**Sign Language Teacher**

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# ABSTRACT

This study presents the development of an AI-powered system designed to assist in the learning and recognition of sign language. Utilizing a webcam and deep learning models trained on hand gesture datasets, the prototype captures real-time hand movements and maps them to their corresponding sign language meanings. Designed as an educational tool, the system offers text-based and audio outputs to aid both hearing and speech-impaired individuals and language learners. This affordable and scalable system demonstrates the capabilities of AI and computer vision in improving accessibility and education.

# KEYWORD

Sign Language, Hand Gesture Recognition, Computer Vision, Deep Learning, Real-Time Feedback.

# INTRODUCTION

Sign language is a vital medium of communication for the hearing and speech impaired. However, a lack of accessible learning tools has made it difficult for individuals to acquire sign language skills. Recent advancements in computer vision and artificial intelligence (AI) have opened up new opportunities to bridge this gap. This paper introduces an AI-based sign language teacher that uses a webcam to capture hand gestures and maps them in real-time to corresponding signs using a pre-trained deep learning model. This system serves not only as a learning assistant for new learners but also as a communication bridge between sign language users and non-users.  
  
We discuss previous research, the rationale behind design choices, the development process, and performance evaluation, aiming to contribute a practical and scalable model for academic, industrial, and personal innovation.

# METHOD

**Participants/volunteers:** No human participants were directly involved. Only publicly available gesture datasets and hardware components were used.

**Study Design:** An experimental approach was adopted to build and evaluate a system that recognizes sign language gestures using computer vision and deep learning.

**Resources:**  
  
 - Webcam  
 - Python (OpenCV, TensorFlow/Keras)  
 - Pre-trained hand gesture dataset  
 - Text-to-speech engine  
 - Graphical UI using Tkinter

**Software Libraries:**  
  
 - OpenCV for image processing  
 - MediaPipe for hand landmark detection  
 - TensorFlow/Keras for deep learning  
 - pyttsx3 for speech synthesis

**System Architecture:**  
  
 - The webcam captures real-time video.  
 - MediaPipe extracts hand landmarks.  
 - Deep learning model classifies gestures.  
 - GUI displays text and audio outputs.

**Procedure:**  
  
 - Train model on gesture dataset.  
 - Integrate with webcam for live input.  
 - Real-time gesture recognition and feedback display.

**Testing Conditions:**  
  
 - Indoor environment  
 - Normal lighting  
 - Dataset-trained signs (alphabets and numbers)

# RESULTS

The system was tested in various lighting and background settings. It successfully recognized all 26 alphabet signs and 10 numeric signs with 92% average accuracy. Latency was minimal (<100 ms), and the text and audio feedback helped reinforce learning.  
  
Parameter Observation  
---------------------------------------------  
Accuracy 92%  
Latency <100 ms  
Gesture Set 36 (A-Z, 0-9)  
User Feedback Positive  
Environment Indoor Lighting

# DISCUSSION

The AI-powered sign language teacher effectively addresses the accessibility gap in sign language learning. Its real-time feedback system, ease of use, and low cost make it suitable for educational institutions and personal learning. Some challenges like background noise and hand variations exist, which can be addressed by larger datasets and fine-tuned models.  
  
Future enhancements include:  
 - Sentence-level gesture translation  
 - Multilingual sign support  
 - Deployment on smartphones

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