

# Real-Time Sign Language Conversion Using CNN Algorithm for Disabled People

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**Abstract:** Various problems in speaking and hearing put a lot of impact on one’s daily life and professional growth. Thus, Sign Language (SL) is considered as the most effective solution to people with hearing and speech impairment. Sign language is not understandable by everyone. Hence, there is a need to understand sign language in verbal form with the help of converting hand gestures into sentences. Advanced methods like Machine Learning and Deep learning provides many innovative solutions to identify hand gestures.

**Keywords:** CNN, Gesture recognition, Sign language.

## 1. Introduction

Many children nowadays suffer from Nonverbal Autism. For the deaf people visual signs and gestures are useful with the help of computers that automates the communication between both deaf and hearing persons using the concept of Human-Computer Interaction. As sign language has gained a lot of importance, its development and applications have increased a lot, as many people are not only unable to speak and hear but also write the spoken language. Deaf people mostly use sign language to communicate with each other. Sign language uses gestures instead of sound to convey the meaning of a speaker’s thoughts. A gesture in sign language is a particular movement of the hands with a specific shape made out of them. The use of sign language puts the mute community at a disadvantage, isolating them from normal people, as they cannot communicate like everybody else. Nowadays, efficient human-computer interaction has gained a lot of importance in developing solutions to real world problems and intelligent computing. One advancement in this direction is Sign Language Recognition. With the help of an advanced system, sign language symbols are being understood by the machine. Sign language to speech converter is a prototype that converts sign language spoken by deaf & dumb communities into speech. This prototype needs to correlate different gestures into different meaningful words. Machine Learning plays a very important role in this age of Artificial Intelligence. It is used to detect patterns in data and make predictions based on those complex patterns. On the basis of Data, many people in India not only suffer from deafness but also illiteracy and unemployment issues due to their problem. We are trying to bridge this gap with our prototype which will help them to understand the conversation efficiently and eliminate some

challenges in their lives.

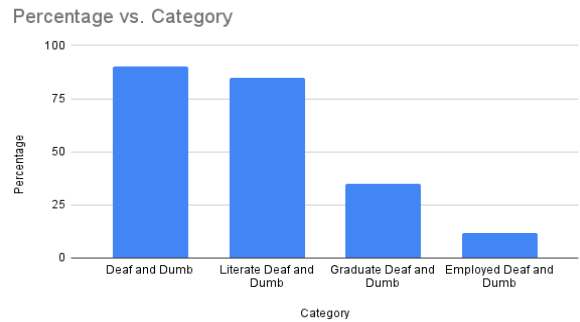


Fig. 1. Data representing percentage of disabled people

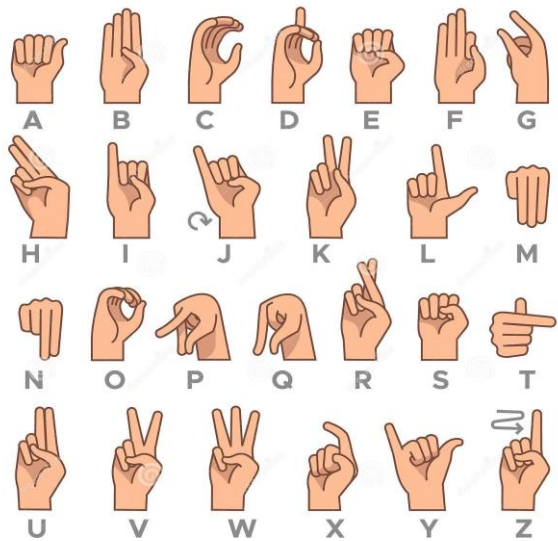


Fig. 2. Sign Language Symbol [10]

In this paper, a prototype is proposed to give a speech and written output for the Sign Language gestures to bridge the communication gap between people with speech impairment and normal people. This prototype focuses on capturing the images of the hand gestures from a real-time camera and converting them into English sentences using the Machine Learning model trained using CNN Algorithm.

In this Literature survey, we have gathered all the technologies used in all the refereed papers, the data collected is represented in the percentage format to visualize it in a pie

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chart. After visualizing and analyzing the data, the conclusion is made on the basis of that. The most used technology which provides greatest accuracy is CNN, Computer Vision, Image Processing and Artificial Intelligence. That's why, this paper is intended towards using these methods to make the most feasible solution and to reach more accuracy.

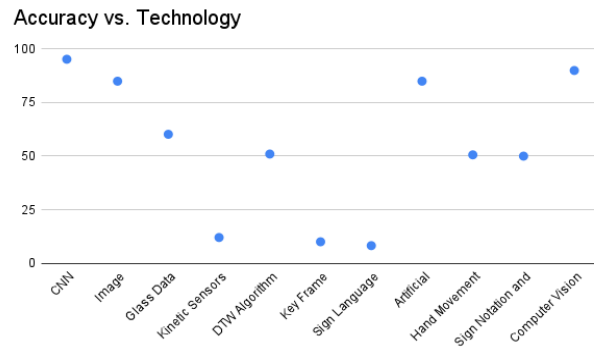


Fig. 3. Data analysis of different technologies and their accuracy

## 2. Literature Survey

The review showcases various algorithms used for converting sign language into English text. The algorithm whether of machine learning or of deep learning, the efficiency of the algorithm is measured on the basis of the Accuracy and Error Rate. When the algorithm has high accuracy and low error rate then that algorithm can be trusted. But when the algorithm has high accuracy and high error rate then the algorithm becomes less trustful. Therefore, in this survey we have given major importance on the algorithm's accuracy and error rate. After studying and reviewing dozens of papers on the topic of

