Human Mental Stage Interpretation Based on the Analysis of Electroencephalogram (EEG) Signals

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Abstract There are various stages in human mental development. Among them are consciousness, drowsiness, and light sleep. These human mental stages and conditions can be affected by human emotions (Ali et al. in Wirel Pers Commun 125:3699–3713, 2022; Katmah et al. in Sensors 21(15):5043). Hence, human brainwaves or electroencephalogram (EEG) signals can be employed to analyze and interpret the development of human mental stage. In this research, 1-channel EEG device is employed to measure neural electrical activity from five people as they are engaged in three different cognitive exercises such as playing a video game, reading a book, and watching a movie. EEG signals are analyzed in LabVIEW software to reveal the unique features which are able to describe various human stages. The EEG power spectrum in terms of mean and standard deviation for each EEG frequency band (theta band, alpha band, and beta band) is computed. Then, the k-nearest neighbor (k-NN) classifier is employed to discover the best feature that is capable to indicate status of human mental stage. The findings of the study demonstrated that the mean EEG feature with the training and testing ratio of k-NN classifier at 80:20 could detect and categorize human stages with the classification accuracy of 81.57%. Meanwhile, LabVIEW graphical user interface (GUI) and block diagram are constructed to display the analyses of human stages of each subject for the specified human stage activities. In addition, a device is built to indicate human mental stage in an off-line manner.

Keywords Human mental stages · EEG power spectrum · LabVIEW GUI · Classification

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