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Optimized Brain Computer Interface System for Unspoken Speech Recognition: Role of Wernicke Area

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Abstract : In this paper, we propose an optimized brain computer interface (BCI) system for unspoken speech recognition, based on the fact that the constructions of unspoken words rely strongly on the Wernicke area, situated in the temporal lobe. Our BCI system has four modules: (i) the EEG Acquisition module based on a non-invasive headset with 14 electrodes; (ii) the Preprocessing module to remove noise and artifacts, using the Common Average Reference method; (iii) the Features Extraction module, using Wavelet Packet Transform (WPT); (iv) the Classification module based on a one-hidden layer artificial neural network. The present study consists of comparing the recognition accuracy of 5 Arabic words, when using all the headset electrodes or only the 4 electrodes situated near the Wernicke area, as well as the selection effect of the subbands produced by the WPT module. After applying the articial neural network on the produced database, we obtain, on the test dataset, an accuracy of 83.4% with all the electrodes and all the subbands of 8 levels of the WPT decomposition. However, by using only the 4 electrodes near Wernicke Area and the 6 middle subbands of the WPT, we obtain a high reduction of the dataset size, equal to approximately 19% of the total dataset, with 67.5% of accuracy rate. This reduction appears particularly important to improve the design of a low cost and simple to use BCI, trained for several words.

Keywords : brain-computer interface, speech recognition, artificial neural network, electroencephalography, EEG, wernicke area
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