

# INDIAN SIGN LANGUAGE RECOGNITION USING PCA and ARTIFICIAL NEURAL NETWORK

Nayan Dilip Sangle, Atira Bagwan, Suyash Balshetwar, Akanksha Bhandhari

Students,

K.K. Wagh College Of Engineering Education And Research Nashik.

**Abstract** – Sign Language is a language which uses facial expression, hand gestures for communication with others. Communication plays the vital role in day to day activities and the sign language is the only communication mean for deaf community but the people who can hear properly hardly try to learn the sign language, as a result deaf people find it difficult to communicate with the normal people without a sign language interpreter. So there is need of sign language recognition system. This paper deals with the classification of single handed indian sign language gestures using Principle Component Analysis and machine learning technique like ANN.

**Keywords**----Deaf and mute people, Hand gestures, Indian sign language, Machine learning algorithm, single handed sign language, PCA, ANN.

## I. INTRODUCTION

Communication is the very important part of day to day life. It is the activity of conveying information. But According to the survey 6.5% of the people in India are not blessed with the power of communication. They neither can speak nor hear because of which they are unable to communicate with the other people well . So these people express their feelings through Sign Language.

Sign Language is the way for the deaf and mute people to connect the outside world using hand gesture and sign language is different from other languages as it has no spoken words. Indian language is communicated using hand gestures made by single hand and double hand. There are various motivation for developing a sign language recognition model. The first is the development of an assistive system for deaf and mute people and the second is that sign language recognition serves as a good basis for the development of gestural human machine interfaces. So The idea is to design a system that can interpret the Indian sign language so that the deaf and mute people will be able to communicate with the outside world without interpreter.

In this grammer usage is not considered and main focus is only on the words. Articles like 'a', 'an', 'the' are omitted. The Sentence structure of sign language is very different which is Subject, Object, Verb(SOV), which is very different from sentence structure of English language as the sentence structure of English language is Subject, Verb, Object(SVO). For Example in normal language we say "I am not feeling good", but in sign language grammer is neglected and said as "Not feeling good".

There are some of the misconceptions about sign language is that sign language is same all over the world but truth is sign language is dependent on spoken language. Indian sign language are of two types single handed and double handed sign language. Figure 1, shows single handed Indian sign language.

This paper deals with Indian sign language recognition using machine learning. The system is trained with single handed sign language using a Principle Component Analysis and Artificial Neural Network(ANN) algorithm.

## II. Preparing the dataset

One dataset is created of 26 English alphabets in Indian sign language. Each of the sign is performed by various different individuals with different kinds of hand gestures in varied lighting conditions.

