Identification Of Electrode Enchepalo Graph Signal To Move The Cursor Using Back Propagation Method

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***Abstract* - In this paper the researchers describe the application of back propagation neural networks as classification and sampling technique (TS) for feature extraction of waveform signals Electro Enchepalo Graph (EEG). This study aims to develop a system that can recognize the EEG signals are used to move the cursor. In this study used 90 EEG signal data files for the training process. In the identification process into four, grade, used 150 files EEG signal data. The results obtained for the classification of this signal is 80% of the 150 files were tested on the data signal mapping process.**

Keywords: sampling techniques, neural networks, EEG signals

I. INTRODUCTION

The brain as the central setting of human activity, is responsible for all human activity. The shape of Electro encephalo Graph (EEG) signal for each person is different. This is because it is influenced by mental condition, the frequency and amplitude changes of alpha rhythm pattern of each individual's thinking in response to stimuli received by the brain. EEG is a signal which can produce one of the most common sources of information used to study brain function and neurological disorders.

Brain Computer Interface is a communication system which does not require muscle activity [1]. Indeed BCI system allows subjects to send commands to the electronic command using only brain activity [2]. BCI systems can also be used to play simple games on mobile devices [3].

Sampling is one of the main important techniques in statistics; if the sample size is quite taken then it can tell the characteristics of EEG signals. There are various types of sampling techniques used in statistics [4]. Application of Simple Random Sampling (SRS) is used to extract the features of the EEG signal in two classes which in normal people and people suffering from epilepsy. Least Square Support Vector Machines (LS-SVM) with RBF kernel was designed and implemented on the extracted feature vectors obtained from these two classes. LS-SVM classification ccuracy reached 80.31% for training data and 80.05% for test data [5]. EEG signal analysis method uses relative wavelet energy, and classification uses neural networks. Classification accuracy is obtained confirming that the proposed scheme has potential in classifying the EEG signals [6]. Other studying uses the extracted features Furia algorithm. Furia is based on the inverse solution algorithm that can learn and use subject-specific features for the classification of the mental part. The results which is obtained, are assessing the different impact of hyper-parameters are also performances from the contribution of the process fuzzyfikasi and Assessing global efficiency of Furia Furia based BCI by comparing with the other [7].

This paper proposes TS which is applied to select the features which is representative of the EEG signal and the selected features are then processed by the back propagation method in order to separate the EEG signal between subjects to imagine the movement to the right, left movements, tongue movements and leg movements. Results from four movement planning will be used to move the cursor to the right, left, up and down.

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II. IMPLEMENTATION METHODS

A. *Description of Data*

EEG signal data is taken from the dataset IIIA of BCI competition III (BCI Competition III 2003). It contains data from three subjects which is the subject of K3b, the subject of two three L1b K6b and subjects. The sample rate is set at 250 Hz. 60 electrodes mounted skin heads. As in the Figure 1. The one subject, subject of two and three subjects to imagine the movement to the right, move to the left.

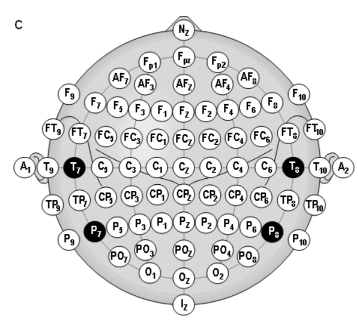


FIGURE 1. EEG ELECTRODE POSITIONS

The tongue movements and footwork appropriate cues. Signal sequence is selected at random. Experiments conducted during the walks (> = 6 seconds) with the number of trials each of 40 trials for each subject. Figure 2 shows the timing pattern of the EEG signal data retrieval process.

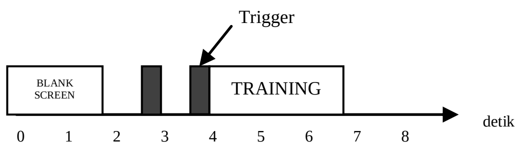


FIGURE 2. TIMING PATTERN

In this study took 150 EEG signals from these movements. From each channel there are 30 to 45 EEG signals.

