Real Time Sign Language Communication with 3D Avatars

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ABSTRACT

Communication barriers between deaf individuals and non-signing people hinder inclusivity across social, educational, and professional domains. This project presents an AI-driven, bidirectional sign language translation system that enables real-time interaction between hearing and non-hearing users. The system leverages Natural Language Processing (NLP) and Speech Recognition to convert spoken language into animated sign language using 3D avatars. Conversely, computer vision and electro optical sensors detect sign gestures and translate them into readable text or speech. Deep learning techniques, particularly in PyTorch, ensure accurate gesture recognition, while the front end, developed using Next.js, enables seamless user interaction. The entire system is hosted on scalable cloud platforms such as AWS, Azure, or DigitalOcean, ensuring accessibility from diverse environments. The platform supports multiple sign languages and adapts to regional and user-specific variations. By integrating Artificial Intelligence (AI), Natural Language Processing (NLP), and computer vision, this solution minimizes the reliance on human interpreters and offers a cost-effective, scalable tool for accessible communication. The proposed system enhances inclusivity and social equity, making public services, workplaces, and daily interactions more accessible for the deaf and hard-of-hearing community.