UNIVERSITI TEKNOLOGI MARA

AUTISM CHILDREN GAIT CLASSIFICATION USING INTELLIGENT TECHNIQUES

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ABSTRACT

Recently, gait patterns of autistic children are of interest in the gait community in order to identify significant gait parameter namely the three-dimensional (3D) gait features. The development of gait patterns via assessing gait deviations in autistic children can help clinicians and researchers to differentiate gait pattern abnormality in diagnosing, clinical decision-making and planning. Understanding the characteristics and identifying gait pattern is essential in order to distinguish normal as well as abnormal gait pattern. Hence in this research, the application of machine learning approach specifically Neural Network (NN) and Support Vector Machine (SVM) along with Singular Value Decomposition (SVD) and Linear Discriminant Analysis (LDA) as feature extractions are evaluated and validated in discriminating gait features between normal subjects and autistic children. Gait features of 32 normal and 12 autistic children were recorded and analyzed using VICON motion analysis system and force platform during normal walking. Here, twenty-one gait features describing the three types of gait characteristics namely basic, kinetic and kinematic in these children are extracted. Next, these three category gait parameters acted as inputs to both classifiers. The performance of NN and SVM in classifying the gait patterns between autistics and normal children as classifier are evaluated. The ability of SVM as classifier are investigated using three different kernel functions specifically linear, polynomial, and radial basis. In addition, the classifiers performance is validated by computing both values of sensitivity and specificity. Results showed that LDA as feature extraction has the highest accuracy with kinematic parameters as gait features along with polynomial function as kernel for the SVM classifier with 100% accuracy. This finding proven that LDA is suitable as feature extraction and SVM is indeed apt as gait classifier in classifying the gait pattern autistics and normal children.

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CHAPTER ONE

INTRODUCTION

1.1   BACKGROUND OF STUDY

Autism Spectrum Disorders (ASDs) are characterized primarily by impairment in communication and social interaction [12,18] which can be seen through repetition of behaviour [3, 5] and stereotyped interests [14]. It is linked to a varied array of neuro behavioural symptoms [14,18] which occur during infancy as early as 14–24 months and becomes established by age two or three years old [1-3]. The occurrence rate of ASD of developmental disability internationally, is approximately at over 1 in 100 children with boy more likely to be identified 5 times more than girl [95]. The deficits associated to ASD are mainly in social interactions and include an impaired use of non-verbal social behaviours such as failure to use eye contact, lack of social, sharing emotions and interests with other people, in addition to develop peer relationships.

Gait is a person's manner of walking. The systematic study of human walking is called gait analysis. Measurement, analysis and assessment of biomechanical features are included in the walking task. It involves the analysis of quantitative domains: temporal-spatial, kinematics and kinetics. In addition, gait analysis applications have been previously used by orthopaedists, physical therapists or kinesiology's to evaluate affected individual's gait. Previous studies found that autistic children have a motor impairment that will cause abnormalities in gait and posture [6, 7]. Children with autism will have defects in early motor development in performing their daily activities. Probably the most abnormal characteristic motor behaviour exhibited by people with autism is the repetitive and stereotypical movement of the body, limbs and fingers [3]. Naturally, they will experience movement impairment such as abnormal walking pattern that impinges their quality of life. Therefore, walking gait analysis can be used to examine the walking gait parameters for autistic children.

Recently, with many advantages increased by automated recognition of gait pattern, the machine classifier has been successfully expected to offer many potential advantages for gait classification. Artificial neural networks (ANN) and Support Vector Machine (SVM) have been widely used in many biomedical analyses because they