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RESEARCH ARTICLE

Emotion identification by dynamic entropy and ensemble learning from electroencephalogram signals

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Abstract

Emotions are biologically based psychological states brought on by neurophysiologic changes, variously associated with thoughts, feelings, behavioral responses, and a degree of pleasure or displeasure. In order to assure active collaboration and trigger appropriate emotional input, accurate identification of human emotions is important. Poor generalization capacity induced by individual variations in emotion perceptions is indeed a concern in the current methods of emotion recognition. This work proposes a new dynamic pattern learning system based on entropy to allow electroencephalogram (EEG) signals for subject-independent emotion recognition with strong generalization and classification through Recurrent Neural Network and Ensemble learning. First, dynamic entropy measurements are used to derive consecutive entropy values over time from EEG signals in quantitative EEG calculations. Experiment findings indicate that in order to distinguish negative and positive emotions, the highest average accuracy of 94.67% is achieved. In addition, the findings have completely shown that this approach produces outstanding performance for emotion detection across individuals relative to recent studies.

KEYWORDS

dynamic entropy, EEG, emotion, ensemble learning, recurrent neural network

1 | INTRODUCTION

Emotion is an integral aspect of human nature and has a major influence on the routine lives of humans, including communication, interaction, learning, and so forth. For natural communication, it is necessary to discern the emotional states of people around us. Moreover, automated emotion identification is also an important and difficult role in the field of human–machine interaction (HMI). In recent years, a significant number of literatures on emotion recognition have been published and it can mainly be divided into three categories[1]: (1) Facial expressions and voice; (2) Physiological peripheral signals[2]; (3) Brain signals produced by central nervous system signals.[3] In these interventions, noncontact detection of emotion is recognized by audio–visual-based detectors. They do not always deliver accurate results because the human can easily conceal their emotions without being noticed.[4] Physiological signals exhibit significantly high detection accuracy when compared to audio–visual methods. The nervous system such as peripheral and central are the two types related to emotion. In general, the detailed information for emotional states could be extracted from electrocardiogram (ECG) which is peripheral physiological signals, skin conductance (SC), and pulse. Electroencephalogram (EEG) that is captured from the CNS can clearly represent the behavior of brain relative to other peripheral