

ABSTARCT

Advances in electronics technology have driven innovation in the field of medical electronics, particularly in the monitoring of Vital Signs (VS). This research aims to develop a portable device capable of measuring five key parameters in an integrated manner: body temperature, Blood Pressure (BP), Respiratory Rate (RR), Heart Rate (HR), and Peripheral Oxygen Saturation (SpO2), using Photoplethysmography (PPG) signals. The focus of this study is on improving measurement accuracy to 95% for BP, 95% for RR, and 98% for body temperature. The system utilizes an optical sensor for PPG signals and a microcomputer as the data processing hub. Machine learning algorithms are applied to enhance accuracy in data analysis and measurement.

Test results demonstrate that the system achieves over 95% accuracy across all parameters compared to standard commercial devices. Body temperature testing achieved 99% accuracy, with an MAE of $\pm 0.2^{\circ}\text{C}$ and RMSE of $\pm 0.2^{\circ}\text{C}$. Estimation of systolic and diastolic values using a Random Forest model yielded 96% and 95% accuracy, respectively, with acceptable MAE and RMSE. RR measurement also achieved 95% accuracy, with an MAE of ± 0.9 bpm and RMSE of ± 1.14 bpm.

This system is designed for portability, enabling simultaneous measurement of all five parameters, making it convenient for use anywhere. Supported by machine learning algorithms and advanced sensors, this device is expected to provide an integrated, accurate, and practical health monitoring solution.

Keywords: machine learning, Photoplethysmography (PPG) signals, and Vital Signs (VS)