ISSN XXXX XXXX © 2016 IJESC

IJESC

Research Article Volume 6 Issue No. 7

Hand Gesture Recognition System for Deaf and Dumb People Using PCA

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Abstract:
The sign language is a technique of communication for hearing impaired-mute people. The proposed system is designed in real time mode to recognize 9 gestures from sign language using MATLAB. Signs are captured through web camera and YCbCr color transformation model used for feature extraction. PCA algorithm is used to recognize sign. PCA compared feature of captured image with training database and to calculate minimum Euclidian distance. Finally recognized output is converted into text and speech. this system eliminates communication barrier between hearing impaired-mute and normal people.

Keywords: Sign Language, Sign Recognition Ycbcr Color Model, PCA, KNN.

I. INTRODUCTION:

Nowadays android and embedded system is appearing as main prime trends in all application. Due to that change our life style in smart way. Hand gesture is a method of communication between dumb and deaf people. Normal people cannot communicate to dumb people. They need to learn sign language. After that they communicate to deaf people more fluently. To change the life style of dumb people, this project is developed. Sign language utilize both physical and non physical communication [1]. Hand gestures are physical movement by using eyes and hand and non physical movement is facial appearance, head movement, body position etc [2]. Dumb people can express their felling with different hand shapes and facial expression. Each gesture has meaning allocate to it. sign language is different in each country. Sign language has different approaches 1. Kinect sensor 2. Image processing, 3. Data glove 4. Leap motion. In kinect sensor technique, sensor is used to detect sign language [11][12]. Image processing used web camera to capture images [5][6]. In data glove technique, flex sensor, accelerometer and motion tracker is used [7] [8][9][10]. Leap motion controller is sensor. It detect sign language convert that into computer commands [3][4].In the proposed system, we have used 0-9 numbers. Each number has given unique single hand gesture. Hand gesture is converted into text and text is converted into speech.

II. System design:

Proposed system shown in figure 1. In this system, image is captured through web camera. Here we take 10 combination of sign stored in training and testing of data base. the system is implemented in offline mode and also in real time mode. Input images are applied to image pre processing and segmentation. In which, object and background is separated. Resultant image has shown some features. Then feature extraction and recognition was done by using PCA and KNN. Finally, this result is converted into text and voice.

FIGURE 1 PROPOSED SYSTEM

A. Database Creation:
To get high accuracy for sign recognition we use 100 images, 10 each of the 10 signs are used. The images are captured through web camera at high resolution. These 100 images are used for training and testing database. The images are captured in white background to keep away from illumination effect.

B. Preprocessing:
It consists of color transformation, morphology, thresholding and binarization. Captured images are in RGB colour model. For segmentation purpose RGB to YCbCr color transformation is used. [13] [14]In YCbCr , Y is illuminance, Cb and Cr are chrominance(hue, saturation). The transformation formula is,

$$\begin{matrix} Y \\ Cb \\ Cr \end{matrix} = \begin{matrix} 0.2990 & 0.5870 & 0.1440 \\ -0.1687 & -0.3313 & 0.5000 \\ 0.5000 & -0.4187 & -0.0813 \end{matrix} \begin{matrix} R \\ G \\ B \end{matrix} + \begin{matrix} 0 \\ 128 \\ 128 \end{matrix}$$

The images are not in standard size. So,to standardize the image in 200 × 200 size. While performing color transformation noise is added in the image. Median filter is used to remove the noise. That is morphology process is performed.

Threshold detection of hands is carried out to separate object and background. For this purpose threshold value is calculated and omits the background. Then resultant image is converted in binary form. It represents certain feature. These features are used for sign recognition. After binarization again morphological filter is used to fiter out the noise from image so that we obtain smooth image.

C. Feature Extraction and Recognition:

PCA was applied on training set to extract the most significant components of feature. PCA converts all of the original variables to be some independent linear set of variables. Those independent linear sets of variables possess the most information in the original data referred as principal components.

Following steps show the how to reduce the size of data and recognition using PCA.

Step 1: Convert the all result image into the column matrix as 'T'.

Step 2: Calculate the *Mean* Column Vector 'm' for 'T'.

Step 3: Computing the difference for each vector set $A_i = T_i - m$ where (i=1, 2 …N)

Step 4: Calculating a *covariance* matrix $C=A*A'$

Step 5: Calculate the *eigenvalues* and unit *eigenvectors* of the *covariance* Matrix 'C'.

Step 6: Sort the *eigenvalues*.

Step 7: Solve the mapping *eigenvectors* and project data on *Eigen space* for matching.

