Smartphone-Based Otoacoustic Emission Testing

A cost-effective Otoacoustic Emissions (OAE) probe, designed to operate with a smartphone, utilizes off-the-shelf earbuds and microphones. The device employs an algorithm to detect distortion-product OAEs, providing a practical solution for early detection of hearing loss in lower- and middle-income countries.

What is the Problem?

Disabling hearing loss is a significant global health concern, affecting one in every twenty people worldwide. Early detection is crucial to mitigate its impact, particularly in young children whose neurodevelopment can be adversely affected by hearing loss. Otoacoustic Emissions (OAE) testing, which involves the detection of sounds generated by the outer hair cells in a healthy cochlea, has become a standard part of infant hearing screening protocols. These sounds provide valuable insights into cochlear function without requiring any response from the subject, making OAE testing particularly effective for infants.

However, the high cost of OAE testing equipment (often running into thousands of dollars) poses a significant economic challenge, especially for low- and middle-income countries (LMICs). As a result, these countries often lack widespread screening programs, explaining why LMICs bear a disproportionate percentage of disabling hearing loss cases.

Efforts to design more affordable OAE testing hardware have made some progress, but these solutions still require the expensive manufacturing of custom electronics and often lack comprehensive data from clinical testing. Therefore, there remains an unmet need for cost-effective, scalable technology that can perform OAE screening with the same level of accuracy as hospital-grade equipment. This technology would significantly improve the accessibility of early hearing loss detection, particularly in LMICs.

What is the Solution?

The solution is a technology pairing commonly available devices with specialized software. It pairs an Android smartphone with off-the-shelf earbuds and microphones to achieve OAE screening that matches the performance of commercial OAE devices. The hardware components are readily available and inexpensive, significantly contributing to the overall affordability of the device and sidestepping expensive custom electronics. The software of the system is designed to recognize both when there is too much noise for a valid signal to be read, as well as if the noise level is too high for a realistic measurement, improving the quality of the resulting data.

Technology ID

BDP 8822

Category

Device/Other
Diagnostics
Selection of Available Technologies
Diagnostic

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In clinical studies conducted across multiple healthcare sites and involving 201 pediatric ears, this device demonstrated its effectiveness by detecting hearing loss with 100% sensitivity and 88.9% specificity. This performance is on par with that of commercial devices, making this solution a promising alternative for early detection of hearing loss, especially in resource-constrained settings.

What is the Competitive Advantage?

- Affordability: With a material cost of approximately US$10, this device significantly reduces the financial barrier to hearing screening. No custom electronics are necessary for the device to function, greatly reducing the cost compared to other OAE devices.

- Accessibility: By utilizing commonly available smartphone technology, the device can be used in a wide range of settings, including resource-constrained environments. Due to its simplicity and availability, this technology aims to be leveraged by anyone ranging from government screening programs to healthcare-focused foundations aiding LMICs.

- Effectiveness: In a clinical study involving 201 pediatric ears across three healthcare sites, the device detected hearing loss with 100% sensitivity and 88.9% specificity, comparable to the performance of a commercial device.

References

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