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Regression-Based Approach for Development of a Cuff-Less Non-Intrusive Cardiovascular Health Monitor

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Abstract : Hypertension and hypotension are known to have repercussions on the health of an individual, with hypertension contributing to an increased probability of risk to cardiovascular diseases and hypotension resulting in syncope. This prompts the development of a non-invasive, non-intrusive, continuous and cuff-less blood pressure monitoring system to detect blood pressure variations and to identify individuals with acute and chronic heart ailments, but due to the unavailability of such devices for practical daily use, it becomes difficult to screen and subsequently regulate blood pressure. The complexities which hamper the steady monitoring of blood pressure comprises of the variations in physical characteristics from individual to individual and the postural differences at the site of monitoring. We propose to develop a continuous, comprehensive cardio-analysis tool, based on reflective photoplethysmography (PPG). The proposed device, in the form of an eyewear captures the PPG signal and estimates the systolic and diastolic blood pressure using a sensor positioned near the temporal artery. This system relies on regression models which are based on extraction of key points from a pair of PPG wavelets. The proposed system provides an edge over the existing wearables considering that it allows for uniform contact and pressure with the temporal site, in addition to minimal disturbance by movement. Additionally, the feature extraction algorithms enhance the integrity and quality of the extracted features by reducing unreliable data sets. We tested the system with 12 subjects of which 6 served as the training dataset. For this, we measured the blood pressure using a cuff based BP monitor (Omron HEM-8712) and at the same time recorded the PPG signal from our cardio-analysis tool. The complete test was conducted by using the cuff based blood pressure monitor on the left arm while the PPG signal was acquired from the temporal site on the left side of the head. This acquisition served as the training input for the regression model on the selected features. The other 6 subjects were used to validate the model by conducting the same test on them. Results show that the developed prototype can robustly acquire the PPG signal and can therefore be used to reliably predict blood pressure levels.

Keywords : blood pressure, photoplethysmograph, eyewear, physiological monitoring
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