

Sign Language Detection System

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I. ABSTRACT

The Sign Language Recognition System helps deaf and mute individuals communicate with people who are unfamiliar with sign language. The proposed system provides an automated and intelligent platform that makes communication easier between deaf and mute individuals and hearing people. The system can identify and interpret sign language gestures and convert them into text form.

This project uses TensorFlow for accurate training and testing of the model to recognize sign language gestures. TensorFlow helps in detecting sign language movements, classifying gestures, making predictions, and improving the accuracy of the system.

MediaPipe is used in the sign language recognition system to track hand key points and detect hand movements. It helps in accurately identifying hand gestures for sign language interpretation.

Keywords — Hand Gesture Recognition, MediaPipe, TensorFlow, Real-Time Gesture Detection, Human-Computer Communication.

INTRODUCTION

Language is the main way people communicate, but some people find it difficult to communicate with others. Sign language helps deaf and mute people communicate easily. It is an important communication method for specially abled individuals[1].

The Sign Language Detection System uses image processing and deep learning techniques to recognize hand gestures. A camera captures hand movements, and the system processes the images and converts the detected signs into text format[2].

The main aim of this system is to recognize sign language gestures and translate them into text for easy understanding. The project is designed to detect gestures through a camera and provide real-time text conversion[3].

Human-Computer Interaction in this system allows users to interact with the system using hand gestures. It helps improve communication between deaf and mute individuals and hearing people[4].

Deep learning is used to train the system for accurate sign language detection. It helps the system recognize different hand gestures correctly and improves the overall accuracy and performance of the system[5].

II. LITERATURE REVIEW

Many sign language detection systems have been developed using image processing and machine learning methods. Existing systems use cameras to detect hand gestures, but some systems have low accuracy and are difficult to use. Deep learning and computer vision help to improve the performance of sign language detection systems.

AI-based systems use cameras to detect hand gestures and convert them into text. Many existing systems are expensive and difficult to use. The proposed system is simple, low-cost, and provides accurate sign language detection.

III. PROBLEM STATEMENT

The major challenges in sign language communication include:

- Low accuracy in gesture detection
- Difficulty in recognizing gestures in real time
- Lack of real-time decision-making
- Complex system implementation

IV. SYSTEM ARCHITECTURE

The Sign Language Detection System uses a camera, computer vision, and deep learning to detect and recognize hand gestures in real time.

A. Input Device

- Camera – captures hand gesture images in real time

B. Processing Module

- OpenCV – used for image processing
- MediaPipe – used for hand tracking and hand point detection.
- TensorFlow – used to recognize gestures
- Deep Learning Model – used to identify sign language gestures

C. Output Module

- Gestures are converted into text
- Output is displayed on the screen in real time

D. Communication

- Camera captures hand gestures
- The system detects the gestures
- Gestures are converted into text
- Users can communicate easily using sign language detection

V. TECHNOLOGIES USED

- **Programming Language:** Python
- **Python libraries :** I use are OpenCV , NumPy, TensorFlow and MediaPipe.
- **machine learning** with Convolutional Neural Network
- **Development Environment:** VS Code
- **Hardware Used:** Camera
- **Operating System:** Windows
- **Dataset:** Sign Language Gesture Dataset
- **Version Control Tool:** GitHub

VI. IMPLEMENTATION DETAILS

Working Principle

1. Camera captures hand signs
 2. The system detects the gesture
 3. The sign is recognized by the model
 4. The gesture is converted into text
 5. Text is shown on the screen
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VII. ALGORITHMIC FLOW

1. First start system
2. on the camera
3. scan hand movements
4. MediaPipe is used to identify these movements
5. process the image, with OpenCV.
6. Hand points are convert into image
7. Final stop the system

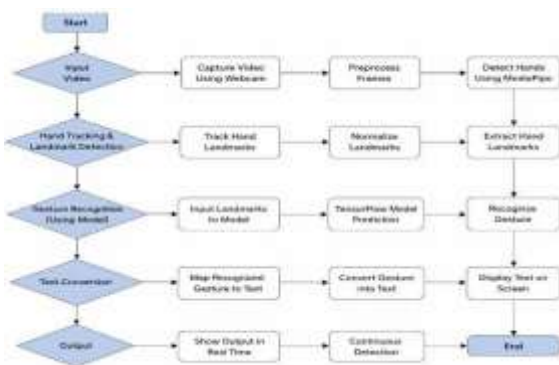


Fig. System Flow Chart



Fig. Sign Language Reference

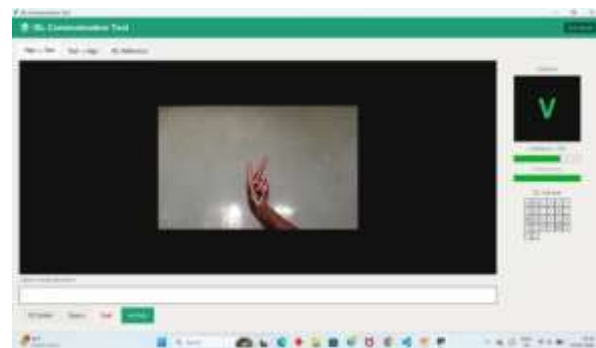


Fig. Sign Language Detected

VIII. TESTING AND RESULTS

A. Functional Testing

- Hand gesture detection verified
- Sign language recognition tested
- Camera functionality tested

B. Performance Results

Condition Sign language detection

Correct hand gesture	Detected	Text display
Wrong hand gesture	Not detected	not display

sign language detection system achieved accurate result and hand gesture detection and convert to text.

IX. APPLICATIONS

- Communication for deaf and mute people
- Schools and colleges
- Hospitals
- Public places
- Sign language learning systems

X. FUTURE ENHANCEMENTS

- Convert the Detected gesture into voice
- Mobile application development
- improve system accuracy
- Multiple languages can be supported

XI. ADVANTAGES

- Efficient water usage
- Reduced manual labor
- Real-time monitoring
- Low cost and scalable
- Environment friendly

XII. CONCLUSION

The Sign Language Detection System helps detect hand gestures and convert them into text. It makes communication easier for deaf and mute people. The system is simple, accurate, and useful for real-time communication.

XIII. LIMITATIONS

- Requires internet connectivity
- Sensor degradation over time
- Limited coverage area

XIV. REFERENCES

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