Focal Non-Specific Seizure Classification Based on EEG Signal Using Artificial Neural Network Method

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***Abstract*—In EEG signals Epilepsy has various signals. One of them is Focal Non-Specific Seizure which has features that are different from other signals. This paper will detect the presence of a signal surge in the Focal Non-Specific Seizure. This detection is based on brain activity using Epilepsy EEG which will be compared with normal people's training data. Focal Non-Specific Seizure Signals will go through the preprocessing process. Then the preprocessing results are feature extraction with Independent Component Analysis (ICA) which will then be classified with Artificial Neural Networks (ANN). From this study the greatest accuracy of one of the characteristics is weight vactor of 90%.**

Keywords*— Focal Non-Specific Seizure, Independent Component Analysis (ICA), Artificial Neural Network (ANN)

I. INTRODUCTION

Epilepsy is a disorder in the human brain that causes spasms in the body. Even the severity can cause death. In developing health technology, epilepsy can be detected by an electroencephalogram (EEG) [1]. In the process of epilepsy which is detected by EEG. One of them is Focal Non-specific Seizure (FNSZ) [2]. Independent Component Analysis (ICA) is one method used to separate data from EEG. ICA has been shown to be efficient in separating data from artifacts such as eye blinking, muscle movement, or heart rate [1]. The output of this research is system reliability in classifying between FNSZ and normal EEG signal.

II. METHOD

A. EEG Data

The dataset used in this study is a dataset that is available at Temple University Hospital. Data is recorded using a sampling frequency of 250 Hz every second of each data. Use the standard 10/20 system to place electrodes on the scalp and the data used is in the frontal cortex. The form of the FNSZ signal and normal signals can be seen in Fig. 1. and Fig. 2. The number of training datasets is 75 data (50 FNSZ and 25 Normal) and the number of evaluation datasets is 65 data (50 FNSZ and 15 Normal). The data used has passed the cutting process according to the duration of the seizure time in milliseconds. After the same length of data then the data is extracted using Independent Component Analysis (ICA) and classified with Artificial Neural Network (ANN).

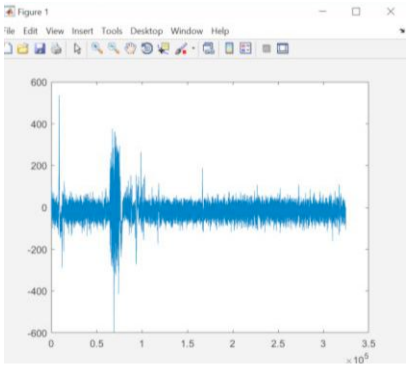

Fig. 1. Normal Signal.

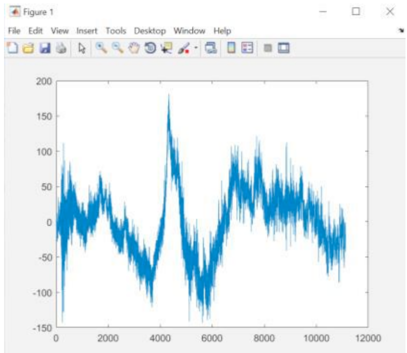

Fig. 2. Focal Non-Specific Seizure Signal.

B. Preprocessing

The data used must pass the preprocessing stage first so that the raw data is separate from the noise. The preprocessing process used is [3]:

1. Fill Missing Value is done by filling in an empty value in the data set with the closest value
2. Normalization aims to change the amplitude range of the signal to 0 and 1 without changing the signal pattern itself. Normalization is done by dividing the total data by the maximum value from the overall data.

C. Independent Component Analysis (ICA)

Feature extraction used is Independent Component Analysis (ICA). Required conditions are met so that the signal can be well separated from the mixed signal in the use of the ICA method. These conditions are: (1) Independent, namely *S1* and S2 as different random variables. (2) Non Gaussianity, in estimating ICA is a very important and essential principle. The presence or absence of kurtosis can indicate Gaussian or not a signal. If the kurtosis value is 0 then the signal is a Gaussian signal. Conversely, if the positive or negative kurtosis value is called a non Gaussianity signal [4].

Extraction of the ICA feature will be combined with statistical features. So that the characteristics obtained are Weight Factor, Enthropy, Kurtosis, Harmmean, Skewness, Mean, Variance, Standard Deviation, Interquartile Database.

D. Artificial Neural Network

In general, neural networks consist of millions of structures of neurons that are connected to each other so that they can carry out activities regularly. Like the function of the human brain, ANN has the ability to analyze a problem, classify patterns, system modeling, and memory associations.

ANN is divided into 2 categories, single layer ANN and multilayer ANN. Multi layer ANN is used to perfect a single layer ANN because it has 3 interconnected layers. The three layers are input layer, hidden layer, and output layer. Hidden layer is an additional layer that does not exist in a single layer. So that multilayer ANNs can recognize patterns during training and the ability to respond to inputs similar to training patterns [3].

In this study, the input layer consisted of 10 neurons, 50 neurons, and 80 neurons. The number of hidden layers is 2 layers with 10 neurons each layer. The training objective is set to 0.1. Training Iterations are set to 1000 epochs. The output is only two because it only classifies normal data and FNSZ.

III. RESULT AND DISCUSSION

In this reseach, 9 characteristics were used, namely Weight Factor, Enthropy, Kurtosis, Harmmean, Skewness, Mean, Variance, Deviation Standard, Interquartile Database to get the best accuracy value. This system was tested with 65 datasets (50 FNSZ and 15 Normal) and trained with 75 datasets (50 FNSZ and 25 Normal). So that the best parameters can be obtained is on the weight factor as in Fig. 3.

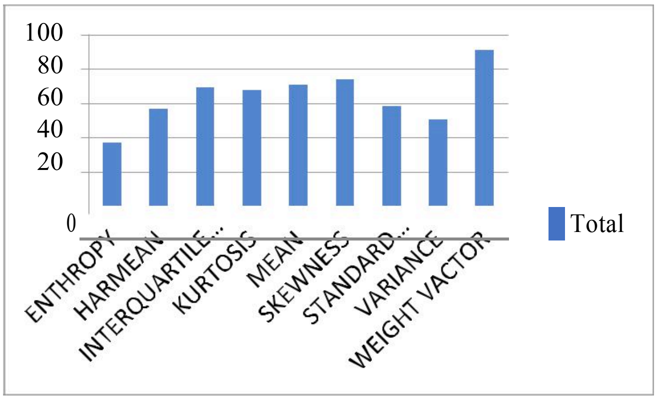

Fig. 3. The Accuracy Performance of ICA and Stasistica Features.

IV. CONCLUSION

In this paper, Focal Non-Specific Seizure signals are detected using Independent Component Analysis (ICA) and Artificial Neural Network (ANN). Judging from the 9 characteristics, they have different accuracy towards classification. The highest accuracy obtained is 90% for the accuracy of Weight Factor with 10 neurons and 2 hidden layers.

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