JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Double Handed Indian Sign Language Recognition Using k-Nearest Neighbor Algorithm

[1] Shalaka Gaikwad, [2] Dr. Girish Katkar, [3] Dr. Ajay Ramteke

[1] Research Scholar, [2] Assistant Professor, [3] Assistant Professor
[1] Department of Computer Science,
Taywade College, Koradi, Nagpur, India

Abstract : **Sign Languages are a set of languages that use predefined actions and movements to convey a message. These languages are primarily developed to aid deaf and other verbally challenged people. We have taken a dataset from Double-Handed Indian Sign Language Characters image and preprocess data extract features from both the training and testing data set and used k-nearest neighbor algorithm for classification of data. It reads a set of images, extracts features, trains a classifier, and allows the user to make predictions on new images for sign language recognition. The accuracy of the model was 99.9872%.**

IndexTerms – k-NN, Machine learning, double handed Indian Sign language, English alphabets.

I. INTRODUCTION

Sign Languages are a set of languages that use predefined actions and movements to convey a message. These languages are primarily developed to aid deaf and other verbally challenged people. They use a simultaneous and precise combination of movement of hands, orientation of hands, hand shapes etc. Different regions have different sign languages like American Sign Language, Indian Sign Language etc. ISL is not a signed version of any spoken language; it has its own grammar, vocabulary, and syntax. It is a complete language in its own right. ISL consists of hand signs, facial expressions, and body language. Each sign represents concepts, words, or phrases, and can vary based on regional dialects. We aim towards analyzing and recognizing various alphabets from a database of sign images. Database consists of various images with each image in different light condition with different hand orientation. With such a divergent data set, we are able to train our system to good levels and thus obtain good results. To implement gesture recognition in MATLAB without using the Deep Learning Toolbox, we have to use traditional image processing and machine learning techniques. We studied different machine learning techniques like K-nearest neighbors (KNN), Support Vector Machines (SVM), Logistic Regression and a neural network technique Convolution Neural Networks (CNN) for detection of sign language and two different approaches of k-NN are Instance-Based Learning: k-NN is a type of instance-based learning where the algorithm classifies a new data point based on the majority class of its k-nearest neighbors in the feature space. Distance Metric: It typically uses a distance metric (like Euclidean distance) to measure how similar or different instances are from one another.

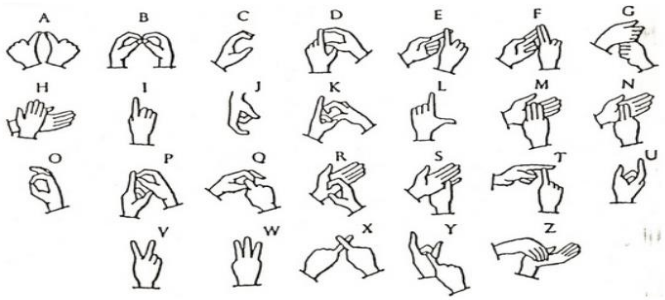


Figure 1: Double handed Indian Sign Language

II. RELATED WORK

In this paper author Yogeshwar I. Rokade and Prashant M. Jadav proposed a method for the automatic recognition of the finger spelling in the Indian sign language. Here, the sign in the form of gestures is given as an input to the system. Further various steps are performed on the input sign image. Firstly, segmentation phase is performed based on the skin color so as to detect the shape of the sign. The detected region is then transformed into binary image. Later, the Euclidean distance transformation is applied on the obtained binary image. Row and column projection is applied on the distance transformed image. For feature extraction central

