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Ancient Indian Diagnosis Techniques for Brain Disorders (Autism, ADHD, Cerebral Palsy, Speech Disorder) with Artificial Intelligence

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ABSTRACT
This document gives a brief review about ancient Indian diagnosis techniques using human pulse and other human body parts includes eyes, tongue, and nails where an experienced physician can examine the human body behavior for three main human body fundamental energies primarily known as Vata, Pita, Kapha which actually governs the entire body's functions and are strongly believed to make an impact on healthy well being. This examination process can be automated by embedding Artificial Intelligence which can shorten the process of diagnosis and provides more accurate results. There is a study used to implement these ancient techniques with AI based algorithms which can diagnosis patient's early disease expectations and can be cured soon.

Keywords — Human Pulse, Brain Disorder, Speech Disorder, Autism, ADHD, Cerebral Palsy, Artificial Intelligence,

I. INTRODUCTION

In this world there is one oldest medication system existing which is more than 5000 years old and it is the only system which comprises both preventive and curative techniques to fight against any disease. This is the system known as Ayurveda which is the combination of two different words where first word is "Ayur" means life and second word is "Veda" means knowledge. So it is the medicinal science of life knowledge. There are three main pillars of Ayurveda science which remains in human body knows as "Vata" or "Air component", "Pita" or "Fire component" and "Kapha" or "Earth component of body". These three important fundamental components of body control the whole body functionality from toe to head. And if any of these components get imbalanced then disease starts to enter into the body. In this paper we mainly focus on diseases related with brain disorders which can be of four different categories includes Autism, Speech Disorder, ADHD and Cerebral Palsy. These types of brain disorders can be diagnosed w. r. t. three body components i. e. Vata, Pita and Kapha with the help of Artificial Intelligence oriented web based system design.

II. VATA, PITA AND KAPHA (DOSHAS)

For brain disordered patients especially with Autism there is one very popular mechanism is used knows as ADOS (Autism Diagnose Observation Schedule) which is designed to evaluate communication, social interaction. Reason being to adapt this tool is to apply therapy based curing model to overcome brain disorder because as per the report of World Health Organization (WHO) there is no medicine existing to cure patients suffering from any of brain disorders.

On the other side, according to Ayurveda human body is formed with five different elements includes air, water, fire, earth and space. And body balances these components in a varying degree which is known as Dosha. With different combinations of elements and their degrees there are mainly three doshas: Vata, Pita and Kapha. Vata is formed with two components air and space, which specify the energy of movement. Pita consists of water and fire which is the principle of digestion and metabolism. And last component Kapha is constituted by earth and water which specify the dosha of lubrication and brain functioning.

Fig 1: Vata, Pita and Kapha body components

With all the different combinations and pulse of human body there the type of brain disorder and level of complexity can be identified easily for the patient.

III. HUMAN BRAIN DISORDERS

There are several types of brains disorders exist which are mainly resulted from imbalance of Vata, Pita and Kapha Doshas. In these three important components when the level

of third component increases in the body then there brain issues start taking place. Also at the time of pregnancy when the child care is to be avoided and not done properly due to reason being may occur poor life style issues mainly include stress, work pressure or some other factors get involved then also brain related issues arise during the birth of the baby.

Fig 2: MRI Reports for Brain Disorder

Above given picture shows the typical example of brain disorder MRI scan. Following are the main types of brain disorders exist and explained further.

1) ***Speech Disorder:*** In this type of brain disorder which affect sound producing vocals where a person feel difficulty to produce accurate sounds for the words that he had in the mind. Speech disorder affects the vocal cords, muscles, nerves and other structure within the throat. Main causes behind this type of disorder mainly includes followings

- vocal cord damage
- brain damage
- muscles weakness
- respiratory weakness
- strokes
- polyps or nodules on the vocal cords
- vocal cord paralysis

People who have certain medical or developmental conditions may also have speech disorders.

Fig 3: Brain Disorder Type – Speech Disorder

This lowers the self esteem while producing wrong sound and further creates a sense of humiliation and put more stress in the brain and the loop goes on which further increase more speech disorder problem. There further exists a different type of Speech Disorders in which Stuttering is the most common type of disorder where people face repetitions, blocks and prolongations of the words. Early diagnose and prevention may cure the problem on time.

