CP-Net: A Deep Learning Framework for Simultaneous Measurement of Heart Rate, Blood Pressure and Respiration Rate from PPG

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Methods: The block diagram of the proposed model is shown in Fig. 1(A). The model's performance was evaluated by calculating the normalized mean absolute error (NMAE) and normalized root mean square error (NRMSE).
Results: Out of 38 subjects, signals collected from 31 subjects were selected in this study for further assessment. The model yielded NMAE of 0.0714 breath rate per minute (brpm), 0.0619 beats per minute (bpm), 0.1620 mmHg, and 0.0321 mmHg, and NRMSE of 0.1054, 0.071, 0.205, 0.039 for RR, HR, SBP, and DBP respectively and the overall loss was 0.0597 along with calculated errors for all four parameters. The normalized value of actual and predicted parameters are represented through a box-whisker plot, as shown in Fig. 1(B). A quantitative comparison with some earlier studies is shown in Table 1.
Conclusion: The results exhibited that there was significantly less difference between actual and predicted values, which reflected the effectiveness of the proposed framework for the simultaneous measurement of all four vital parameters from PPG.

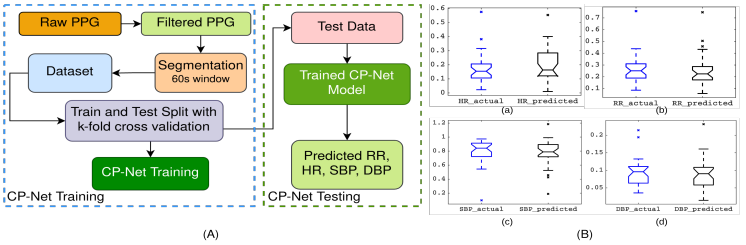

Figure 1: (A) Block diagram of the study, (B) Actual and predicted normalized values of each parameter.

Table 1: Quantitative Comparison of the proposed framework with previous related studies.

Work	Database	Subject	Method used	Performance (MAE±SD)			
				RR (brpm)	HR (bpm)	SBP (mmHg)	DBP (mmHg)
Chowdhury et al.	VORTAL(i), BIDMC (ii)	39 (i), 53(ii)	ConvMixer	1.27(i), 0.77(ii)	–	–	–
Ismail et al.	IEEE signal processing cup	22	Conv-recurrent regressor	–	2.41±2.9	–	–
Yen et al.	Own	100	CNN	–	–	0.17 ±0.46	0.27±0.52
Lei et al.	MIMIC	90	Comp-ensemble EMD	97.78%	99.95%	–	–
Panwar et al.	MIMIC-II	1557	LRCN	–	2.32±0.095	3.97±0.064	2.30±0.196
Our work	MIMIC-III	31	CNN-GRU-LSTM	**0.0714 NMAE**	**0.0619 NMAE**	**0.162 NMAE**	**0.0321 NMAE**