moments along with HU's moments are used. For classification, neural network and SVM are used [1]. This research focuses on recognizing American Sign Language (ASL) letters and numbers, addressing the evolving technology landscape and the growing demand for improved user experiences among those primarily using sign language for communication. Leveraging deep learning, particularly through transfer learning, this study aims to enhance ASL recognition technology. Various deep learning models, including VGG16, ResNet50, MobileNetV2, InceptionV3, and CNN, are evaluated using an ASL dataset sourced from the Modified National Institute of Standards and Technology (MNIST) database, featuring ASL alphabetic letters represented through hand gestures [2]. ISL uses a combination of one-handed and two-handed gestures, which makes it fundamentally different from other common sign languages like American Sign Language (ASL). This paper aims to address the communication gap between especially abled (deaf) people who can only express themselves through the Indian sign language and those who do not understand it, thereby improving accessibility and communication for sign language users. This is achieved by using and implementing Convolutional Neural Networks on our self-made dataset. This is a necessary step, as none of the existing datasets fulfils the need for real-world images [3]. In this paper they used vision -based approach, direct pixel value local histogram, and hierarchical centroid features were extracted from an input image. k-NN, Neural Network classifier, Naïve Bayes algorithm are used as classifier [4]. Adithya V, Vinod P. R, Usha Gopalakrishnan, presented in their work, Artificial Neural Network Based Method for Indian Sign Language Recognition. For segmentation RGB colour spaced are transformed into YCbCr color space, the pixel of skin colour in the input images are identified by applying a thresholding technique based on distribution of the skin colour in YCbCr colour space. The result of segmentation produces a binary image in which the skin pixels are white in colour and background in black colour. For feature extraction distance transformation, row and column projection applied on distance transformed image, Fourier descriptor is applied on row and column projected image [5]. In this paper the problem with two deep learning (DL) techniques, namely Convolutional Neural Networks (CNN) and stacked denoising autoencoder (SDAE) networks, to recognize 24 ASL alphabets. Their data source was the gesture recognition database curated by Thomas Moeslund [6]. Automatic Indian Sign Language Recognition for Continuous Video Sequence- Joyeeta Singha, Karen Das This paper describes a novel approach towards a system to recognize the different alphabets of Indian Sign Language in video sequence automatically. The proposed system comprises of four major modules: Data Acquisition, Preprocessing, Feature-Extraction and Classification. Pre-processing stage involves Skin Filtering and histogram matching after which Eigen vector-based Feature Extraction and Eigen value weighted Euclidean distance-based classification technique was used. 24 different alphabets were considered [7]. Dynamic Hand Gesture Recognition Using the Skeleton of the Hand- Bogdan Ionescu, Didier Coquin, Patrick Lambert, Vasile Buzuloiu. Hand gestures can be divided into two main categories: static gestures and dynamic gestures. In this paper, a novel dynamic hand gesture recognition technique is proposed. They proposed gesture recognition method using both static and dynamic gesture [8].

III. DATA SET

We have taken double handed Indian sign language data set. We split the data into training set and training for classification. The dataset includes 1000 images per class which makes the dataset of 24000 images and the following image pre-processing techniques were applied on the dataset.
This model is trained for A-Z English alphabets.

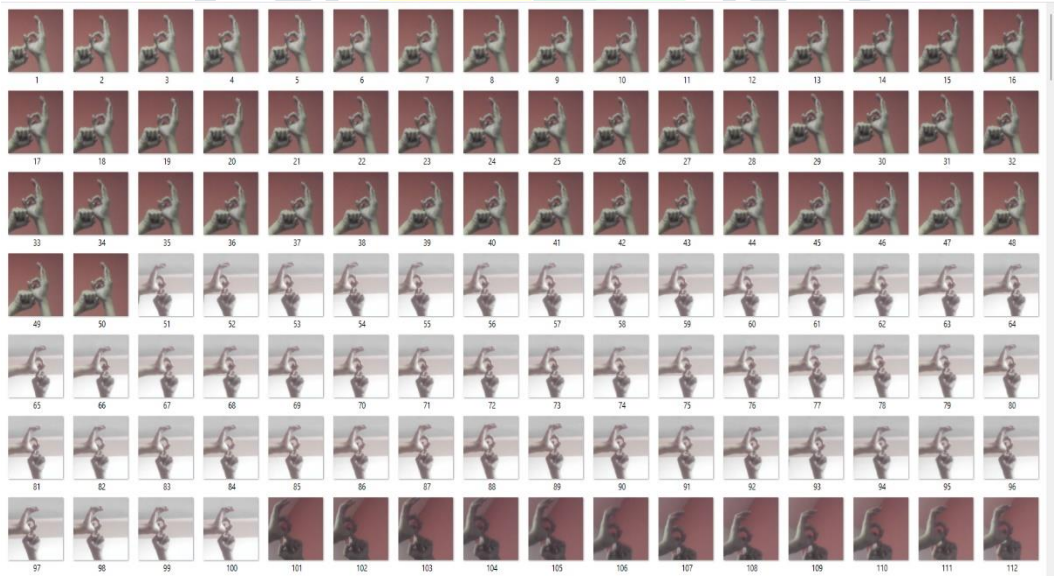


Figure 2: Indian Sign Language (ISLRTC referred)

IV. METHODOLOGY

This algorithm is designed for a sign language detection task which uses machine learning approach.

