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An Incisive Framework for Attention Deficit Hyperactivity Disorder Discernment

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***Abstract* - Common disorders related to brain in child and adult prevail only on few situations. The Attention Deficit Hyperactivity Disorder (ADHD) is one such psychological disorder that can be found in all irrespective of the age. The identification of ADHD is itself a very challenging task. The reason for it is the different categorical types and its sensitivity. This paper proposes a framework for identifying all the categories of ADHD. The approach is simple and concise approach to identify ADHD. The results are very satisfactory to be applied on a ADHD subjects.**

***Abstract* – Brain, Common Disorders, ADHD, DNM, fMRI.**

1. INTRODUCTION

Neuropsychiatric disorders like schizophrenia, autism and Attention deficit hyperactivity disorder (ADHD) are prominently found to be growing more in children. ADHD falls into the category of behavioural disorder. Approximately 4% of adults and 5% of children have this disorder in United States as given in [1]. ADHD displays a disruptive behaviour which is characterized by inattention, impulsivity, and over activity. The difficulty in concentrating on a activity or task (until it is completed even for tasks that may take only a few seconds), interrupting conversations and half done tasks, most importantly finding it difficult to remain seated in a place are the exact state of the children or adults having ADHD. Boys are three times more likely to get diagnosed for ADHD [2]. The subtypes of ADHD include: Predominantly inattentive, predominantly hyperactive-impulsive and combined type of inattentive-hyperactive-impulsive.

On a sample of 770 children in a survey done in [3] it has been concluded that 11.3% has been diagnosed for ADHD and it conforms the fact that it is prevalent more in boys. In a study in 2008, it's clearly stated due to less epidemiologic information on scarce population a concrete conclusion on the statistical data could not be given. But as an apprehension it informs the prevalence of 10-20% bracket for Indian children. A review of more than 50 studies informs that, the same situation of prevalence would persist in India as in US, which is extremely alarming and appalling [4].

ADHD is generally diagnosed on a criteria specified by Diagnostic and Statistical Manual for Mental Disorders. It is a disability mainly diagnosed in childhood and prevails in adolescence and persists in adult hood. Its impact on society is enormous in terms of financial cost, stress to families, and interference with academic and vocational activities as well as negative effects on self-esteem[5]. It has to be diagnosed to help the children, the society and the community helpers. A lucid method to find ADHD is very important. There are no well known or formal methods of test that are prevalently adopted for diagnosing ADHD. There is a vague reasoning on the brain mapping, the gene structure and the functioning of the frontal lobe in the brain. In a small sample population the ADHD has always shown a higher percentage of existence [6], the percentage of affected population be it high or low, the identification and treatment methods must be concise to help[7].

2. REVIEW OF LITERATURE

As in [8] about 6.4 million children have received diagnosis for attention deficit hyperactivity disorder (ADHD) at some point — an increase of 16 percent since 2007 and 53 percent in the past decade — according to new data released by the Centers for Disease Control and Prevention. ADHD has profound importance and its growing statistics does claim for a methodological identification and treatment. There are three common approaches used generally to identify or classify ADHD. They are briefed in the following subsections.

1. Practical approach:

The diagnostic method in practical approach is not a single test or information analysis from one source, the practical approach of diagnosis involves multiple assessment methods. It has a series of procedures as shown in fig 1.

Fig 1: Practical procedure of ADHD diagnosis

As depicted in the figure it makes it clear that the steps are time taking and involves lot of human data and in

turn human perceptions. A diagnosis of such a serious disorder may not settle or merge well with the data provided on perceptions. The practical approach also involves academic skills information like productivity, accuracy and progress. One major drawback that can be lucidly seen is there are no assessment instruments like formal tests available from the forefronts of medicine and psychology. The identification in this procedure may take months for compilation for identification. The practical procedure has to be adopted as a cyclic model as in fig. 2.

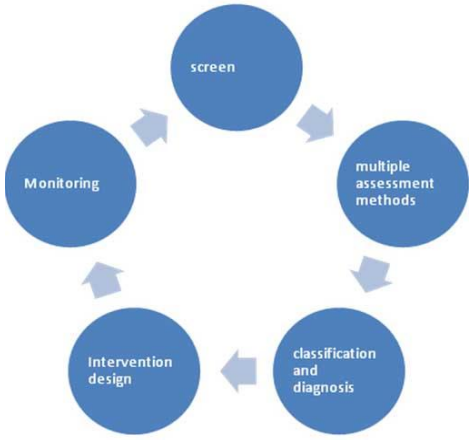

Fig. 2. Model for diagnosis

2. Brain Mapping:

The functional Magnetic Resonance Imaging (fMRI) scans of the subjects are taken and an analysis of the brain wiring based on structural and functional connectivity is studied in [9]. It is strongly believed by the neuroscience research that the functional impairments are strongly connected to the brain network. From the resting fMRI, the Default Mode Network (DNM) of the brain is monitored. Unsuccessful attenuation of the DNM reporting longer reaction times and less accuracy on an attention task, is said to be subject to ADHD. There is a lot of conflict in discussion with DNM, a hyper or a hypo connectivity of DNM is ADHD. Results from various studies related to DNM on pathological changes are inconsistent. As stated that the DNM activity has no issue in resting state when a transition from resting state to task happens, the DNM fails to respond for ADHD subjects. The conflict in the studies and their clear findings can be found in literature [10].

