UNIVERSITI TEKNOLOGI MARA

ANOMALY GAIT DETECTION IN CHILDREN WITH AUTISM SPECTRUM DISORDER BASED ON MARKERLESS-MODEL APPROACH

NUR KHALIDAH BINTI ZAKARIA

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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 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.

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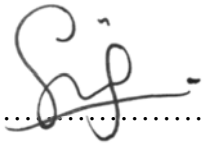
Name of Student	:	Nur Khalidah Binti Zakaria
Student I.D. No.	:	2016200616
Programme	:	Doctor of Philosophy (Electrical Engineering) – EE950
Faculty	:	Electrical Engineering
Thesis Title	:	Anomaly Gait Detection in Children with Autism Spectrum Disorder based on Markerless-Model Approach
Signature of Student	:	 ……..
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ABSTRACT

Autism spectrum disorder or ASD is known as one of neuro-developmental disorder that consists of a range of conditions characterised by some degree of impairment and the symptom(s) can normally be seen at an early age. However, this lifelong condition has no known cure, but the condition can be reduced and recovered through therapies and treatments. At present, numerous studies have been done in investigating the behaviours among ASD children especially in their walking gait. Different approaches are used in order to highlight the gait features that may be associated with differentiating the walking gait of these children. Several studies experimented with gait features using different types of gait techniques. Among the gait techniques, there is limited literature existed for the markerless-based gait techniques in gait analysis for ASD. Therefore, in this thesis, anomaly gait detection in children with autism using the markerless-based approach is proposed. Firstly, the markerless-model approach features are extracted from 23 ASD subjects and 30 typically development (TD) subjects using Kinect Sensor. The originally extracted gait data is represented by the depth values (m) by 300 observations for each group. From these attributes, 10 sets of features are derived and divided into two categories namely Direct Joint Feature (DIR), and Reference Joint Feature (REF). Next, the principal component analysis (PCA) and linear discriminant analysis (LDA) techniques are used as feature extraction in order to determine the significant features, and the outputs of new features are labelled or known as DIR PCA-CPV, DIR PCA-Scree, DIR LDA and REF PCA-CPV, REF PCA-Scree and REF LDA features. Further, to evaluate the effectiveness of these new groups' features, four different classifiers namely the Support Vector Machine (SVM), Naïve Bayesian (NB), Artificial Neural Network (ANN) and Long-Short Term Memory (LSTM) are used to classify the gait samples from the different sets of features for the two groups of subjects as ASD or TD. Results attained showed that the NB classifier achieved the highest accuracy with 99.33% using DIR LDA specifically Set 1 that represents the full body and extracted by selecting all body points in x, y, and z axes. Additionally, this feature set is capable to correctly classify the ASD group with sensitivity of 99.66% and the TD group with specificity of 99.00%. In addition, based on the utilised of the intra-group and inter-group normalisation for the evaluation and validation of the hip, knee and ankle angles, the kinematic plots showed that the hip and the knee plots are similar for both techniques based on comparison of the markerless-based technique versus the marker-based technique. The ANOVA test supported the analysis that showed the insignificant means of differences for all angles. Hence, it is proven that the proposed markerless-based gait technique and the proposed gait feature are indeed apt to be used in classifying the gait of both ASD and normal children with LDA as the most suitable feature extraction and NB as the optimum classifier.

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TABLE OF CONTENTS