Step 1: Load Images

Image Datastore function is used loads images from the specified directory and it also includes subfolders and uses folder names as labels. The function disp(imds) displays information about the datastore, including the number of images and their labels.

Step 2: Initialize Variables

Then initializes empty arrays to store the extracted features and corresponding labels for each image.

Step 3: Process Each Image

Iterates each image in the datastore, then read the current image, resize it to 64*64 pixels for uniformity. Next step is to convert the RGB image to grayscale to simplify feature extraction. From the grayscale image extract histogram of oriented gradients (HOG)features. Then add the feature vector and its corresponding label to respective arrays.

Step 4: Train a Classifier

We have train a k-Nearesr Neighbors (k-NN) classifier using the extracted features and labels, with five neighbors considered for classification.

Step 5: Predict on a New Image

uigetfile is used to open a dialog box for the user to select a new image file for prediction.

Step 6: Check User Input

It checks if the user cancelled the file selection. If not, it constructs the file path, reads the selected image, and optionally displays it.

Step 7: Prepare the Test Image

Then resizes and converts the selected test image to grayscale, and then extracts its HOG features, just like for the training images.

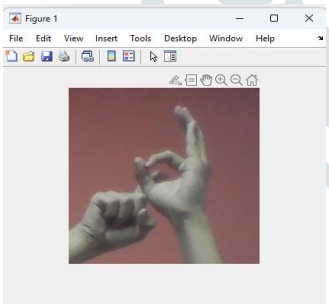
Step 8: Make Prediction

Uses the trained classifier to predict the label of the new image based on the extracted features. Displays the predicted label for the test image.

V. RESULTS

```
ImageDatastore with properties:

 Files: {
'C:\Users\admin\Desktop\Sign Language Detection\SL\A\1.jpg';
'C:\Users\admin\Desktop\Sign Language Detection\SL\A\10.jpg';
'C:\Users\admin\Desktop\Sign Language Detection\SL\A\100.jpg'
 ... and 25997 more
        }
 Folders: {
'C:\Users\admin\Desktop\Sign Language Detection\SL'
        }
  Labels: [A; A; A ... and 25997 more categorical]
   AlternateFileSystemRoots: {}
   ReadSize: 1
   SupportedOutputFormats: ["png"    "jpg"    "jpeg"    "tif"    "tiff"]
   DefaultOutputFormat: "png"
   ReadFcn: @readDatastoreImage
```