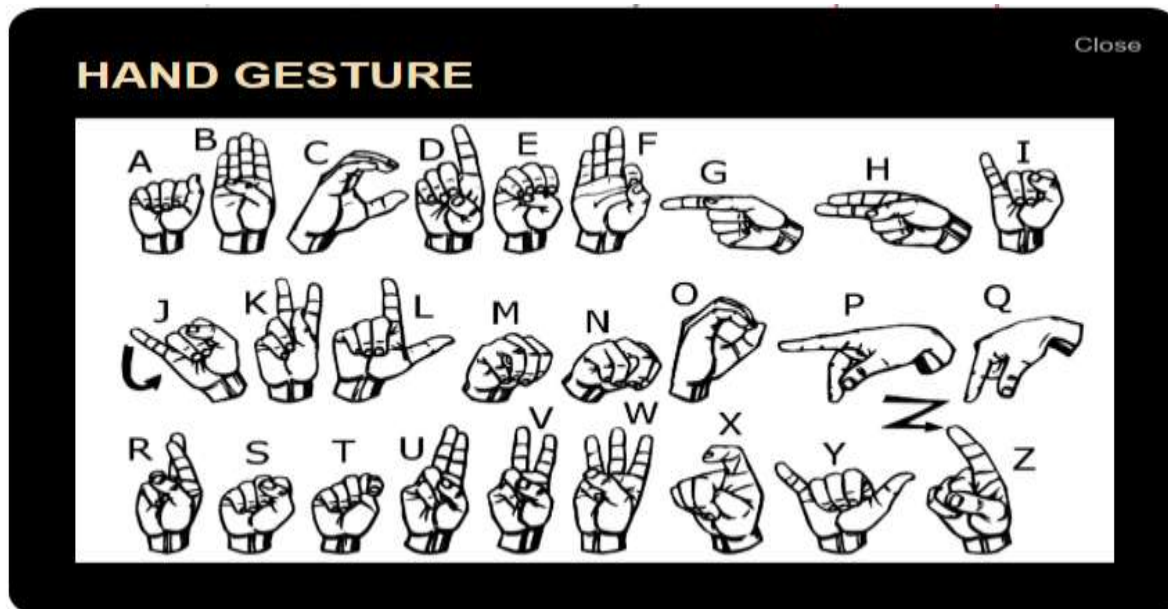


Figure 1

## III. Image Preprocessing

Before feature extraction and dimensionality reduction, image must be processed in a such way that only the needed information is considered and the redundant and superficial data are neglected. Open computer vision (OpenCV) library used to produce datasets. Firstly capture 600 images of each symbol then collect different 80 images of each symbol in ISL for training purposes and there is a need of around 20 images for testing purposes. Then Capture each frame shown by the webcam of system. In each frame, define a region of interest (ROI) which is denoted by green bounded square. From the whole image extract ROI which is RGB, and convert into the grayscale image.

Finally apply a gaussian blur filter to the image which helps to extract various feature of the image after that resize the image into 320\*320. Below fig. shows the pre-processing step by step.



Fig.3.1



Fig. 3.2



Fig.3.3

#### IV DIMENSIONALITY REDUCTION

The hand gestures of different sized and complexion are acquired and made an image database having each image of size 200 by 300. The image are pre-processed and resized to 300 by 9000.

But dimensionality reduction plays a vital role for faster computation. Dimension reduction and feature extraction can be done in one step using principle component analysis(PCA). PCA is used to reduce the dimensionality of the dataset and increasing interpretability .PCA is very famous linear dimension reduction method but there are some advantages and disadvantages of PCA stated below

##### Advantages Of PCA

- a) PCA removes the correlated features
- b) Improves the performance of algorithm
- c) Reduces the over fitting

##### Disadvantages Of PCA

- a) Data must be standardized before PCA
- b) Loss of information

There are various advantages of dimensionality reduction such as it reduces the time and storage required and removal of multi- collinearity improves the performance of the model.

#### IV. TRAIN THE SYSTEM

##### 4.1 Artificial Neural Network (ANN)

An artificial neural network is nothing but a computational model based on the structure and functions of biological neural network. The structure of ANN affects by the information that flows through the network because neural network changes based on the input and output. An artificial neural network has three or sometimes more layers. First layer consist of input neuron and those input layer sends the data to the deeper layers, which will send the final data to the last layer. The inner layers of ANN are hidden and the inner layers are formed by the units that changes the information received from layer to layer through a series of transformation. Use a multilayer feedforward neural network. A multilayer feedforward neural network is an Artificial Neural Network in which connections between the nodes do not form cycle. A multilayer feedforward neural network in combination with a supervised learning scenario is used. The multilayer feedforward neural network was the primary and simplest sort of artificial neural network. The backpropagation algorithm is employed for training multilayer feedforward neural network. It

iteratively learns a group of weights for the prediction of the category label of tuples. Backpropagation aims to attenuate the value function by adjusting the network's weights and biases.

#### 4.2 ANN Model

The six-layer of the ANN model consists of 1 input layer, 4 hidden layers, and 1 output layer with each layer fully connected to the following layer.

Input Layer:-

The feature vector is the input of the input layer it consists of 64 neurons and activation function is used in that layer is the hyperbolic tangent activation function (tanh)

Hidden Layer:-

There are 4 hidden layers in model. All four hidden layers consist of 128, 64, 32, and 16 neurons respectively. The outputs of the hidden layer units are often input to a different hidden layer, and so on. The activation function used for the hidden layer is rectified linear unit (RELU). This activation function is non-linear and allows the network to learn the complex pattern in data and maps the resulting values in 0 or 1.

Output Layer:-

The final a part of a neural network is that the output layer which produces the predicated value. The total number of neurons within the output layer is 26. The number of neurons in the output layer is equal to the total number of alphabet/classes that will predict the probability of each image being in a different class. The activation function is used for the output layer is softmax. Softmax convert vector of number into a vector of probability. This activation function is used in multiclass classification problems where class membership is required on more than two class labels. Below shows the block diagram of training and testing process.

