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Sign Language Recognition System Using Indian Sign Language

Sneha B S[1],Sowmya R[1],Srilakshmi T M Bhat[1],Sumanth S[1],Sumanth Reddy[2]

[1.]Student, 4th year , Department Of Computer Science,Dayananda Sagar Academy of Technology and Management,Bangalore,Karnataka,India

[2.]Professor, Department Of Computer Science,Dayananda Sagar Academy of Technology and Management,Bangalore,Karnataka,India

Abstract—**Deaf and mute people communicate via hand gestures, i.e., sign language, which makes it difficult for non-deaf and non-mute people to understand their language. The problem statement here is to devise a technique for bridging the communication gap between the deaf/dumb community and the general public. The user's hand gestures are detected in real time. An efficient machine learning algorithm will be used to train the model to identify the letters of the ISL and thus converting it to a text format accessible to the normal people. This application will also enable the normal people to convey their message in terms of speech which will further be converted to text so that the latter will be able to receive their message.**

*Keywords— **deaf, mute, Sign Language Detection, Indian Sign Language, Image processing, Machine Learning***

I. INTRODUCTION

Modern research into sign language recognition can be categorized into contact-based and vision-based approaches:

i) Physical engagement between the user and the sensor devices is required in contact-based techniques.

ii) Data is acquired from images or video frames captured using a camera as the system's input in vision-based techniques. There are two types of Vision-based approaches: 3D model-based and appearance-based.

Main phases in the Sign Language Recognition:

i) The segmentation phase's major goal is to remove the image's background and noises, leaving only the Region of Interest, which is the image's sole valuable information.

ii) The distinctive features of the ROI will be extracted during the feature extraction phase.

iii) The extracted features will then be categorized, with the features of each gesture being grouped together, and this database will be used to match new sign language gesture inputs to which of the previously identified groups they belong.

Only about 250 competent sign language interpreters serve India's deaf population, which ranges from 1.8 million to 7 million individuals. A small number of interpreters for such a large population is unsustainable.

As a result, technology like this is the need of the hour. The details pertaining to the same are discussed in the coming sections of this paper.

The paper is organized as follows: Section II describes the Literature Survey, Section III discusses the Proposed System which includes Problem Description and Methodology, and

System Architecture, Section IV discusses Conclusion and Section V provides References.

II. LITERATURE SURVEY

C. M. Jin, Z. Omar and M. H. Jaward at [1] has proposed a mobile application of American sign language. This system uses image processing techniques to recognize the various gestures performed by the deaf/mute people. The proposed system has been successfully implemented on smartphone platforms. Several experimental results have proposed utmost accuracy in recognition of the sign languages in this system.

Sumaira Kausar and M. Younus Javed at [2] have proposed a survey on the current trends of sign language.They have categorized the signs into two categories — Static Signs and Dynamic Signs. They have also analysed the problem areas and the challenges faced by the researchers which provides a guideline for the future advances in this field.

Helen Cooper, Brian Bolt and Richard Bowden at [3] have proposed a sign Language recognition system. Before summarizing some of the approaches to the non-manual parts of sign languages, the manual aspects of sign (similar to gestures) are classified from a tracking and non-tracking perspective. The advancement towards speech recognition techniques and the further adjustments needed for the sign specific scenario are shown by methods for merging the sign classification findings into full SLR. Finally, current frontiers are covered, as well as recent research.

Manuel Eugenio Morocho Cayamcela and Wansu Lim at [4] have proposed a real-time American Sign Language hand gesture recognizer based on an artificial intelligence execution. Their method involves training a CNN on a dataset of hundreds of ASL alphabet instances, extracting features from each pixel, and generating an accurate translator based on predictions. Their method uses an unusual trade-off for a translator, in which better precision and speed during the inference phase compensates for the computational cost of early training. They have applied Fine-tuning to deep learning models that've been trained on different datasets.

Lean Karlo Tolentino, Ronnie Serfa Juan and August Thio-ac at [5] have proposed a static sign language recognition using deep learning. This system is based on a skin-color modeling technique, i.e., explicit skin-color space thresholding. The skin-color range is predetermined and will extract pixels (hand) from non–pixels (background). The images were fed into the model called the Convolutional Neural Network (CNN) for classification of images. Keras was used for training of images. Provided with proper lighting condition and a uniform background, the system acquired an average testing accuracy of 93.67%, of which 90.04% was attributed to ASL alphabet recognition,

Priyanka Mekala , Ying Gao , Jeffrey Fan and Asad Davari at [6] have proposed an architecture based on neural networks identification and tracking to translate the sign language to a voice/text format. They claim that the addition of Points of Interest and Track Points adds variety and minimizes the amount of storage memory needed. Each move that is trained has its own MV sequence. In the neural network model, every gesture has a matching stored model. They applied a new search strategy called combinatorial neural networks to minimize the size of the search space. CNN's architecture is based on the CPU's cache search memory concept. A new scheme termed combinational neural networks is utilized in their proposed solution.

CNN is built using a three layer network called back propagation.

P. Subha Rajam at [7] proposed a sign language recognition system for one of the south Indian languages.It uses techniques such as representing the 32 signs as the binary "UP" and "DOWN" by using the fingers.The images taken are converted into text by recognising the tip of the finger position.One advantage with respect to this technique is that there is an accuracy of 98.125% when the model is trained with 320 images and tested with 160 images.

