BRAIN IMAGING TECHNIQUE FOR DIAGNOSIS OF ADHD : A SURVEY

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ABSTRACT

Attention Deficit Hyperactive Disorder (ADHD) is a neurological childhood disorder. It affects four to eight percent of school-aged children. It makes difficulty in the ability to control their behaviour and pay attention to tasks. In this proposed paper, the facts related to ADHD and the Brain Imaging techniques that help in identifying the abnormalities are pointed out. The main four parts of the brain are the corpus callosum, the basal ganglia, the frontal lobes and the cerebelar vermis. Brain scans showed that the reduced volume of these parts explain typical ADHD symptoms. The techniques like MLP and SVM classifiers, WEKA tool, FreeSurfer 5.1 , caudate segmentation, atlas-based segmentation, Graph Cut energy-minimization, isotropic local binary patterns, Support vector machines (SVM) are discussed here. This study reveals that ADHD is neurological disorder and should be identified earlier for better results.

Keywords : Attention Deficit Hyperactivity Disorder, Brain Imaging Techniques.

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I. INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is a neurological disorder. It affects children and persists into childhood. ADHD can be a combination of problems, such as inattention, hyperactivity and impulsive behaviour. It is the chronic condition due to brain disorder such as: Brain Injuries, Brain Damage, Brain Abnormalities.

a. Brain Injuries

Traumatic brain injuries such as maternal smoking, problems related to genetic basis are lead to ADHD.

b. Brain Damage

Head injuries due to accidents, violence, etc cause brain damage. These brain damages were lead to ADHD.

c. Brain Abnormalities

The abnormalities happen by before birth, such as Problems in utero, physical violence injuries, swelling of blood vessels in the brain, cerebral palsy, etc are some abnormalities which happen before birth. These type of brain abnormalities lead to ADHD. [9]

II. BRAIN IMAGING TECHNIQUES

This technology is now fast growing and everyday innovations are carrying out in this field. It helps in neuroscientific inquiry into the human brain. The most important brain functions related to emotion, cognition,

memory, language are examined here. The other externally induced stimuli as well as resting-state brain function can also be investigated. It assists to determine the psychiatric and neurological disorders functional as well as structural information provided by these techniques.

Neuro imaging is a interdisciplinary field. Statistics plays an important role in establishing methods to extract information and to quantify evidence for formal inferences. Neuro imaging data challenges for statistical analysis, The data are collected from each individual in vast amount. After that the complex temporal and spatial dependence is presented present. [8]

Modern technology provide several ways to know about the human brain:

For getting the structural information we use structural imaging techniques. Magnetic Resonance Imaging (MRI) and Diffusion Tenser Imaging (DTI) help us for structural imaging. It provides a two- or three-dimensional image of the brain. But the main demerit is that it does not give any information about the activities and the abnormalities.

Functional Imaging as its name suggests provides information about the functions. Functional Magnetic Resonance Imaging (FMRI), Electroencephalography (EEG) and Magneto Encephalography (MEG) are the tools used to get functional imaging. It gives information about the activities of particular areas of the child's brain while the child is doing certain activities.

III. Existing Techniques

Radhamani (2016) et. al, proposed "Diagnosis and Evaluation of ADHD using MLP and SVM classifiers" – here they used MLP and SVM classifiers to diagnose the attention deficit hyperactivity disorder. Evaluation is done by using the Performance Metrics, ROC curve. For checking the accuracy they use the measures by WEKA tool.[1]

Ricardo Saute (2014) et. al, proposed "Brain Morphology in Children with Epilepsy and ADHD" – In this study, the children with epilepsy, with and without ADHD, and healthy controls were underwent high resolution MRI. The program FreeSurfer 5.1 is used to measure the cortical morphology. Subcortical and Cerebellar volumes are compared between this groups using the program FreeSurfer 5.1 [2]

Laura (2012) et. al, proposed "Automatic brain caudate nuclei segmentation and classification in diagnostic of Attention-Deficit/Hyperactivity Disorder"- here they proposed a new method. This consists of different steps. For external and internal segmentation of caudate they used Machine Learning methodologies. For caudate representation and classification, they used the definition of a set of new volume relation features, 3D Dissociated Dipoles [3].

