

Engineering for all: Empowering Students with Visual and Hearing Impairments through Inclusive Learning

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Abstract: Modern educational technologies frequently overlook the imperative of equitable and accessible learning opportunities, particularly for students with sensory and communicative disabilities. Prevailing methods often suffer from inadequate real-time assistance, limited sign language interpretation capabilities, and a scarcity of comprehensive multimodal content access, thereby perpetuating significant educational disparities. Furthermore, the absence of integrated, automated support functionalities hinders personalized learning pathways and timely interventions. To address these critical challenges, this research introduces "**Engineering for All**," an innovative, AI-driven inclusive learning platform meticulously designed to empower students with visual and hearing impairments.

The platform integrates MediaPipe for accurate sign language recognition, potentially enhanced by wearable sensors. OpenAI Whisper and FFmpeg enable seamless conversion of educational videos into synchronized text and audio. An intelligent NLP chatbot, powered by Random Forest, offers interactive query answering in text, voice, and sign language, adapting to individual communication preferences and considering the local linguistic context. Word embeddings and attention mechanisms ensure contextually relevant responses.

This research highlights AI's transformative potential in creating inclusive education, offering an affordable and scalable solution to democratize learning and foster equity for students with disabilities in culturally diverse environments like Tamil Nadu and beyond.