Human emotional stress assessment through Heart Rate Detection in a customized protocol experiment

Abstract

Continuous existence of negative emotions (disgust, anger, fear and sad) over a longer period of time induces emotional stress. This emotional stress can be analyzed through physiological signal characteristics such as Electrocardiogram (ECG), Electromyogram (EMG), etc. In this work, we have proposed a customized protocol experiment to induce emotional stress through audio-visual stimuli (video clips) and simultaneously acquired ECG signals. ECG signals are preprocessed using Elliptic filter and Discrete Wavelet Transform (DWT). Heart Rate Variability (HRV) signals is derived from ECG signals through QRS detection algorithm. Heart rate (HR) is used as a statistical feature to distinguish the emotional stress through a nonlinear classifier (K Nearest Neighbor (KNN)) into three different classes namely, negative emotions, positive emotions (surprise and happy) and neutral. We have analyzed the HRV signals based on segmenting the data into 5 and 10 segments. The maximum classification rate of 93.1% on positive emotion, 85.1% on negative emotion and 71.7% on neutral state is achieved using KNN. Indeed, the negative emotions are further categorized as emotional stress and emotional non-stress and achieved a maximum classification rate of 82.9% and 86.9%, respectively. This accuracy proved that the customized protocol experiment is successful in inducing emotional stress among subjects.