Sign Language Recognition System to aid Deaf-dumb People Using PCA

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Abstract: The Sign Language is a method of communication for deaf-dumb people. Here vision based approach has been used. This paper presents design and implementation of real time Sign Language Recognition system to recognize 26 gestures from the Indian Sign Language using MATLAB .The signs are captured by using web cam. This signs are preprocessed for feature extraction using HSV color model. The obtained features are compared by using Principle Component Analysis (PCA) algorithm. After comparing features of captured sign with testing database minimum Euclidean distance is calculated for sign recognition. Finally, recognized gesture is converted into text and voice format. This system provides an opportunity for a deaf-dumb people to communicate with non-signing people without the need of an interpreter.

Keywords: Sign Language, Feature Extraction, Sign Recognition, HSV Color Models, PCA.

I. INTRODUCTION

The sign language is an important method of communication for deaf-dumb persons. As sign language is well structured code gesture, each gesture has a meaning assigned to it. In the last several years there has been an increased interest among the researchers in the field of sign language recognition to introduce means of interaction from human –human to human – computer interaction. Deaf and Dumb people rely on sign language interpreters for communications. However, finding experienced and qualified interpreters for their day to day affairs throughout life period is a very difficult task and also unaffordable [1].

The propose system is able to recognize single handed gestures accurately with a single normal webcam using bare human hands and convert it into text and voice message. The aim of this project is to recognize the gestures with highest accuracy and in least possible time and translate the alphabets of Indian Sign Language into corresponding text and voice in a vision based setup.

II. LITERATURE REVIEW

Various works have been carried out previously on various sign language recognition techniques. The research on Gesture recognition system can be classified into two types first is the use of electromechanical devices. This type of system affects the signer's natural signing ability. The second category is classified into two types, one is the use of colored gloves and the other is not using any devices which might affect the signer's natural signing ability [3].

Al-Ahdal and Tahir [1] presented a novel method for designing SLR system based on EMG sensors with a data glove. This method is based on electromyography signals recorded from hands muscles for allocating word boundaries for streams of words in continuous SLR. Iwan Njoto Sandjaja and Nelson Marcos [2] proposed color gloves approach which extracts important features from the video using multi-color tracking algorithm.

Ibraheem and Khan [4] have reviewed various techniques for gesture recognition and recent gesture recognition approaches. Ghotkar et al. [5] used Cam shift method and Hue, Saturation; Intensity (HSV) color for model for hand tracking and segmentation .For gesture recognition Genetic Algorithm is used. Paulraj M P et al. [7] had developed a simple sign language recognition system that has been developed using skin color segmentation and Artificial Neural Network.

III. PRINCIPLE OF SIGN RECOGNITION

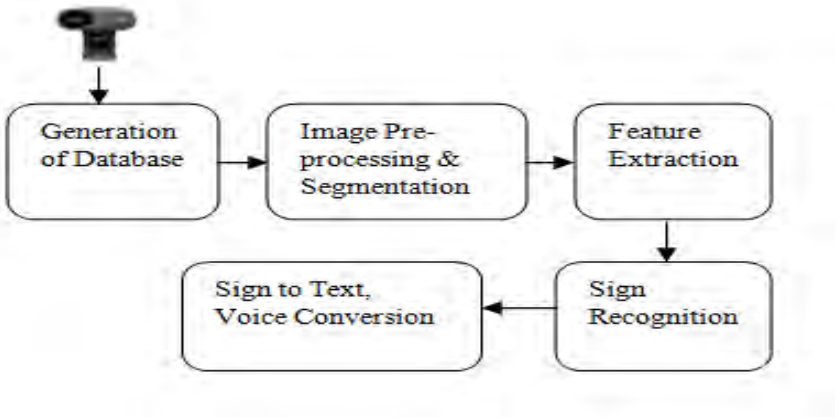

Figure 1 Proposed system of Sign Recognition

Block diagram of proposed system is shown in the figure.1.Here our system takes the input hand gestures through the web camera. In this proposed method, 26 combinations of Indian sign are developed by using right hand stored in training data base. Pre processing is done on these captured input gestures. Then the Segmentation of hands is carried out to separate object and the background. The segmented hand image is represented using certain features. These features are used for gesture recognition using the PCA algorithm which gives optimized results. The final result obtained is converted into corresponding text and voice. The sign recognition procedure includes four major steps. They are a) Data Acquisition b) Pre processing and segmentation c) Feature extraction d) Sign recognition and e) Sign to text, voice conversion.

A. Data Acquisition :

To achieve a high accuracy for sign recognition in sign language recognition system we use 260 images, 10 each of the 26 signs are used. These 260 images are included in training and testing database. The images are captured at a resolution of 3000x4000 pixels. The runtime images for test phase are captured using web camera. The images are captured in white background so as to avoid illumination effects. The images are captured at a specified distance (typically 1.5 – 2 ft) between camera and signer. The distance is adjusted by the signer to get the required image clarity.

B. Image preprocessing and segmentation:

Preprocessing consist image acquisition, segmentation and morphological filtering methods. Then the Segmentation of hands is carried out to separate object and the background. Otsu algorithm is used for segmentation purpose. The segmented hand image is represented certain features. These features are further used for gesture recognition Morphological filtering techniques are used to remove noises from images so that we can get a smooth contour. The preprocessing operation is done on the stored database.

C. Feature Extraction

Feature extraction is a method of reducing data dimensionality by encoding related information in a compressed representation and removing less discriminative data. Feature extraction is vital to gesture recognition performance. Therefore, the selection of which features to deal with and the extraction method are probably the most significant design decisions in hand motion and gesture recognition development. Here we used Centroid, skin color and principal component as main features.

