UNIVERSITI TEKNOLOGI MARA

DETERMINATION AND CLASSIFICATION OF HUMAN STRESS INDEX USING NON-PARAMETRIC ANALYSIS OF EEG SIGNALS

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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 work. 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

Regardless of type of stress, either mental stress, emotional stress or physical stress, it definitely affects human lifestyle and work performance. There are two prominent methods in assessing stress which are psychological assessment (qualitative method) and physiological assessment (quantitative method). This research proposes a new stress index based on Electroencephalogram (EEG) signals and non-parametric analysis of the signals. In non-parametric method, the EEG features that might relate to stress are extracted in term of Asymmetry Ratio (AR), Relative Energy Ratio (RER), Spectral Centroids (SC) and Spectral Entropy (SE). The selected features are fed to the k-Nearest Neighbor (k-NN) classifier to identify the stressed group among the four experimental groups being tested. The classification results are based on accuracy, sensitivity and specificity. To support the classification results using k-NN classifier, the clustering techniques using Fuzzy C-Means (FCM) and Fuzzy K-Means (FKM) are implemented. To ensure the robustness of the classifier, the cross-validation technique using k-fold and leave-one-out is performed to the classifier. The assignment of the stress index is verified by applying Z-score technique to the selected EEG features. The experiments established a 3-level index (Index 1, Index 2 and Index 3) which represents the stress levels of low stress, moderate stress and high stress at overall classification accuracy of 88.89%, classification sensitivity of 86.67 % and classification specificity of 100%. The outcome of the research suggests that the stress level of human can be determined accurately by applying SC on the ratio of the Energy Spectral Density (ESD) of Beta and Alpha bands of the brain signals. The experimental results of this study also confirm that human stress level can be determined and classified precisely using physiological signal through the proposed stress index. The high accuracy, sensitivity and specificity of the classifier might also indicate the robustness of the proposed method.

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