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Bridging Silence: A Real-Time Gesture-to-Voice Translator Using ESP32 and Flex Sensors

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Abstract: *Communication is a fundamental human need, yet individuals who are deaf and mute often face significant barriers in expressing themselves to the broader society. Traditional methods like sign language require both parties to be proficient, and interpreters are not always available or affordable. To address this challenge, this research presents a wearable Gesture-to-Speech System that translates hand gestures into audible speech using an ESP32 microcontroller, flex sensors, and a speaker module. The system is designed to be lightweight, cost-effective, and user-friendly, aiming to empower non-verbal individuals with a tool for real-time communication.*

The device operates by detecting specific hand gestures through flex sensors attached to a glove. These sensors measure the bending of fingers, and the data is processed by the ESP32 microcontroller to identify predefined gestures. Upon recognition, the system generates corresponding speech output via a speaker and displays the text on an optional screen for visual confirmation. The integration of these components ensures seamless translation from gesture to speech, facilitating more inclusive interactions. This paper delves into the system's architecture, detailing the hardware and software components, and discusses the methodology employed in developing and testing the prototype. A comprehensive literature review highlights existing technologies and their limitations, establishing the novelty and necessity of the proposed system. The results demonstrate the device's effectiveness in accurately recognizing gestures and delivering prompt speech output, indicating its potential to significantly enhance the quality of life for deaf and mute individuals..

Keywords: Gesture Recognition, ESP32, Smart Glove, Flex Sensors, Speech Conversion, Assistive Technology

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