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Research Paper

Detecting Sign Language for the Deaf and Mute Using Neural Networks

Basel A. Dabwan[1]*, Mukti E. Jadhav[2], Prachi Janrao[3], Avinash B. Kadam[4]

ABSTRACT

Living without communication is extremely challenging for humans. People employ different methods to express and exchange their ideas between the sender and receiver. Speaking and using gestures are the most common means of communication. Speech refers to audible communication perceived through hearing, whereas gestures involve using body movements like hands and facial expressions. Sign language is a form of communication categorized as a gestural language that is understood and conveyed through visual perception. While most people have the choice to use gestures in their communication, deaf individuals primarily rely on sign language as their main form of communication. Deaf and dumb individuals require communication to engage with others, acquire knowledge, and participate in the activities in their surroundings. Sign language serves as the connection that closes the divide between them and the rest of society. We have developed models for detecting sign language and converting it into normal text, allowing ordinary people to understand what individuals with disabilities want, after training these models on dataset using neural network, we achieved excellent results.

Keywords: *Sign Language, Neural Network, Deaf and Dumb, Machine Learning*

An automated system designed for translating sign language has the potential to significantly impact both users and non-users of sign language as a means of communication. Sign language, used by over 70 million people globally, is a unique form of nonverbal communication that involves various physical components. It relies on facial expressions, eye movements, hand gestures, and lip motions to convey information. Deaf and hard of hearing individuals primarily rely on sign language for their daily communication needs [1]. According to the World Health Organization, hearing loss affects 5% of the global population, which translates to over 460 million people worldwide, including 34 million children. It is projected that by 2050, this number will surpass 900 million [2]. Additionally, 1.1 billion children worldwide are at risk of developing hearing loss due to factors like noise exposure and other causes. Hearing loss has resulted in a substantial economic burden of 750 billion dollars [2].

[1]AlBaydha University, AlByadha, Yemen
[2]Shri Shivaji Science & Art College,Chikhali Dist. Buldhana., India
[3]Thakur Engineering College, Kandewli Mumbai, India
[4]Shri Shivaji Science & Art College,Chikhali Dist. Buldhana., India
*Corresponding Author : Basel A. Dabwan e-mail: baseldbwan@yahoo.com
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Hearing loss can be categorized into four levels: mild, moderate, severe, and profound, depending on the degree of impairment. Those with severe or profound hearing loss often struggle to engage in effective communication, leading to potential mental health issues such as feelings of isolation and loneliness. Sign language serves as a vital communication tool within the deaf community, but it presents a barrier for hearing individuals who do not understand its gestures. There are approximately 200 different sign languages worldwide, each with its own unique features, much like spoken languages. Sign language is a fundamental aspect of communication for the deaf, utilizing significant bodily movements, known as gestures or signs, to convey messages, distinguishing it from other natural languages. These gestures encompass actions like head nodding, shoulder movements, facial expressions, and hand and finger motions. Consequently, the proposed work aims to facilitate interactions between deaf individuals, as well as between deaf and non-deaf individuals. In sign language, each sign represents a letter, word, or emotion, and like spoken languages, combining signs creates meaningful phrases. Thus, sign language has evolved into a complete and functional natural language with its own syntax and sentence structure.

RELATED WORK

In recent times, some research has emerged focusing on sign language. However, these studies have not been comprehensive enough. These areas lack many of the research efforts required to address such an issue that affects many individuals with disabilities. As an illustration, in [3], Inception is employed to recognize spatial attributes, while Recurrent Neural Networks (RNN) are utilized to train on temporal characteristics. In [4], Sign Language is predicted with an impressive 95% accuracy using a Convolutional Neural Network (CNN). [5] applies a CNN for real-time prediction and logs both model weights and specifications. In [6], there is a discussion of the model's pertinent attributes, the process of feature extraction, and the utilization of an Artificial Neural Network (ANN) for sign identification. Lastly, [7] put forward a model aimed at detecting and translating ASL alphabets through the application of AdaBoost and Haar-like classifiers. Also, in the studies, several methods have been proposed for translating sign language into text such [8],[9].

METHODOLOGY

Proposed Models

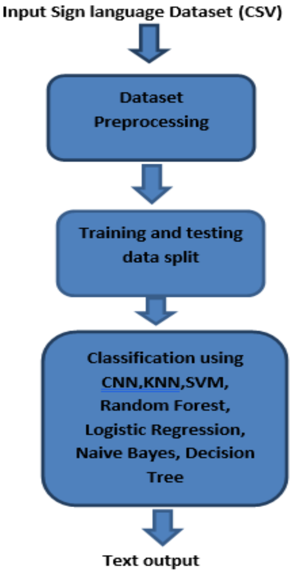

Figure 1. Proposed System

1. **Dataset**

In this model, we used the dataset consist of 27,455 images for training and 7,172 for testing, in CSV format,