So we get the reduced and significant features of PCA. Then we calculate the result. The recognition of sign language were carried out by PCA and KNN. Finally , recognize sign is converted into text and speech.

III. Result :

The procedure was executed and tested with set of images. Input images captured through web camera. These images used for training database. Images captured at high resolution and in white background to avoid illumination. Training database shown in figure 2. To analyze output , live image is captured and send to the colour transformation model. After segmentation is done, we get preprocessed images. Preprocessing result shown in figure 3.

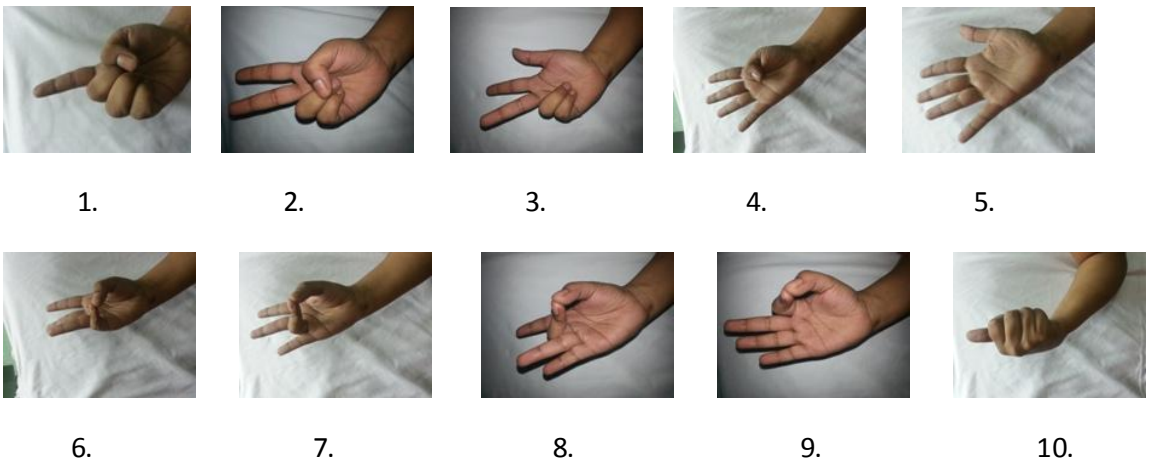

FIGURE 2. DATABASE OF 10 NUMBERS

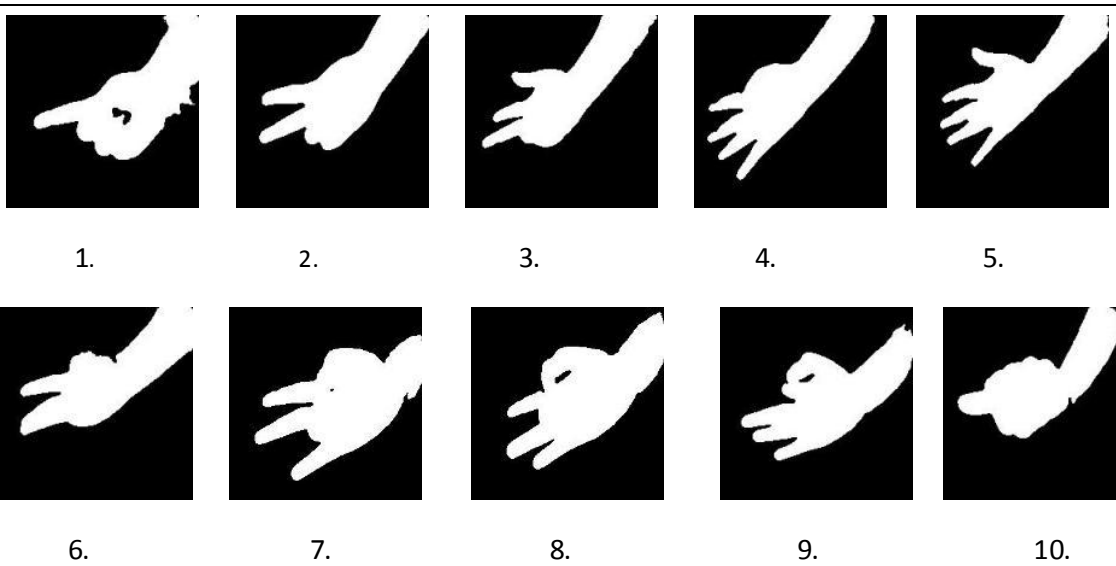

FIGURE 3 PREPROCESSING RESULTS

These preprocessed result compared with stored database. If eigen value of processed image is matched with stored image then text is displayed. After that , by using speech synthesizer to convert that text into speech. Figure 4 shows the snapshots.

