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HAND GESTURE RECOGNITION SYSTEM

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ABSTRACT

Man is a social animal and cannot live without expressing his feelings or emotions to others. A normal human being is blessed with the ability of talking, hearing and watching the events in his surroundings. But there are some less fortunate ones who are deprived of this valuable gift of God. Such people are dependent on Sign language for expressing themselves. Our attention is on this section of the society. With the advancements in technology, the use of computers has increased many folds. The motive of the project is to design a Human Computer interface system that can understand the sign language accurately.

Keywords: *Sign language; Human Computer Interface system (HCIs); edge detection; kNN search; Canny's Filter*.

I. INTRODUCTION

Sign language is the only means being used by deaf and dumb society for expressing themselves with the world. In the world of fast growing technology, it is necessary that such people should be able to use the computers and other devices without any difficulty. Various Human Computer Interface systems (HCIs) [1] have been developed so far this purpose, but unfortunately no system has been able to perform the recognition accurately. Our project aims at improving the performance of the existing systems in terms of recognition rate and recognition time. There is no one standard form of sign language and it varies from region to region. A sample sign language is shown in figure 1.

Figure 1 SIGN LANGUAGE

Various sign languages use single hand whereas others are double handed sign languages. Considering that a normal hand has four fingers and a thumb, a single hand can be used to generate 25 = 32 gestures that can include all the alphabets of English vocabulary. Our project uses single hand gestures as well.

II. SYSTEM OVERVIEW

The idea of gesture recognition may be achieved by capturing the image of the hand using a simple web camera and then processing it for recognition [2]. The idea may be represented in the form of chart as shown in figure 2.

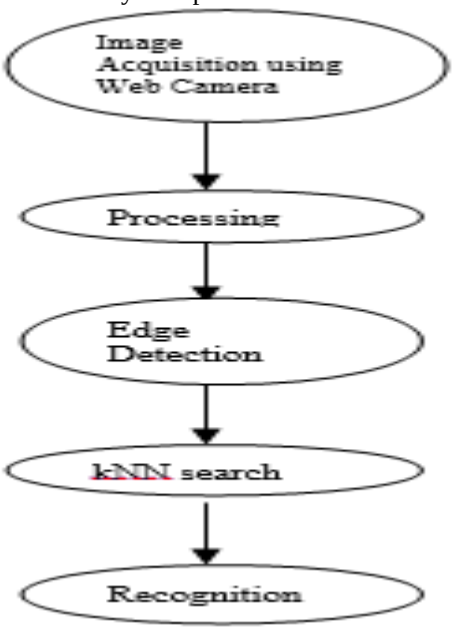


Figure 2 SYSTEM REPRESENTATION

A. Image Acquisition using Web Camera

The first step towards gesture recognition is acquiring the image of the gesture to be recognized. A simple web camera of resolution 320x240 pixels is used. The image captured using the windows of the computer are linked with the Matlab software by creating an object. The captured image is a RGB image. An RGB image is represented in Matlab as three matrices each of red, green and blue. Such an image occupies more size and is tedious to analyze, and so it needs to be processed before moving further.

B. Processing and Edge Detection D. Recognition

As already said, an RGB image is represented in Matlab as three matrices, one for each color. Such an image occupies more memory and is difficult to analyze. Also many operations in Matlab are not applicable on an RGB image. So, it is necessary to process the image [3] before applying edge detection and kNN search

Figure 3, 4 ,5 ACQUIRED RGB IMAGE, GESTURE 'O', IMAGE, GESTURE 'O', BW IMAGE, GESTURE 'O'

The first step in image processing is converting the acquired RGB image into a grayscale image. In a grayscale image all the three colors have the same intensity and so a grayscale image [4] is represented as a single matrix in Matlab.

The gray image is then converted into black and white image (BW). A BW image has only two logical levels of '0'and '1'. A BW image is used to find edges of the image.

In our project, Canny's Edge detection technique is used for detecting the edges of the BW image.

C kNN Search

Once the edges have been detected, the BW image so obtained has lots of discontinuities in it. Our next aim is to join the discontinuities and make the image as a single object. This is done with the help of kNN search [5]. The k-Nearest Neighbor is an algorithm that finds the nearest 1of the pixel under test. The image is first processed using Canny's edge detection filter [6] and then discontinuities are joined using kNN search. Since the image has discontinuities, there are a number of objects in it. The Edge Detector finds the number of objects in the image. Sobel, Prewitt and Roberts algorithms may also be used to find the edges in the image by calculating the gradient magnitude of the image. The gradient is obtained by calculating the convolution of the image with the Sobel, Prewitt or Roberts's kernel. In Canny algorithm, the edges are found by calculating local maxima of the gradient of the image. This algorithm is more immune to noise and more likely to detect true weak edges. Watershed management technique may also be employed on the morphological image [7] to produce the same result as kNN search.

D Recognition

Feature extraction may be done based on skin tone or intensity of the image. In this project finger tips detection has been done. Classification has been done based on prediction tables. We take gray scale image here for ease of segmentation problem [1] [3]. The user is not required to wear any bandage or glove around the arm or on the hand. The project does not require any complicated set up for recognition process. This makes the application of the project easier and uncomplicated. A simple web camera is used to capture the hand gesture performed by the performer. The camera produces RGB image. The resolution of grabbed image is 320x240 pixels. By default, the captured image is of YUY data type which is converted into RGB and grayscale and finally to logical image [8]. Feature extraction may also be accomplished using Wavelet family method. Wavelet analysis uses decomposition of the image into a hierarchical set of approximations.

Fuzzy Rule set may be used to make the classification after detecting the finger tips. The logical image is converted back to RGB. Classification of the recognized gesture may be done by using simple if – then rule. In this program MATLAB if-else condition is being used. Once the gesture has been classified it may be converted into text or speech [9].

III. RESULTS AND DISCUSSION

The wav play function may be used to play the audio signal stored on PC- based audio output device. Once the finger tips have been detected, recognition is done based on the number of finger tips detected and the presence or absence of thumb [2].

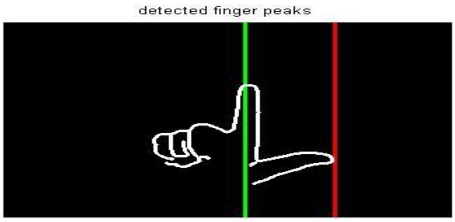
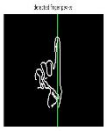
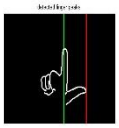
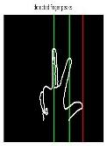


FIGURE 5 RECOGNIZED IMAGE, GESTURE 'O'

Gesture	Recognized Image	No.of fingers detected	Recognition Rate	Recognition Time (sec)
A		Fingers: 01 Thumb: No	100%	1.52
D		Fingers: 02 Thumb: No	100%	1.50
J		Fingers: 02 Thumb: No	100%	1.61
O		Fingers: 01 Thumb:Yes	100%	1.50
P		Fingers: 02 Thumb:Yes	100%	1.57

The project has been designed to work on five gestures. It has been observed that the recognition rate has been improved to a perfect 100%. Also the recognition time has been greatly reduced [3]. This has been achieved by the use of simpler and faster techniques as Canny's Filter and kNN search.

With a few changes, the program can be made to recognize all the alphabets of English language. Much is needed to be done for the social as well as emotional upliftment of the visually impaired and the deaf and dumb people. This is a step taken in this direction.

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