



Artificial Intelligence Techniques for Sign Language Recognition

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ABSTRACT

The main objective of this Project is to present a website that bridges the communication gap between the impaired people and the normal people. Communication plays a vital role in everyday life, and this website primarily focuses on facilitating communication between impaired and normal individuals. According to the world federation of the Deaf, there are currently over 1.5 billion people living with the hearing loss, which amounts to 20% of the global population. In India, the World Health Organization estimates that 63 million people suffer from hearing loss. As it is impossible for people with hearing or speaking impairments to communicate without sign language, it is inevitable that sign language is used. The primary focus of research is on the application of AI in the recognition and interpretation of sign language. The Machine learning model is accurately recognizes sign language, particularly American Sign Language format, from images. This model captures the user's as input and provides output in the form of text. Additionally the website addresses the current limitations of existing Sign Language Recognition systems. This new website has the potential to provide significant benefits to both impaired people and normal people in bridging the communication gap.

Keywords: Communication, Impaired people, Sign Language, Inevitable, Recognition.

1. Introduction

In the today's world, Artificial Intelligence techniques have played a crucial role in the development of sign language recognition systems. AI techniques, such as computer vision, machine learning, and deep learning, have been applied to various stages of sign language recognition, including hand detection, feature extraction and gesture classification. Computer vision techniques have been used to process images, identify hand gestures and track hand movements. These systems work actively when two different persons involved in the communication are present in the same place. This sign language recognition system website helps in connecting impaired people and normal people by bridging the communication gap between them.

2. Literature Review

The following sources provide a fluid explanation of the design of Sign Language Recognition system and have been drawn from a survey of a few research publications on sign language recognition today.

Kumud Tripathi, Neha Baranwal, G.C. Nandi [1] upon reviewing a few research publications on sign language recognition this source offers a clear explanation of the design of a sign language recognition. The authors have conducted a study that shows how hand gestures are a powerful means of communication for the people with hearing impairments. Such gestures are also useful in establishing interaction between humans and computers. In this paper the authors proposed a dynamic Indian sign language recognition system that uses either one hand or both hands to perform gestures. The system uses a Frame Overlapping Method to track use frames from gestures, thereby speeding up the recognition process. Additionally, the system employs Discrete Wavelet Transform (DWT) to extract the features of an image and Hidden Markov Model (HMM) to test gestures.

Feng Wen, Zixuan Zhang and others [2] Sign Language Recognition, particularly sentence recognition, is crucial for reducing communication barriers for individuals with hearing impairments. However, existing glove solutions that detect the motion of the hands are limited to recognizing discrete single gestures and do not fully satisfy the communication needs of signers. The others have proposed an AI-enabled SLR and communication system that utilize sensing gloves. Their approach involves segmenting entire sentence signal into word units, which improves the accuracy of SLR results. These results are then projected into virtual space and translated into text, allowing for remote and bidirectional communication between signers and non-signers.

Rahul D, Ashish Jasuja [3] This study that demonstrates a method for recognizing British sign language. The proposed approach uses Histogram of Oriented Gradients (HOG) for image processing and Artificial Neural Network (ANN) as the classifier. The pictures of the hand gestures are captured using a camera and then processed by the system. The system extracts HOG features from the results and feeds them into the ANN for recognition.

Kusumika Krori Dutta, Satheesh Kumar Raju, Anil Kumar G.S and others [4] This paper sheds light over a method with the classification of doubled handed Indian sign language gestures using principle component analysis and machine learning technique like ANN. Sign language is a language which uses facial expressions, hand gestures for communication with others. Communication plays the vital role in daily activities and the sign language is the only communication mean for impaired community but the people who can hear properly hardly try to learn the sign language, as a result deaf people find it difficult to communicate with the normal people without a sign language interpreter. So there is a need of sign language recognition system.