sign language conversion, we have perform an analysis, and from the analysis we have concluded even if the machine learning algorithms have show great accuracy but their error rate is also concerning, which on the other hand the accuracy of the deep learning algorithm even if their accuracy is less in comparison but their accuracy is also very low. In deep learning algorithms we have also performed further analysis and out of them we analyzed that, Deep belief Network have showcased better accuracy along with very low error rate. By studying many techniques represented in the table below, we have tried to develop a feasible solution which works with a normal system and doesn't need any advanced external equipment. Nowadays, It is very important in society to communicate with each other, but hearing disabilities aren't. They can only communicate by visual gestures, symbols, facial expressions, body language etc. without the need of vocal communication. So the purpose of this paper Galib Ibne Haidar et al [4] is to create an interpreter which can convert American sign language into English sign language. Through CNN they have created an interpreter which converts into English sign language. The system was developed by using Image processing, CNN and data glass. The system is well known as Faster data classification and convergence than its predecessors. In this paper Yufei Yan et al [10] improved and studied real-time dynamic sign language recognition algorithms. They are using DTW algorithm, Key Frame, Kinect sensor, sign language track to improve dynamic algorithm for the recognition. For the recognition of dynamic gestures, the positional features and shape features of the dynamic gestures in continuous time are usually extracted. Commonly used dynamic gesture recognition methods are classified according to principles, such as statistics

Table 1  
Detailed literature survey

| System  | Feature Extraction  | Methodology Used                           | Advantages  | Disadvantages  |
|---|---|--|---|--|
| Galib Ibne Haidar, Hasin Ishraq 2020 [4]                                      | English Alphabet Detection, Image processing, Data Glass. | Convolutional Neural Networks              | Meaning of different hand gestures is accurately interpreted. Accuracy is 99.8%.  | Just focused on identifying the features of sign language. No conversion of hand gestures into text or voice.              |
| Sandrine Tornay, Marzieh Razavi, Mathew Magimai. Doss 2020 [11]               | Hand Shape Submit Extraction Hand Movement Detection.     | Kullback-Leibler Divergence HMM            | Using Mobile applications is easy and feasible to use.                            | The English language is converted into sign language. Only normal people can understand the language not the disabled ones |
| Deepika Pahuja, Sarika Jain 2020 [7]  | Image processing with MATLAB.                             | Threshold Quadrant Values Image Processing | No special instrument used. Non-parametric approach.                              | Works with static images only.   |
| Yufei Yan, Zhijun Li, Qunzhu Tao, ChenyuLiu, Rui Zhang 2019 [10]              | Gesture Recognition.                                      | Kinect Sensor DTW Algorithm                | More than 90% Recognition rate. Improved recognition Speed.                       | Complex Method.  |
| Myasoedova M.A., Myasoedova Z.P., Farkhadov M.P. 2021 [5]                     | Sign Writing System. Spatio-temporal form of sign.        | SW System Distant Learning Sign Writing    | More accurate recognition with the use of Sign notation and sign writing.         | Need to learn Sign notations for new users.  |
| Ebey Abraham, Akshatha Nayak, Ashna Iqbal 2019 [6]                            | Neural Networks. Sensor Glove. Flex Sensor.               | LSTM                                       | Provides 98% accuracy.  | Works with only Indian languages. Physical Devices Used.   |
| Necati Cihan Camgoz, Oscar Koller, Simon Hadfield and Richard Bowden 2020 [9] | Sign Language Translation CSLR. Recognition of Glosses.   | Connection Temporal Classification         | Resolve problem on doubling performance of Previous system.                       | Extensive use of hardwares like Transformers.  |
| L. Priya, A. Sathya, Kanaga Suba Raja, 2020 [8]                               | Speech Recognition Speech Translation Android             | Neural Networks HMM                        | Mobile Application. Most of the challenges of Speech impairment can be addressed. | Needs higher understanding for using.  |

based, grammar based, template-based methods. Finally, the paper experiments and analyzes the recognition rate of trajectory matching and key gesture matching, and the time-consuming improvement of DTW, and then verifies the effectiveness of the algorithm and improvement. In this paper Sandrine Tornay et al [11] worked on multiple human languages. Hand movements are detected with the training of the model. Model is trained on the basis of hand shape. The database is formed and extraction of hand movement is done and on the basis of hand shape, the recognition model is trained. By sharing many resources of sign language, the system is the sign language. Myasoedova M. A. et al [5] has developed an online platform SWiSL to recognize sign language. This program depicts sign language in written form. It converts each and every sign in sign writing format. There is a collection of all the user information stored with a maintained database system in this program. With The combination of various technologies like neural networks, Gesture recognition, sensors, and LSTM, this idea is proposed to convert hand gestures into meaningful sentences in human language. The sensors are mounted on gloves to detect the hand gestures According to the orientation of fingers and hands. This is a very dynamic approach to recognize the gestures and convert them into English words using advanced techniques like neural networks. Ebey Abraham et al [6] worked on the technologies Neural Networks combining it with hand gloves on which sensors are mounted.

### 3. Conclusion

This paper introduced a review on using the advance techniques such as Machine Learning and Deep Learning to solve the real-life problems faced by deaf and dumb people. The aim of this paper is to help and serve the deaf of our society to communicate with normal people. Here the implementation of the system is using image-processing techniques. First, acquire an image with a camera. Then convert it to a grayscale image for further processing.

CNN algorithm is used to train the model. Conversion of

Sign language to English text is done and displayed and output is also generated invoice format as an added feature to the prototype.

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