A review on Recognition of Indian Sign Language using classifier

Mr. Dinesh Dattatraya Rankhamb
Electronics and Telecommunication Engineering Department
. VVP College Of Engineering, Solapur (M.S.) India.

Mr. S. C. Mhamane
Assistant Professor at Electronics and Telecommunication Engineering Department
VVP College Of Engineering, Solapur (M.S.) India.

Abstract- Sign language is helpful with communication between deaf, mute, hard hearing people and normal people. In normally, sign language is understandable for the signer and the person who know the sign language but it is so much difficult for who does not know the sign language or meaning of any gesture. It is very difficult to understand & exchange the information between them. So between this gaps, there is need of interpreter required for communication between them. This interpreter can be performed the operation of translate the gesture into text or speech. So due to in absence of physical interpreter this sign language is helpful for both communities for communication purpose. Where the images of Indian sign language can be used as input and the system will display the English alphabet, which the mute, deaf people want to tell. A regular camera is used for acquiring this sign. For developing this project we need numeric sign database with 26 English alphabets sign & 9 Numeric sign with proper images. In that project every word or every alphabet is assigned with a particular image. This image is in the form of .jpg so that we can easily use the database .This images are in static or dynamic form. Static gestures have fixed position of hand whereas dynamic gestures have movement of hands and body parts.

Keywords – PCA , SVM classifier.

I. INTRODUCTION

Sign language is a language for the people who are challenging in hearing and speech. Despite common misconceptions, sign languages are complete natural languages, with their own syntax and grammar. Signs are made of units referred to as cheremes, which are any of a small set of elements, analogous to the phoneme in speech, proposed as the basic structural units by which the signs of a sign language are represented, and including the hand shapes, hand movements, and locations of the hands in relation to the body employed in a particular sign language. A sign is made of cheremes and any two signs can be differentiated using at least one chereme. There are mainly two different approaches in sign language recognition - Glove based approach and vision based approach. Sign language is helpful with communication between deaf, mute, hard hearing people and normal people. In normally, sign language is understandable for the signer and the person who know the sign language but it is so much difficult for who does not know the sign language or meaning of any gesture. [4].The strategy of the Eigenvectors method consists of extracting the characteristic features. Where the images of Indian sign language can be used as input and the system will display the English alphabet, which the mute, deaf people want to tell. A regular camera is used for acquiring this sign. For developing this project we need numeric sign database with 26 English alphabets sign & 9 Numeric sign with proper images. In that project every word or every alphabet is assigned with a particular image. This image is in the form of .jpg so that we can easily use the database .This images are in static or dynamic form. Static gestures have fixed position of hand whereas dynamic gestures have movement of hands and body parts.

The proposed scheme uses PCA for feature extraction. Principal Component Analysis (PCA) is a well-known and one of the most successful techniques used in image recognition and compression for extracting feature and representing data. It is technique widely used in the area of pattern recognition, computer vision and signal processing. Principal component analysis (PCA), is a classical feature extraction and data representation technique widely used in the areas of pattern recognition and computer vision such as face recognition. The purpose of PCA is to reduce the large dimensionality of the data space (observed variables) to the smaller intrinsic dimensionality of feature space (independent variables), which are needed to describe the data economically. This is the case when there is a strong correlation between observed variables. By discarding minor components, the PCA effectively reduces the number of features and displays the data set in a low dimensional subspace. In this study the feature extraction algorithm based on PCA is chosen. The coefficients of these methods are used as feature vectors which efficiently represent extracted image.

II. LITERATURE REVIEW

There are different theories used for Indian Sign Convention presented by different authors. The surveyed literature on Sign Convention is as follows:

In tamil sign letter Balakrishnan, G, Subha Rajam, [1] proposed a method .which was recognizing a 32 set of combinations & 10 for each up and down position of fingers. This method is used for the up/down position of fingers which is converted into decimal numbers, this number is recognized in to the Tamil alphabet A set of database in the form of images of sizes 640×480 pixels are captured. Palm image extraction is used to convert RGB to grayscale images. The experiment result is 96.87%.

For static and dynamic alphabet sign RekhaJ, [2] proposed a system this system was used 23 static ISL alphabet signs from 40 different signers are collected as training samples and 22 videos are used as testing samples. The images are extracted by the method of Principle Curvature Based Region Detector. Multi class non-linear KNN are used as sign classifiers. The experiment result for static 94.4% and for dynamics it was 86.4%.

The next Indian sign recognition system for 25 English alphabets (double handed signs) and nine numeral signs is developed by Deora, D and Bajaj,[3]. The signers used for data acquisitions are required to wear blue and red gloves. They used segmentation and fingertip algorithm for feature extraction and PCA for classification of signs. The overall recognition rate reported is 94.00%.

Geetha, M, and U C Manjusha [4] proposed a vision based recognition of Indian Sign Language characters and numerals using B-Spine approximation. This data set consist 50 samples of every alphabet and numbers The extracted boundary from the region of interest from image signs into a B-Spline curve by taking the Maximum Curvature Points (MCPs) as the Control points are used as features extraction technique. For classify input sign Support Vector Machine classifier is used, and the recognition result is obtained around 90.00%.

