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Hand Gesture for Controlling a Robotic Device using a Personal Computer

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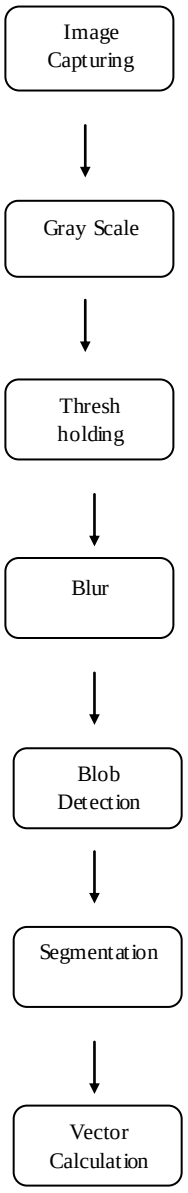
Abstract-
In the field of IMAGE PROCESSING hand gesture recognition is one of the most interesting and challenging genre. Gesture recognition is basically a non-verbal way of communication. Under this title, we will be basically developing a system which recognizes human hand gestures performed in front of the personal computer and uses this gesture for performing movement of a robotic car placed in the vicinity. In this paper web camera is used, after the grabbing of the image we subject the image to image processing algorithms like gray scaling, thresholding , blur, blob detection, segmentation and finally vector calculation. The system will use a single, color camera mounted above a neutral colored desk surface next to the computer. The paper briefly describes the schemes of capturing the image from web camera, image detection, processing the image to recognize the gestures as well as few results. This approach can be implemented in real time system very easily.
Keywords: Hand gesture recognition, web camera, image processing algorithms

I. INTRODUCTION

This project is to design and build a man-machine interface using video camera to interpret hand gesture[2]. Humans communicate mostly by vision and sound, therefore, a man-machine interface would be more intuitive if it made greater use of vision and audio recognition. Another advantage is that the user not only can communicate from a considerable distance, but need not to have physical contact with the computer. Unlike audio commands, a visual system would be more preferable in noisy environments or in situations where sound can cause disturbance. The visual system chosen here is the recognition of hand gestures. The amount of computation required to process hand gestures are much greater than that of the mechanical devices, but now a days standard desktop computer are now quick enough to make this project. Therefore, hand gesture recognition using computer vision is feasible. A gesture recognition system could be used in any of the understated areas such as man-machine interface, 3D animation, visualization, computer games, control of mechanical systems and many more. Hence hand gesture recognition can be used to control a robot in a controller freeway. Previously we had fast algorithm for automatically recognizing a limited set of gestures from hand images for a robot control application. They have considered a fixed set of manual commands and a reasonably structured environment, and developed a simple, yet effective, procedure for gesture recognition. Their approach contains steps for segmenting the hand region, locating the fingers and finally classifying the gesture. They demonstrated the effectiveness of the technique on real image. But they have certain limitations that they have only considered a limited number of gestures. Their algorithm can be extended in a number of ways to recognize a broader set of gestures. The segmentation part of the algorithm is too simple, and would need improvement if this technique would need to be used in challenging

operating conditions. In another approach features used are centroid in the hand, presence of thumb and number of peaks in the hand gesture. But the lacunas in this approach are that this method uses a custom camera instead of the Ip Webcam app which will further enhance the success rate of the system. The image is grabbed and further certain algorithms are implemented on it. Sufficient light should be present to avoid any errors.

II. PROPOSED FLOW



The system is basically divided into four modules:

1) Image Grabbing[2],[3]
2) Image Processing[6],[7]
3) Gesture recognition[1],[7],[5]
4) Command to microcontroller

(1) Image Grabbing

In order to recognize hand gestures it is first necessary to collect information about the hand from raw data provided by sensors used. This section deals with the selection of suitable sensors and compares various methods of returning only the data that pertains to the hand. Since the hand is by nature a 3D object the first optical data collection method considered was a stereographic multiple camera system. Alternatively, if using prior information about the anatomy of the hand it would be possible to garner the same gesture information using either a single camera or multiple two dimensional views provided by several cameras. A single camera system is going to be used in this paper.This system would provide considerably limited information about the hand. Some features would be very difficult to distinguish since no depth information would be recoverable. Essentially silhouette information could be accurately extracted. The silhouette data would be comparatively noise free and would require less processor time to evaluate than either multiple camera system. It is possible to detect a large subset of gestures using silhouette information alone and the single camera system is less noisy, expensive and processor hungry. Although the system exhibits more ambiguity than either of the other systems, this disadvantage is more than outweighed by the advantages mentioned before. Therefore, it was decided to use the single camera system. We will be using JMyron for Webcam interfacing. A library called JMyron is to be used to interface Web Camera from within java application. Basically JNI(Java native interface) is used for hardware interfacing in java. After the 24 bit image is grabbed we pass it for image processing.

