Deployment of an on-the-edge Clinical Decision Support System in Neonatal Intensive Care Units

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Context: Premature infants require continuous monitoring prior to discharge from neonatal intensive care units (NICU). Conditions such as icterus, apnea, bradycardia, sepsis, etc. are life-threatening and/or cause long-term consequences for this population. The deployment of an AI-based clinical decision support system (CDSS) facilitating early prediction, diagnosis and intervention in the NICU setting is challenging yet promising. This work presents the design, implementation and deployment analysis of a CDSS, allowing for quasi-real-time processing of high-resolution monitoring time series and hospital information system (HIS) data, embedded into a virtual machine (VM).

Methods: Raw signals from NICU monitors are exported through Philips' Data Warehouse Connect system. Also, regularly-sampled clinical data from the HIS are exported. Every 15 min, data concerning the last 20 min from these two sources are copied into a VM mounting point. This VM contains the entire chain of data handling, processing and model inference, which is activated each time a new data segment arrives. The processing pipeline includes RR series calculation and correction, HRV analysis, feature extraction and the application of a previously trained and tested model, in inference mode, to make clinically meaningful predictions, while minimizing computation time and memory footprint.

Results: The proposed system was deployed at the University Hospital of Rennes in Jan 2023. Improved stabilization was quantitatively measured through the continuous error-free running time increasing from < 5 hrs. to > 12 hrs. and > 3 days during three deployment stages. The system has been running steadily for over a month, constantly receiving data from 10 neonates, processing live data, and producing bilirubin level estimations uninterruptedly.

Conclusion: To our knowledge, this is the first description of a multi-source, on-the-edge CDSS deployed in a NICU scenario. This proof-of-concept is particularly encouraging and required for the forthcoming prospective clinical evaluation of our inference models.

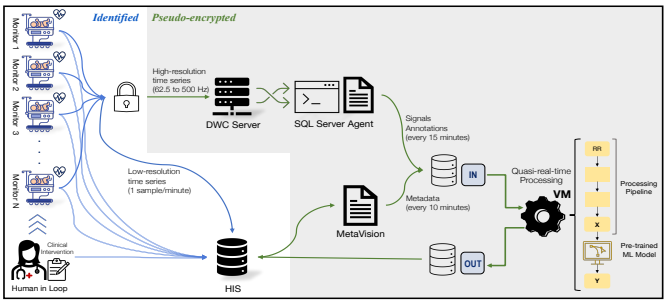

Figure 1. Architecture of the proposed on-the-edge system for quasi-real-time clinical decision support in NICU.