In Indonesia, northern Bali jungle village of “Bengkala” for generations, where a high percentage of residents are Deaf. Bengkala has a higher than normal deaf-since-birth population for over seven generations. Today, 42 of Bengkala's almost-3,000 villagers have been deaf since birth. By comparison, about two or three births per 1,000 in the United States produce a deaf or hard of hearing child. The high percentage of deafness is caused by a geographically-centric recessive gene, called DFNB3, which has been present in the village for over seven generations. Rather than ostracizing deaf residents, villagers in Bengkala have adapted to a deaf lifestyle. Throughout the village, people speak with their hands. Kata kolok, known as "the talk of the deaf," is a unique, rural sign language, independent of international or Indonesian sign language. Around 5% of world community in all parts of the world is using sign language as a medium of communication [5]. After analysis of work by different authors some drawback are found. The first drawback is dataset which is not in the standard form. Due to nonstandard dataset experiment conducted by researcher are not clear. The system which we are planned to use in public places different types of noises or background present in acquiring sign. The second drawback which we found is that all the databases were developed in some laboratory. So the laboratory required more processing power or higher cost.

III. NEED OF PROJECT:

We can establish communication between deaf, mute and hard hearing people with human being. so they utilize their work with the public platforms in which such communication required like banks, public transport systems, educational establishments, etc. The main objective of this project is “To analyze the Indian sign language character recognition with normal people.”

IV. PROBLEM STATEMENT:

To make the system which is capable of recognizing Indian sign language with static and dynamic sign with higher accuracy by using Indian Sign Language so the system is used for “working system’ in everywhere for Indian sign language alphabetical & numerical recognition.

V. METHODOLOGY:

The proposed system is shown in the figure 1. If no standard data set is available to experiment on automatic recognition of ISL gestures then data set of ISL character signs is created. Data set contains gestures belongs to single handed 22 Indian Sign Language characters and 10 numeric sign. The details of acquiring of data set are given below in section-1.

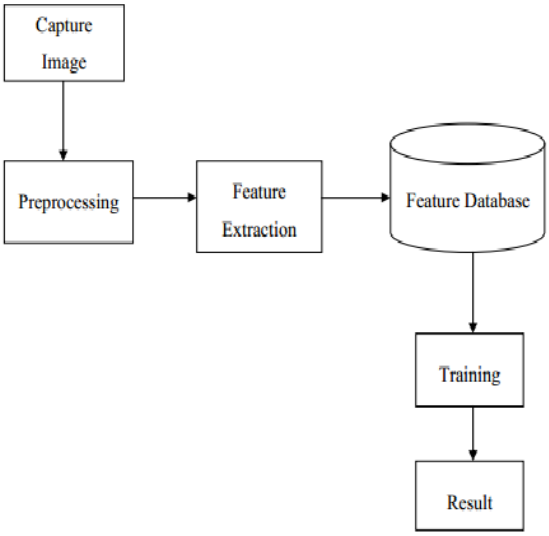

Fig1. Overview of proposed system

1] Input Sign language Image –

Two types of dataset are creating for this experiment. In this dataset 32 images of single & double handed images are captured using digital camera. These images are in the form of jpg RGB images. These images are collecting from different person for each character as well as numeric dataset. We use this image in the JPG format because it is very easy to extract the image in different hardware and software environment. The dataset created for this experiment are images for each number 1-10 and 22 character i.e. alphabets a-y. These images are flat rectangular shape in structure as shown in fig.2 below.

Fig.2 Input image

2] Preprocessing –

After collecting the database from user we need to preprocess those images. Preprocessing images commonly used for removing low-frequency background noise, normalizing the intensity of the individual particles images, Firstly we convert RGB images into grey scale images by using MATLAB (rgb to gray converter). This will convert RGB images to high intensity Grey scale images. In this step we can perform segmentation and noise removal operation. The main aim of pre-processing is an improvement in input data (sign language images) that data suppresses unwanted distortions. Image preprocessing technique uses the considerable redundancy in images. Neighboring pixel corresponding to one object in real image have adjusted some or similar brightness value. Preprocessing consists of thresholding, erosion and dilation of collected data images.

i. Skin Thresholding:

Skin detection is used to search for the human hands and discard other skin colored objects for every f rame captured from a webcam shown in fig 3. Image thresholding is used for extracting the significant or desired part of an image and removing the unwanted part or noise. The point operator of major interest is called thresholding which selects pixels that have a particular value, or that are within a specified range. With thresholding, the image can be segmented based on the color. This holds true under the assumption that a reasonable threshold value is chosen. A reasonable threshold value is the taken from the histogram of the original image. The point operator helps us to find objects in a picture if the brightness level or range is known. Hence the object's brightness must be known.

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.