1. Centroid

In this step, we have calculated the centroid for partitioning the hand in to two halves, one which represents the finger portion and other which represents non finger region. Centroid is also called centre of mass and it divide the hand in to two halves at its geometric centre if the image is uniformly distributed. Centroid is calculated using image moment, which is the weighted average of pixel's intensities of the image. Centroid represents the relative position of fingers with each other, so it is consider as main feature in sign recognition which is shown in figure.2

Figure2.Original image, Centroid, Localized hand object

2. Skin Detection:

Skin detection is used to search for the human hands and discard other skin colored objects for every frame captured from a webcam shown in fig ure3.

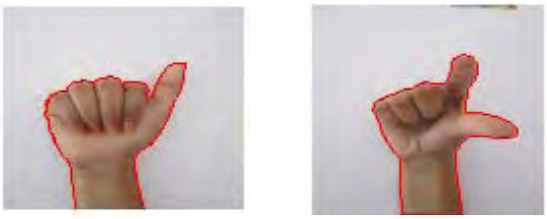

Figure3 .Skin detection and counter extraction in uniform background of sign A and Q resp.

After detecting skin area for every frame captured, we used contours comparison of that area with the loaded hand postures contours to get rid of other skin like objects exist in the image. If the contours comparison of skin detected area complies with any one of the stored hand gesture contours, a small image will enclose the hand gesture area only and that small image will be used for extracting the PCA features. Here the *hue, saturation, value* (HSV) color model used for skin detection since it has shown to be one of the most adapted to skin-color detection. It is also compatible with the human color perception. It has real time performance and robust against rotations, scaling and lighting conditions.

D. Sign Recognition

It is a dimensionality reduction technique based on extracting the desired number of principal components of the multi-dimensional data. The gesture recognition using PCA algorithm that involves two phases

• Training Phase

• Recognition Phase

During the training phase, each gesture is represented as a column vector. These gesture vectors are then normalized with respect to average gesture. Next, the algorithm finds the eigenvectors of the covariance matrix of normalized gestures by using a speed up technique that reduces the number of multiplications to be performed. Lastly, this eigenvector matrix then multiplied by each of the gesture vectors to obtain their corresponding gesture space projections.

In the recognition phase, a subject gesture is normalized with respect to the average gesture and then projected onto gesture space using the eigenvector matrix. Finally, Euclidean distance is computed between this projection and all known projections. The minimum value of these comparisons is selected for recognition during the training phase. Finally, recognized sign is converted into appropriate text and voice which is displayed on GUI.

IV. EXPERIMENTAL RESULTS

The proposed procedure was implemented and tested with set of images. The set of 26 images of single person is used for training database shown in fig.4. Preprocessing results of same was shows in fig.5.

Figure4. Database of 26 sign alphabets

Figure5.Preprossing results

These preprocessed gesture taken as input for feature extraction. Minimum Euclidean distance is calculated between test and train image and gesture is recognized. Recognized gesture is converted into text, voice format and also respective features will be display on GUI screen. Fig.6. shows a snapshot of application working and detecting two different hand gestures for sign H and Sign O in real time.

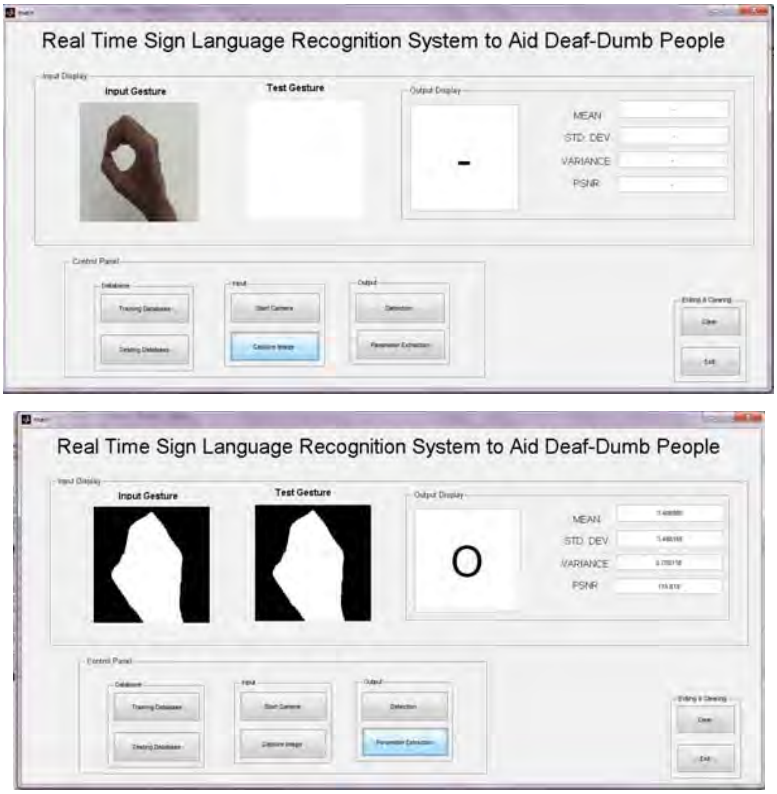

Figure.6 Snapshots of application performing real-time sign detection

V. CONCLUSION

A Matlab based application performing hand gesture recognition for human– computer interaction using PCA technique was successfully implemented with accuracy comparable with those of recent contributions. The proposed method gives output in voice and text form that helps to eliminate the communication barrier between deaf-dumb and normal people. In future this work will be extended to all the phonemes in Marathi signs.

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