3. Image Analysis:

The images analysis method takes the fMRI the image data and captures it as a feature vector and the voxel based information is mapped across a mask, a correlation analysis is made and fed to a classifier. This is a common approach based on the image obtained from the subjects. The classification performance on the subjects is proved high, but the purpose of identification of ADHD in a child is not sufficed.

All these methods have their own difficulties in terms of the time consumed, human perceptions, conflict in the findings, and not supporting the identification of the disorder. This paper proposes a method which would aim in identifying the children with ADHD clearly eradicating all the disadvantages of the existing methods.

3. METHODS AND MATERIALS

The framework proposed has an advantage of collecting data at a lesser cost and not much of human effort. After enough literature survey it could be seen that data collection is one predominant difficulty. They are very expensive MRIs or lot of human effort with consistency is a mandate. The input of the framework is a video file of predominantly the face of the child. It is very easy and quite comfortable to capture the facial video when compared to the data collection done in the other approaches. When no task is being done by the child that is the resting state, this is to match with the saccadic movements of the child, the video can be recorded.

The video file is then split into photo images or pictures for every second of the video. A one hour video would provide 60 pictures of the child.

A maximal differential co-efficient can be calculated for a pair of photos, which follow in sequence. The change in the co-efficient would exactly inform the changes in the faces that is the action. The action on the facial muscles account towards the facial expression of a person. We get a secondary source of information from the sequential photos appearing in the stream.

Each photo can be labelled on one of the seven universal expressions as happy, sad, disgust, angry, fear, contempt and surprise.

The same experiment is continued with an anti saccade task to identify the behaviour. Any visual stimuli can be given to the child and the child's reaction can be video graphed and the facial expressions can be analyzed. The method suggested is a direct framework which could be adopted for the identification of ADHD in children and adults.

Procedure:

1. Take a video recording of the face of the child or adult suspected as subject to ADHD (assuming the brain is in resting state).
2. Slice the video file into image clips.
3. Identify the change in facial expression of the child every frame per second.
4. Label and Record the expressions from the entire video.

5. Repeat the procedure performing an anti-saccade task and take the labelling.

Since no such video dataset is available to prove the framework, a video of an individual with facial changes was taken as test data. A clinical psychologist rating for the same video was taken for all the expressions. The video has a list of expressions close to 40 different variations within 10 minutes given by the psychologist. The implementation was done in MATLAB where each expression was individually identified which mapped accurately with the psychologist rating. So there is enough scope for identifying the change in facial expressions. A regular behaviour can be well identified within the facial expressions. With that we can conclude the ADHD children would have a different frame of facial expressions which may not be in tune with the regular expected expression flow. The expression classification was made based on Paul Ekman's expression model [11].

4. Experiments and Results

A test data was taken from internet which was used for testing the frame work suggested. The video file used was a one hour video [12]. The video was by an actress performing different expressions on facial context. The figure 3 gives a snapshot of the video.

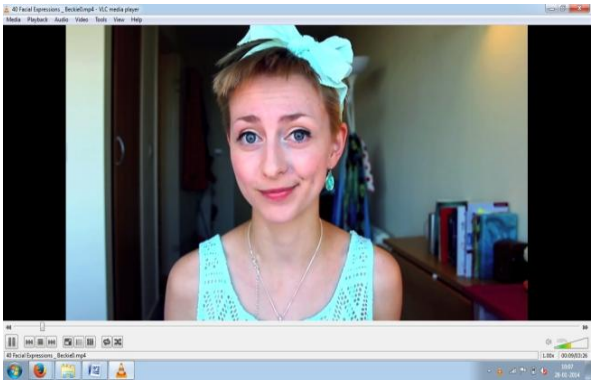

Fig. 3. Snapshot of the video

There were 40 expressions in the video, the ones identified were happy[13], sad, scared, bored, and angry. The basic expression model was designed as in [14]. The expressions picked are bound to have a high correlation in children with ADHD. The figure 4 shows the expression identified for the basic five affects picked out of the list of several universal emotions.

Fig. 4. Identified Expressions

5. Conclusion

The video analysis helped in concluding that if there was no facial expression change in the video when there is a saccade task given shows sign of serious anti saccade activity and higher the change in facial expression in the video infers the attention deficiency. Both extremes can be concluded as very positive for the ADHD identification. The ADHD behavioural symptoms include a regular and frequent attention change, and a no change in behaviour when expected a change. The frame work suggested has been successful in identification of basic expression change.

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