B. Feature Extraction with Sampling Techniques

In this paper, the signal is divided into five sub-signals. Of the five sub-signals are determined maximum value, minimum, average and standard deviation for feature extraction is used for the classification process as in figure 3.

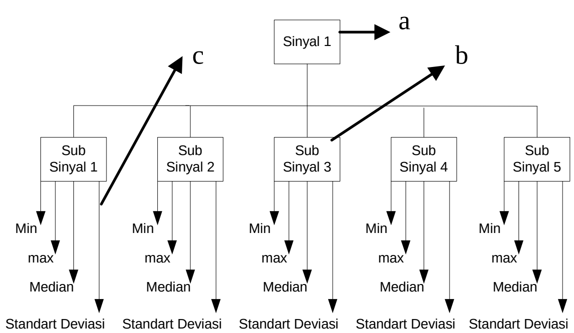


FIGURE 3. A. SAMPLES, B. SUB SAMPLES AND C. FEATURE SELECTION

Data is taken in this studying, is the subject of 150 files. One file has a 250-points data signal. This riset splits one signal into five sub-signals. So that, each sub-signal has 50 points data. From the sub signal then is sought the minimum, maximum, average and standard deviation.
From each value of max, min, mean and standard deviation for each sub-EEG signals. So we get 4 x 5 sub signal = 20 points then we make the data input for the classification of back propagation networks.

C. Propagation through Artificial Neural Networks

At the end of this processing, the identification of EEG signals are processed by using back propagation neural network as shown in Figure 4. Final processing is done after the initial process is feature searching with the sampling technique.

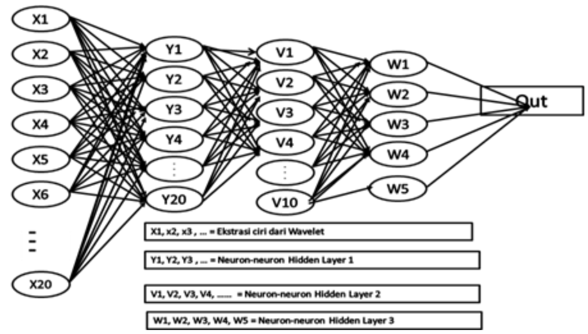


FIGURE 4. BACK PROPAGATION NETWORK ARCHITECTURE 3 HIDDEN LAYER.

The results of feature extraction is used for input to the neural network, this studying uses back propagation method (20-20-10-5-1) with 20 inputs coming from the characteristics of EEG signal and the third hidden layer, each of which there are 20 units, 10 units and 5 units as well as a target (movement to the left, right movement, footwork and movement of the tongue).

In the process of identification with the first neural network training process which is done is search the best weights with the smallest error value from the acquisition of the desired output targets. In the process the EEG signals classification mapping is done to the right of movement, movement to the left, the movement of the foot and tongue movements based on the weights that have been obtained in the training process.

III. RESULTS AND DISCUSSION

To analyze the system has been designed to use the method as described in the implementation of the method. In this studying emphasizes the identification analysis of EEG signals using sampling techniques. Furthermore, the process of learning and mapping by using back propagation neural network.

A. Taking the EEG signal data

Figure 5 is one of the EEG signal data taken from the subject k3b for all the imagination of the movement to the right, left, leg and tongue.

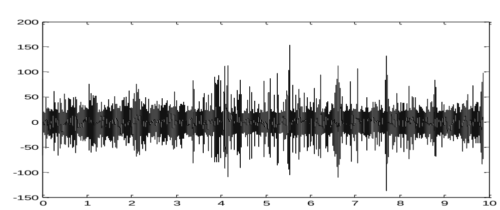


FIGURE 5. EEG SIGNAL CHANNEL 1 DATA BCI SUBJECT K3B

TABLE 1. THE RESULTS OF THE SAMPLING TECHNIQUE WAS TAKEN A MINIMUM VALUE, MAXIMUM, AVERAGE AND STANDARD DEVIATION OF THE EEG SIGNAL K3B CLASS CHANNEL 1EACH SUB SIGNAL.

