Monthly Progress Report

NeoCare - Contactless Neonatal Health Monitoring System

September 2025

1 Individual Contributions

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

Met with Prof. Anusha Withana (University of Sydney) online, who advised focusing on a specific technical novelty and suggested homomorphic encryption for privacy preservation. Contacted the previous team regarding PhysMamba GPU crashes, discovering the issue occurs when running on a single CUDA GPU. Explored Region of Interest (ROI) detection methods; identified forehead and cheeks as the most effective regions. In MediaPipe 468-point Face Mesh, landmark indices were mapped as follows: Left cheek: 234–243, Right cheek: 454–463, Forehead: 1–5, 152–159. Received ethical clearance from De Soysa Hospital, after adjustments to information sheets and consent forms. Translated documents into English and Tamil and proofread them. University of Moratuwa ethics review committee requested proposal clarifications, which were addressed with supervisor guidance.Purchased Google Colab GPU units for model training. Trained a jaundice detection model using the NJN dataset after augmented to 600 Normal and 600 Jaundice samples to mitigate class imbalance. Applied transfer learning with MobileNetV2 backbone, added GlobalAveragePooling2D, Dense, Dropout, and output layers for binary classification. Tested hyperparameter variations, including unfreezing layers after 120 for further training. Developed eye blurring process for privacy preservation. Videos were converted to frames, eyes detected with MediaPipe landmark detector, and Gaussian blur applied. Tested multiple methods for handling missing eye detections across frames; In some frames eyes were not detected. Copying previous-frame coordinates was the effective solution. Evaluated video stitching methods and addressed data loss issues by switching from PNG to lossless JPG format.

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

Reviewed peak detection and Fast Fourier Transform (FFT) methods for heart rate estimation. Peak detection involves identifying local maxima and calculating HR from time differences; FFT involves transforming PPG to frequency domain, applying bandpass filter, and selecting frequency with maximum power. Tested peak detection and FFT on predicted rPPG signals from PhysNet and PhysMamba using UBFC-rPPG videos. Peak detection showed PhysMamba outperforming PhysNet due to more accurate peak identification. FFT produced values identical to ground truth but inherent error exists due to frequency resolution ($\Delta HR \approx 1.8$ bpm; margin of error $e = 0.9$ bpm). Explored synchronization of mobile video feed with pulse oximeter PPG signals. Found Android 14+ devices can act as webcams over USB. Tested pulse oximeter connectivity; device detected only under Human Interface Devices, requiring alternative methods or drivers to acquire live PPG signals. Validated peak detection and FFT using VideoPulse dataset. FFT achieved MAE = 2.5534 bpm, RMSE = 3.8816 bpm; peak detection MAE = 4.9983

bpm, RMSE = 6.4854 bpm. Developed a scalable training script for heart rate estimation, compatible with any model or dataset, and successfully tested on a subset of video data.

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

Tested MobileNetV5 on NHBR dataset videos. Real-world challenges (occlusion, low lighting, small face regions, color interference) led to poor performance. Feature activation maps showed model misclassifying background textures. Concluded that robust preprocessing for accurate skin/face detection is needed. Improved preprocessing pipeline using MediaPipe Face Detection and color-based skin segmentation (YCbCr thresholds). Gaussian smoothing applied. Preprocessed frames provided cleaner inputs, slightly improving MobileNetV5 performance. Developed 1D-CNN model using color-based features from segmented skin regions. Steps included: White balancing to standardize lighting, Conversion to HSV color space, Yellow color range masking, Contour detection for largest skin region, Conversion to LAB space for color analysis, Histogram normalization and color correction and ROI extraction for skin-only pixels.Average color intensity values were extracted and fed into a 1D-CNN. Initial results showed reasonable differentiation between jaundiced and non-jaundiced samples. Further optimization planned for comparison with MobileNetV5. We presented the project to the De Soysa Hospital Ethics Review Committee, where feedback led to revisions of the information sheet and consent forms in all three languages, after which ethical approval was granted under specific conditions. The University of Moratuwa Ethics Review Committee also requested clarifications, which were addressed and resubmitted.

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

Implemented respiratory rate estimation from rPPG signals using the method from Xiao et al. (2020), where RIAV, RIFV, and RIIV signals were first extracted from the PPG, followed by application of a Signal Quality Index (SQI) to filter unreliable segments. Autocorrelation (AC) and autoregressive (AR) modeling were then applied to estimate respiratory frequency, and the results were fused to produce a robust RR prediction, achieving an error of 3.72% on the CapnoBase dataset. Coordinated De Soysa hospital visits, attended ethics committee meetings, refined forms, and explored segmentation techniques for neonatal facial videos to extract reliable ROI (forehead and cheeks). Tested Android phones as webcams to stream live video for rPPG extraction. Investigated pulse oximeter integration and synchronization with video feed. Explored software and manufacturer documentation for real-time PPG acquisition. Developed mobile application. Frontend: React Native for capturing video frames and displaying results. Studied lightweight deployment strategies, real-time video feeding, and preprocessing pipelines for on-device inference. Coordinated with previous team for code and dataset references.

2 Overall Progress Summary

During this month, significant progress was achieved in both technical groundwork and administrative preparation. Literature surveys, experiments, and hospital consultations established a strong foundation for non-contact neonatal monitoring. Completion of University of Moratuwa ethical clearance documentation for the second submission. De Soysa Hospital ethical clearance is granted. Identification of technical novelties, including privacy-preserving architecture and neonatal-specific rPPG modeling. Development and benchmarking of MediaPipe Face Mesh for accurate ROI extraction, focusing on the forehead and cheeks. Evaluation of state-of-the-art deep learning models (PhysNet, PhysMamba, RhythmFormer) for physiological estimation. Implementation of privacy-preserving preprocessing, including eye blurring, face-region masking, and feature-only transmission. Training of MobileNetV2 on an augmented NJN dataset for jaundice detection and development of a 1D-CNN using color-based features from segmented skin regions. Preliminary setup for mobile deployment, including frontend development using React Native and backend integration with Docker and PostgreSQL. Overall, the team successfully transitioned from exploratory work to well-defined, ethically compliant, and technically feasible objectives, setting a strong foundation for model training, preprocessing, and mobile deployment in the upcoming 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:** .....