Static Gesture Recognition of Devnagari Sign Language using Feed-Forward Neural Network

Ms. Shraddha Taunk, Mr. Dipesh Kumar Sharma, Mr. Ram Nivas Giri

Abstract - Hand gestures are primary means of communication among deaf and dumb humans and sign language is the most natural ,expressive and effective way of communication for dump and deaf people. This paper presents an image processing technique for finding equivalent readable text of Devnagari Sign Language. It attempts to process static images of the Devnagari sign language and then matches them to a statistical database of pre-processed images to recognize the specific set of signed letters that contains sign of vowel alphabets. We consider a constant Environment for gesture recognition. Our approach contains steps for resizing image, converting the RGB image to Binary image, removing noise from this image, segmenting the hand region, finding out its area, mean, and centroid, solidity , entropy ,correlation features from this preprocessed image. Then we create a database based on this features and classify the gesture. We use Feed-forward neural network (pattern recognition tool) to classify and detect the signs of Devnagari Sign Language.

***Index Terms*— Devnagari Sign Language (DSL), Feed Forward Neural Network, patten recognition ,Gesture Recognition, Features Extraction.**

I. INTRODUCTION

The sign language is the fundamental communication method between the people who suffer from hearing defects. In order for an ordinary person to communicate with deaf and dumb people, a translator is needed for translating sign language into natural language in which they can explain their thoughts to other normal person and vice versa. Sign language can be considered as a collection of gestures, movements, posters or body language, and facial expressions corresponding to letters and words in natural languages. Also, gestures can be divided into static gestures (hand Postures) and dynamic gestures. The hand motion conveys as much meaning as their posture does. A static sign is determined by a certain configuration or position of the hand, while a dynamic gesture is a moving gesture determined by a sequence of hand movements with respect to time and configurations. Dynamic gestures are sometimes accompanied with body and facial expressions. Here also we have classification of image background first is background independent image and other is background dependent image. Background dependent image is also known as complex background. In background dependent image there is fixed background used behind hand posture. The aim of sign language recognition is to provide an easy, efficient and accurate mechanism to transform sign language into readable text or speech/voice . With the help of computerized digital image processing and neural network the system can interpret sign language alphabets.

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A. Devnagari Sign Language

There are many work done with different types of technology but still in devnagari its just a beginning phase. Here in india maximum population of peoples knows only devnagari language because Devnagari is basic language of Indians. Devnagari Sign Language is the language of choice for most deaf people in the India. It is part of the "deaf culture" .However; DSL is one of the many sign languages of the world. As an English Speaker would have trouble understanding someone speaking Japanese, a speaker of Devnagari Sign Language would have trouble understanding the Sign Language of United State. DSL also has its own grammar that is different from English. [16] "Devnagari Sign Language Recognition Using Image Processing" Mr .Kapil Hande, Hussam Haider, Ishan Mahadule, Harshad Gharote Kartik Iyer have worked on Devnagari sign language but only on 26 hand gesture and also its method is not properly described. In proposed methodology we are decided to use 7 static gestures for recognition .these 7 sign are vowels in alphabets.

II. RELATED WORK

There are many different techniques are used for sign language recognition .But there are some limitations in previous work.

In 2012 [1] R. Pansare, Shravan H. Gawande, Maya Ingle recognize sign language using area and perimeter and can achieve a 90.19% recognition rate in complex background. In 2012 [2] Divya Mandloi work is done using PSNR and MSE comparison ratio. In 2012 [3]Manar Maraqa, Farid - Zboun, Mufleh Dhyabat, Raed Abu Zitar work on Neural Network. Limitation of this work was Some of the mistakes of