(2) Image Processing

Image processing[6],[7] is necessary because:
Using intensity alone reduces the amount of data to analyze and therefore decreases processor load. Color also makes differentiating skin from background difficult(since black and white data exhibit less variation than color data)[4].Image processing will involve following algorithms.

i. Gray scale[6],[7]
ii. Thresholding[4]
iii. Blurring
iv. Blob detection
v. Segmentation[2],[3]
vi. Vector calculation

(3) Gesture Recognition

Knowing that the hand is made up of bones of fixed width connected by joints which can only flex in some directions and by limited angles it would be possible to calculate the silhouettes for a large number of hand gestures. Thus, it would be possible to take the silhouette information provided by the detection method and find the most likely gesture that corresponds to it by direct comparison. The advantages of this method are that it would require very little training and would be easy to extend to any number of gestures as required.

However, the model for calculating the silhouette for any given gesture would be hard to construct and in order to attain a high degree of accuracy it would be necessary to model the effect of all light sources in the room on the shadows cast on the hand by itself.

III. LITERATURE SURVEY

PAPER 1: Ankita Saxena, Deepak Kumar Jain ,Ananya Singhal" HAND GESTURE RECOGNITION USING ANDROID DEVICE"2014 Fourth International Conference on Communication Systems and Network Technologies,2014

This paper aims at recognizing 40 basic hand gestures. The main features used are centroid in the hand, presence of thumb and number of peaks in the hand gesture. That is the algorithm is based on shape based features by keeping in mind that shape of human hand is same for all human beings except in some situations. The recognition approach used in this paper is artificial neural network among back propagation algorithm. This approach can be adapted to real time system very easily. In this paper for image acquisition android camera is used, after that frames are send to the server and edge detection of the video is done which is followed by thinning that reduce the noise, tokens are being created from thinning image after tokens are fetched. The paper briefly describes the schemes of capturing the image from android device, image detection, processing the image to recognize the gestures as well as few results. Limitations of this paper are use of a custom camera instead of the Ip Webcam app which will further enhance the success rate of the system. Other different type of gestures can also be made part of the database. Try to eliminate noises from background to improve the accuracy rate.

PAPER-2:Asanterabi Malima, ErolÖzgür, and MüjdatÇetin,"A FAST ALGORITHM FOR VISION-BASED HAND GESTURERECOGNITION FOR ROBOT CONTROL", supported by the European Commission under Grant FP6-2004-ACC-SSA-2 (SPICE) 2003

In this we have 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. They have considered a fixed set of manual commands and a reasonably structured environment, and developed a simple, yet effective, procedure for gesture recognition. Their approach contains steps for segmenting the hand region, locating the fingers and finally classifying the gesture. The algorithm is invariant to translation, rotation, and scale of the hand. They demonstrated the effectiveness of the technique on real imagery. The limitations of this paper are they have only considered a limited number of gestures. Their algorithm can be extended in a number of ways to recognize a broader set of gestures. The segmentation portion of their algorithm is too simple, and would need to be improved if this technique would need to be used in challenging operating conditions.

IV. ALGORITHMS

A. Gray Scaling

Gray scaling [7]is the method that is used to convert colored image into image made from shades of grey. A gray scale image is different from black and white image since a gray scale image includes shades of grey apart from pure black and pure white color.

```
gs = (r + g + b) / 3;
```

Above formula can also be written as

```
gs = r * 0.33 + g * 0.33 + b * 0.33;
```

where gs = gray scale component
r = red component
g = green component
b = blue component

B. Thresh holding

Thresholding[4],[7] is the simplest method for image segmentation. From a gray scale image, thresholding can be used to create binary images i.e. image with only black and white colors. It is usually used for feature extraction where required features of image are converted to white and everything else to black or vice-versa.

```
gs = (r+g+b) / 3; // grayscale
if(gs<th) {
pix = 0; // pure black
    }
else
    {
```

```
pix = 0xFFFFFF; // pure white
}
```

C. Blurring

Next step is blurring[6],[7], in image terms blurring means that each pixel in the source image gets spread over and mixed into surrounding pixels. There two type of blurring an image

i. Gray scaled blur.
ii. Color blur

D. Blob Detection

In blob detection we calculate the center of gravity of each pixel. After we obtain the COG[2], we calculate the distance from the most extreme point in the hand to the center. Normally this farthest distance is the distance from the centroid to tip of the longest active finger in the particular gesture .In the field of computer vision, blob detection refers to visual modules that are aimed at detecting points and/or regions in the image that differ in properties like brightness or color compared to the surrounding.

The operators can also be referred to as *interest point operators*, or alternatively interest region operators (see also interest point detection and corner detection).There are several motivations for studying and developing blob detectors. One main reason is to provide complementary information about regions, which is not obtained from edge detectors or corner detectors. In early work in this area, blob detection was used to obtain regions of interest for further processing. These regions could signal the presence of objects or parts of objects in the image domain with application to object recognition and/or object tracking. In other domains, such as histogram analysis, blob descriptors can also be used for peak detection with application to segmentation. Another common use of blob descriptors is as main primitives for texture analysis and texture recognition. In recent work, blob descriptors have found increasingly popular use as interest points for wide baseline stereo matching and to signal the presence of informative image features for appearance-based object recognition based on local image statistics. There is also the related notion of ridge detection to signal the presence of elongated objects.

V. CONCLUSION

Our proposed system is basically a prototype of larger systems that can be used in various fields of technology like device control for disabled person,medical purposes like surgery or move any machine.One more important advantage of the system is that there is no requirement of database hence it would prove space efficient.

VI. REFERENCES

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