UNIVERSITI TEKNOLOGI MARA

INTELLIGENT IQ CLASSIFICATION MODEL AND PERCEPTUAL ABILITY USING EEG POWER RATIO FEATURES

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PhD

August 2020

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 results 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 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

Electroencephalogram (EEG) is a popular and effective approach for measuring brainwaves, as well as to explore cognitive performance like intelligence and perceptual ability. Assessment on cognitive abilities have been established via conventional psychometric tests however, the method presents a biasness in terms of cultural and linguistic barriers. Previous study had implemented an intelligence quotient (IQ) classification model via power ratio features and artificial neural network but the findings contribute to inaccuracy of quantified features and did not achieve highest performance measure. The cross-relational study between perception and intelligence using EEG is relatively new subsequently, provides a new research opportunity to relate the cognitive performance via EEG features and intelligent classification approach. This research proposes an intelligent IQ classification model via resting EEG. It focuses on the recorded brainwave from left prefrontal cortex where the subjects were necessarily in relaxed state and closed eye condition. Initially, data are collected from fifty healthy subjects and segregated into three IQ levels; low, medium and high based on Raven's Progressive Matrices. The brainwave features are extracted into respective bands; theta, alpha and beta using equiripple filter and revised power ratio features. The patterns of brainwave features are analysed for each IQ levels. The brainwave features then are used to develop an intelligent IQ classification model. This model is implemented using power ratio features and support vector machine with Radial Basis Function technique. Meanwhile, the perceptual ability dataset is constructed from 65 samples which required to complete EEG recording procedure and also perceptual ability assessment. The samples are then segregated into perceptual ability levels; low, medium and high based on Comprehensive Trail Making Test. The brainwave recording is further continued with signal processing and feature extraction which is similar procedure to IQ dataset. The extracted brainwave features are used to predict the IQ level of perceptual ability dataset via the intelligent IQ classification model. Findings show that intelligence and perceptual ability have positive relationship where high IQ level are presented by high perceptual ability level and vice versa. This positive correlation was expected by relating both attributes with attention. This study presents the intelligent IQ classification model achieves the highest performance measure, 100% for accuracy, sensitivity and specificity. Conclusively, this thesis proves that the brainwave features from resting EEG present as suitable descriptors to classify and predict individual IQ levels. The brainwave features also present as stable descriptors for perceptual ability. Furthermore, this study confirmed that intelligence and perceptual ability can be correlated thus, present positive relationship.

ACKNOWLEDGEMENT

Alhamdulillah, all praise belongs to Allâh, we praise Him, seek His help, and ask for His forgiveness. We seek refuge in God from evils of our souls and our bad deeds. A person, who is guided by God, will never be misguided by anyone and a person who is misguided by God can never be guided by anyone. I bear witness that there is no God but Allâh alone, Who has no partner. That which Allâh wills (will come to pass).

There is no power but with Allâh.

Firstly, I wish to thank God for giving me the opportunity to embark on my PhD and complete this challenging journey successfully.

My gratitude and thanks go to my supervisor, Professor Dr. Ir. Hj. Mohd Nasir Taib for his valuable advice and precious insights, for the admirable support in the completion of this thesis, as well as for his unparalleled commitment to mentoring. Not forgetting to my co-supervisor, Dr. Aisyah Hartini binti Jahidin who is very helpful and motivating. I am very blessed to have them consistently guiding and encouraging me throughout this journey.

My appreciation also extends to Dr. Megat, Dr. Najidah, Dr. Nadia, Dr. Hezri, Dr. Laila and all supportive friends for their assistance on different tasks related to my research. Also, many thanks to all the members of the Advanced Signal Processing Research group and Faculty of Electrical Engineering, for their support and prayers. May Allah reward them all.

I appreciate the support provided by Institute of Research Management and Innovation, Universiti Teknologi MARA and Universiti Teknologi MARA for funding my allowances as graduate research assistant under grants (600-RMI/FRGS 5/3 (63/2015)) and (600/IRMI/MyRA 5/3/GIP (081/2018)). Also, (600-IRMI/MyRA 5/3/LESTARI (015/2017)) for supporting my research instruments.

Most important of all, my deepest gratitude goes to my loving husband, Mr. Mohamad Zaimi and adorable son, Adam Faliq, my parents Mr. Ros Azamin and Mrs. Kheirul Maslina and my parents in law for their unrelenting prayers and their love throughout the years. Special thanks to all my family members. Without them, I am nothing. Alhamdulillah.

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August 2020

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