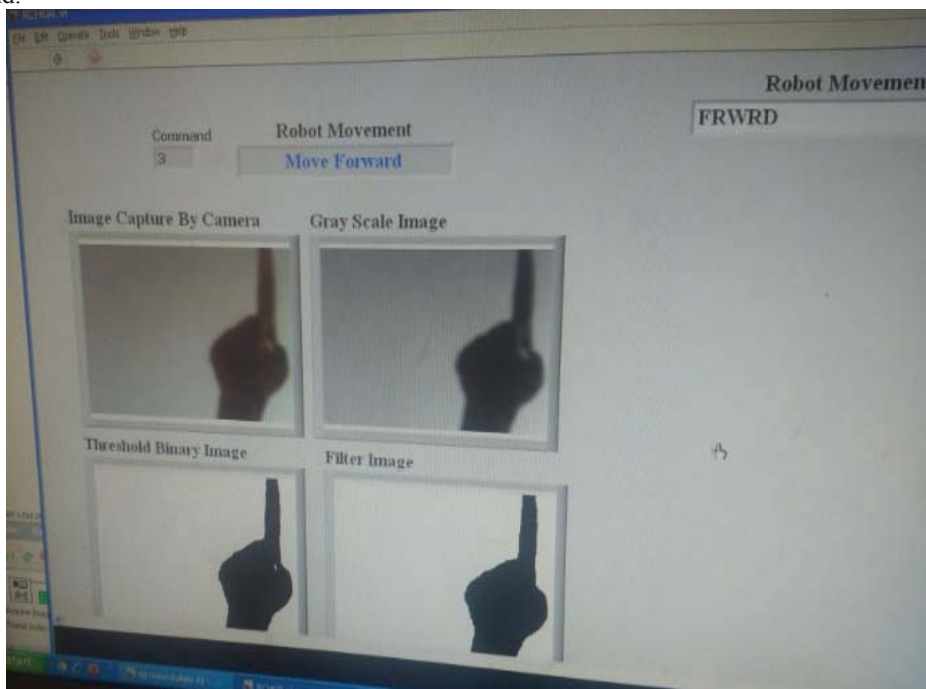

Figure 4.1 Run LabVIEW window -forward command.

4.1Gesture Data Base

The commands which are transmitted from transmitter to receiver are as shown in table given below. If we want more accuracy then we should take the data base of trained images more than 10.

Sr. No	Command	Transmitted Data	Trained images
1.	Forward	'3'	6
2.	Reverse	'4'	6
3.	Right	'2'	6
4.	Left	'1'	6
5.	Stop	'5'	6
6.	Other	6	-

Table 4.1: Summary for the commands for robot

V. CONCLUSION

We presented an approach to robustly recognizing a number of well-defined hand gestures representing a limited set of commands that the humans can give to the mobile robot.

Firstly, by analyzing the distribution of the specific color in HSV model, a color multithresholding method was developed for detecting hand gestures in video sequence under varying lighting conditions. Secondly, the feature extraction of gestures was performed by the software. Finally, a real-time vision system on hand gesture recognition for a human-robot interaction is presented. Our approach has been implemented and evaluated on a mobile robot under different lighting environments, such as indoor white light, indoor yellow light, and outdoor sunlight.

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