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Hand Gesture Recognition for Switching Action

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ABSTRACT: In recent years, the use of computer vision is increased exponentially. The advance applications are started to developed using image processing and computer vision techniques. This paper proposed a Hand gesture recognition system consist of pre-processing, skin color segmentation, recognition of a number of finger and counting of figure steps. The proposed approach is implemented using open source OpenCV library and python language. The system is built on Raspberry Pi hardware. The proposed approach gives good results for the different environment.

KEYWORDS: Computer vision (CV), Convex Hull, HCI, OpenCV, Raspberry Pi, Switching actions.

I.INTRODUCTION

The recognizing gestures using machine vision provides an intuitive interface for human-machine interaction. The hand gesture is a common and natural way for humans to interact with machines to perform various tasks. Gestures are some form of action which human performs to express information without talking.

Fig. 1 Different gestures of the hand

In our daily lives we can see such hand gestures are frequently used for effective interaction between humans, for example, thumbs us, thumbs down, victory, direction, etc. as shown in figure 1. If same hand gestures can be used for communicating with machines to give commands to machines to perform task, it will prove very effective and convenient for humans, the computer vision and machine learning techniques evolved.Gesture recognition system has tremendous application likes home automation, industry automation, traffic control, it can replace many devices like mouse, keyboard. This system can be a helpful to handicapped and visually impaired person. There is various image processing, and soft computing algorithms which can be used for any of above applications provided the necessary hardware. In this paper, we implement the Skin color-based algorithm for hand detection. The fingers are detected using convex hull algorithm. At the last number of fingers counted and according to the number offingers switching

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action has to be taken. These algorithms have been optimized for rapid real-time detection yielding high frame rates and robust detection or recognition.

The paper is organized as Part II of the paper is described the previous gesture recognition methods. Part III presents the proposed system in detailed. The flow and software description is explained in part IV. Results and analysis are discussing in part V and finally, paper is concluded with future scope in part VI.

II.PROPOSED METHODOLOGY

As we discussed there are the different algorithm for hand gesture detection algorithm. Skin color-based algorithm is proposed to recognize the hand gesture in the real time domain.
The block diagram for proposed image processing module is shown below:

1. Input Image: The input for the system is captured by the camera. The camera may be external USB camera or webcam of the Computer. The input of the camera is in color (RGB) format. The input is in video format, and frames are extracted from the video for further processing. The frames are then resized into small image frames called image scaling. Resize the image frame to 320x240 pixels.

2. RGB to HSV Conversion:The RGB contain three channels Red, Green and Blue channel convert into Hue, saturation and value

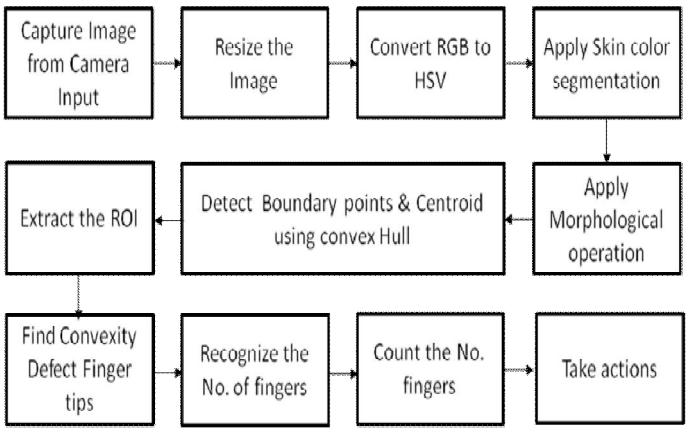

Fig 2. Block diagram of gesture recognition system

3. Segmentation :It is the method which separates out region of an image corresponding to object which we wants to analyze. Thresholding technique can be used as a segmentation technique. It is most useful in high contrast images. In this method we focused on Hand gestures hence this approach uses the skill color segmentation method. It selects skin-color to get characteristic of hand.

4. Morphological Operation :After thresholding, we have to perform the morphological operation which is useful to enhance object structure. Erosion and dilation are two morphological operations to removes the noise. Erosion is used to erode the boundaries of foreground pixel which shrink in size. Dilation is opposite to erosion. It expands the areas of foreground pixel i.e. grows in size.

