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SIGN LANGUAGE TRANSLATOR FOR DEAF AND DUMB

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Abstract

Sign Vision is all-in-one solution for transparent communication by providing instant one-way translation of sign and spoken language. It uses state of the art computer vision, deep learning, and speech processing technologies to understand gestures and convert them into text and speech. It is a versatile tool for communication, useful in public spaces, schools and healthcare settings. Sign Vision consists of multiple integrated modules that handle gesture recognition and text generation. Using computer vision technologies such as OpenCV and Media Pipe, it captures and preprocesses hand gestures through a webcam, while deep learning models trained with attribute based classification enable accurate and fine grained sign recognition.

Keywords: Sign Language, Translation, Assistive Technology, Gesture Recognition, Sign-to-Speech.

1.INTRODUCTION

Communication barriers often isolate individuals who rely on sign language. Technology has emerged as a crucial bridge to address this gap, especially in the form of real-time sign language translation systems. Sign Vision presents an intelligent solution that integrates multiple AI-driven modules to recognize hand gestures and enable one-way interaction between signers and non-signers. Its design promotes accessibility and empowers diverse users.

Sign Language Recognition (SLR) has emerged as a crucial field in human computer interaction and assistive technology, aiming to bridge the communication gap between the hearing impaired community and the wider population [1], [2]. It involves the use of computer vision and machine learning, to interpret manual and non-manual gestures into readable or audible forms [3], [4]. With advancements in artificial intelligence and real-time processing, SLR systems are becoming increasingly effective in recognizing complex gestures and sequences, making them suitable for real-world applications [5].

2. METHODOLOGY

The development of SignVision follows a modular and iterative design methodology, consisting

of the following key phases:

1. Data Acquisition: Collection of labeled datasets for hand signs.

2. Gesture Preprocessing: Image normalization, background removal, and keypoint

detection to enhance gesture recognition accuracy.

3. Model Training: Use of deep learning (e.g., CNNs) to classify signs accurately.

4. Sign-to-Text Conversion: Real-time conversion of recognized gestures into text and

subsequent speech output using TTS engines.

5. Visual Rendering: Mapping recognized text into corresponding sign visuals

(image/GIF) for reverse translation.

6. GUI Development: Building an intuitive user interface for accessibility and interaction.

3. MODULES DESCRIPTION

a. Hand Gesture Recognition Module: This module captures live video using the webcam and applies Media Pipe to detect 21 hand landmarks in real-time. The extracted landmark coordinates are input into a trained CNN model that classifies the gesture into predefined sign labels. The recognized word is displayed as text and spoken aloud using the TTS engine.

b. User Interface (GUI) Module: The GUI, developed in Tkinter, offers real-time video previews, gesture recognition results, language selection options, and speech input triggers. It is designed to be user-friendly, responsive, and adaptable for users with varying technical skills.

i.SYSTEM WORKFLOW

1. Sign-to-Text/Speech Workflow

1. Video Input:

Captured via HD Webcam

2. Hand Tracking & Landmark Detection: MediaPipe extracts 21 hand landmarks in real time

3. Gesture Classification:

CNN model classifies landmarks into specific sign

4. Output Processing:

Text Generation: Displayed on GUI

Speech Output: Converted to audio using TTS (gTTS/pyttsx3)

5. User Interaction:

Real-time GUI feedback and language switching via Tkinter

CONCLUSION

Sign Vision addresses the critical need for accessible communication tools. Its real-time, AI-driven translation capabilities make it a scalable solution for reducing communication barriers. The system's adaptability and low hardware requirements make it ideal for integration in schools, hospitals, and public institutions

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