the recognition process are due to false feature extraction and others are due to the similarities of some gestures, In this colored hand gloves is used for detecting fingers and wrist. In 2014 [20]Ch.Raghava Prasad, Dr.P.V.V.Kishore, M.Siva Srinivasa Rao haswork on recognition of Gestures of Sign Language Using Feed forward Neural Networks. Indian sign language database was created for around 36 signs with 10 different signers. For training 4 sets gesture images were used and the remaining 6 sets were used for testing. After extensive testing under various conditions the average recognition rate stands at 98.2% In 2010 [4] Vaishali S. Kulkarni, Dr. S.D.Lokhande used ANN .there are some limitations and those limitations are due to Using Histogram technique and work get misclassified results. Hence Histogram technique is applicable to only small set of ASL alphabets or gestures which are completely different from each other. The system deals with images with uniform background.In 1998 [19]Chung-Lin Huang, Wen-Yi Huang had worked on Sign language recognition using model-based tracking and a 3D Hopfield neural network .this work is consists of some modules: model-based hand tracking, feature extraction, and gesture recognition using a 3D Hopfield neural network (HNN). In 2006 [5]Noor Saliza Mohd Salleh, Jamilin Jai, Lucyantie Mazalan, Roslan Ismail, Salman Yussof, Azhana Ahmad, Adzly Anuar, Dzulkifli Mohamad used vision based method and limitation of work are limitation of this Matrox camera was in separating hand region from other image including background. Hand region depends on skin colour non-influenced easily classified by value of RGB colour. But, by having input of grayscale, classifying the hand region are not easy and sometimes disturbed by other region which have similar grayscale value such as signer's forehead or face. In 2012 [12]Kaushik Deb, Helena Parvin Mony & Sujan Chowdhury has worked on two handed bangle sign language recognition using stastically based template matching technique. The proposed method is sensitive with different back ground condition and rotated hand sign images. In 2011 [8] Corneliu Lungociu worked on sign language recognition with neural network. This system was trained to recognize a set of 14 letters from the English alphabet: A, B, C, D, E, F, I, K, L, R, U, V, W, X. Recognition accuracy is 80% .In 2011 [10]Lorena P. Vargas1, Leiner Barba, C. O. Torres and L Mattos has recognize American sign language.In 2012 [12]Bikash Chandra Karmokar, Kazi Md. Rokibul Alam and Md. Kibria Siddiquee has worked on sign language recognition using train extracted featurs of sign images using NCL(negative correlation learning) .NCL give better result then back propogation learning. In 2000 [9] Klimis Symeonidis used orientation histogram vector as input to neural netwok. major goal was speed and the avoidance of special hardware.

In 2011 [13] Nashwa El-Bendary, Hossam M. Zawbaa, Mahmoud S. Daoud Aboul Ella Hassanien, and Kazumi Nakamatsu work on MDC and MLP. Each feature element will be represented as the distance from the orientation point to one of the fifty points on the contour. Classifier used minimum distance classifier (MDC) and multilayer perceptron (MLP) classifier and system was able to recognize a representing subset (15 letters) of the Arabic manual alphabets. In 2011 [7] Md. Atiqur Rahman, Ahsan-Ul-Ambia and Md. Aktaruzzaman worked using ANN with extracted features height, area, centroid, and distance of the centroid from the origin (top-left corner) of the image . Limitation of this system is that, for learning NN, the feature vector should have integer values only. In 2011 [11] Lawrence Y. Deng, Jason C. Hung recognize sign language Using Shape Context Based Matching and Cost Matrix. Here Success recognition rate was 70-90%. In 2012 [13] Shekhar Sign work on sign language recognition .The scheme is based on neural network (NN) classifier using a back propagation. The input parameter vector to neural network is the Fisher score. this fisher score which represents the derivate of the matrix of symbol probability in hidden Markov model (HMM). System is improved with the decreasing of the variance of the data with respect to the initial approach of the kernel of fisher, arriving to a rate of 99.30 % of success. In 2009 [15]Ravikiran J, Kavi Mahesh, Suhas Mahishi, Dheeraj R, Sudheender S, Nitin V Pujari introduces an efficient and fast algorithm for identification of the number of fingers opened in a gesture representing an alphabet of the American Sign Language. Finger Detection is accomplished based on the concept of Boundary Tracing and Finger Tip Detection. The finger recognition works accurately for 95% of the cases.

This paper is organized as follows: Section 2 demonstrates hand gesture recognition's workflow. Section 3 explains gesture recognition techniques; here we are using Artificial Neural Network for classification. Section 4 explains summary of result,conclusion and future work.

III. PROPOSED WORK

In this section, the proposed hand sign recognition system is described. A typical sign recognition system consists of pre-processing of image , segmentation, feature extraction from preprosessed image, classification and recognition of sign .The flow of hand sign recognition system and flow of work is presented as shown in Fig 1and Fig 2.

