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SignSpeak AI: Converting Sign Language to Text and Speech

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Abstract: *SignSpeak AI is a real-time assistive framework designed to break down communication barriers for the hearing- impaired community. The system utilises a fine-tuned YOLOv8 deep learning model to translate static Indian Sign Language (ISL) finger-spelling gestures into meaningful text and synthesised speech. The model was trained on a custom- curated dataset spanning 26 alphabetical classes, rigorously stratified into a 70% training, 15% validation, and 15% testing split to ensure robust generalisation. Performance evaluations validate the system's high fidelity, with optimal gesture classes achieving a Precision of 0.949, a Recall of 1.0, and a mean Average Precision (mAP50) of 0.992. Beyond core recognition, the architecture incorporates a 'human-in-the-loop' confirmation mechanism and the Gemini API to facilitate context-aware, bidirectional dialogue. Deployed via a low-latency Streamlit interface, the system provides simultaneous translation into two regional languages (Hindi and Kannada) with synchronised audio output, establishing a highly inclusive and data-driven solution for daily interactions..*

Keywords: Sign Language Recognition, YOLOv8, Streamlit, Gesture Detection, Multilingual Translation, Text-to-Speech (TTS), Gemini API, Assistive Technology, Accessibility

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