Hand Gesture Recognition using Webcam

Sai Suma[1], *Varshitha*[2], *Gedela Aditya*[3], and *Snehasis Mukherjee*[4]
Indian Institute of Information Technology, Chittoor, Sri City, A.P, India
saisuma.k15@iiits.in[1], *varshitha.c15@iiits.in*[2], *aditya.g15@iiits.in*[3]
snehasis.mukherjee@iiits.in[4]

***Abstract*—Hand detection and gesture recognition are the active research area topics in the Computer vision. Our project's main purpose is to develop a technique to recognize hand posture of American sign language using a live web camera.The input image is segmented by K-means and filtered by applying morphological techniques.Then using segmented image we determined the character(letter) shown in the input image.**

***Index Terms*—Hand gesture recognition, k-means,Web camera,American sign language,Morphological techniques.**

I. Introduction

Hand gesture is an important way for communication between people. On a simple human-machine interface, the hand gesture recognition is very important. Making the resulted hand gestures to be understood and well interpreted by the computer is considered as the problem of gesture interaction.Possible applications also include from console replacement to the communication with a deaf as a virtual reality device.

Nowadays two methods are used primarily to perform gesture recognition. One is based on professional, wearable electromagnetic devices, like special gloves. The other one utilizes computer vision. The first one performs well but is costly and unusable in some environment. The latter one involves image processing. However, the performance of gesture recognition directly based on the features extracted by image processing is relatively limited.

This paper is organized as follows: Section II discusses the hand gesture recognition techniques available. Section III describes the hand gesture recognition technique we used and it's implementation.Section IV describes about the database used in the project for obtaining threshold values. Section V discusses the performance evaluation results. A brief summary is given in Section VI, with the scope of future work, in this domain.

II. Literature Survey

Hasan[1] applied multivariate Gaussian distribution to recognize hand gestures using non-geometric features. The input hand image is segmented using two different methods: skin color based segmentation by applying HSV color model and clustering based thresholding techniques.

Authors[2] presented the static hand gesture recognition system using digital image processing. For hand gesture feature vector SIFT algorithm is used.The SIFT features have been computed at the edges which are invariant to scaling, rotation, addition of noise and some others recognized using PCA[3].A paper proposed neural network to which hand features are given as a input and trained[4].

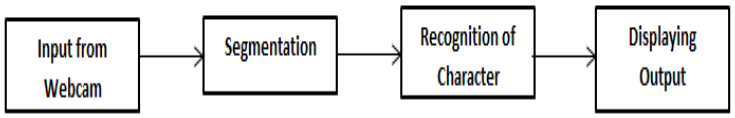

Fig. 1: Block Diagram

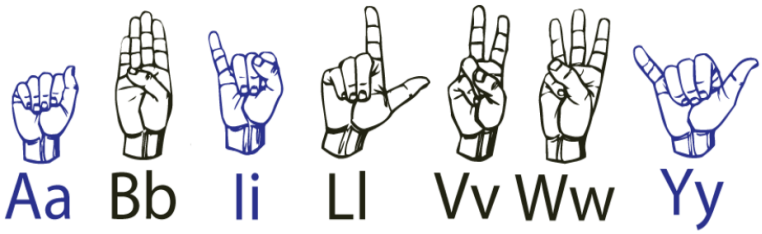

Fig. 2: Gestures of Letters in American Sign Language

III. Hand Gesture Recognition: Implementation Details

The basic idea of our implementation is to get a segmented image taken from the live web camera, then performing morphological operations like opening and closing and then recognizing the character shown in the image by using some threshold values which are obtained by training the images(gestures) present in the database. In this paper, we are distinguishing 7 letters A,B,I,L,V,W,Y. The schematic view of the our implementation is shown in Fig.1..

A. Segmentation

An input image is acquired through a web-cam. The acquired image must be hand centered and should be taken in adequate amount of light to get maximum feature of the image as shown

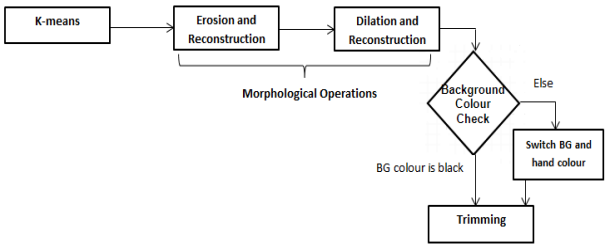

Fig. 3: Block Diagram of Segmentation

Fig. 4: Input Image,Segmented Image,After performing morphological operations

in Fig.4.The overall segmentation procedure is as shown in the Fig.3.

(i) k-means is applied on the image taken from the web camera thereby converting RGB image into a binary image as shown in Fig.4.

(ii) Opening is performed after the above step so as to remove external noise .

(iii) Closing is performed after the above steps so as to remove internal noise if any .

The results after performing the opening and closing are as shown in Fig.4.

(iv) Background Check is performed after the above steps (i.e) if the background is not black then the hand and background colors are switched.

(v) Trimming is performed in a way such that only the area containing hand is obtained which makes recognition of the character simpler.