A. Data Set

The data set used for training and testing the recognition system consists of RGB images for all the DSL signs used in the experiments. Images obtained from image extraction are color images, the red, green and blue (RGB) components of the image are extracted separately.The samples will be taken from by digital camera. In this way a data set will be obtained and we can apply feature extraction scheme. Here we have prepared database of some static devnagari sign language images. dataset is shown in Fig.3.

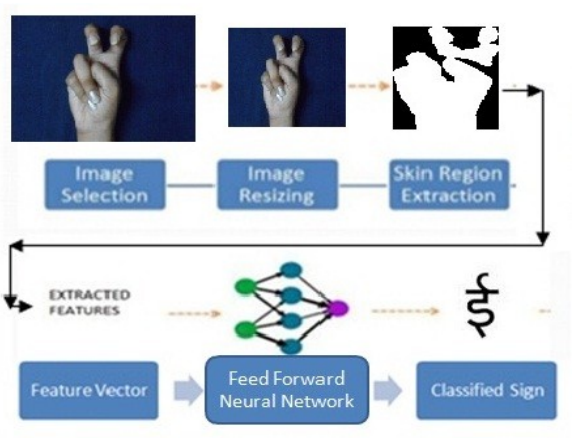

Fig.1. Flow Diagram Of Proposed Methodology

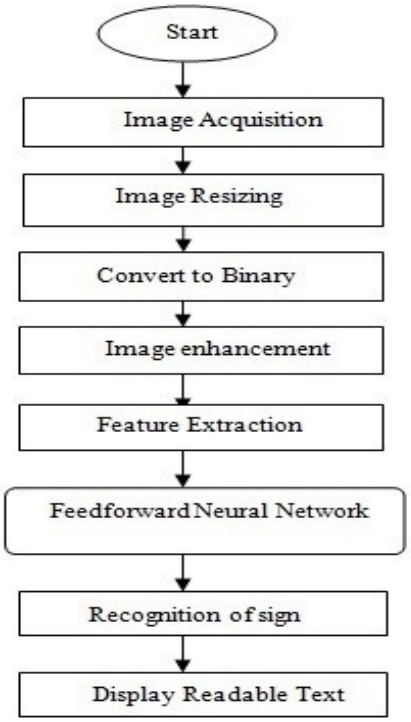

Fig 2: Flowchart of Work

B. Image Acquisition

Here we capture images in a constant environment. Pixel-based skin color segmentation is very sensitive to the environmental effect such as noise and illumination. We use a black cloth as background. We capture the image from a constant distance and maintain a constant light. In this method, first of all, the photo of sign is captured by the 20 megapixel digital camera. In this database, the image size is 3648*2736.

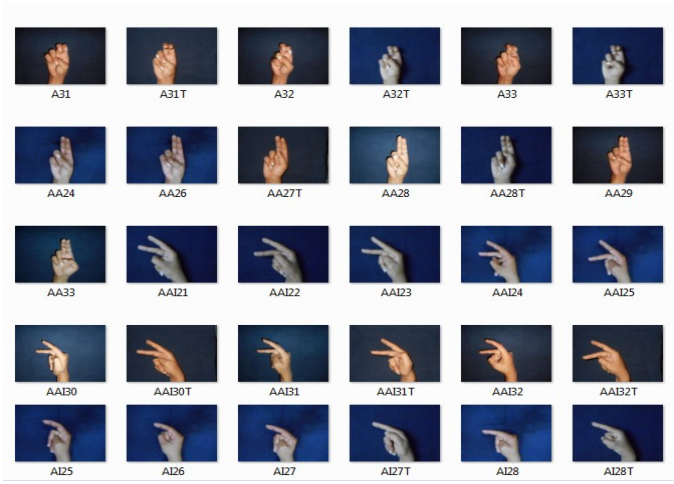

Fig 3: Data Set for Work

C. Binary Conversion

First we resize these captured images into 512*512 pixel size.After analyzing lots of images we decide a threshold limit. Then using this threshold limit we convert this RGB to gray scale image then gray scale image to Binary image .We read the image pixel by pixel and whenever we read a pixel that has the RGB within our threshold limit, we store 1 for this pixel position in an array and for other pixel position we store 0. In this way we obtain a binary image that has 1 for our desired region and 0 for background given in Fig.4