Fig.3 Thresholded image

ii. Dilation and erosion: Dilation and erosion are basic morphological operations. They are defined in terms of more elementary set operations, but are employed as the basic elements of many algorithms. Dilation is used to increase the object size whereas erosion is used to diminish the size of the object. Both dilation and erosion are produced by the moving the mask around the image. The mask which is also called as structuring element or sub image or kernel (Lim, 1990) and (Soille, 2004) and it has both a shape and an origin. The following Eq. 1 and 2 are generally used for dilation and erosion:

Dilation = $X \oplus S$	(1)
Erosion = $X \oplus S$	(2)

Fig.4 Dialted image Fig.5 Eroded image

Where, X is an original image and S is a structuring element. Based on the image which is to be dilated or eroded the size of the structuring element is choose it is a odd square matrix which contains binary elements that is 0's and 1's and also the dimension should not exceed the size of the image which is to be processed. The structuring element is a set of coordinates. The origin of the structuring element is the centre element for most cases but it may not be centre point for less cases. The structuring element (Lim, 1990; Soille, 2004) is used to remove the eyelashes and eyelids whose dimension based on region of interest. Following are the examples of structuring elements. In our work we choose the 3×3 structuring element having its all element as 1:

1 1 1	0 1 0	1 1 0
1 1 1	1 1 1	1 0 1
1 1 1	0 1 0	1 0 1

The origin of the structuring element identifies the pixel of interest in the input image and all the pixels in its neighborhood are assigned to the corresponding pixel in the output image. The result of Erosion is subtracted from the result of dilation will provide the edge. The following equations are used for dilation and erosion respectively. The result of erosion and dilation is given in Fig. 4 and 5:

$$F\theta B = \hat{}_{B(i,j)} \left[F(x+i, y+j) - B(i,j) + 1 \right]$$

$$F \oplus B = B_{(i,j)}{}^{\vee} \left[F(x-i, y-j) + B(i,j) - 1 \right]$$

. VI. FEATURE EXTRACTION

The input data which is to be processed is transformed into a reduced representation set of features. This is referred as feature extraction. Every image consists of large amount of data. This information can be automatically extracted from the images is called as feature extraction. Here we are using Principal component analysis method for extracting the features.

i) PCA:

Linear Discriminant Analysis (LDA), Independent Component Analysis and PCA are some of the techniques used for feature extraction, among them PCA is powerful method in image formation, Data patterns, similarities and differences between them are identified efficiently.

The other main advantage of PCA is dimension will be reduced by avoiding redundant information, (Daugman,1993) without much loss. Better understanding of principal component analysis is through statistics and some of the mathematical techniques which are Eigen values, Eigen vectors. PCA is a useful statistical and common technique that has found application in fields such as image recognition and compression. Principal Component Analysis (PCA) is a mathematical procedure that uses linear transformations to map data from high dimensional space to low dimensional space. The low dimensional space can be determined by Eigen vectors of the covariance matrix.

ii) PCA Algorithm:

Following are steps involve;

Step 1: Column or row vector of size N2 represents the set of M images (B1, B2, B3…BM) with size N*N

Step 2: The training set image average (μ) is described as

$$\mu = \frac{1}{m}\sum_{n=1}^{M} Bn \qquad (1)$$

Step 3: the average image by vector (W) is different for each trainee image

$$Wi = Bi - \mu \qquad (2)$$

Step 4: Total Scatter Matrix or Covariance Matrix is calculated from Φ as shown below:

$$C = \sum_{n=1}^{M} wnwnt = AAT\ , \qquad (3)$$

where A= [W1W2W3…Wn]

Step 5: Measure the eigenvectors UL and Eigen values λL of the covariance matrix C.

Step6: For image classification, this feature space can be utilized. Measure the vectors of weights

$$\Omega T = [w1, w2, \ldots, wM'], \qquad (4)$$

Where by,

$$Hk = UkT\ (B - \mu),\ k = 1, 2, \ldots, M' \qquad (5)$$

iii) Feature vector

In machine learning and pattern recognition feature vector is a n-dimensional vector consist of numerical vector which represent some object. Many algorithm requires feature numerical representation of object. When representing the image feature value shows the pixel of image or whole object in images. Feature vector are equivalent to vector of variable used in linear process. It is just a vector consisting of multiple element or feature. Examples of features are color component length, area, circularity, grey level intensity, magnitude, direction it's depend on which feature is useful for application.

Fig.6 Extracted image

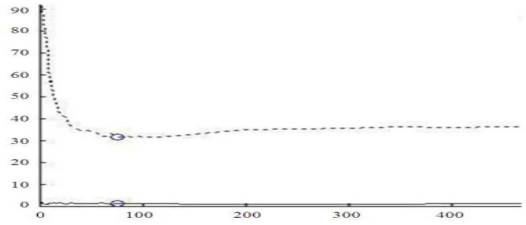

Fig. 7: PCA Performance Evaluation

VII.CONCLUSION

This paper gives us review on different sign language recognition system. The system can be useful for ISL Static alphabetical and numerical sign. The system is not useful for complete system. For complete system we have to include ISL word or sentences in future. Also other feature extraction algorithms like Wavelet transform, Invariant moments, Shape lets descriptors and other existing methods can be included in conducting experiments for improvement in the results. Other classifiers like Principal Component Analysis (PCA) and Linear Discriminant

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