

Towards Developing Neonatal Hearing Screening System

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Abstract

A customized neonatal hearing screening system was developed to enable high-fidelity extraction of Auditory Brainstem Response (ABR) and Mismatch Negativity (MMN) signals. The core of the system is an optimized electronic acquisition platform built upon a low-noise analog front end that employs the AD8421 instrumentation amplifier for microvolt-level EEG sensing and the LTC6910-1 programmable gain stage for digitally controlled amplification. These conditioned signals interface with a high-resolution AD7768-4 sigma-delta ADC, synchronized to the dual-core STM32H757IIT6 microcontroller, enabling precise multi-channel neural data acquisition, audio stimulus timing, external memory management, and SD-card-based data logging. Complementing the electronics, flexible hydrogel-based scalp electrodes featuring a Polypyrrole/Ag-decorated SWCNT composite embedded in a PVA-glycerol matrix were fabricated to achieve low skin-electrode impedance, improving neonatal comfort and signal integrity. The electrodes are integrated into a custom wearable headband engineered for stable placement at Fz, Fpz, and Cz positions, ensuring consistent ABR/MMN extraction during clinical testing. Overall, the integration of optimized electronics, conductive hydrogel electrodes, and a dedicated wearable interface positions this system as a promising next-generation platform for accessible, early-stage neonatal hearing assessment in diverse clinical settings.

Keywords

Neonatal hearing screening, auditory brainstem response (ABR), mismatch negativity (MMN), hydrogel-based EEG electrode.