5. Convex Hull :We implement the convex method to calculate the points with minimum and maximum x and y-coordinates. The hull is formed by connecting the x and y coordinates. Other aspect is to find convexity defects. The convexity defects points are the center of finger valleys.

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6. Find convexity defects Fingertips and count fingers: Then find out the average of all these defects which is definitely bound to be in the center of the palm. The radius of the palm is an indication of the depth of the palm using radius. The ratio of palm radius to the length of the finger triangle should be more or less same. Thus we can find out a number of location of the tip of the finger. Here Adaptive Boost algorithm and Haar-like feature set algorithm are adopted for hand detection and recognition. The detected ROI is extracted for next processing.

7. Actions :The output of the above step is provided to the hardware module. The switching actions are takes as per the gesture.

III.SOFTWARE AND HARDWARE DESCRIPTION

The proposed hand gesture detection system is implemented using OpenCV 3.2 and raspberry Pi 2 hardware module. The software and hardware modules are described in detailed below:

- Software platform

The system is implemented using open source image and video processing library OpenCV. OpenCV is open source library developed by INTEL mostly focused on computer vision and real-time application. It is available in C, C++, python and java language with Window, Linux, Mac OS, Android platform. It has plenty computer vision and machine learning algorithms.

- Hardware platform

Raspberry Pi 2 is used as a hardware module which provides the interaction between the machine and real time world. The hardware module for proposed system is as shown in fig. 2.

The block diagram of raspberry pi consists of GPIO pin, SD slot, USB port, Camera port, Micro USB connector, Ethernet port etc. The GPIO pins are used for serial communication. SD card is inserted into SD slot. SD card is a hard disk of the raspberry. It is used for booting and storage purpose. Pi board supports USB camera as well as the raspberry camera. The power supply is provided through USB connector.

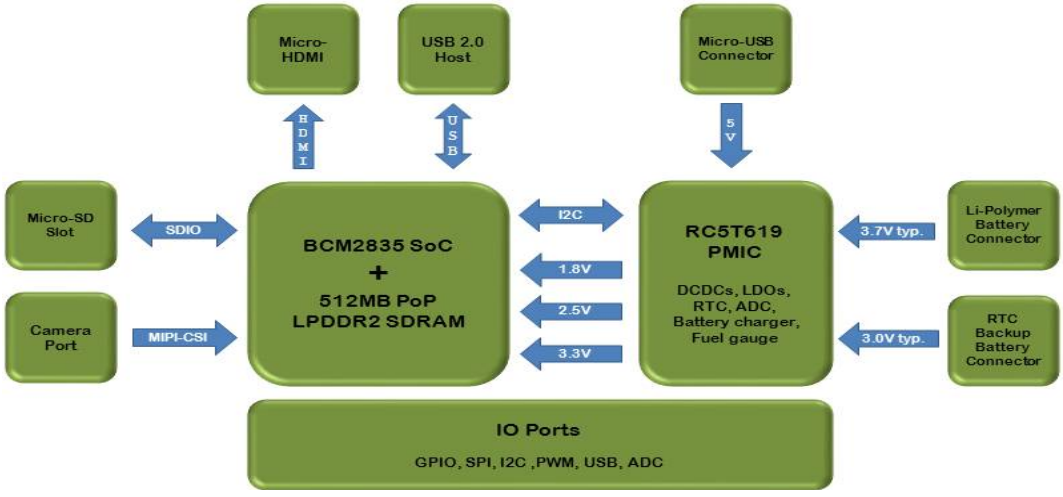

Fig.3 Component of Raspberry Pi hardware

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IV.RESULTS AND ANALYSIS

The result of the proposed system is shown below; in the proposed system, six gestures were considered for switching action.