Martin (2010) et. al, proposed "Cortical Gray Matter in Attention-Deficit/Hyperactivity Disorder: A Structural Magnetic Resonance Imaging Study"- Under this method, the images were processed first using a volumetric pipeline. Hence it provide a fully automated estimate of regional volumes of gray and white matter. Then the analysis of cortical thickness for each lobe and for regions in the frontal lobe is done using FreeSurfer[4].

Laura (2011) et.al, proposed "A fully-automatic caudate nucleus segmentation of brain MRI: Application in volumetric analysis of pediatric attention-deficit/hyperactivity disorder" – here they present a method called Cau-dateCut. This is a new fully-automatic method of segmenting the caudate nucleus in MRI . This method combines atlas-based segmentation strategy and the Graph Cut energy-minimization framework. The Graph Cut model is used for small segmenting. Muti-scale edgeness measure method is used for boundary detections[5].

Che-Wei Chang (2012) et. al, proposed "ADHD classification by a texture analysis of anatomical brain MRI data" - here they introduces a simple method to classify ADHD on the basis of the morphological information. They did not use functional data. They used isotropic local binary patterns on three orthogonal planes (LBP-TOP) for feature extraction from MR brain images. Support vector machines (SVM) were used to develop classification models [6].

Laura (2012) et. al, proposed "Supervised Brain Segmentation and Classification in Diagnostic of Attention-Deficit/Hyperactivity Disorder" – provides an automatic method for external and internal segmentation based on statistical and structural machine learning approaches. The external segmentation method adapts the Graph Cut energy-minimization model. The internal segmentation method is based on shape features of the Region of Interest (ROI) in MRI slices. The results of this approach show accurate external and internal caudate segmentation in a real data set. For the ADHD diagnostic test also it shows better results when compared to manual annotation [7].

IV. Existing Tools And Techniques - Pros & Cons

SL. NO	TECHNIQUES	ADVANTAGES	DIS ADVANTAGES
1	MLP [1]	Used to map an *N*-dimensional input signal to an *M*-dimensional output signal, can also be non-linear. Best one for ADHD data classification when compared to SVM classifiers	Stops during training in global minima and stucks in a local minima. Setting of number of Hidden neurons.

SL. NO	TECHNIQUES	ADVANTAGES	DIS ADVANTAGES
2	SVM [1]	Produce very accurate classifiers. Less overfitting, robust to noise	Binary classifier. To do a multi-class classification, pair-wise classifications can be used (one class against all others, for all classes). Computationally expensive, thus runs slow
3	WEKA [1]	Platform independent and portable. Available under GNU General Public License. Very easy to access	Lack of proper and adequate documentations. Systems are updated constantly(kitchen sink syndrome)
4	FreeSurfer [2] FreeSurfer 5.1 [4]	Cortical surface representation from the grey matter segmentation. Surface based group registration capabilities. Accuracy of subcortical structure measurements. Stereotyped analysis	Does not consider the correlation among the repeated measures, and thus, there is a significant reduction in statistical power.
5	Machine Learning [3]	Feature Learning Parameter Optimization	Works with continuous loss functions Limited Large data requirements

SL. NO	TECHNIQUES	ADVANTAGES	DIS ADVANTAGES
6	3D Dissociated Dipoles [3]	Biological plausible representation which also includes non-local comparisons	These feature sets cannot be used with the classical Adaboost approach due to computational limitations, an evolutionary learning algorithm has to be used .
7	Atlas-based segmentation [5]	Fully automatic, no user interaction required Repeatable, reproducible results	Require the use of image registration in order to align the atlas image or images to a new, unseen image
8	Graph Cut energy-minimization [5]	FStereo depth reconstruction Texture synthesis Video synthesis Image de-noising	Require the use of image registration in order to align the atlas image or images to a new, unseen image
9	LBP-TOP [6]	ımproved accuracy Least sensitive to rotation errors.	Accuracy depends upon the temporal and statistic features

V. Conclusion :

In this proposed paper, the brain imaging techniques used in diagnosis of ADHD are discussed. From this discussion we can conclude that the ADHD is an indicator of neurological disorder. It affects children and can be persist in adulthood also. ADHD, or Attention-Deficit Hyperactivity Disorder, is a behavioural condition which makes difficult on focusing everyday requests and routines challenging. They have habit of fidgetting, making noises and unable to adapt to the changing situations. Children with ADHD are defiant, socially inept or aggressive. Proper diagnosis and treatment can bring out positive outcomes. We can make this disorder as a gift by proper guidance and therapies.

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