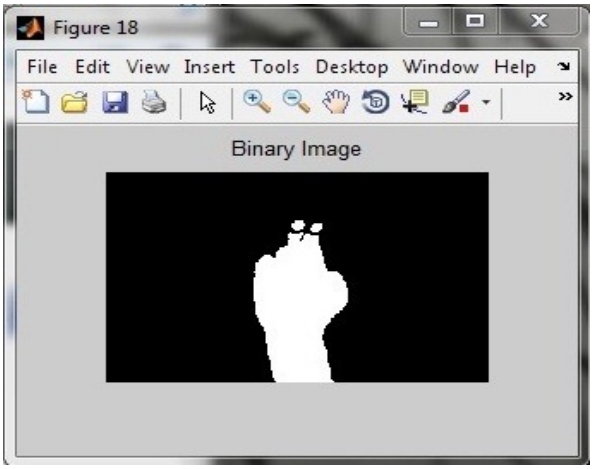

Fig.4: Binary Image

D. Noise Remove

It is important for us to remove noise from the image. Noise means unwanted white pixel inside the desired region Here we use morphological operation for enhance image quality Fig.5. After doing so; the image should be narrowed by using four lines approaching the black pixels. By doing this the image will express the clipping area just, by doing this we are able to crop only interested part of our work i.e. hand region.

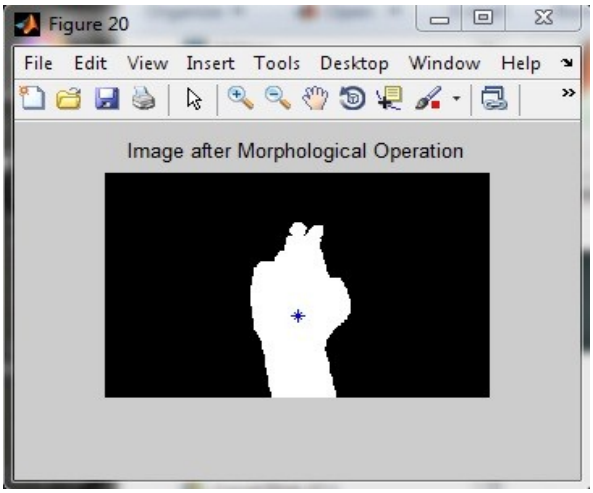

Fig.5: noise removal of image

E. Feature Extraction

Here we have calculated many features of image those are given below:

a) Area of hand region

b) Correlation

c) Solidity

d) Mean

e) Entropy

f) Maximum area of cropped region

g)Energy

IV. ARTIFICIAL NEURAL NETWORK

Artificial Neural Networks (ANNs) are computational systems whose architecture and operation are inspired from our knowledge about biological neural cells (neurons) in the brain. ANNs can be described either as mathematical and computational models for non-linear function approximation, data classification, clustering, and non-parametric regression or as simulations of the behavior of collections of model biological neurons. These are not simulations of real neurons in the sense that they do not model the biology, chemistry, or physics of a real neuron. They do, however, model several aspects of the information combining and pattern recognition behavior of real neurons in a simple yet meaningful way. Neural modeling has shown incredible capability for emulation, analysis, prediction, and association.

A. Feed-Forward Neural Networks

Feed forward neural networks are the most popular and most widely used models in many applications. In this architecture each neuron in one layer has directed connections to the neurons of the subsequent layer; there are no links between neurons in the same layer neither with any of the previous layers. The data flow in a strictly forward behavior. Since single-layer neural network has limited capabilities regarding pattern recognition; a multilayer feed forward neural network will be used.

B. Multilayer Feed forward Neural Networks

A multilayer feed forward network has a layered structure. The input layer where its neurons serve only as distribution points, one or more hidden layers of computation neurons, and the output layer[18].