Shujjat Khan,Gourab Sen Gupta, Donald Bailey at [8] have analysed the basic components required for a sign language recognition model and have also researched various techniques which are helpful to build this system. One of the vital steps focused on this particular research is to highlight the unaddressed issues and challenges we might come across and also various solutions to overcome these challenges.

III. PROPOSED SYSTEM

Figure 1 shows the components of the proposed system. This section describes the proposed system along with the vital factors and processes that has to be done to communicate using sign language.This system allows us to communicate with deaf and dumb people without having to learn the sign language.

Fig 1: System architecture

Different Components of the system are:

A.Signer

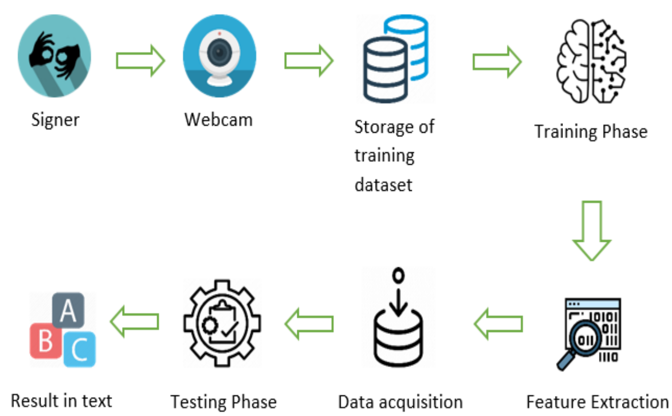
For this application "Signer" is an essential actor. Using the signer's action or hand gestures we train our model to understand the sign language or in other words the hand gestures. The signer uses nonverbal communication to convey his or her thoughts to the other person who cannot understand the sign language.

B.Webcam

A good quality webcam inorder to capture the images of the signs or hand gestures made by the signer in the previous step. There should be a specific distance of 1.5 to 2 ft between the webcam and the signer.Along with the good quality webcam we also need clear background and the arm extension from the palm should not be included.

C.Storage of training data

The method we use to store our training data has



important implications for building an effective machine learning model.We can optimize our training process by storing our training data in such a way that it is secure, easily accessible and reliable even if there occurs any alterations to the data over time. The figure 3 displays the Indian sign language which is stored as the training dataset.

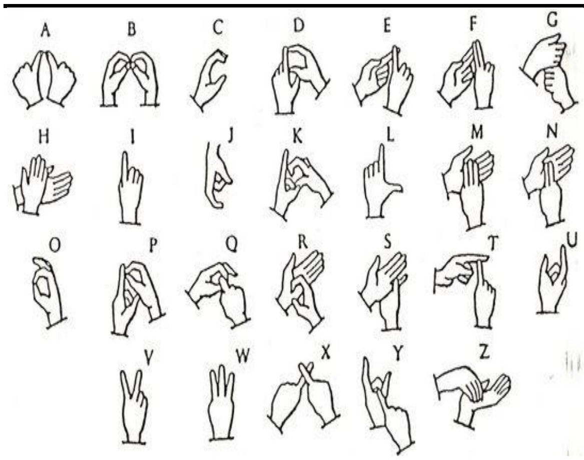


Fig 3. Gestures of Indian Sign Language

D.Training Phase

This is an important process where we basically train our algorithms in order to provide the right set of outputs for the given input data.This particular phase is similar to a learning phase for our algorithms,where it tends to train itself by memorizing and analyzing various input data and its corresponding output data. An efficient machine learning model is dependent on the successful completion of the training phase.

E. Feature Extraction

In this phase of the system, the essential features are extracted from the image that belongs within a threshold region. During this phase, segmentation of the image takes place i.e the hand gesture will be detected in the presence of a background and the essential features are extracted.

F. Data Acquisition

The essential features extracted are further analyzed and the data is acquired to match the stored training dataset. This feature extracted data is stored for further procedures and analysis to obtain the desired result.

G. Training phase

This phase is an important phase in which the data is compared with the stored training datasets to match with appropriate sign language gestures. The acquired data checks with the stored data with which it has a higher match to output the alphabet that the signer wants to convey.

H. Result in text

This is the final step of analysis of data. Once a suitable match is obtained from the dataset, the output is displayed in the form of alphabets. Every alphabet is the result of the hand gesture shown by the signer. Combination of these alphabets will lead to the formation of words and further to sentences which is the message that the signer wants to convey to the receiver. In this way, the sign gestured by the deaf/mute gets converted to text format, leading to a better communication with the society.

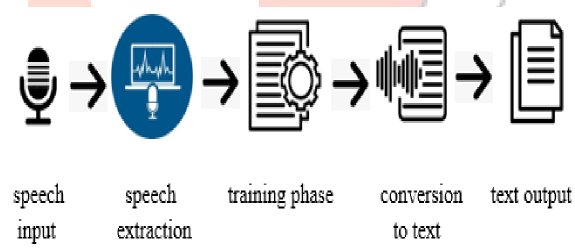


Fig 4: Speech to text format

The figure 4 describes the conversion of speech input to text format which helps with the communication of the normal to deaf/mute.

IV. CONCLUSION

We can conclude that a system that builds a good communication gap between two communities can benefit the greater good in the world. Using our proposed system, this communication gap will be filled. Using specific algorithms and functions, we intend on making this dream a reality. The system is a desktop application that takes a signer's hand signs as input and the well trained model breaks down the image to understand individual elements, compares those and gives the required output. In this system, we also intend on removing limitations of the present system and make the system a two way communication device.

Further, this system can also be enhanced by making this system a mobile application to better help accessibility for the society.

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