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A NOVEL SCORING SYSTEM FOR EPILEPSY DETECTION USING EEG

Mandeep Singh[1] and Sunpreet Kaur[2]

Abstract: Epilepsy is neurological disorder of brain that is needed to be detected efficiently. In this paper an efficient scoring system for detecting epilepsy in Electroencephalogram is presented. The results show that the proposed method detects epilepsy in EEG signals with a high accuracy.

Keywords: Electroencephalogram (EEG), Epilepsy, Discrete Wavelet Transform (DWT), scoring system.

1. INTRODUCTION

Electroencephalogram (EEG) is the recording of the brain's electrical activity over a period of time. Epilepsy is a disease due to alternation in brain functions due to abnormal and excessive electrical activity of a group of neurons. Epilepsy detection is an attractive area for researchers for past many years. The Wavelet Transform is appropriate for analysis of non-stationary signals like EEG signals, therefore number of researches are being done for detection of epilepsy using wavelet transform. For distinguishing normal EEG from an epileptic one, time-frequency distributions are widely used. Researchers used various time frequency distributions to obtain representations, decomposition of signal into its subbands of their peculiar frequency range and extract the features of interest and then classify the signals based on various techniques like artificial neural networks [1-4].

2. PROBLEM DEFINITION

Considering EEG signal to detect epileptic cases using appropriate features extracted from various subbands i.e. Delta, Theta, Alpha, Beta, and Gamma, the non-overlapping ranges for the epileptic and non-epileptic cases were found [4]. This system, however does not take into account several inaccuracies that may creep in the practical system on account of machine error, human error and other factors. There is a need to develop a system which is tolerant to these inaccuracies and is flexible enough to give high detection rate in practical situations.

3. PROPOSED SOLUTION

It is proposed that a scoring system be developed which efficiently determines any input EEG signal for its nature to be epileptic or normal. This scoring system has to has a built in tolerance to the aforesaid inaccuracies.

[1,2] Department of Electrical & Instrumentation Engineering, Thapar University, Patiala, India
[1] *E-mail: mandy_tiet@yahoo.com*
[2] *E-mail: sunpreet.kaur25@gmail.com*

4. METHODOLOGY

EEG Data sets available online as described in the earlier publication is used [4]. Data SET A for non-epileptic case and SET E for epilepsy case, each containing 100 single-channel EEG segments are selected for the present study. Subband decomposition of each segment in both the sets is done using Discrete Wavelet Transform (DWT)[5]. Features that resulted in non-overlapping range as shown by Mandeep Singh and Sunpreet Kaur are calculated of 50 subjects from each subband of SET A and SET B respectively [4]. Using MATLAB 2011a these non-overlapping features are extracted from other 50 subjects from both sets for the purpose of validation. A scoring system is generated by assigning certain score for each feature of a subband and calculating the final score. A tolerance range is decided in order to detect whether that final score falls in the range of epileptic or non-epileptic data.

A score '–1' is assigned to each of the feature falling in the range of normal EEG and '+1' is assigned to each feature falling in the range of epileptic EEG. If a feature falls in neither of the two ranges it is assigned score '0'. For each of 50 subjects of SET A and SET B, these scores of each feature are calculated to get a final score. Considering Tolerance band for normal data is '–5' to '–8' and of epileptic data is '+5' to '+8'. In case the score happens to be between '–5' to '+5', that case will be declared as INDETERMINATE. To increase the detection rate, two features namely minima of Power spectral density (min2) and minima of Power spectral density (min3) is dropped from the earlier study that proposed 10 features [4]. The remaining eight namely, $y1$, $y2$, $y3$, $y4$, max2, max3, $e2$, $e3$ are used in the scoring system.

5. RESULT

Assigning scores to each of 8 features and calculating final score we get the number of subjects falling in the category of Epileptic and Non-Epileptic range is shown in Table 1. There are no False positives and no False negatives detected. Further none of the cases fell under category INDETER-

MINATE, so the efficiency is 100% for this particular dataset.

6. CONCLUSION

In this work, eight features are extracted from the sub-bands obtained after the decomposition. Based on that a System tolerant to various inaccuracies pertaining in practical situations is developed with high detection efficiency of 100%. Thus the need of accurately detecting the epileptic activity from EEG of a patient is fulfilled.

Table 1
Number of Subjects with Final Scores Falling in Epileptic and Non-epileptic Range

	Epileptic				*Non-Epileptic*				*TOTAL*
Score	+5	+6	+7	+8	–5	–6	–7	–8	
No. of subjects	3	0	10	37	1	0	3	46	100

7. FUTURE SCOPE

The present work detects Epilepsy in the subjects while they are not having seizures. Further in case of normal subjects EEG is recorded while their eyes are closed. This work may be extended to the epileptic subjects while they are having seizure and to the novel subjects while their eyes are open. Thus from current two class classifier it may be extended to four class classifier.

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