# Sign Language Recognition System

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***Abstract*— A sign language recognition system built using computer vision and machine learning methods is presented in this research. Hand gestures are recognized by the system, which then translates them into written language. The suggested method extracts elements from video input and categorizes them as Sign Language motions using a convolutional neural network (CNN) architecture. The system is an effective tool for communication between the deaf and hearing communities because of its excellent precision and real-time performance. The suggested system has a number of potential uses, including assistive technology for the deaf, automatic sign language translation, and instructional aids for teaching sign language. The testing findings show how proficiently and reliably the suggested system can recognize Hand Gestures.**

***Keywords—Sign Language, CNN, Hand Gestures, Computer Vision.***

## I. Introduction

Deaf (hard of hearing) and dumb (unable to speak) individuals mostly utilise sign language to communicate inside and outside of their respective communities. People who are unable to speak or hear use hand gestures to communicate in this language. The goal of sign language recognition (SLR) is to identify acquired hand motions and to continue until related hand gestures are translated into text or speech. Typically, sign language is not understood by the general public. As a result, deaf and dumb people have a tough time communicating with the rest of the world.

The major goal of this project is to decipher sign languages and convert them into English so that everyone can interact with one another. analysing sign language, transcribing it into English, and providing the results as text or audio. The suggested system must correctly identify and translate the hand signs.

## II. Problem Statement

To create a system that can aid in the translation of sign language into text format so it will be much simpler for the dumb and deaf to communicate with the outside world as the majority of the general populace cannot understand sign language. The hand motions are recognised by the "Sign language Recognition System" from the photographs, the hands are separated from the picture and the gestures are categorized. The user will receive text as an output from it.

## III. Scope

The development of a computer vision and machine learning-based technology to decipher sign language motions and translate them into written or spoken language is part of the project scope for a sign language recognition system. A wide variety of sign language gestures should be recognised by the system, and it should be able to accurately translate them in real-time. Additionally, the system should be made to be user-friendly, accessible, and flexible enough to work in a variety of settings and contexts, such as those related to education, healthcare, customer service, and emergency response. In order to make sure that the system satisfies the demands of deaf people and non-sign language users and can successfully close the communication gap, the project scope should involve thorough testing and evaluation.

## IV. Methodology

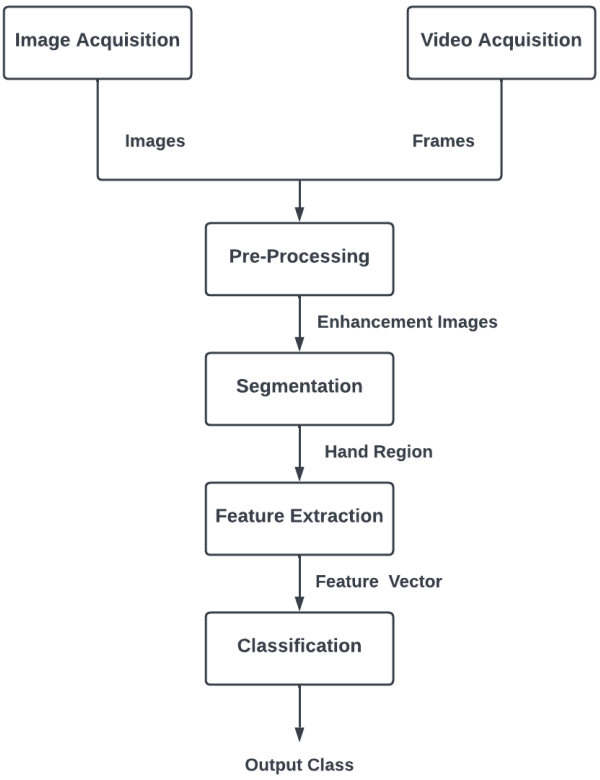


Fig. 1. Module Flow Diagram of Sign language recognition

A brief description of the modules used in this methodology are explained below:

**Image acquisition:** Image acquisition in image processing and machine vision is the process of obtaining an image from a source, typically hardware such as cameras or sensors. The data that is recorded from a scanner or digital camera may be in binary, colour, or grayscale.

**Video acquisition:** The process of gathering frames from a source typically a hardware device like a camera is known as video acquisition. The input comes from hardware systems as video.

**Image Pre-Processing:** A sequence of operations known as pre-processing are carried out on the scanned input image. In essence, it improves the image, making segmentation possible.

The tasks performed on the images in image Pre-processing stage are as follows:

- **Noise Reduction:** Required to improve the image quality before sending them to the subsequent stages. Techniques like filter, median filter, max and min filters can be applied.
- **Grayscale conversion:** Input image may be in RGB format which is converted to shades of grey.
- **Binarization:** A greyscale image is transformed into a binary image using the binarization process. Both local and adaptive thresholding are possible. We are utilising the adaptive technique in our project.

**Segmentation:** Image segmentation is a method for breaking down a digital image into different groups, which makes the image easier to process or analyse in the future by reducing its complexity. The segmentation technique we use in our project is region-based segmentation..

