Monthly Progress Report

NeoCare - Contactless Neonatal Health Monitoring System

August 2025

1 Individual Contributions

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

The focus was on preparing and presenting the feasibility study, investigating hospital practices for neonatal jaundice detection, and analyzing the NJN dataset. Efforts were made to ensure privacy and security considerations were addressed. Neonatal temperature estimation was removed from the project due to the need for thermal imaging, which most mobile phones cannot capture. At De Soysa Hospital, a hospital environment investigation was conducted with Dr. Nishani Lucas. Observations included a jaundice-diagnosed neonate, highlighting the challenge of identifying jaundice visually for non-trained individuals. The pulse oximeter available in the hospital lacked a USB port, preventing PPG signal acquisition. Discussions with hospital staff clarified the standard jaundice detection procedure, which begins with visual inspection, followed by bilirubin testing if signs of jaundice appear. Treatment decisions are based on bilirubin level and risk assessment, including phototherapy for low-risk and exchange transfusion for high-risk cases. Both bilirubin level and days from birth were noted as essential parameters for data collection. The NJN dataset contains 760 facial images of newborns, including 560 normal and 200 jaundiced infants. Three classification techniques including k-Nearest Neighbors (kNN), Random Forest (RF), and XGBoost were evaluated, with XGBoost achieving the best performance. Facial landmark detection was performed using Dlib's 68-point detector to identify key facial features. This model provides coordinates for various facial landmarks, including points 36–41 for the left eye and 42–47 for the right eye. But it was unable to detect landmarks in some frames. So trained it on more data to make the detections robust. After detecting the face, the corresponding coordinates of the eyes were extracted for further processing.

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

During the visit to De Soysa Hospital, there was an opportunity to observe a neonate diagnosed with jaundice. It was noted that, as non-professionals, it was not possible to visually identify jaundice or distinguish between jaundiced and non-jaundiced infants. Only trained medical professionals are capable of making such visual assessments accurately. Work focused on neonatal jaundice detection and rPPG-based physiological monitoring, emphasizing the selection of suitable regions of interest (ROI), dataset exploration, and model evaluation. The study concluded that the forehead is the most suitable ROI for jaundice detection due to practical limitations and privacy concerns associated with using the eyes. Accuracy metrics for state-of-the-art methods were reviewed: ResNet50 with image augmentation - 84.1%, Smartphone-based skin color segmentation - 93.0% and Spectral-Spatial Graph Neural Network (SSGNN) - 96.5%. The rPPG Toolbox repository was reviewed and cloned, with inference tests successfully conducted on the

UBFC-rPPG dataset. The NBHR dataset received from the previous group includes PPG signal values, heart rate, and SpO_2 data sampled at 60 Hz, with videos at 640×640 resolution. Mobile-compatible datasets were also investigated, identifying the MMPD dataset as the primary source. PhysNet and PhysMamba models were tested on adult and neonatal data. Both models performed well on adult datasets but poorly on NBHR neonatal videos, emphasizing the need for neonatal-specific adaptation. Analysis of the NBHR PPG signals revealed sine-wave patterns differing from adult signals, likely due to neonate movement affecting probe stability. Testing confirmed that FFT-based heart rate predictions aligned precisely with ground truth values.

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

The work began with preparing for the feasibility presentation, where the slides were finalized, refined and practiced to ensure a clear and confident delivery. After the presentation, the project scope was refined by removing the neonatal temperature estimation feature, as it required thermal images that most mobile devices cannot capture. This helped focus the project on more practical and achievable goals. Following discussions with supervisors, more attention was given to strengthening the privacy and security aspects of the system, since this area has not been explored in similar neonatal monitoring applications and adds significant novelty and value to the project. At the same time, preparations for De Soysa hospital ethical clearance were carried out in consultation with Prof. Nishani Lucas, who guided the team through the ethical review process and required documentation. All necessary documents, including consent forms, information sheets, project proposal, funding details, and GCP certificates, were finalized and carefully reviewed before submission to De Soysa Maternity Hospital to avoid any delays. Later, the team visited the hospital with Dr. Nishani Lucas to observe real jaundice cases. It was found that mild jaundice is often difficult to detect visually and that lighting variations in the hospital environment significantly affect skin color appearance. This highlighted the importance of integrating lighting correction and color normalization methods into the preprocessing stage. From a technical point of view, experiments were conducted using the JaunEnet model, which was trained on images taken under controlled lighting with color calibration cards placed beside the skin region. Their preprocessing involved color space transformations such as converting RGB images into HSV and LAB spaces to handle illumination differences effectively. While this approach worked well theoretically, it is not practical for a mobile application since real-life images captured by parents won't have calibration cards or isolated skin patches. Therefore, instead of directly using the JaunEnet model, we plan to integrate key ideas like color correction and color space transformations while adding automatic skin segmentation to make the system robust for real world use.

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

Work centered on respiratory rate (RR) estimation from rPPG signals and large dataset handling. Lightweight deep learning models, including MobileNetV3, EfficientNet-Lite, and TinyPhysNet, were explored. Model optimization through quantization and pruning was studied to enable mobile deployment with reduced size and latency. Research papers reviewed included methods for RR estimation from PPG/ECG signals and weakly supervised learning for temporal feature extraction. Initial implementations in Jupyter

Notebook applied filtering and peak detection as a first step for neonatal RR estimation. Large datasets were downloaded and organized for testing, including VideoPulse (159 GB). SSH access to the project server was established, and preliminary tests verified data accessibility and readiness for signal extraction and analysis.

2 Overall Progress Summary

This month saw significant progress in both technical implementation and administrative preparation. Feasibility validation was completed, hospital environment observations provided crucial insights into clinical workflows and lighting conditions, and neonatal datasets were thoroughly analyzed. All ethical clearance preparation and submission for De Soysa Hospital were finalized, consolidating the following documents: Applicant and supervisor CVs, Request letter and project funding details, Consent forms and information sheets in three languages, Project proposal copies and certificates, GCP training proof and submission checklist. Technical achievements included the verification of preprocessing pipelines for ROI extraction and color normalization. Analyzed JaunEnet dataset and tested the model to identify key insights of how to handle the lighting effects. Moreover rPPG signal extraction and respiratory rate estimation workflows were tested, and privacy-preserving video preprocessing, including automated eye masking, was implemented. Large datasets were structured for remote processing, ensuring data accessibility and suitability for neonatal-specific physiological monitoring experiments.

Declaration

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

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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:** ....