The Classification of Wink-Based EEG Signals: The Identification of Significant Time-Domain Features

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ABSTRACT

Brain-Computer Interface (BCI) has become popular with physically challenged individuals, particularly in enhancing their activities of daily liv-ing. Electroencephalogram (EEG) signals are used to control BCI-based devices. Nonetheless, it is worth noting that the use of a multitude of features may impede the real-time execution of BCI devices. The present study aims at identifying significant time-domain based features that could provide a reasonable classification of the right or left wink based on EEG signals evoked by the aforesaid facial expressions. The Emotiv Insight mobile EEG system was used to capture the EEG signals acquired from the winking of the left and right eye of five healthy subjects between the age of 23 and 27 years old. Nine statistical time-domain based features were extracted, namely maximum (Max), minimum (Min), mean, median, stan-dard deviation (SD), variance, skewness, kurtosis, and root mean square (RMS) on five channels. An ensemble learning method, i.e. Extremely Randomised Trees, was used to identify the significant features. The feature selection effect towards wink classification was evaluated via the *k*-Nearest Neighbours (*k*-NN) classifier. The training to test ratio of the extracted signals was set to 70:30. It was shown from the study, that five features were found to be significant, viz. Max_AF4, SD_AF4, skewness_AF3, kurtosis_AF4 and kurtosis_AF3, respectively. The training clas-sification accuracy (CA) by considering all features and selected features was ascertained to be both 100%, respectively, whilst, the test CA was also found to be identical for both models with no misclassification transpired. Therefore, it could be established from the study that a comparable classification efficacy is attainable through the identification of significant features. The findings are non-trivial, particularly with respect to the implementation of the developed classifier in real-time.

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KEYWORDS: EEG, BCI, Machine learning, Classification, Feature selection

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