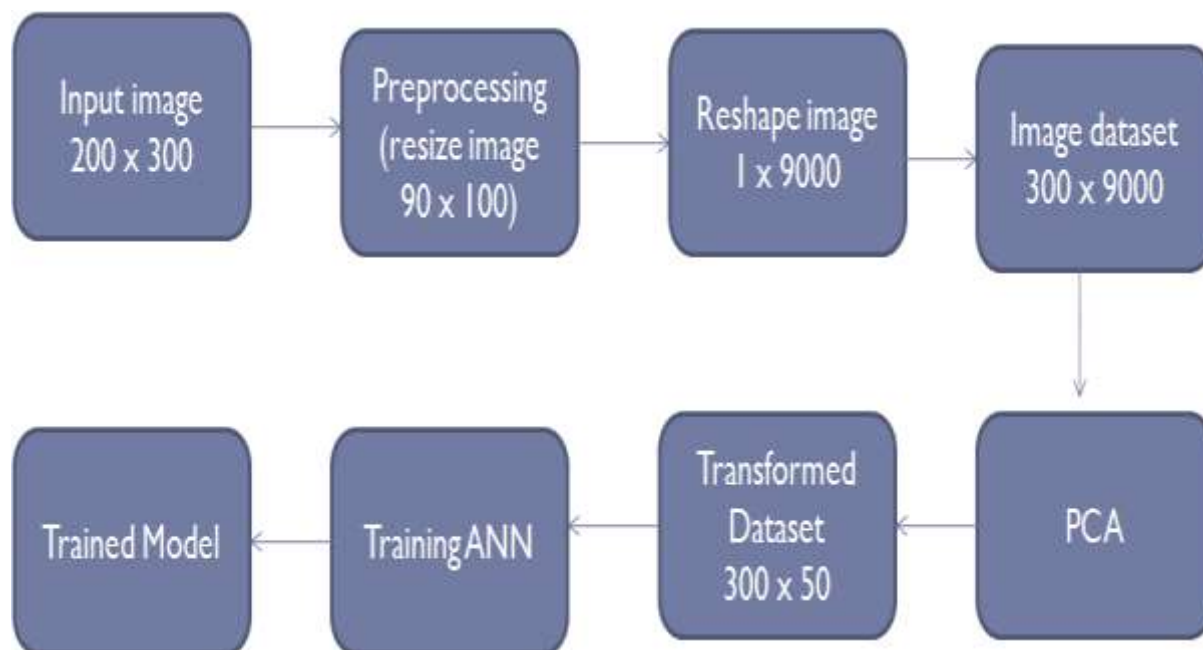


Fig. Block diagram of training process

## V. SYSTEM ARCHITECTURE

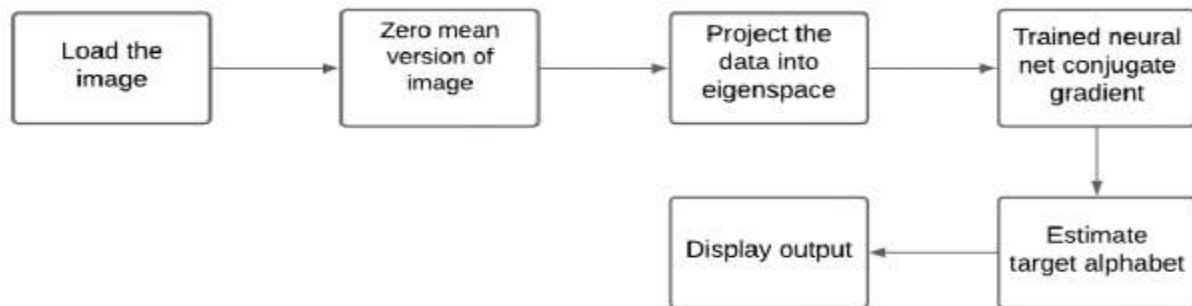


Figure 2. System Architecture

## VII RESULTS AND CONCLUSION

The experiment was conducted over the various images of single handed Indian sign language alphabets and the images are trained using the ANN technique and image preprocessing. The overall accuracy of the model is 70%.

## VIII CONCLUSION

The Indian sign language alphabet could be identified from the image of the input hand gestures. The position of hand and fingers plays the vital role in process. The signs which are represented by hand gestures are identified by feature extraction. PCA technique is used for dimensionality reduction. After the feature extraction from the image of sign are used to train a ANN that recognizes the sign.

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