Monthly Progress Report

NeoCare - Contactless Neonatal Health Monitoring System

July 2025

1 Individual Contributions

1.1 A.A.W.L.R.Amarasinghe 210031H

My focus was on evaluating existing non-contact vital sign estimation applications, preparing ethical clearance documents, and coordinating hospital discussions to refine project feasibility. Initial testing was carried out using the Doc99 Selfie Scan mobile app, which estimates parameters such as pulse rate, HRV, blood pressure, and BMI. Although readings roughly matched pulse oximeter measurements, the lack of transparency in estimation methods and unsuitability for pediatric use were noted. Work also involved discussions with the previous year's project team to identify potential technical and domain novelties. Key identified novelties included a privacy-preserving architecture that transmits only extracted physiological features (instead of raw facial videos) and the first known attempt at non-contact neonatal blood pressure estimation using facial imaging. University of Moratuwa ethical clearance document preparation included Forms A and B, multilingual consent forms, and information sheets. Meetings with Prof. Thanuja Sandanayake, Chairperson of University Ethics Review Committee, clarified submission requirements. Following an online meeting with Dr. Nishani Lucas (Consultant Neonatologist, De Soysa Hospital), the project direction was adjusted. Neonatal blood pressure and HRV estimation were removed due to practical limitations in ground-truth collection. The scope expanded to include non-contact neonatal jaundice detection. Device benchmarking determined the Samsung Galaxy S25 Ultra as the optimal choice for real-time AI processing due to its high-performance NPU, 12 GB RAM, and hardware-accelerated inference capability.

1.2 M.K.I.G.Morawakgoda 210391J

The primary focus was on literature review, model analysis, and dataset exploration related to remote photoplethysmography (rPPG) and neonatal vital-sign estimation. Three core architectures were compared — 3D CNNs, Vision Transformers (ViTs), and Mamba-based models. Findings highlighted that 3D CNNs provide low latency but limited temporal range, ViTs offer high accuracy but with high computational cost, and Mamba-based models achieve a balanced trade-off between accuracy and efficiency. The state-of-the-art models identified for those architectures are FactoryPhys (3D CNN, 0.05M), RhythmFormer (Vision Transformer, 3.25M), and PhysMamba (Mamba, 0.56M). Analysis of previous project implementations (PhysNet-based) confirmed that heart-rate estimation was derived using FFT on PPG signals, while SpO_2 prediction employed added fully connected layers. Potential extensions were proposed, including ROI-based preprocessing, motion-augmented training, and privacy-preserving deployment. Further, research established the forehead and cheek regions as the most effective ROIs for rPPG signal extraction. Comparative evaluation showed that deep learning–based approaches outper-

form traditional color-signal methods in robustness and accuracy. Accuracy metrics for SOTA methods were reviewed, with PhysMamba (MAE = 0.25 bpm) and PhysNet (MAE = 2.97 bpm on neonatal datasets) demonstrating strong performance, though neonatal data still requires specialized adaptation.

1.3 S.M.S.M.B.Abeyrathna 210005H

Work centered on analyzing the previous year's VideoPulse project, exploring privacy-preserving techniques, and conducting an extensive review of neonatal jaundice detection methods. The VideoPulse model, based on 3D CNNs (PhysNet), used rPPG signal extraction to estimate heart rate and SpO_2. The architecture, evaluation metrics (MAE, MAPE, weighted RMSE), and optimization strategies such as Label Distribution Smoothing (LDS) and time-reversal augmentation were thoroughly studied. Privacy-preserving video methods were reviewed through key papers: *Privacy-Preserving Remote Heart Rate Estimation from Facial Videos* (Gupta, D. Etemad, A., 2023 IEEE International Conference on Systems, Man, and Cybernetics (SMC), Melbourne, Australia, Oct. 2023.) and *De-Identification of Facial Videos while Preserving Remote Physiological Utility* (Savic & Zhao, 2023). Findings led to adopting a face-region masking approach that retains only the forehead and cheek areas for signal extraction while obscuring identity features. Following clinical feedback from Dr. Nishani Lucas, attention shifted toward non-contact neonatal jaundice detection. Literature review covered methods using RGB, HSV, and YCbCr color transformations and machine learning models (ResNet50, MobileNetV2, EfficientNet) trained on the JaunEnet dataset. Challenges such as lighting variation and camera calibration were noted.

1.4 U.M.Y.B.Alahakoon 210027C

The main responsibilities included research coordination, ethical-clearance preparation, and privacy-preserving strategy development. Early work involved studying existing literature on video-based blood pressure and heart-rate estimation, focusing on methods by Chen et al., Dasari et al., and Trirongjitmoah et al. Insights were gained into ROI extraction, signal filtering, and mapping facial color variations to physiological indicators. Extensive exploration of privacy-preserving techniques was conducted, including differential privacy, federated learning, homomorphic encryption, and SMPC. For practical deployment, simplified strategies were identified: Face-region masking (retain forehead / cheek areas), On-device preprocessing to avoid raw data transmission and Immediate raw-video deletion after feature extraction. Led communication with De Soysa Hospital and coordinated the De Soysa hospital ethics review submission, preparing translated documents (Sinhala, Tamil, English) and ensuring compliance with ethical standards. The feasibility presentation was compiled and refined with feedback from Dr. Lucas, focusing on clinical viability and privacy alignment.

2 Overall Progress Summary

During this month, we have made great progress in both technical groundwork and administrative preparation. Literature surveys and experiments established a solid foundation for non-contact neonatal monitoring. Hospital consultations refined the scope of the clinical approach to jaundice and respiratory rate detection, ensuring practical feasibility. Key achievements included: Completion of university and hospital ethical clearance documentation, including multilingual consent forms and information sheets, Identification of technical novelties, privacy-preserving architecture,, and neonatal-specific rPPG modeling, Selection and benchmarking of MediaPipe Face Mesh for ROI extraction and preprocessing, Evaluation of SOTA deep learning models (PhysNet, PhysMamba, and RhythmFormer) for physiological estimation, Review and integration of privacy-preserving preprocessing (eye masking, blurring, feature-only transmission) and The feasibility presentation wastion was finalized and delivered, establishing clear clinical, ethical, and technical directions for the project. Overall, we successfully transitioned from initial exploration to well-defined, ethically compliant, and technically feasible objectives, setting the foundation for implementation in the coming months.

Declaration

We certify that the information provided in this report is true and accurate to the best of our knowledge.

Student: A.A.W.L.R.Amarasinghe **Signature:** .....

Student: M.K.I.G.Morawakgoda **Signature:** .....

Student: S.M.S.M.B.Abeyrathna **Signature:** .....

Student: U.M.Y.B.Alahakoon **Signature:** .....

Approval

Approval of project supervisors.

Supervisor: Dr. Sampath K. Perera **Signature:** .....

Supervisor: Dr. Pranjeevan Kulasingham **Signature:** .....