Ms. Greeshma Pala, Mr. Sathish Shivaji Kumbhar and others [5] The authors have conducted a study that demonstrates how sign language is used by the impairment community to communicate with others. However, a common problem is that not everyone can understand sign language since hand gestures differ in shape and orientation from person to person, leading to issues of linearity. In recent years, various algorithms and methods have been developed to address this problem and create a functional system. Algorithms such as KNN, SVM, and experiments using hand gloves were used to decode the hand gesture movements.

3. Design and Development

A detailed study was conducted to design a machine learning model for sign language recognition. The model was built using the Convolutional Neural Networks algorithm. HTML and CSS were chosen as the primary front-end frameworks for website development, while PHP was used to integrate both the Python and HTML code.

Algorithms: Convolutional Neural Network

The following steps were used to design the sign language recognition system.

1. Data Collection
2. Image Pre-processing
3. Feature Extraction
4. Classification

1. Data Collection

The first step was to collect a large dataset of sign language images. These images needed to include a variety of signers, lighting conditions, and backgrounds to ensure that the system could recognize the signs in different situations. The required amount of data can be collected and this data can be further used for processing.

2. Image pre-processing

Once the data set was collected, it was preprocessed by cleaning the data, segmenting the images into individual signs, and extracting relevant features from the images. This involved extracting frames from the images.

3. Feature Extraction

The next step was to select and extract relevant features from the pre-processed data. These features could include hand shape, hand movement and hand orientation.

4. Classification

Finally, the supervised learning algorithm Convolutional Neural Network was used for the classification of data. The algorithm processes input data through a series of convolutional layers, pooling layers and activation functions to learn important visual features from the input. These learned features are then used to make predictions about the input data.

CNNs can be trained to recognize the unique hand gestures and movements associated with different signs. They are particularly effective in sign language recognition because they can learn to recognize the features that are important for identifying the specific signs such as the position of the fingers, the orientation of the hand, and the movement of the hand.

4. Module Description

The project includes the development of two types of modules:

- **Admin:** The Admin module is responsible for training the system by providing the datasets and specifying the desired output in text format for users.
- **User:** The User module allows users to sign up using their Gmail accounts and communicate with others using different gestures.

Some of the sub modules in our model are:

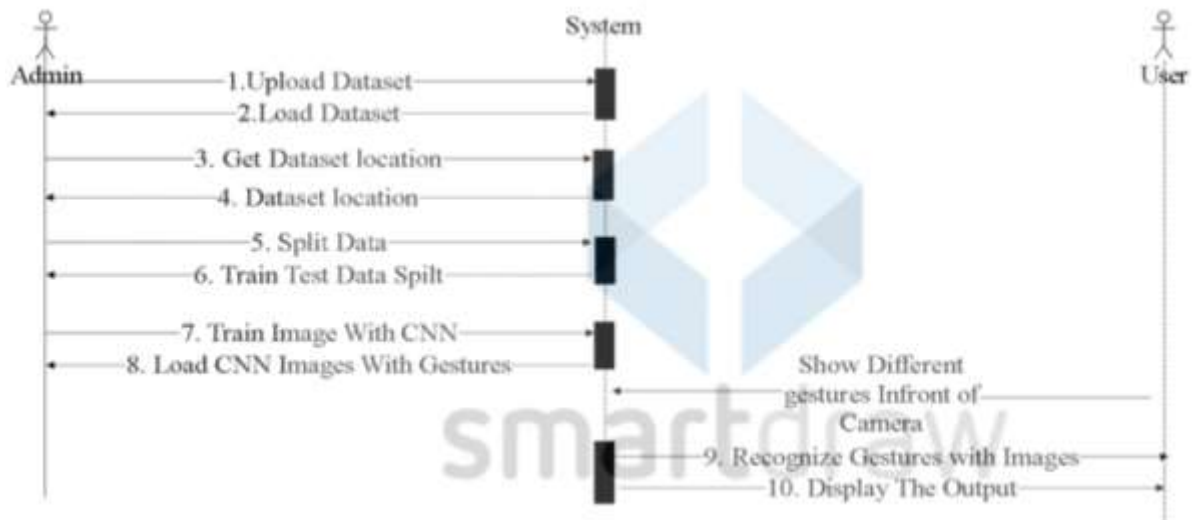
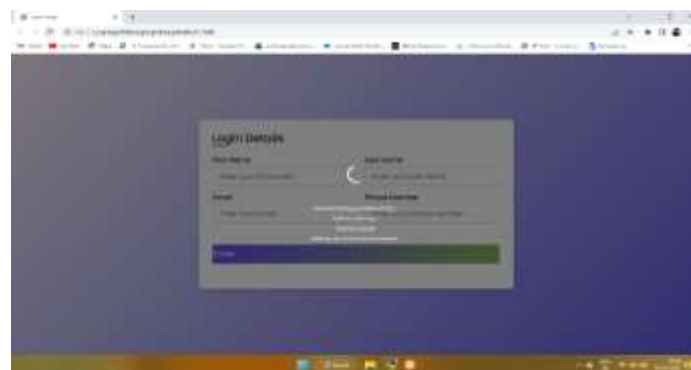