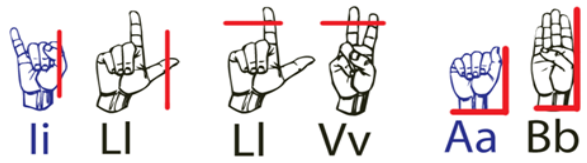

Fig. 5: Regions of interest for thumb raised , count fingers , hand raised used in Recognition

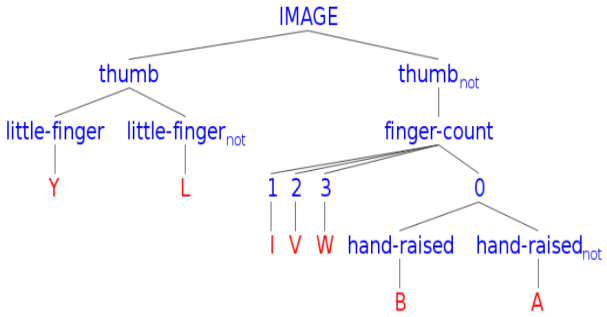

Fig. 6: Recognition Tree

Letter	has_thumb	has_littlefinger	count_fingers	hand_raised
A	0	-	0	0
B	0	-	0	1
I	1	-	1	-
L	1	1	-	-
V	0	-	2	-
W	0	-	3	-
Y	0	1	-	-

Fig. 7: Outputs for functions performed for different letters

B. Gesture Recognition

The schematic flow of detecting a letter is as shown in Fig.6.The major functions are:

(i) Thumb raised : The right most part of the segmented image is taken as shown in figure in the Fig.5.The thumb is detected based on the threshold value obtained by training the images in database. For example thumb will detected for letter L but not for letter I.

(ii) Little finger : Takes a specific row of segmented image and the little finger is detected based on the threshold value . The little finger will be detected for letter Y but not for L.

(iii) Hand Raised : First width/height ratio is calculated on the segment image. And if it is greater than the predefined threshold value then it is detected as hand raised indicating the character shown is B else the character is detected as A as shown in Fig.5.

(iv) Count Fingers: Takes a specific row of segmented image and the number of fingers raised is detected based on the predefined threshold value . For example number of fingers raised for letters L,W,V,B will be 1,3,2,0 respectively as shown in Fig.5.

The table shown in Fig.7 tells which functions are applied on different letters and output values returned from each function.

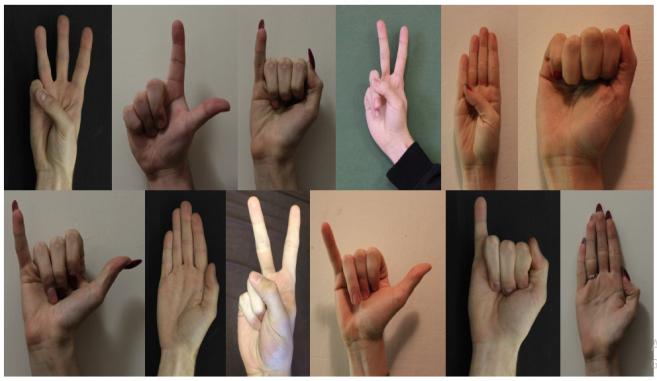

Fig. 8: Database Preview

Different Backgrounds	Overall Efficiency
Dim Light	77.5%
Bright Light	84.5%
Dark Light	69.3%

Fig. 9: Overall efficiency under different lighting conditions

IV. Database

There are a total of 59 images in which there are 8 complete sets(7 gestures) . The images are taken under different lighting conditions like in bright light,dark light from different subjects (both male and female) . These images are trained to obtain the threshold values which are to be used in this project.

V. Performance Evaluation and Results

In this paper, hand gestures are recognized from the image taken using the web cam. The efficiency of different letters under all lightning conditions is as shown in Fig.10 . And the overall efficiency of all letters under each lightning condition is as shown in Fig.9 .

The better results are obtained under bright lighting conditions. The performance of this project is higher in bright light than dim/dark light.The Letter L has the highest efficiency of recognition where as the letter Y has the least efficiency.

VI. Conclusions

Summary

Hand gesture recognition has been a popular research area in past few areas.Our main focus is recognizing the gesture out of the seven letters present in the database. Firstly, a segmented image is obtained by k-means after which morphological operations are performed. The threshold values are obtained by training the images present in the database based on them the output is obtained from the segmented image. The experimentation is done under different lighting conditions but best results are obtained under bright light.

Letters	Efficiency
A	82.5%
B	79.8%
I	72.6%
L	89.1%
V	87.9%
W	78.4%
Y	70.1%

Fig. 10: Efficiency for each Letter

Future Improvements

The results obtained from the experiments discussed in the previous section indicate that the project works better under bright light so this project can be extended to work good under dim light . And this project can be extended for recognizing all the letters in English alphabet and even the numbers(0-9). The Other improvements that can be made are make the project work when input is given with left hand and when there is more background noise.

References

[1] Mokhar M. Hasan, Pramod K. Mishra, (2012) "Features Fitting using Multivariate Gaussian Distribution for Hand Gesture Recognition", International Journal of Computer Science and Emerging Technologies IJCSET, Vol. 3(2).

[2] Sagar P.More, Prof. Abdul Sattar, "Hand gesture recognition system for dumb people".

[3] Mandeep Kaur Ahuja, Amardeep Singh, "Hand Gesture Recognition Using PCA", International Journal of Computer Science Engineering and Technology (IJCSET), Volume 5, Issue 7, pp. 267-27, July 2015.

[4] 1]Ashish Sethi, Hemanth ,Kuldeep Kumar,Bhaskara Rao ,Krishnan R, "Sign Pro-An Application Suite for Deaf and Dumb", IJCSET , Volume 2, Issue 5, pp-1203-1206, May 2012

[5] Mahmoud E., Ayoub A., J¨org A., and Bernd M., (2008). "Hidden Markov Model-Based Isolated and Meaningful Hand Gesture Recognition", World Academy of Science, Engineering and Technology 41.