**Feature Extraction:** It is a step in the dimensionality reduction process that divides and condenses an initial collection of raw data into more manageable groups. This will make processing simpler. This vast data sets' abundance of many variables, which they contain, is their most significant feature.

**Classification:** Classification is the process of categorising and identifying groups of pixels or vectors included within a picture in accordance with pre-established guidelines. The textual attributes or spectral properties can be combined to construct the categorization law. 'Supervised' and 'unsupervised' are two terms used to describe broad categorization procedures.

## V. TESTING AND RESULTS

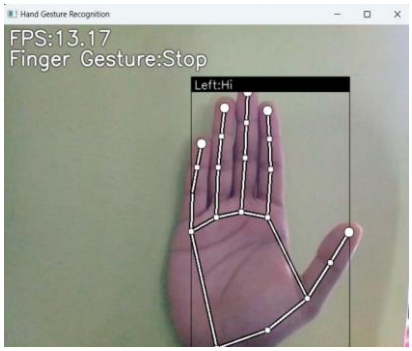

Fig. 2. Recognition of "HI"

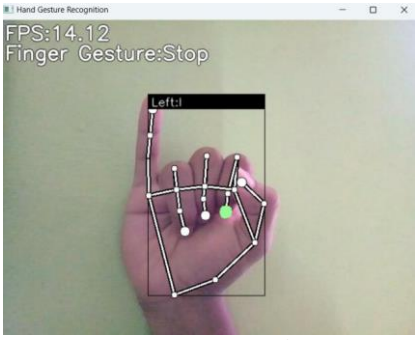

Fig. 3. Recognition of "I"

Fig. 4. Recognition of "NEED"

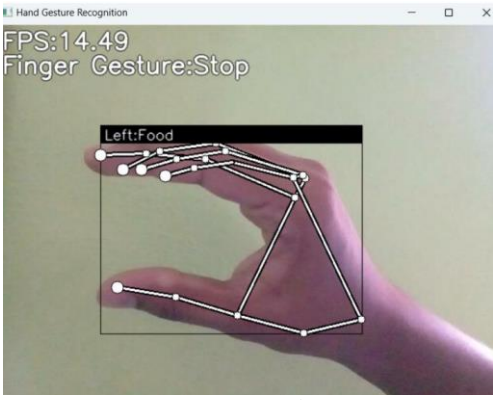

Fig. 5. Recognition of "FOOD"

The figures from Fig. 2. To Fig. 5. Show the simulation environment the user will see in the system. The sign language Recognition system is recognizing the signs

"HI","I","NEED","FOOD". These signs' translation is displayed right at the top of the hands in the image.

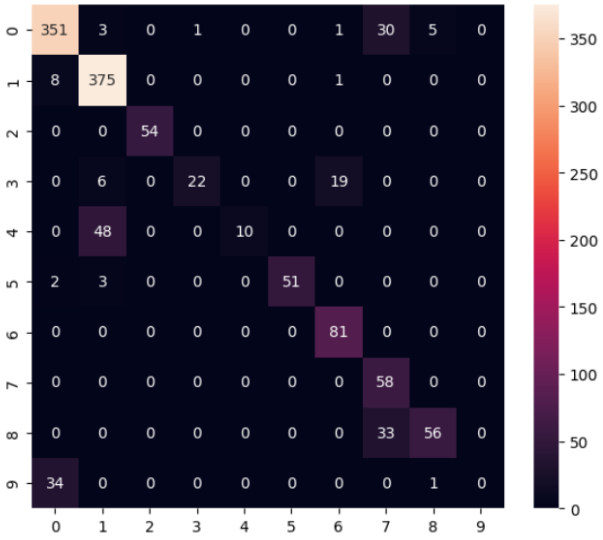


Fig. 6. Heat Map of Sign Language Recognition System

TABLE 1

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| 0 | 0.89 | 0.90 | 0.89 | 391 |
| 1 | 0.86 | 0.98 | 0.92 | 384 |
| 2 | 1.00 | 1.00 | 1.00 | 54 |
| 3 | 0.96 | 0.47 | 0.63 | 47 |
| 4 | 1.00 | 0.17 | 0.29 | 58 |
| 5 | 1.00 | 0.91 | 0.95 | 56 |
| 6 | 0.79 | 1.00 | 0.89 | 81 |
| 7 | 0.48 | 1.00 | 0.65 | 58 |
| 8 | 0.90 | 0.63 | 0.74 | 89 |
| 9 | 0.00 | 0.00 | 0.00 | 35 |
| accuracy | | | 0.84 | 1253 |
| macro avg | 0.79 | 0.71 | 0.70 | 1253 |
| weighted avg | 0.85 | 0.84 | 0.82 | 1253 |

The average accuracy of the Sing Language Recognition System is 84%.

## VI. Conclusion

This project is a smart solution for deaf and dumb people to communicate. This project will help people who communicate using sing language to communicate easily and bridge the gap between them and the rest of the world. Hence, we focus on developing an application which will help convert sign language to English text and audio. This project will make sure that deaf and dumb people are not left out of the rest of the world as this is a very fast passed world.

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