Glasses for the Hearing Impaired

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This study addressed the engineering challenge: can a low cost, microcontroller based device reliably detect and visually represent alerts in real time for individuals with hearing impairments? To test this, a prototype was developed utilizing a MAX4466 microphone amplifier (16kHz sampling rate, analog voltage output converted to decibel readings via code conversion, Adjustable gain) wired with a Seeed Studio XIAO ESP32S3 microcontroller. Audio data was sent over Bluetooth to a convolutional neural network based on the VGG 19 architecture. The network was retrained in Keras for 20 epochs on a dataset of horns, gunshots, jackhammers, and sirens. A 3 second background noise calibration set detection thresholds as the mean decibel level. Performance was evaluated across over 1,000 trials across five ambient noise levels (40 to 80dB) and all distances up to 9 meters with an interval of 1 meter (1, 2, ..., 9). The microphone subsystem achieved a 95% detection rate at 1 to 5 meters, decreasing to below 80% at 9 meters under high noise conditions. The neural network classifier had 89.8% overall accuracy when classifying sirens, horns, and gunshots. These results demonstrate the prototype's potential as an assistive tool for the hearing impaired. Future work will expand the training dataset to additional sound classes and the training for improved accuracy and detection in various environments.

Awards Won: