Chapter 6
Impact of Pairwise Electrode Features in the Classification of Emotions for EEG Signal Analysis

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ABSTRACT

Emotion recognition is the capacity to recognize and interpret an individual's emotional state through a variety of techniques, one of which is the detection and interpretation of patterns of brain activity linked to specific emotional states. Applications for emotion recognition are numerous and include human-computer interaction, marketing research, and mental health diagnosis. Electroencephalography (EEG) signals are another name for the patterns of brain activity. To extract features from EEG waves, many techniques have been used. The wavelet transform (WT), differential entropy (DE), statistical features (SF), and convolutional neural network (CNN) are some of the feature extraction techniques performed. This proposed method utilizes a custom CNN model to train and test on the preprocessed SEED data.

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1. INTRODUCTION

The technique of determining a person's emotional state is known as emotional recognition. (Zheng et al., 2015). An impact on our capacity to act logically in situations requiring decision-making, perception, and human intelligence is indicated by the relationship between emotional states and a wide range of human emotions, ideas, and behaviors (Bazgir et al.,2018). Enhancing human-machine interaction across a range of application areas, including medical, industrial, military, and many other fields, is the aim of emotion recognition-based technology in computer science. (Duan et al.,2013). There are two sorts of approaches that have been presented for emotional recognition (Duan et al.,2013). The first classification involves recognizing a certain emotion based on emotional behavior signs such body language, tone of voice, and facial expression. Using physiological clues in order to identify emotions is the second category. The EEG, ECG, pulse respiration signals, etc... are examples of these physiological signals (Wang et al.,2018). Creating emotion recognition systems based on EEG signals has grown in popularity among cognitive scientists in recent years (Bazgir et al.,2018). The most challenging aspects of creating an EEG-based emotion recognition system are flawless categorization and effective feature extraction. The nature of EEG signals is random, non-stationary, non-linear, buried in numerous types of noise, and non-stationary (Li et al.,2016). To effectively construct an emotion identification system, processing and extracting significant characteristics from EEG signals is essential. The EEG signals are quantified by the extracted features, which are then employed as classifier attributes. Intelligent emotion identification systems have retrieved a number of properties from EEG data in the time, frequency, and joint time-frequency domain (Takahashi et al.,2004), (Wang et al.,2011), (Duan et al.,2013).

Various techniques exist for recognizing emotions, including EEG, ECG, Galvanic Skin Response (GSR), and Heart Rate Variability (HRV). Dimensional models of emotions seek to locate human emotions within two or three dimensions, thereby providing a framework to conceptualize them. Valence and arousal or intensity dimensions are included in most dimensional model's Dimensional models of emotion propose that there is a single neurophysiological system that underlies all emotional states. On the other hand, theories of basic emotion suggest that different brain systems are responsible for various emotions, are opposed by these models. Although many other dimensional models of emotion have been created, only a select few continue to be the most widely used and accepted models today. The valence-arousal model is the most well-known two-dimensional model.

In 1-dimensional(1D), the mode of representation is most simple form in which emotions are categorized into 3 or more parts on emotion scale. If we take the emotion scale as 3. Then it represents 3 emotions Positive, Negative, Neutral. In 2- dimensional(2D) Valence and arousal are the two key attributes that define an emotion model. A person's stage of attraction or repulsion toward a specific object or situation is measured by its valence. From bad to good, it ranges. Arousal refers to bodily and mental conditions that range from being receptive to actively responding to stimuli. (Jirayucharoensak et al.,2014). Several studies have employed the valence-arousal dimensional model of emotion, which is depicted in Figure 1.

The approach suggests that arousal and valence, two circular dimensions, can be used to map out emotions. The valence dimension can be observed parallel to the horizontal axis, and the arousal dimension is represented in a vertical direction. The center of the circle corresponds to neutral valence and moderate arousal. In essence, this approach proposes a two-dimensional model that can represent the full range of human emotions. This paradigm allows for the representation of emotional states at any level of valence and arousal in addition to a neutral level for either one or both of these elements. In 3-dimensional(3D), Valence, arousal, and dominance are the three dimensions that the VAD paradigm