Letter:
Automated Identification of Chronic Alcoholism from Brain Signals

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Abstract: The present work has used the EEG collected from alcoholic subjects, and controls. The results suggest that EEG has sufficient information for development of a non-invasive online diagnostic tool for chronic alcoholism.

Key Words: EEG, Chronic alcoholism, Non-invasive online diagnostic tool

The chronic consumption of alcohol creates permanent alteration on the structure and function of the central nervous system (CNS).[1,2] Alcoholism is a chronic disease characterized by impaired control over drinking in which the brain and its behavior are directly affected by alcohol. Now days, it is established that the altered CNS functions can be assessed with advanced digital signal processing and soft computing tools. In the present work, using the EEG collected from alcoholic subjects, a procedure based on the combined framework of time and frequency domain features third order Nonlinear Autoregressive Model (NAR-3) and Power Spectral Density (PSD) along with the computational classifiers Support Vector Machine (SVM) and Fuzzy C-Means (FCM) clustering has been applied to detect chronic alcoholism.

The study was carried out with 40 male right handed subjects (mean age of 35 years), divided in two groups, 20 each in alcoholic and control. The alcoholic subjects selected were consuming same kind of alcohol known as Mahuwa, fermented from the flower of mahuwa (Madura Longifolia) almost every day from the age around 20 years, while, the control subjects were those who had never taken any kind of alcohol or tobacco in their life time. The EEG data were recorded from frontal, central and partial cortex using RMS System (Recorders & Medicare Systems Pvt. Ltd., India). The analysis of EEG data and its further classification showed maximum average classification of 87% with NAR-3 feature model coefficients using SVM classifier for the EEG data of frontal cortex followed by central and partial zones with 72% and 71%, respectively. While, with FCM, the maximum average classification accuracy was 80% from the frontal zone. Conversely, the maximum accuracy of 90% was obtained from FZ focal area from both classifiers with NAR-3 features. On the other hand, using PSD feature in SVM, maximum average classification accuracy (77.6%) was obtained from ß2 band power in the central zone. The results also indicate that the maximum accuracy (80%) has been found in FZ electrode position in both B1 and ß2 bands. With FCM the maximum average accuracy of only 53.6% was obtained from the electrodes of central zone in d bands. However, C3 electrode position showed the maximum accuracy 73% among the focal areas of EEG recording. The highest classification accuracy obtained with the EEGs extracted from FZ area can be explained in the light of past findings that demonstrated desynchronized firing of neurons in alcoholic subjects.[3] Further, analysis of results also indicates that the classification accuracy with higher bands (ß1 and ß2) of EEG frequency spectra is observed more vulnerable to the chronic alcoholic conditions. The obtained results are also in the agreement with the existing studies on analyzing the effects of alcohol on cerebral cortex.[4] From the obtained results, it is also revealed that the SVM is a superior EEG feature classifier for chronic alcoholism in
comparison to FCM. Based on the results, it can also be suggested that EEG has sufficient information for development of a non-invasive online diagnostic tool for chronic alcoholism.

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Conflict of interest: None

Ethical Approval: This research methodology was approved by the Institutional Ethical Committee of Rajendra Institute of Medical Sciences, Ranchi, India. The work adheres to the “Declaration of Helsinki” and conducted following the ‘Ethical guidelines for Biomedical Research on Human Subjects’ of the Indian Council of Medical research.

References


