SeatVitals: Geophone-Based Unobtrusive Vital Sign Monitoring for Office Environments

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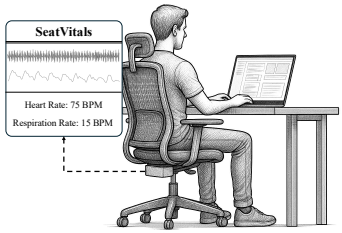
Real-time monitoring of vital signs in offices enables health promotion, stress management, and workplace optimization. This paper presents SeatVitals, a geophone-based system for unobtrusive and privacy-preserving monitoring of heartbeats and respiration, designed for seamless deployment under office chairs without user involvement. In workplace settings, however, the acquired signals are often heavily contaminated by diverse environmental noise, and labeling heartbeat time series remains inherently challenging. To address these issues, SeatVitals adopts a two-stage learning strategy. SeatVitals first applies self-supervised contrastive learning on large-scale, high-quality sleep data with lower noise levels to learn stable feature representations. The model is then fine-tuned on limited, noisier seated data by aligning these representations with target labels. By leveraging abundant clean unlabeled data together with limited noisy labeled data, SeatVitals achieves both robust generalization and high accuracy in workplace vital sign estimation. Evaluation across 32 subjects yields a mean absolute error (MAE) of 2.44 bpm for heart rate (HR) and 2.20 bpm for respiration rate (RR). The system also achieves competitive performance with only 5% of labeled data for HR and 15% for RR, demonstrating strong label efficiency. These results highlight SeatVitals as a reliable and practical solution for healthcare and wellness monitoring in future smart offices.



SeatVitals system deployed under an office chair.

Comparison of proposed and supervised baseline

Method	Vital	MAE	MAPE	STD
Supervised	HR	3.33	0.046	4.71
	RR	2.28	0.190	1.69
Proposed	HR	2.44	0.033	4.30
	RR	2.20	0.183	1.57