**HAND SIGN LANGUAGE TRANSLATION**

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**Abstract:** This paper presents **SignLingo**, a real-time hand sign conversion system that translates sign language gestures into readable text and using a combination of computer vision and machine learning. Built to bridge the communication gap between the hearing-impaired community and the general public, SignLingo utilizes a deep learning-based image recognition model trained on a diverse dataset of hand signs from Indian Sign Language (ISL). The system processes live video input to detect, classify, and convert signs with high accuracy and speed. This paper outlines the model architecture, preprocessing techniques, real-time conversion mechanism, and performance analysis, highlighting SignLingo’s impact on accessible communication technology.

**Keywords** – Sign Language Recognition, Hand Gesture Detection, Computer Vision, Deep Learning, Accessibility Technology, Real-Time Communication

# I. INTRODUCTION

Communication is a vital component of human interaction. However, individuals with hearing or speech impairments often face significant barriers when engaging with others who are unfamiliar with sign language. The lack of widespread sign language education further compounds this issue, making real-time communication difficult in public, educational, or healthcare settings.

Globally, over 70 million people use sign language as their primary form of communication. Yet, a majority of these individuals are underserved by mainstream technological solutions. Interpreters are expensive and not always available, and most existing digital tools

require expensive sensors, gloves, or are limited to static image recognition.The need for a low-cost, real-time, and non-invasive sign language translator has never been greater. **SignLanguage** addresses this challenge by leveraging the power of deep learning and computer vision to translate hand gestures into readable communication. The system provides accessibility using just a webcam, making it ideal for schools, hospitals, public service centers, and home use.

# II. PROBLEM STATEMENT

People with hearing and impairments often face communication challenges due to the general public's lack of knowledge about sign language. This results in social barriers, limited opportunities, and dependency on others. Existing solutions are either

too expensive or not user-friendly.

There is a need for a low-cost, real-time, web-based system that can detect and translate hand gestures into meaningful text. Such a solution should be platform-

independent, require minimal hardware, and be easy to use for anyone, regardless of their technical background.

# III. OBJECTIVES

o To design a web-based system that uses a webcam to detect hand gestures

and convert them into letters.

o To use machine learning and computer vision algorithms to recognize each sign

accurately.

o To collect and process individual letters to form complete words for better understanding.

# IV. SYSTEM ARCHITECTURE

A block diagram is a simplified visual representation of a system, process, or concept

using blocks (usually rectangles) connected by lines or arrows. Each block represents

a major component or function, and the arrows show the flow of data, control, or

information between those components.

# V. RESULTS AND OBSERVATIONS

The SignSense system was tested on both standalone and web versions. It successfully recognized ASL hand signs with an average accuracy of 92%–95% in good lighting conditions. Real-time prediction speed was smooth, with letters appearing in under 1 second. Word formation using gestures worked well, including the "space" and "delete" signs. The system performed consistently across Chrome, Firefox, Edge, and Android/iOS. Most users (88%) found the interface easy to use and responsive. The project met expectations for real-time gesture recognition, usability, and cross-device support.

# VI. FUTURE SCOPE

* Even though the system performs well, there are several areas where improvements and new features can be added in the future:
* Voice Output: Adding a speech module that converts detected text into spoken audio for better interaction.
* Support for Sentences: Instead of one letter at a time, future models can recognize full words or sentences using continuous gestures.
* Mobile App Version: Creating a mobile application for Android/iOS will increase portability and ease of access.

# VII. CONCLUSION

The primary goal of this project was to design and develop a web-based real-time hand sign recognition system that helps individuals who are hearing or speech impaired to communicate more easily. Using a combination of MediaPipe for hand tracking, CNN for gesture classification, and Flask for backend integration, we successfully built a system that detects hand signs via webcam and converts them into text output.

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