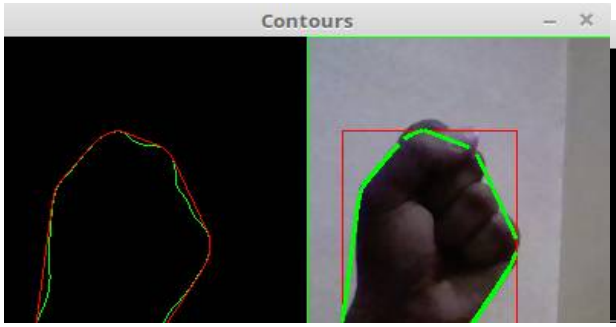

Fig.4 First action: Fist action

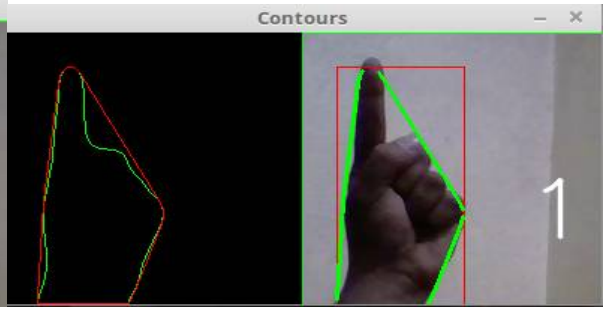

Fig.5 Second action: single finger count

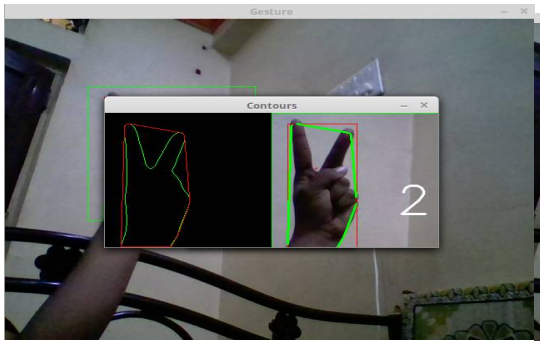

Fig.6 Third action: Two finger count

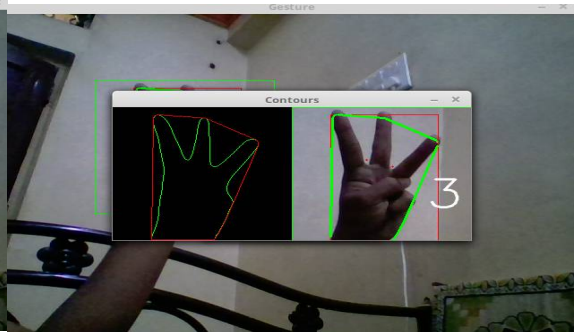

Fig.7 Fourth action: Three finger count

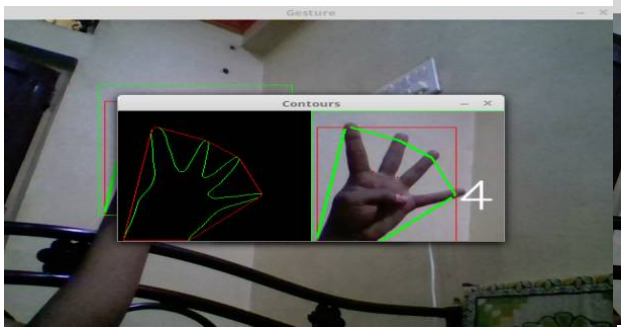

Fig.8 Fifth action: Four finger count

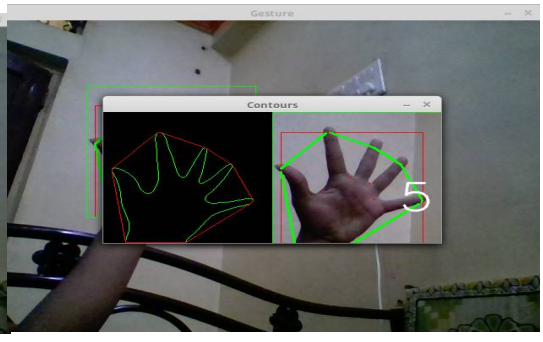

Fig.9 Sixth action: Five finger count

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V. CONCLUSION

The proposed system is implemented on OpenCV 3.2 using python language. It is better working in real time with the speed of 25 fps. The live feed is taken from the USB camera connected to Raspberry Pi board. The five switching actions are considered for the single finger action switch on the Light, two finger action switch off the light, three finger action switch ON the Fan while four finger gesture switch OFF the Fan. Five finger gesture switch on both FAN and light and Fist gesture switch OFF both Fan and Light.

The proposed system working well in low light conditions also. In future scope, the system can be implemented by using machine learning techniques for more gesture and actions.

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