A Study on Diagnosis of Autism Spectral Disorder Using Artificial Intelligence Techniques

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***Abstract*- Autism Spectrum Disorder(ASD) is a collection of heterogeneous disorders with prevalent cognitive and behavioral abnormalities. It is a complex neurological disorder that have a lifelong effect on the event of assorted talents and skills. Electroencephalography (EEG) studies have been identified as one of the most widely used tool for assessing the cognitive functions. But now a days MRI scan also suggested for proper diagnosis of ASD. There is a discussion of deep learning on the raw signal without explicit hand-crafted feature extraction. Because the EEG signal has subject dependency, it is better to train the emotion model subject-wise, while there is not much epochs available for each subject. Deep learning algorithm provides a solution with a pre-training way using three layers of restricted Boltzmann machines (RBMs). Thus, epochs of all subjects to pre-training the deep network, and use back propagation to fine tuning the network subject by subject. The foremost vital goal of the paper is to review the autism problem, to detect the levels of autism with the help of data mining classification algorithms. The data mining has been typically accepted as a decision making process to facilitate higher resource utilization in terms of autism students' performance.**

***Index Terms*- ASD, deep learning, Convolution Neural Network, training classifiers, Graphics Processing Unit, EEG, MRI Scan.**

I. INTRODUCTION

ASD is a neuro-developmental condition that is relatively common,affecting 1 in 150 children. ASD is characterized by impaired social communication, social reciprocity and repetitive stereotype behavior. Motor function, attention and other cognitive domains may also be affected. Early detection of ASD using non-invasive methods play a major role in providing treatment that may slow down its progress. Traditionally, ASD is diagnosed solely on the basis of behavioral criteria. This can be time consuming and problematic. Emotion classification is an active topic in the past decades. It is the bridge of human and machines, and it is essential for computer to understand the emotion of users as a brain computer interface (Bel) system [1-2]. There are many ways to recognize the emotion, such as facial expression and brain waves. However, it is difficult to recognize emotion from some disabled people based on their appearance, such as autism. Brain signal is an alternative way to access human emotion, which can be acquired in invasive and noninvasive manners. An invasive Be1 places electrodes on the exposed surface of a brain using surgical operation, such as an incision into the skull. This is not an acceptable way for most of human beings. The non-invasive way provides a more convenient and favorable way to collect the brain signal, which includes magnetoencephalography (MEG), Various machine learning algorithms have been used to recognize emotion of EEG signal, including K-Nearest Neighbor (KNN) [9], Regression Tree (RT) [10], Bayesian Network (BNT) [11], Support Vector Machine (SVM) [12] and Artificial Neural Networks (ANN) [13]. A Non-invasive method of early detection of ASD can be done by brain imaging. Magnetic Resonance Imaging (MRI) is the most important brain imaging procedure that provides accurate information about the shape and volume of the brain. The studies of analyzing MRI brain scans can be categorized into two classes: Region-of-Interest (ROI) method [3] and whole brain morphometric method [4]. In ROI, the volumetric measurements of specific brain regions are used to detect neurological disorders. These algorithms are successfully applied to emotion recognition; however, the performance in terms of accuracy is not high enough due to the subject dependency of

emotion. Deep learning algorithm [14] provides a solution with a pre-training way using three layers of restricted Boltzmann machines (RBMs), which is widely used in many applications [21]. This paper gives detailed information towards ASD and diagnosis of ASD.

The remainder of this paper is organized as follows. Section A describes the types of ASD and causes of ASD. Section B,C,D,E describes the symptoms of ASD. Section II deals with diagnosis of ASD using convolutional methods and related work. Section III describes future work and required advancement in the field and finally in Section IV, we conclude the paper.

A. Types of Autism Spectrum Disorders :

The term autism is derived from the Greek word "autos" means "self". It includes a wide range of spectrum disabilities. The autism spectrum disorders belong to an "umbrella" class category of five childhood-onset Conditions called pervasive developmental disorders (PDD). They are concerning the three most common PDDs.

1. Autism
2. Asperger's Syndrome
3. Pervasive Developmental Disorder - Not Otherwise Specified (PDD-NOS) Childhood dis integrative disorder and Rett Syndrome are the other pervasive developmental Disorders.

