Chapter 3
Classification Algorithms for EEG-Based Brain-Computer Interface: A Review

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ABSTRACT

In recent years, a vast research is concentrated towards the development of electroencephalography (EEG)-based human-computer interface in order to enhance the quality of life for medical as well as nonmedical applications. The EEG is an important measurement of brain activity and has great potential in helping in the diagnosis and treatment of mental and brain neuro-degenerative diseases and abnormalities. In this chapter, the authors discuss the classification of EEG signals as a key issue in biomedical research for identification and evaluation of the brain activity. Identification of various types of EEG signals is a complicated problem, requiring the analysis of large sets of EEG data. Representative features from a large dataset play an important role in classifying EEG signals in the field of biomedical signal processing. So, to reduce the above problem, this research uses three methods to classify through feature extraction and classification schemes.

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INTRODUCTION

EEG signal illustrates the electrical movement of the brain. They are exceptionally arbitrary in nature and might include valuable data about the brain state. EEG signals are profoundly non-Gaussian, non-stationary and have a non-linear nature. Electroencephalography is a non-invasive procedure utilized to analyze brain associated diseases and side effects. It assists in diagnosing numerous neurological sicknesses, for example, epilepsy, tumor, cerebrovascular sores, depression and issues related with shock. EEG traces are distinctive for various brain actions. The brain action of an anomalous individual can undoubtedly be recognized from an ordinary individual utilizing signal preparing strategies.

EEG signals are exceptionally client-specific, and in that capacity, most existing BCI frameworks are aligned particularly for every client. This training informationset ought to have EEG signals registered while the client played out each psychological undertaking of interest quite a lot of times, as indicated by given commands. The registered EEG signals will be applied as mental state cases with a specific end goal to locate the best adjustment parameters for this client. EEG is the most well-known technique for recording brain signals in people since it is protected, inexpensive, simple to utilize, and for the reason that it has a elevated temporal resolution (of the order of milliseconds) portrayed by Yoshida et al. (2015). EEG electrodes, put on the scalp, are capable of either “passive” or “active”. Metallic passive electrodes are associated with an amplifier by a wire. Active electrodes contain an inherent preamplifier to construct them less responsive to ecological noise and cable actions. The two kinds of electrodes require gel or saline fluid to work, keeping in mind the end goal to lessen the skin-electrode contact resistance. This keeps their utilization for extended periods, for example, an entire day, for the reason that the gel dries with time, making the resistances toincrease and the signals to debase. Consequently, dry electrodes are as of now being created and tried for BCI. Notwithstanding a low spatial resolution, (at best the inter-distance connectingelectrodes is 1-2 cm) and a shortsignal-to-noise proportion, this arrangement gives numerous favourable circumstances for extensive use.

There are modern medical devices for imaging techniques used for human being they are Electrocardiography (ECG) utilized in support of heart, Electromyography (EMG) utilized in support of muscular contractions, Electroencephalography (EEG) utilized in support of brain activity, Magneto encephalography (MEG) also used for brain activity, Magnetic Resonance Imaging (MRI) and many more such devices are used for various diagnosis of human described by Joseph and Bronzino (2000). The EEG machine is used on the scalp of the brain to diagnose various activities in different lobes of the human brain.

Murugappan et al. (2007) composed a competent attainment protocol for obtaining the EEG signals under audio-visual initiation condition. The EEG data has been gathered from 6 strong subjects with inside an age set of 21-27 utilizing 63 biosensors. From the subjective investigation on every emotion, three emotions have been related to higher understanding. Subsequent to preprocessing the signals, distinct wavelet change is utilized to remove the EEG parameters. The feature vectors got from the above feature extraction technique on 63 biosensors create an information network for emotion classification. Here, we have utilized Fuzzy C-Means (FCM) and Fuzzy k-Means (FKM) grouping strategies for ordering the emotions. We have additionally examined the execution of FCM and FKM on decreased number of 24 biosensors revealed in Figure 1. At long last, it looked at the execution of clustering the distinct emotions utilizing FCM and FKM on both 64 biosensors and 24 biosensors. Results affirm the likelihood of utilizing wavelet change based feature extraction for evaluating the human emotions from EEG signal, and of choosing an insignificant number of channels for emotion acknowledgment test.