UNIVERSITI TEKNOLOGI MARA

EEG SUB-BAND FREQUENCY ANALYSIS OF SPECTROGRAM IMAGE FOR BALANCED BRAINWAVE AND IQ APPLICATIONS

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of the requirements for the degree of
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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced word. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

This thesis introduces new methods in analyzing Electroencephalogram (EEG) signal by utilizing EEG spectrogram image and image processing texture analysis called Gray-level Co-occurrence Matrices (GLCM). The methods attempt to apply in balanced brain and Intelligence Quotient (IQ) applications. The relationship between balanced brain and IQ application also proposed in this thesis. Collection of EEG signals were recorded from 101 volunteers. EEG signals recorded for the balanced brain application contain closed eyes state meanwhile for the IQ application contains closed eyes and opened eyes state. Before processing the information from the EEG signals, signal preprocessing is done to remove artefacts and unwanted signal frequencies. A time-frequency based technique called EEG spectrogram image was used to generate an image from EEG signal. The spectrogram image was produced for each EEG signals sub-band frequency Delta, Theta, Alpha and Beta. The GLCM texture analysis derives features from EEG spectrogram image. Then, Principal Component Analysis (PCA) was applied to reduce the results and selected principal components features were used as inputs to the classifier. Two classifiers involved in this experiment are K-Nearest Neighbor (KNN) and Artificial Neural Network (ANN). The number of training and testing ratio is assessed at 70 to 30 and 80 to 20 to find the best model based on percentage of accuracy, sensitivity, specificity as well as Mean Squared Error (MSE). The relationship pattern of balanced brain and IQ application were observed via histogram and then Scatterplot. The strength and significant of the relationship was evaluated by using Pearson correlation test. The percentage of correctness classification for balanced brain application is 90% and MSE 0.1. The sensitivity and specificity of this application is ranging from 66.67% to 100%. The accuracy for IQ application is 94.44% and MSE 0.0752. Meanwhile, the sensitivity and specificity of this application is ranging from 0% to 100%. The relationship between balanced brain and IQ achieved with positive and strong correlation with r ranging between 0.860 to 1.000 and $p<0.05$ for some cases. The experiments reported in this thesis showed that the proposed technique were highly successful in indexing the balanced brain level and IQ.

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TABLE OF CONTENTS