Units in each layer receive their input from units from a layer directly below and send their output to units in a layer directly above the unit which means that the values only move from input to hidden to output layers; no values are feed back to earlier layers. Multilayer neural networks have proven their ability to solve many difficult problems such as pattern recognition as well as the ability of to extract more meaningful features from the input patterns through the use of hidden layers. The multilayer network architecture chosen for this research is a three layers neural network, i.e. a network that has one hidden layer. Since each gesture is represented by a vector containing seven features; the input layer has been chosen to have 7 input units. There is no rule for determining the number of nodes that the hidden layer should have; many simulations lead us to decide on its number; fifteen units. The output layer is 7 units since we have 7 gestures in the Devnagari sign language, each output unit will represent one of the gestures. Each unit in the input layer has been fully connected to every other unit in the second layer—the hidden layer. Also, every unit in the hidden layer is connected to every other neuron in the output layer in a feed forward behavior.

Fig.6 shows a model of the feed forward fully connected multilayer neural network that has been designed and tested for this research

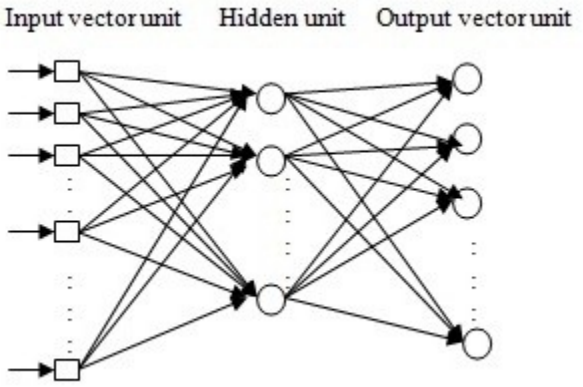

Fig.6 Feed –Forward Fully Connected multilayer neural network.

V. RESULT AND CONCLUSION

The Primary focus of this study was to examine Feed-forward neural network as a tool for the conversion of signs of Devnagari Sign Language to text.fig 7 shows snapshot of GUI of work The recognition rate of 60% is achieved for testing image. In future the system can be extended to recognize dynamic hand gestures in an unrestricted environment for real

life applications. Some of the mistakes of the recognition process are due to false feature extraction and others are due to the similarities of some gestures. In table 1.total number of testing sign for all 7 vowels and number of accurate recognized sign is given. Total accuracy is also defined there .

Sign	No. of test sign	No. of sign recognized	Accuracy (%)
A	8	6	75
AA	8	2	25
AAI	8	5	62.5
AI	5	5	100
E	5	2	45
EE	8	4	50
O	8	6	75
Total	50	30	60

Table1. Total number of recognized sign

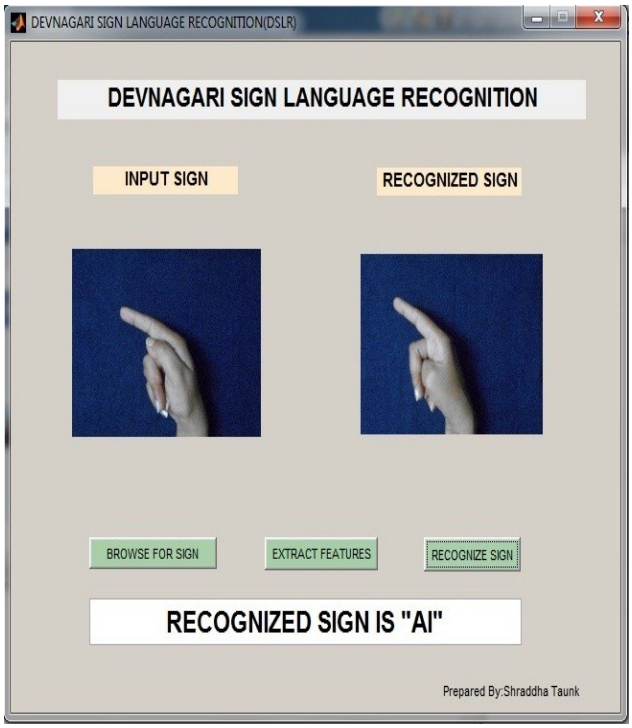

Fig 7. snapshot of GUI of work

Regarding the future work, research will be devoted to the following topics:

- By using both hands may be a considerable improvement.
- Improving this system by classifying all Devnagari sign language. Here in this work only 7 vowels signs are classified .
- By using Dynamic sign language for classification.
- By improving this system from single person to ;multi person system.

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