Fig 1: Sequence Diagram of Sign Language Recognition

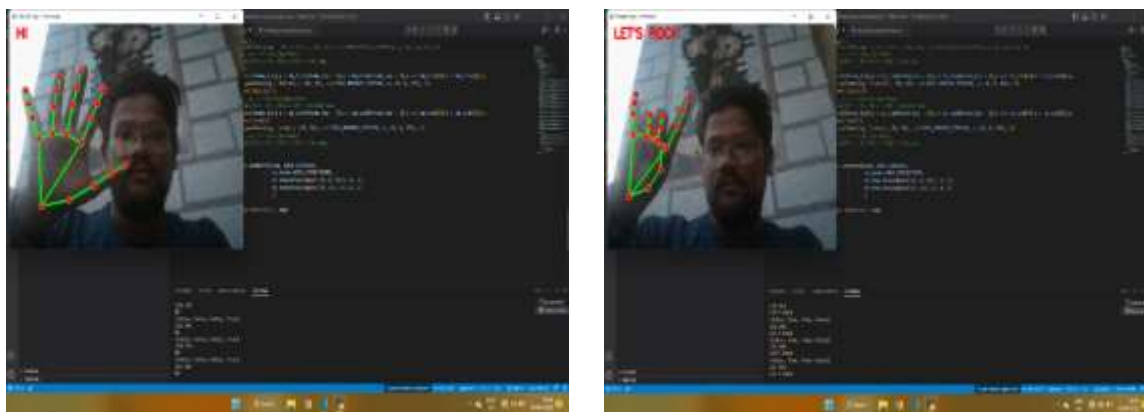
- **Sign Up:** Registration process allows users to create an account by using their Gmail credentials.
- **Login:** It is possible for users to utilize their Gmail account to log in directly.
- **User:** Shows the gestures in front of the camera. This will act as input for the system.
- **System:** After accepting the input from the user, the system pre-process the image and identifies the gesture by using the trained dataset and gives the output in the form of text.

5. User Interface

The user interface of the Sign language recognition has been designed with a focus on user experience and ease of use. The website's interface is modern and intuitive, with a clean and simple layout that allows users to easily navigate and access its features. It provides simple, responsive, call-to-action functionality, and real-time updating interface. Figure 2(a) and 2(b) show application's snapshots.



2(a). Output Snapshots

**2(b). Output Snapshots**

6. Conclusion

This new website is an innovative and much-needed addition to the existing sign language recognition system. By using AI techniques, it has the potential to greatly improve communication, accessibility and inclusivity for the deaf and hard of hearing communities, and can help to bridge the communication gap between the hearing and deaf communities. A user interface for sign language recognition using AI would typically involve a camera or other sensor that captures the user's hand movements, and an AI model that analyzes these movements to recognize the corresponding sign language gestures. As AI technology continues to advance, it is likely that we will see more applications of sign language recognition in a variety of fields, including education, healthcare and entertainment.

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