

Automatic Emotions Assessment using Heart Rate Variability Analysis and 2D Regression Model of Emotions

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Background:

Emotions are psycho-physiological experiences that affect all aspects of human daily life. It is a complex process that involves many components such as senses, physical changes, behavior, thoughts, and cognitive responses. Different models have been presented considering the different ways of interacting these components to create emotions, but there is still no definite formula which can measure the emotions quantitatively. In this research, the new formula is introduced based on the 2D regression model of emotions.

Method:

ECG signal of 70 healthy female volunteers (Age: 22.32 ± 1.65) was recorded while the participants were stimulated by four different colors (blue, red, green, and yellow) for five minutes. Induced arousal and valence by each color were assessed using Self-Assessment Manikin. Based on the positive or negative level of arousal and valence, four different emotions (pleasure, sadness, anger, and joy) considered in this research. Using nine extracted features that quantify the points' distribution in Poincare plot relative to line of identity, two regression models were developed for estimating the level of Arousal and Valence. In the second phase, the value of emotion is calculated in percentages using a mathematical formula.

Results:

The 75% and 25% of data were used as train and test data, respectively. Sensitivity of 96.78%, specificity of 99.4%, and the accuracy of 98.75% were achieved in the emotion classification. The mean square error for the resulting outputs were 0.0393 and 0.0536 for arousal and valence models, respectively.

Discussion:

In this study, an algorithm for emotion assessment using heart rate variability features was developed and evaluated. The proposed method could be used for automatic emotion assessment using wearable sensors. Using this method, one can measure and express the amount of emotions individually and has a comparative criterion for this feeling in different individuals.