	Sub sinyal 1				*Sub* sinyal 2				*Sub* sinyal 3				*Sub* sinyal 4				*Sub* sinyal 5			
	min	*max*	*mean*	sd	*Min*	*max*	*mean*	sd	*Min*	*Max*	*mean*	sd	*Min*	*Max*	*mean*	sd	*Min*	*Max*	*mean*	sd
Gerakan ke kanan	-5.63	20.62	9.20	5.59	-6.68	11.57	2.47	4.22	-22.05	2.87	-4.86	5.28	-11.98	9.44	-1.04	5.95	-2.61	10.08	3.72	3.04
Gerakan ke kiri	-14.77	9.59	0.34	6.64	-15.20	7.95	1.30	6.40	-15.19	0.10	-5.79	4.02	-20.59	19.77	1.92	11.60	-8.91	10.94	2.30	5.66
Gerakan kaki	-15.84	8.33	-4.92	4.92	-12.87	11.57	3.49	4.99	-8.17	3.39	-0.88	2.87	-8.10	7.43	0.36	4.09	-8.68	8.33	0.50	4.77
Gerakan lidah	-11.69	11.45	-2.28	7.15	-5.30	14.49	7.02	5.14	-11.93	3.62	-5.66	3.36	-20.80	11.51	-2.73	6.75	-6.51	12.04	3.08	5.17

Figure 5 is a signal in one channel EEG experiment, so the four movements blended into one. To get each move then there is the process of sorting for each movement. This segregation based on 4 motion / movement class. It is imagine to move right, move left, move the foot and tongue movements. From these results obtained 30 to 45 signal data file. Each signal has a 250-point data. As shown in Figure 6.

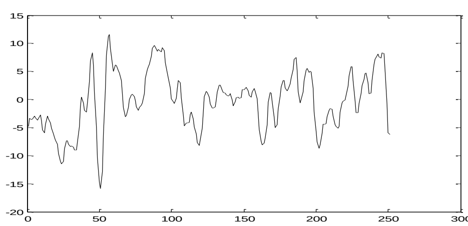
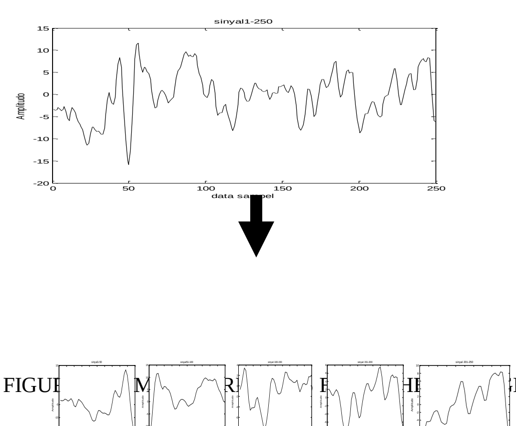


FIGURE 6. SAMPLE EEG SIGNAL FROM CHANNEL 1 K3B SUBJECT MOVEMENT TO THE LEFT.

B. Method of Sampling Techniques

Of EEG signals which have been selected based on the movement and then do the sampling process, each sampled signal into five sections such as figure 7.



FIGU M R E HE GNAL

For the process of sampling techniques, the EEG signal which has been sorted out based on the imagination of the movement to the right, move to the left, foot movement and tongue movements, the data is divided into five sub-signals. Each sub-sought signal minimum value, maximum, average and standard deviation. The results of the minimum, maximum, average and standard deviation of the feature as an input for artificial neural networks. at the Table 1 is an example of looking for features of each signal. So we get 4 x 5 = 20 sub-signal extraction of characteristic features for each movement.

C. Back Propagation Artificial Neural Networks

Data input from the sampling technique of table 1 is used as input classification process, the system uses artificial neural network method of propagation behind. There are two stages in the process of classification is learning Process and process mapping. The learning process using the parameters of 0.1 and an error rate of learning to be achieved 0.000001. The initial price is determined randomly with a weight range -1 to 1.