B. Signs and Symptoms of Autism Spectrum Disorders

In every children and adults, the signs and symptoms of the autism spectrum disorders embrace issues with social interaction skills, speech and communication. The autism spectrum disorders are measured based on the presence of multiple symptoms that disrupt the child's ability to talk, make the relationships, explore, play, and to study. The method an individual communicates and relates to people. Educational data mining is an emerging field which can be effectively applied with in the field of education. The symptoms of autism spectrum disorders: Social skills, Basic social interaction may be troublesome for children with autism spectrum disorders.

Symptoms might include

1. Unusual or inappropriate visual communication, gestures, and facial expressions (e.g. avoiding eye contact or facial expressions that don't match what he or she is saying).
2. Lack of interest in people or in sharing interests or achievements (e.g. showing you a drawing, pointing to a bird).
3. Unlikely to approach others or to pursue social interaction; comes across as aloof and reserved; prefers to be alone.
4. Problem and difficulty in understanding individual person's feelings, reactions, and nonverbal cues.
5. Resistance to being touched.
6. Difficulty or failure to create friends with children of the same age.
7. Low sensory feelings, low in flexible thinking and intellectual development.

C. The Symptoms of Autism Spectrum Disorders: Speech and Language

Problems with speech and language comprehension is a sign of the autism spectrum disorders.

Symptoms might include

1. Delay in learning the way to speak (after the age of or doesn't talk in the least.
2. Speaking in abnormal tone of voice, or with an odd rhythm or in high pitch.
3. Repeating words or phrases over and over.
4. Trouble beginning a spoken language or keeping it going.
5. Difficulty communicating needs or desires.
6. Doesn't perceive straightforward statements or queries.
7. Taking what's same too virtually, missing humor, irony, and satire.

D. The Symptoms of Autism Spectrum Disorders: Restricted Behavior and Play

Children with autism spectrum disorders are typically restricted, rigid, and even psycho neurotic in their behaviors, activities, and interests.

Symptoms could include:

1. Repetitive body movements (hand undulation, rocking, spinning); moving perpetually.
2. Obsessive attachment to uncommon objects.
3. Preoccupation with a particular topic of interest, typically involving numbers or symbols (maps, license plates, sports statistics).
4. A strong would like for sameness, order, and routines.

5. Gets upset by modification in their routine or surroundings.
6. Clumsiness, abnormal posture, or odd ways that of moving.
7. Fascinated by spinning objects, moving items, or elements

E. Related Signs and Symptoms of Autism Spectrum Disorders

1. Sensory issues
2. Emotional difficulties

II. RELATED WORK

There is no definite treatment for autism. Serving to autistic children by providing games and teaching facilities to improve their skills. In the year 2013 Santos examines the first detection of Autism means that taking the symptoms of patient during childhood supported by pre-verbal vocalization by using the classification technique supervised learning SVM (support vector machine). Chaminade, 2012 started a shot to use MRI study of young adults with autism interacting with a humanoid robot. Prud'hommeaux et al.[15] examines the difficulties for classification of non standardized text of machine learning techniques. Kathleen T Quach [16] suggested that problem through the classification problem is that ASD may be a terribly heterogeneous disorder which will have subgroups with totally different genetic expression signatures. To boost classification, it should be helpful to stratify the ASD class into subgroups and enrich the input set with clinical measures. Alexander Genkin et al. [17] have given a easy Bayesian logistic regression approach that uses a Laplace prior to avoid over fitting and produces sparse predictive models for text data. They applied this approach to a spread of document classification issues and show that it produces compact predictive models a minimum of as effective as those created by support vector machine classifiers or ridge logistic combined with feature selection.

Traditional methods used to Diagnosis of Autism:

1. Cohen's model of autism:

A correctly dimensioned neural network has a sufficient number of neurons and synapses to learn the required response to the presented inputs but only in an approximate way. Cohen uses a multilayer feed-forward backpropagation network

2. Gustafsson's model of autism:

Autism have shown that it is not a "single-gene disorder" but rather that multiple, possibly interacting, genes are involved in causing autism. Therefore it is reasonable to search for complementary explanations for narrow minicolumns. Two such alternative/complementary explanations have been presented by Gustafsson.Gustafsson argues that narrow columns with fewer than normal neurons would be responsive to a narrower than normal range of stimuli and therefore exhibit good discrimination at the cost of poor generalization. He discuss, a self-organizing map with lateral excitatory and inhibitory feedbacks (both biologically motivated) in which synapses change according to Hebb's law. In such one-layered neural networks groups of neurons all of which are active upon presentation of one class of stimuli, such as a phoneme in speech, also emerge as a result of self-organization.