Predicted label for test image: Q

Figure 3: Test image **Recognized character**

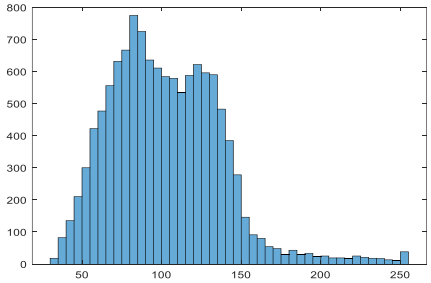


Figure 4: Histogram of test image

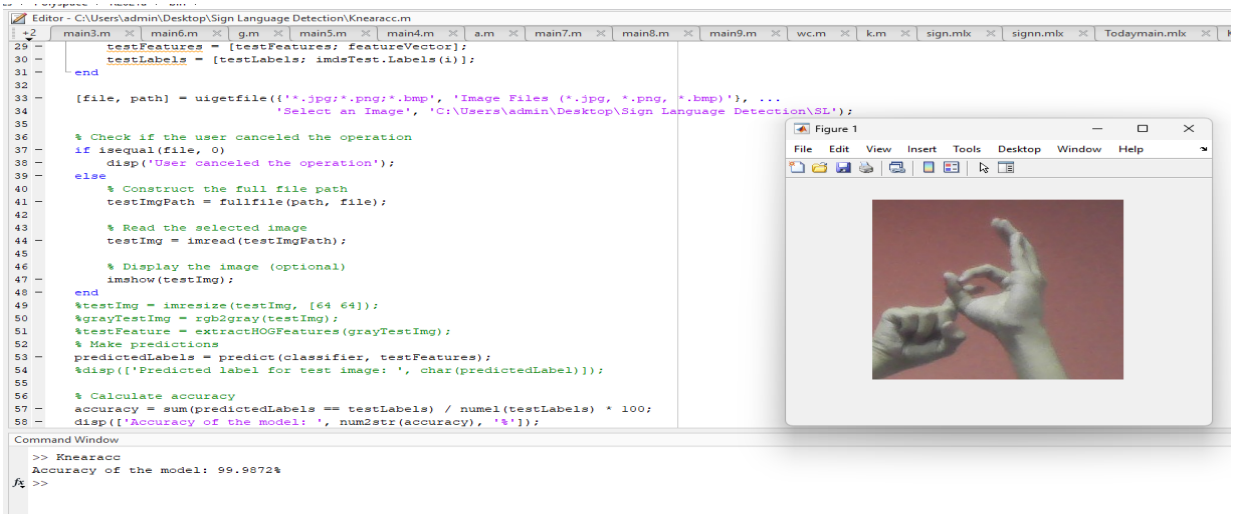


Figure 5: Figure shows accuracy of the model

Above results shows the total images taken in the data set and the default output format is .png. We can select one image at a time for testing that is read size is 1. We have selected image in fig.3 as test image and it predict result of selected test image and fig.5 shows accuracy of the model.

VI. CONCLUSION

We have taken a dataset of Double-Handed Indian Sign Language Characters image and preprocess data extract features from both the training and testing data set and used k-nearest neighbor algorithm for classification of data. The accuracy of the model was 99.9872%. We will study this problem in depth and will apply deep learning toolbox for recognition which will be helpful for deaf and dumb community and normal community which will remove communication barrier between two community which also increase recognition rate.

VII. ACKNOWLEDGMENT

This research is supported by Mahatma Jyotiba Phule Research Fellowship an Autonomous Institute of The Other Backward Class Bahujan Welfare Department, Govt. of Maharashtra.

REFERENCES

[1] Yogeshwar I. Rokade and Prashant M. Jadav., "Indian Sign Language Recognition System", *International Journal of Engineering and Technology (IJET)*, vol. 9, 2017.

[2] Sanaa Mohsin, Baraa Wasfi Salim, Ashty Kamal Mohamedsaeed, Banar Fareed Ibrahim and Subhi R. M. Zeebaree, "American Sign Language Recognition Based on Transfer Learning Algorithms", *International Journal of Intelligent Systems And Applications In Engineering*, pp.390-399, 2024.

[3] Harsh Kumar Vashisth, Tuhin Tarafder, Rehan Aziz, Mamta Arora and Alpana, "Hand Gesture Recognition in Indian Sign Language Using Deep Learning", Engineering Proceedings, 2023.

[4] A. K. Sahoo1, P. K. Sarangi, P. Goyal, "Indian Sign Language Recognition Using Soft Computing Techniques", *Machine Vision Inspection Systems*, vol.1, ch2, 2020.

[5] Adithya, V., P. R. Vinod, and Usha Gopalakrishnan. "Artificial neural network-based method for Indian sign language recognition" *IEEE Conference on Information & Communication Technologies (ICT)*, IEEE, 2013.

[6] Aly, Walaa & Aly, Saleh & Almotairi, Sultan, "User-Independent American Sign Language Alphabet Recognition Based on Depth Image and PCANet Features", IEEE Access. PP. 1-1. 10.1109/ACCESS.2019.2938829, 2019.

[7] M. M. Hasan, P. K. Misra, "Brightness Factor Matching for Gesture Recognition System Using Scaled Normalization", *International Journal of Computer Science Information Technology (IJCSIT)*, Vol. 3.

[8] J. Singha and K. Das, "Indian Sign Language Recognition Using Eigen Value Weighted Euclidean Distance Based Classification Technique", *International Journal of Advanced Computer Science and Applications (IJACSA)*, vol. 4.