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Conference Abstract

Efficient contactless heartbeat rate measurement for health monitoring

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Abstract

Motivations: Heartbeat Rate (HR) is an important physiological parameter required in health monitoring. Recent methods use videos captured by simple webcams to track subtle periodic changes of facial skin color for contactless HR measurement. These methods denoise the raw Heartbeat Signal (HS) and then transform the signal to frequency domain to measure the HR from the highest frequency component. However, simple denoising does not provide visible heartbeat peaks for analysis, and the highest frequency component does not always represent heartbeat. Thus, we propose a novel way for HS processing, which solves the aforementioned problems and provides a precise measurement of HR for health monitoring.

Method: We, first, extract the HS from facial video by tracing the facial color changes. As heartbeats are cyclic, the HS is passed through a Hodrick–Prescott filter to reduce trends. The signal is then decomposed into some Intrinsic Mode Functions (IMF) by employing a Complete Ensemble EMD with Adaptive Noise (CEEMDAN) [1]. As the raw HS from facial video is composed of heartbeat and noise components, the decomposition generates an IMF that keeps the heartbeat peak in an uncontaminated form. We empirically select that IMF and employ a peak detection (local maxima) method to detect the number of heartbeat peaks in a time interval. The number of peaks provides us with the measurement of HR.

Results and discussions: We tested a Matlab implementation of the system on the well-known MAHNOB-HCI database [2]. The database has 491 videos, each video longer than 30 seconds which are collected from 23 subjects in realistic scenarios. The proposed method obtained the Root Mean Square Error (RMSE) 8.54 bpm and Mean Error Rate (MER) 11.96% while comparing to the ground truth ECG. In addition, we compared the results of the proposed method with the state-of-the-art-methods proposed in [3]–[5]. The proposed approach outperformed these methods both by RMSE 5.06, 16.56 and 12.46 bpm and MER 1.24%, 11.30% and 8.11%, respectively. The results imply that the proposed method can provide a highly accurate (around 90%) system for HR measurement and can be effectively used for health care and monitoring application.

Keywords

heartbeat rate; facial video; health monitoring; empirical mode decomposition

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