Assistive Glasses for Venezuelan Sign Language: Sign-to-Speech Translation Using Computer Vision

Salas, Martina (School: Colegio Bellas Artes)
Sleiman, Farah (School: Colegio Bellas Artes)
Garofalo, Ana (School: Colegio Bellas Artes)

Communication between Deaf individuals who use Venezuelan Sign Language (VSL) and hearing people presents significant barriers in everyday, academic, medical, and professional settings when interpreters are not available. The purpose of this project was to develop and evaluate a smart-glasses prototype capable of recognizing fundamental VSL signs and translating them into synthesized speech in real time using computer vision. The system was built using a Raspberry Pi Zero 2 W microcomputer, a front-facing camera, an integrated audio system, and a portable battery. The software was programmed in Python using computer vision libraries such as OpenCV and MediaPipe for hand landmark detection, combined with a TensorFlow Lite-based artificial intelligence model for sign recognition. A custom dataset of the VSL manual alphabet was developed through repeated trials, and the model was trained to convert detected gestures to speech output using a text-to-speech system. Testing was conducted using 1,400 controlled trials (50 per sign), with an automated logging system recording predicted labels, confidence scores, and latency. The system achieved an overall accuracy of 91.64%, with most signs reaching near-perfect classification. Mean system latency was 428.14 milliseconds, while real-world response time averaged approximately 1975 milliseconds due to stabilization requirements. Errors were primarily observed in visually similar signs. System usability was moderate, with a SUS score of 66.67/100. These results demonstrate that a lightweight, vision-based wearable system can achieve reliable real-time sign recognition and speech translation, with strong potential to improve accessibility and communication between Deaf and hearing individuals.

Awards Won: