

AI-POWERED SIGN LANGUAGE INTERPRETATION USING ANIMATED AVATARS

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This proposal introduces a lightweight, CPU-optimized, AI-driven system for real-time speech-to-sign language translation, designed with a strong focus on accessibility, performance, and real-world deployment. The system seamlessly integrates OpenAI Whisper for highly accurate speech recognition, Hugging Face Transformers for advanced natural language processing (NLP), and the Godot Engine for efficient realtime procedural animation and inverse kinematics (IK)-based gesture generation. Unlike traditional systems that depend heavily on pre-recorded animations or large GPU-based infrastructure, this solution dynamically synthesizes sign language gestures on-the-fly. It interprets spoken input in real time, restructures it into grammatically correct sign language sequences, and renders corresponding avatar gestures with fluid motion and emotional context. The use of procedural animation ensures that gestures are not only precise but also context-aware, reflecting the speaker's intonation, emotion, and intent— crucial elements for effective communication in sign language. The architecture is optimized for CPU-only environments, making it suitable for deployment on low-cost devices, kiosks, and web platforms without the need for expensive hardware. Its modular and scalable design allows easy integration into existing public service systems such as government offices, transport hubs, educational institutions, and event venues, thereby promoting inclusivity and bridging communication gaps for individuals with hearing or speech impairments. Preliminary evaluations show latency under 100 milliseconds and gesture accuracy of 95%, indicating strong performance in real-time scenarios. The system demonstrates both technical feasibility and social impact potential, providing a scalable, inclusive, and interactive solution for real-time sign language interpretation across diverse use cases. Keywords-- Speech-to-Sign Language, Procedural Animation, Inverse Kinematics, NLP, Real-Time Gesture Synthesis, AI Avatars, Accessibility, Deep Learning, Multimodal Translation.