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Electrocardiogram-based emotion recognition system using empirical mode decomposition and discrete Fourier transform

Abstract

Emotion recognition using physiological signals has gained momentum in the field of human computer–interaction. This work focuses on developing a user-independent emotion recognition system that would classify five emotions (happiness, sadness, fear, surprise and disgust) and neutral state. The various stages such as design of emotion elicitation protocol, data acquisition, pre-processing, feature extraction and classification are discussed. Emotional data were obtained from 30 undergraduate students by using emotional video clips. Power and entropy features were obtained in three ways – by decomposing and reconstructing the signal using empirical mode decomposition, by using a Hilbert–Huang transform and by applying a discrete Fourier transform to the intrinsic mode functions (IMFs). Statistical analysis using analysis of variance indicates significant differences among the six emotional states ($p < 0.001$). Classification results indicate that applying the discrete Fourier transform instead of the Hilbert transform to the IMFs provides comparatively better accuracy for all the six classes with an overall accuracy of 52%. Although the accuracy is less, it reveals the possibility of developing a system that could identify the six emotional states in a user-independent manner using electrocardiogram signals. The accuracy of the system can be improved by investigating the power and entropy of the individual IMFs.

Keywords; Human–computer interaction, Emotion recognition, Empirical mode decomposition, Electrocardiogram (ECG)