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Non-contact assessment of newborn and preterm infant activity levels, behavioral states, and sleep-wake cycles in Neonatal Intensive Care Units

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Background: Preterm births are increasing worldwide. Every 10th baby stays in an incubator for weeks or months. Surveys confirm the importance of undisturbed sleep in surviving and healing during this period. However, there are no medical means of monitoring sleeping habits or disruptive environmental hazards.

Material and Methods: To support minimal intervention practice, we develop surveillance, sleep, and behavior analysis systems for medical professionals in neonatal intensive care units. Our vision is to give a tool for caregivers and families to see the babies and their development. The intelligent surveillance system is based on our incubator-friendly day and night working cameras and AI sleeping stage classification. The system is working in a closed local network, securely and independently of the hospital intranet. For data analysis and AI training, we store the videos and annotate them offline and online with bedside tablets. Infants' data is acquired by parental questionnaire in recorded in a REDCap database for further analysis.

Results: The achieved accuracy of the recognition of the neonates' NIDCAP behavioral phases is 85.5-95.8% on a 1000+ hours dataset. We recognize stages besides behavioral phases, like invasive, and non-invasive treatments, and skin-to-skin contact periods.

Conclusion: The non-contact and continuous 24/7 surveillance gives great help for minimal intervention practice, furthermore our design is suitable for a wide range of closed incubator types. We are working on to make the system available.

Keywords: NIDCAP, non-contact monitoring, NICU