2) ***Autism:*** Autism or in an elaboration Autism Spectrum Disorder (ASD) is an evidence of neurological imbalance during early childhood which reflects the disorder while neurological brain development. Majorly there could be two possible factors for this under development of brain which includes genetic issues which may get transferred from parents or environmental conditions in which pregnancy formation take place due to high stress conditions.

Fig 4: Brain Disorder Type – Autism

The symptoms of Autism become early evident during the first twelve to twenty four months of age. Autism involves a variety of issues with communication which usually appear before the age of five. E.g. eye contact from birth, not relating

their face expressions with the emotions like anger, surprise etc by age of nine months, not engaging with basic activities to call basic words like mama, dada with no gestures by age of twelve months. In USA, the most developed country like used to diagnose Autism at age of four because by this time, the developmental stage that early intervention has been greater results has already possessed. Therefore the goal is to apply earlier the evaluation tools and the classifiers. There is a vast variety of behaviour among the children who posses autistic spectrum and this makes the diagnosis more difficult and harder since it is critical to create behavioral models that interact socially with children.

3) ***ADHD:*** It is known as "Attention deficit Hyperactivity Disorder" which is a mental condition in which a person has problems with brain development that impact brain activity and cause unusual levels of hyperactivity and impulsive behaviors.

Fig 5: Brain Disorder Type - ADHD

In this type of brain disorder the patient behaves very aggressively and could hurt himself or someone else. To control these kinds of patients is very tough job for the parents. Sometimes these patients need to tie with some object using ropes etc. People with ADHD may have trouble to keep focus on some particular task or may be sitting at one place for not even possible for few seconds. Many people experience inattention and changes in energy levels. It can have a significant effect on their studies, work, relationships, and home life which could be a disaster. A wide range of behaviors is associated with ADHD. Some of the most common ones given following.

- Having trouble on focus and concentration
- Being forgetful for completing given tasks
- Being easily distracted
- Having difficulty sitting still
- Interrupting people while they are talking
- Becoming stubborn to do something as per wish

4) ***Cerebral Palsy:*** This type of brain disorder is a group of movement and coordination disorders caused by abnormal brain development or brain damage. It may affect the body part that can include upper limb of the body or sometimes lower limb of the body.

Fig 5: Brain Disorder Type – Cerebral Palsy

Symptoms of cerebral palsy vary in severity, but they usually come or within the first two years of life. Common symptoms are listed below.

- Abnormal reflexes
- Stiff muscles
- Floppy or rigid trunk and limbs
- Walking issues
- Abnormal posture
- Eating problems while swallowing
- Eye muscles imbalances
- Trouble with fine motor skills
- Learning disabilities

Usually this disease occurs during the pregnancy time and issue occur specifically the time of baby's brain development process. According to the Centers for Disease Control and Prevention (CDC), CP usually develops before birth but may also be acquired during early childhood.

The condition doesn't get worse with time, and many children with this type of disorder go on to live independent lives. More than half of children with CP can walk without aid, according to the CDC world report.

IV. PATIENT SYMPTOMS DIAGNOSIS

Patient diagnosis to be done manually where mainly four body components to be checked which include eyes (both left and right), tongue (upper side, bottom side and sometimes left

side, right side as well), nails (left hand, right hand) and lastly human pulse.

Below are the sample real time pictures to be taken of some patient shown below.

Fig 6: Left Eye and Right Eye

Fig 7: Tongue Upper Side and Bottom Side

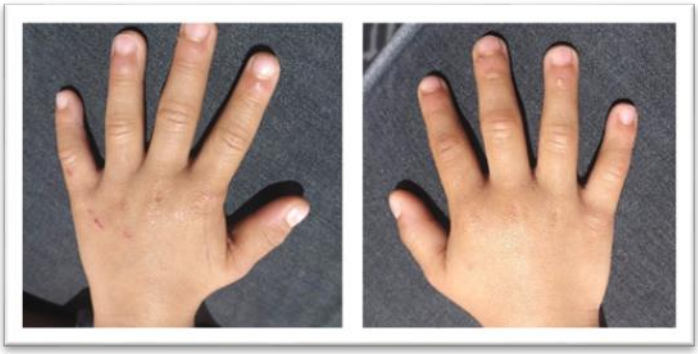

Fig: 8 Nails for Left Hand and Right Hand

After doing analysis of eyes, tongue and nails thereafter patient's pulse is to be examined. And finally the three factors are calculated which is known as Doshas includes Vata, Pita and Kapha with certain numeric values where the maximum weight is to be taken for some value out of 100 mass values.

