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Hearing Aid with Real-Time Noise Filtering and Volume Protection for People with Hearing Disorder

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Abstract: *Hearing loss impacts millions globally, affecting their ability to perceive and interpret sounds clearly in noisy environments. Traditional hearing aids amplify all sounds, often resulting in discomfort and audio distortion. This paper presents the design and development of a real-time digital hearing aid system equipped with noise filtering and volume protection features for individuals with hearing disorders. Unlike conventional hearing aids that amplify all surrounding sounds indiscriminately, the proposed system intelligently filters background noise and dynamically regulates output volume to prevent sudden loud sounds from causing discomfort or further damage. The device is built around the ESP32 microcontroller and utilizes an INMP441 digital MEMS microphone for sound capture, along with a PAM8403 amplifier for audio output. The system processes the audio in real-time and transmits it to a speaker with optimized gain and clarity. Designed to be compact, power-efficient, and affordable, this hearing aid offers a practical and enhanced auditory experience for users in various acoustic environments*

Keywords: Hearing loss

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