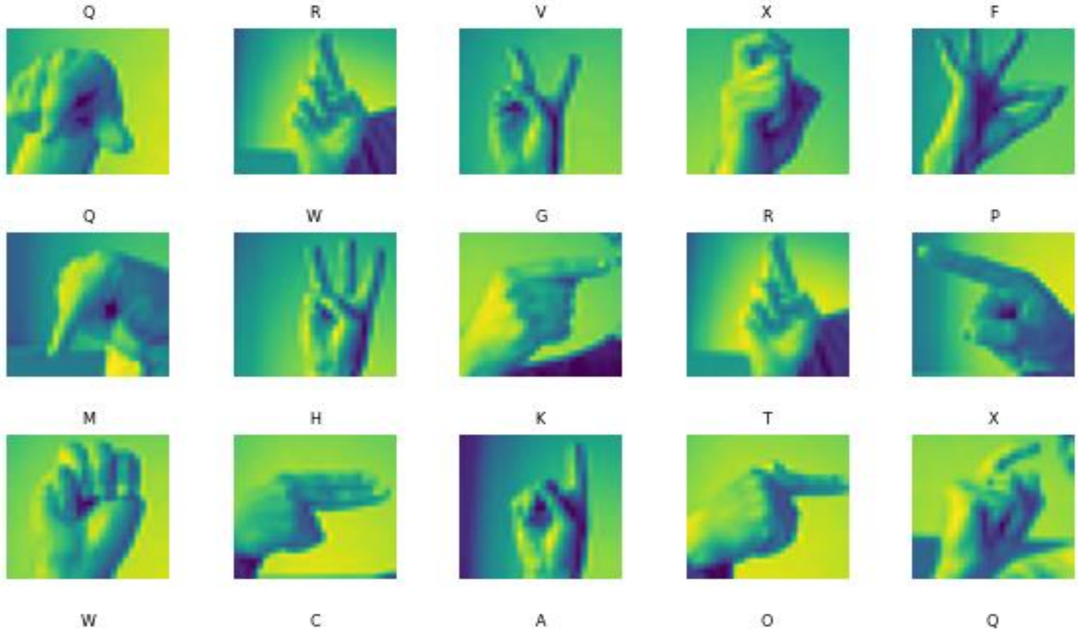

Figure 2. Sign Language Dataset

2. ***Preprocessing***

All preprocessing operations were performed to remove the noise, and facilitate and speed up the computations such as resizing images, Rescaling (1. /255), and splatting the dataset into testing and training.

3. ***Training and testing dataset split***

the size of the training and testing dataset is 80%, 20% respectively.

4. **Features Extraction and Classification with CNN, KNN, SVM, Random Forest, Logistic Regression, Naive Bayes, and Decision Tree**

We developed sign language Models using the previously mentioned algorithms and dataset, with 26 classes represent of sign language letters.

RESULTS

After executed the aforementioned models we got excellent results, as shown in the following.

Table No. 1 Results and Comparison of Classifiers

Classifier	Accuracy
KNN	99.7%
SVM	1.0%
Random Forest	98.8%
Logistic Regression	99.9%
Naive Bayes	53.5%
Decision Tree	91%
CNN	1.0%

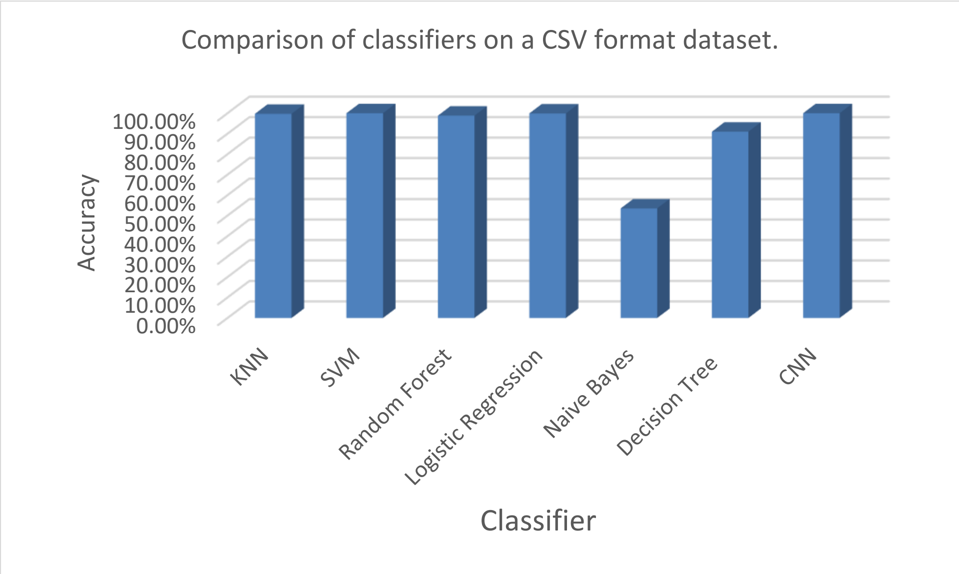

Figure 3. Comparison of Classifiers

CONCLUSION

We have developed models to convert sign language for deaf and mute individuals into regular language that ordinary people can understand. We used datasets and trained them with algorithms, that mention previously. We obtained excellent results from some of the algorithms, despite the slight discrepancy, such that KNN 99%, SVM 100%, Random Forest 98%, Logistic Regression 99%, Naive Bayes53%, Decision Tree 91% and CNN 100%.

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Conflict of Interest

The author(s) declared no conflict of interest.

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