Also besides doshas there is one more factor considered importantly which is called acidic value of the blood also called PH level of the body and that is also analyzed with the help of the above given pictures. And thereafter by calculating all the above four factors further it is to be examined by which level and what type of brain disorder existing with the patient and then the prescription prepared as per the dosage.

To diagnose the level of brain disorder with the calculations done with the reference of images taken and the pulse is time consuming and further that may add inaccuracy with manual procedures. So the concept of Artificial Intelligence helps here to automate the diagnose the disorder as well as the level the patient has that type of brain disorder that may include Speech Disorder, Autism, ADHD or Cerebral Palsy.

V. ARTIFICIAL INTELLIGENCE IN MEDICAL PRACTICE

Using Artificial Intelligence there is a web based system developed where fuzzy logic based concepts embedded and system data analysis trained by machine learning algorithms to generate fuzzy rules to deal with questions provided by users seeking to get immediate responses on preliminary diagnosis of brain disorder type and impact level on brain. A sample of small data set size of 50 patients has been tested with age plus four years. The results of the test exhibit that the web application can be useful for the diagnosis of the brain disorder in children as it performs high level of accuracy. Below are the following sample questions that are asked from the patients.

- Is there any problem to swallow or in chewing?
- Take proper sleep?
- Pass urine/ stool properly and inform to elders?
- Perform hand clapping and flapping?
- Maintain proper eye contact while talking?
- Choosy to eat food items?
- Concentration problem?
- Self talking?
- Aggressiveness for some particular act or situation?
- Understanding issues?
- Toe walking?
- Words or sentence repeating?
- Follow command properly or ignore?
- Digestion issues or constipation?

- Seizers?
- Teeth grinding?
- Sweating?

By asking several questions from the patient in the form of web based questionnaire which contains set values for each question for example question we ask regarding sweating then there could a set of answers where patient can reply less, very less, moderate, high or very high. This term create fuzziness because the answer does not lie in a binary region which contains answer only as yes or no.

Fig 9: Artificial Intelligence based Brain Disorder Diagnosis

A. Machine Learning

This is field of science and is a main pillar of Artificial Intelligence which has the ability to learn data provided with the past experiences as inputs and improve the new outputs for making the system more intelligent as human brain works.

Fig: 10: Machine learning with past data

It's examined some prediction after a three years clinical observation, interventions and psychiatric therapy of a group of children with autism related brain disorder. Specifically they used machine learning methods to study the psychiatric, developmental, social and demographic elements that affect the prognosis for children with autism.

B. Fuzzy Logic Techniques

Fuzzy logic is one of three main branches of Artificial Intelligence where the other two branches popularly known as Genetic Algorithms and Neural Networks. Fuzzy logic is a mathematical model where the decision is to be taken w.r.t. a raw data which is imprecise and scattered with more than two values. Crisp logic had its decision making procedures based two value data set containing either yes of no format. Probability theory is a perfect implementation of crisp logic in which the decision contain two values in the form of percentage e.g. 30-70, 50-50, 80-20 etc. But in fuzzy logic for one single decision the data set has more than two values for example the brain disorder values could be {very low, low, moderate, high and very high}. So we can see there are five different values for one decision to be taken. Earlier it's discussed about various questions to be asked for a patient and contains different multi valued data sets for each question. By noting down all the responses for each question there a information set is formed and thereafter defuzzyfication is to be done for any given data set and then the decision can be taken. Human brain also thinks in the way of Fuzziness not in the way of Crispness thus Fuzzy Logic becomes a very strong pillar of Artificial Intelligence having the capacity to think like a human brain.

C. Wearable Devices

Another novel technology of AI is Wear Sense popularly known as Body Sensor Networks, which utilizes the abilities of modern wearable devices like smart watches for the detection of stereotypical behaviour in children with brain disorder. Is used an integrated sensor in wearable device in order to detect the typical behaviors of people who possess symptoms of brain disorder and collects all the sensory data of the sensor and also from machine learning algorithms that detect and classify the repeated behaviour.

Fig 11: Smart Watch Wearable Device to Detect Human Pulse

Wearable is very useful technology to detect fourth parameter of Ayurvedic Diagnosis System in which the pulse reading can be done with the help of sensor based wearable device.