A. Neural Network

Neural network are generally organized in layers. Layers are created by Variety of Interconnected 'nodes' that contain an 'activation function'. Patterns are given to the network via the 'input layer' that communicates to one or more 'hidden layers. The hidden layers then link to an 'output layer'. Most Artificial Neural Networks contain some type of 'Learning rule' that modifies the weights of the connections in step with the input Patterns.

B. Support Vector Machine

In classification support vector machine are supervised learning models with associated learning algorithms that analyze data and acknowledge the patterns, used mainly for classification and regression analysis. A SVM training algorithm builds the model that assigns new examples into one class or the other, creating it a non probabilistic binary linear classifier. An SVM model could be a representation of the examples as points in space, and it is mapped so that the examples of the separate categories are divided by a transparent gap that is as wide as possible.

C. Fuzzy Logic

The term "fuzzy logic" was introduced with the 1965 proposal of fuzzy set theory by Lotfi A. Zadeh. Fuzzy

logic has been applied to several fields, including ANNs.

IV. DISCUSSION

Deep learning, which is a set of algorithm in machine learning that attempt to model high-level abstractions in data by using model architectures composed of multiple non -linear transformations. convolutional neural networks (CNN) is one of the classic deep learning models, which is a biologically inspired variant of multi-layer perceptrons. There are different techniques to detect these nonverbal behaviors using neural networks such as Multi-layer perceptrons (MLP) or a Deep Convolution Neural Network (DCNN) which uses back propagation algorithm where the input image is repeatedly given to the network, and a loss is computed by comparing the desired output with the neural network output. This estimated loss is fed back to the network to minimize the error by adjusting the weights with each iteration, producing an intended output. This procedure is called as "training." With the support of multiple Graphics Processing Unit (GPU), training rate could be accelerated. Limitations of the study were the non-optimized ML pipeline and the limited database.

Limitations of the deep learning method are twofold. First, the network structure that results after training is not straightforward to interpret. Although there are possibilities for interpretation [9], the interpretation of standard ML pipeline has been more broadly investigated. More work is needed in this regard for deep learning. Besides, the computational time needed for training is generally higher than for standard ML pipelines. However, this is not relevant for run time.

Advantages of deep learning in the aforementioned context are: (i) there is no need to rely on expert-defined features [9] that may or may not represent the information content of the signal that is subjected to classification; (ii) the analysis procedure resembles what human experts do, since the whole signal segment is rated with one, continuous and clinical scale-like output [7]; (iii) an adaptation of the network to an individual patient is possible [13]; and (iv) especially deep learning based frameworks can be expected to produce better results with the growing amount of data that will become available. However, these data need high quality labels from clinical experts.

IV CONCLUSION

Autism spectrum disorders (ASDs) are measured by impairments in social functioning and language, and by the presence of restricted interests and repetitive behaviors. To be diagnosed with autism, the behavioral symptoms altogether of the above-mentioned areas should be present by age 3. Even if the parents typically notice that something is wrong throughout infancy, it is terribly tough to diagnose autism before the age of eighteen months. The bulk of children with autism even have a learning disability (mental retardation), though many have brain disorder and visual and hearing impairment are over-represented in this group. Persons with Asperger's syndrome resembling autism, have average or higher than average intelligence. This paper mentioned concerning the matter of autism and the various kinds of disorder autism and compares the effectiveness of popular machine learning methods with Artificial Neural Network (perceptron), Support Vector Machine, and with the fuzzy logic. But from constant analysis, the deep learning is a promising method for good diagnosis of neural disorder. The development of wearable sensors has opened the door for long-term monitoring of patients in the home and community settings. There is a need to develop methods suitable to monitor the severity of ASD symptoms in patients .We think that the recent advancement of deep learning methods in ML may make an important contribution to sensor-based motor behavior analysis.

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