As shown in figure , live image captured and transformed to preprocessing. If this is done, compared with stored database for testing and corresponding text is displayed. Here output is four

.

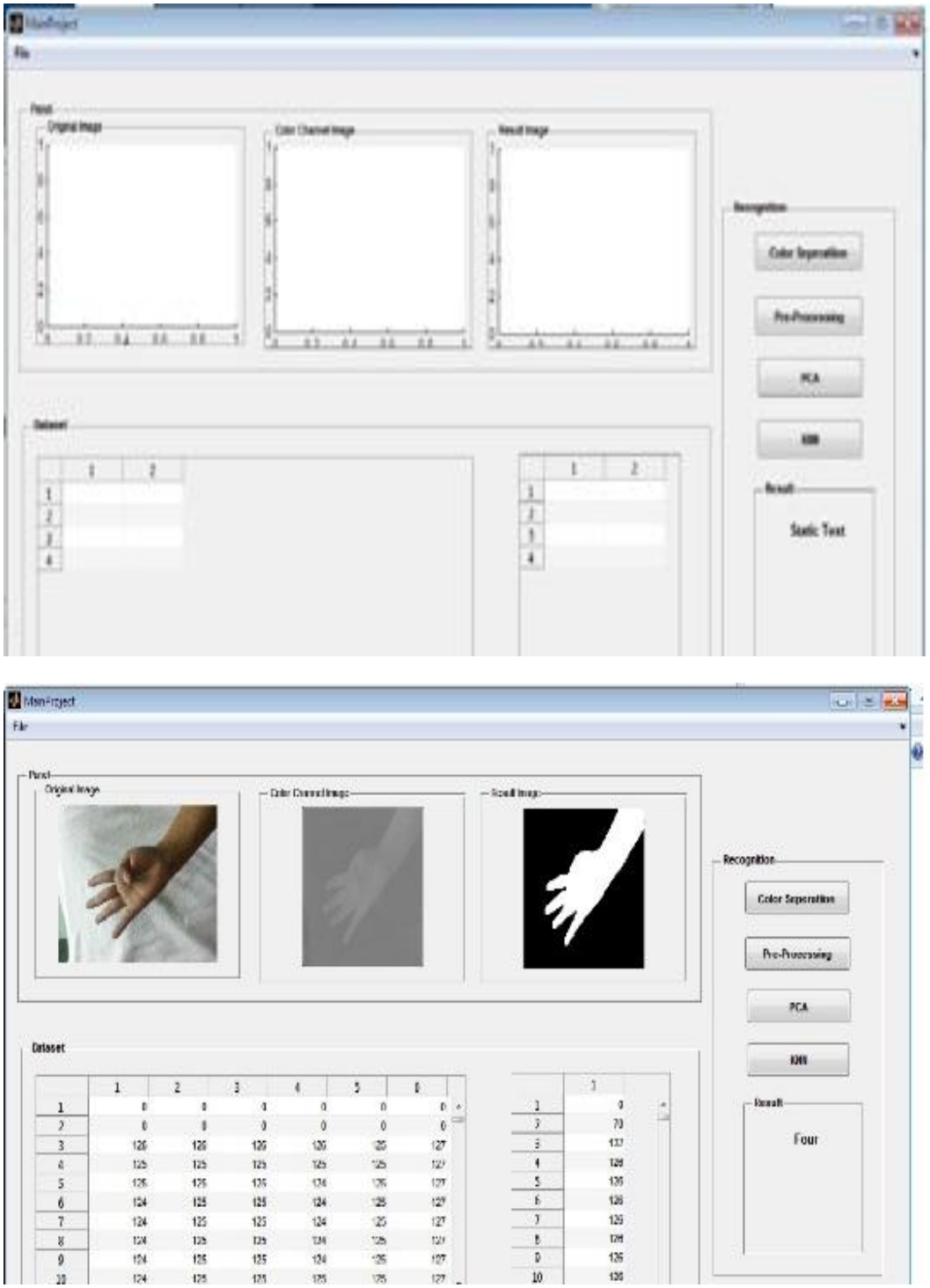

FIGURE 4 SNAPSHOTS

IV. Conclusion:

Sign language recognition system for deaf and dumb people using image processing was successfully executed with high accuracy. The method gives output in text and speech format that helps to reduce the communication gap between deaf – mute and normal people. Thus the implementation of system output is done in MATLAB environment.

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