VI. IMPLEMENTATION

There is web based system is designed in which a front end is designed where the patient first enter all the parameters starts with patient's basic parameters like name, age, gender etc. Then the parameters entered which help to diagnose the disease type and level like body weight, pictures of eyes, tongue, nails, pulse reading to be taken by some device e.g. wearable smart watch.

After entering all the basic and body parameters of the patients there comes a questioner in front of patient where several questions asked which are given in paragraph V above with the multi values data set and then all these questions responded by the patient. And lastly the complete information which has been entered get rechecked by the system and finally submitted to the server.

At the server side with the manual analysis of pictures of eyes, tongue, nails there Vata, Pita and Kapha calculated and entered into the system. Later fourth parameter PH value or Acidic value calculated and entered into the system.

Finally all the data entered by both sides i.e. from patient side and Medical Practitioner side there Artificial Intelligence come into the picture and do the process of Defuzzification and calculate a single output which refers the Disease type and the level of disease present into the human body. The disease is considered here related to brain disorder only which could be Autism, Speech Disorder, ADHD, Cerebral Palsy.

VII. CONCLUSION AND FUTURE WORK

At conclusion it is observed that Artificial Intelligence can play a vital role in the diagnosis of various brain disorders like Speech Disorder, Autism, ADHD and Cerebral Palsy. With the help of applying AI using Fuzzy Logic that can calculate the parameters from the image precisely though at the end the final diagnosis to be done by the medical practitioner to make a precise prescription for the patient but this way a lot of time to diagnosis disorder can be reduced for the practitioner and also the diagnosis precision can achieved at next level.

In this paper we discussed various doshas of three types Vata, Pita and Kapha formed with five main components of the body includes air, fire, earth, water and space. Identifying doshas of the body we can further apply Artificial Intelligence to calculate the level of dosha intensity impact on the human body along with the acidic value of the human body. This further makes a perfect diagnosis to create a prescription.

Finally by applying AI to diagnose brain disorder the cost and the time as well for the assessment can be reduced up-to a large extent. Also it's important to mention here the for future work where AI can be applied in more advance way where an image processing can be done to calculate doshas intensity in human body automatically and hence further it become more advance system where various families can detect disorder type and level by sitting at home only and this benefits them to make an early detection of their child's problem and may get intervened to cure that disease.

REFERENCES

[1] M.E Block, V.E Block, and P. Halliday, "What is autism?," Teaching Elementary Physical Education, vol. 17, no. 6, pp 7-11, November 2006.

[2] A. Gena, Autism and pervasive developmental disorders. Athens: Idiotiki. 2002.

[3] K. Baraka, F. Melo, and M. Veloso, "Simulating Behaviors of Children with Autism spectrum disorder through reversal of the autism diagnosis process," In Proc. of the Portuguese Conference on Artificial Intelligence, 2017, 753-765. https://doi.org/10.1007/978-3-319-65340-2_61

[4] F. Thabtah, and D. Peebles, "A new machine learning model based on induction of rules for autism detection," Health Informatics Journal, January 2019. Available: https://journals.sagepub.com/doi/10.1177/1460458218824711. [Accessed: May 13, 2019].

[5] J. Daniels, J. Schwartz, A. Nikhila, M. Du, and D.P Wall, "The GapMap project: a mobile surveillance system to map diagnosed autism cases and gaps in autism services globally," Molecular Autism, vol.8, no. 55, October 2017. Available: https://molecularautism.biomedcentral.com/articles/10.1186/s13229-017-0163-7. [Accessed: 17 April, 2019].

[6] B.U. Mirac, K. Karabekiroglu, B. Sahin, M. Aydin, A. Bozkurt, T. Karaosman, and E. Urer, "Use of machine learning methods in prediction of short-term outcome in autism spectrum disorders," Psychiatry and Clinical Psychopharmacology, November 2018.

[7] Healthline website. [Online]. Available: http://healthline.com/health/autism#symptoms

[8] Gynoveda website. [Online]. Available: http://gynoveda.com/blogs/ayurveda/understanding-vata-pitta-kapha/

[9] Electropathy [Online]. Available: https://electropathy.world

[10] Biopathy [Online]. Available: https://biopathy.in

[11] Youayurveda https://youayurveda.com/find-your-body-type-a-comprehensive-guide-to-vata-pitta-kapha