ABSTRACT

Brain Computer Interface (BCI) is getting a lot of attention from researchers because BCI is a system used to translate, manage and recognize human brain activity. Electroencephalography (EEG) is one type of BCI which is included in non-invasive because EEG uses external sensors to measure brain activity. However, EEG has a non-stationary characteristic. Therefore the information on the EEG signal is difficult to process.

This thesis proposes (i) converting the EEG signal into an image and (ii) optimizing the BCI system using feature selection and channel selection. The data used is the EEG stroke signal data set from Universiti Teknologi Malaysia. EEG signal feature extraction with the power spectrum density (PSD). The value of the energy distribution is carried out by brain mapping for each channel. The image feature extraction used is GLCM with 11 statistical characteristics. Feature selection using the GA, MI, and Chi-Square methods to find the optimal method for the system. Therefore, in this thesis, we propose channel selection in the energy distribution image to eliminate irrelevant channels by taking the value of the selected channel on the channel. The classification method in this thesis is Artificial Neural Network Back-Propagation (ANN-BP). The validity of the proposed BCI system is training accuracy, test accuracy, time complexity, and brain mapping.

The feature selection results using the GA method are 7 GLCM characteristics: correlation, energy, homogeneity, inverse difference momentum, different variance, and sum variance. Optimization with channel selection produces 9 channels: AF4, FCz, FC4, FT8, C4, T8, Cp4, Pz, and Oz. Compared with the image system without and with channel selection, the accuracy with channel selection can improve 5% and the time complexity is faster, with a gap of 1,928 ms. Since the EEG signal has a non-stationary characteristic that makes each class challenging to identify, irrelevant values can be omitted because they can confuse the system. This thesis generates the optimal system by using an energy distribution image system using the GA-GLCM feature selection and channel selection.

Keywords: EEG signal, energy distribution image, channel selection, feature selection, brain mapping.