To find the optimal parameters which produce a rich best performance of neural networks is to make an assessment according to scale Mean squared error (MSE) and the optimal number of hidden units during training. Performance results can be obtained in table 2 and figure 8 - 10. In figure 8 by the number of hidden layer2, the classification process has a magnitude which is far below the target MSE.

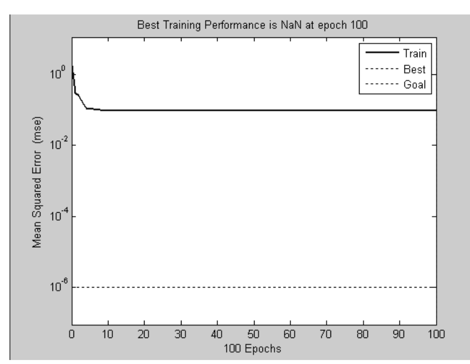


FIGURE 8. THE PROCESS OF TRAINING WITH THE NUMBER 2 HIDDEN LAYER.

In figure 9 with the number of hidden layer 3, the classification process has exceeded the target amount of MSE is the desired error is 0.000001.

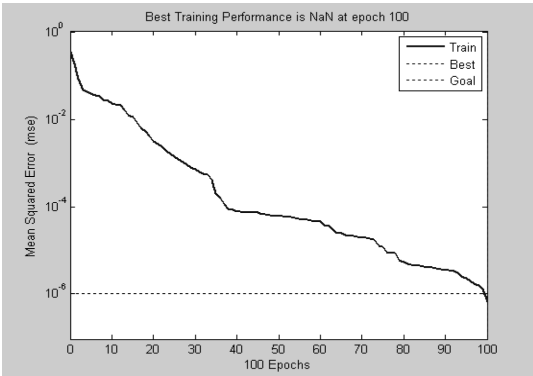


FIGURE 9. THE PROCESS OF TRAINING WITH THE NUMBER OF HIDDEN LAYER 3.

In figure 10 the number of hidden layer 4, the classification process has exceeded the target amount of MSE is the desired error is 0.000001.

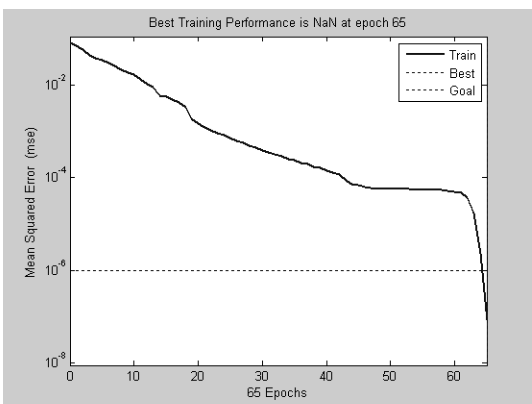


FIGURE 10. THE PROCESS OF TRAINING WITH THE NUMBER 4 HIDDEN LAYER

TABLE 3. THE PERFORMANCE OF ARTIFICIAL NEURAL NETWORK TO A DIFFERENT NUMBER OF HIDDEN LAYER

	MSE (2 Hidden Layer)	**MSE (3 Hidden Layer)**	**MSE (4 Hidden Layer)**
Time	29 second	19 second	46 second
Iterasi	100	100	100
MSE	0.092	$6{,}44 \times 10^{-7}$	$8{,}16 \times 10^{-8}$

IV. CONCLUSION

In this paper, the researchers introduced a sampling technique to extract features and classify the EEG signal is divided into four classes. This study uses 90 data files EEG signals for training and then at the time of identification to the four classes of EEG signal data files data files plus 60 to 150 signals so that the EEG signal data file, through the propagation of classification accuracy reaches 80% for test data. This study shows that the number of hidden layers in back propagation affects the amount of mean squared error (MSE). The work of researchers who will come, examine the appropriate search techniques for feature extraction and classification of EEG signals, so that the level of accuracy for the command to move the cursor will be better. The results obtained will be compared with methods that have been studied.

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