

NRTS: A Client-Server Architecture for Supporting Education in a Neonatal Resuscitation Simulation Scenario

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Abstract. In this paper, we describe Neonatal Resuscitation Training Simulator (NRTS), an Android mobile app designed to support medical experts to input, transmit and record data during a High-Fidelity Simulation course for neonatal resuscitation. This mobile app allows one to automatically send all the recorded data from the Neonatal Intensive Care Unit (NICU) of Casale Monferrato Children's Hospital, (Italy) to a server in the cloud managed by the University of Piemonte Orientale (Italy). The medical instructor can then view statistics on simulation exercises, that may be used during the debriefing phase for the evaluation of multidisciplinary teams involved in the simulation scenarios.

Keywords. Cloud architecture, High Fidelity Simulation, Intensive Care Unit, Mobile app, Neonatal resuscitation, Simulation based training.

1. Introduction

The delivery room is a complex and dynamic environment, and although most new-born babies present a normal adaptation to birth, about 5-10% need some form of help in the transition from intra- to extra-uterine life, with 3-5% requiring mask ventilation, and about 1% requiring advanced resuscitation measures such as intubation, chest compressions and medication [1]. In consequence of the relative infrequency of extensive resuscitation intervention needs, and of the complexity and dynamism of neonatal emergencies, the delivery room can become a high-risk place for patients and a very stressful setting for the care staff, who must be fully aware of the various steps and be trained and prepared to skilfully perform the procedures, working effectively in a team. By combining teaching and risk analysis in a safe environment for healthcare

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workers, medical simulation can decrease errors caused by human factors and create a more effective and safer patient treatment. Naturally, simulation programs must be standardized and of verifiable effectiveness. This work aims at supporting multidisciplinary team education through medical simulation in the domain of neonatal resuscitation. Students and medical personnel attending the sessions also work with real patients (newborn and premature babies), but the goal is that they will be more prepared and aware when they are faced with real cases and patients. Stemming from our previous experience in data recording and transmission in an emergency context [2], we have defined a Client-Server architecture called **Neonatal Resuscitation Training Simulator (NRTS)**, designed for recording the neonatal resuscitation procedure realized by students during the simulation scenario, and for facilitating the subsequent evaluation of the multidisciplinary student team in the debriefing phase.

2. The NRTS client-server architecture

The architecture provides a mobile app which, through a minimalist interface implemented with the help of domain experts, enables the medical supervisor to input, transmit and record data during the simulation exercise. The app automatically sends all the recorded data to a server in the form of a process trace (i.e., the sequences of actions executed by the student team on the “Newborn Anne” device²: an anatomically correct manikin of a baby born at 25 weeks).

The medical instructor can also enter and send other significant patient and simulation parameters, such as body temperature T, saturation levels SpO₂, or qualitative notes and comments, acquired through a speech-to-text function.

Once the process traces generated by the different student teams have been received by the server, they are automatically analyzed, by means of a comparison to the “gold-standard” trace, defined by the reference clinical guideline. Trace comparison resorts to a metric [3], able to deal with discrepancies in temporal information. Indeed, in a medical emergency domain, it is important to penalize the fact that a possibly correct action has required an excessive duration, or that an unjustified delay has taken place. The comparison results are then shown to the instructor through the app. The NRTS app has been developed and designed to run on smartphone devices with a minimum operating system of Android v. 13 “Tiramisù”. More information on how to download the app can be found here: <https://sites.google.com/uniupo.it/massimocanonico/misc/projects/nrts>. The app is being used and we are collecting data and feedback from the users in order to improve the user experience and the data accuracy.

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² <https://laerdal.com/us/products/simulation-training/obstetrics-pediatrics/premature-anne/>.