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Opinion Article

Mental State Diagnosis with EEG Signal from Wearable Device

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DESCRIPTION

Detecting or analyzing the thoughts of humans is age old dream of any researchers. The closest thing we have got to measure the emotion of humans is reading EEG signals and differentiating the various patterns. But the main problems with those techniques are they are, very intrusive and painful at times. Therefore, measuring the human emotions in a laboratory is not the ideal way to go. This problem can be rectified with the help of wearable devices that can be carried by the patients. There are many types of headset based wearable devices that can be used to extract EEG signals effectively. When compared to all the other medical grade EEG recording devices the Signal to Noise ratio of this commercial EEG recording devices are still low. Therefore, the important factor that we have taken into consideration for this research are cost, reliability, error handling capacity and Signal to Noise ratio of the devices. There are also some artefacts that are needed to be taken into consideration before progressing into the classification steps. The artefacts like ocular, motion, sweet and electrode can greatly affect the performance of classification algorithm. Thus many researchers have done on artefact removal and different techniques are suitable for different types of artefacts. Therefore, introducing a universal artefact removal technique is of much importance. This kind of positional dependence is not suitable for neural network algorithms as they may hugely affect the classification accuracy. The main advantage of shift invariant algorithms is they have same output even if the value of the input signal is changed in position.

There are many techniques that formulated to tackle this shift dependence of wavelet algorithms. This technique generates complex coefficients of the inputs that are using dual tree filters to make the algorithm more shift resistant. The main drawback with those techniques is that they will provide low to moderate level of filtering for lower bandwidth regions. The polyphase filter bank method that was used to extract signals lack efficiency for high bandwidth inputs. After successful implementation of shift independent filtering the next part of implementation will lead to feature detection and classification. Using neural network for classification is age old technique. But the main problems with neural network algorithms are increased training time, more energy consumption and its high need for data. All those things make it complicated to be used in wearable device applications. The conventional method that is used in signal processing application is Recurrent Neural Networks (RNN). The main drawback with RNN algorithm are their training complexities, vanishing gradient problems, staking problems and difficulty to training long sequences. If we look back into what we discussed this are the exact things we have to implement in wearable applications. In wearable device applications it is important to reduce the memory and computational cost of neural networks as it may increase the energy consumption of the device. In order to reduce this energy consumption issues. There are also other important fully connected neural networks. The main problem with fully connected neural networks is that it increases the number of connections in the neural network which increases the memory value for each weight as well increases the processing time in computation.

This Mental state diagnosis using EEG signal algorithm is also designed to be shift invariant and can handle real world online data from wearable devices.

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