

A SUVEY ON NEURODEVELOPMENTAL DISORDER USING MACHINE LEARNING APPROACHES

R.Lalitha¹, Dr. J. Jebamalar Tamilselvi²
Research Scholar, Bharathiar University, Coimbatore, Tamil Nadu, India¹.
Research Guide & Professor, Department of CSE
Jaya Engineering College, Chennai, Tamil Nadu, India².

Abstract : There are millions of children and adults suffering from neurodevelopmental disorders across the globe. In recent days Cognitive scientists have developed interest in the study of children and adults with neurodevelopmental disorders using cognitive model. Researchers also interested in this area using many data mining algorithms. This paper surveyed past ten years research articles related to different neurodevelopmental disorders which dealt on machine learning techniques.. We have also highlighted the important challenges involved with the data mining approaches as well as cognitive model for neuro developmental disorder

IndexTerms - Neurodevelopmental disorder; Cognitive model, Machine Learning, Data Mining

I. INTRODUCTION

The neurodevelopmental disorders are a group of predicament starts in the developmental period. The disorders normally detected early in development, regularly before the child enters grade school, and characterized by the developmental discrepancies, that causes lack of personal, social, academic, or occupational functioning. The dimension of developmental discrepancies varies from very specific restrictions of learning to global impairments of social skills or intelligence.

Commonly the neurodevelopmental disorders are caused by genetic deformities that has been classified into several categories. They are the disorders that result from alterations in a single gene (e.g., phenylketonuria or fragile-X syndrome), and chromosomal disarray where an entire chromosome (e.g., Down syndrome) or segments of

chromosome (e.g., WMS) are either missing or duplicated. Another group of disorders is considered to as polygenic or complex because they are caused by several interacting genes.

These disorders (e.g., autism or dyslexia) typically involves the inherited quantitative cognitive, behavioral or personality traits .Across all neurodevelopmental disorders genetic abnormalities disarray the possibility of brain development started early during the prenatal stage. The developmental brain abnormalities lead to distinct cognitive and behavioral phenotypic outcomes which includes mental retardation or learning disabilities, that are characteristic of the majority of individuals with specific disorders.[1]

The main objective of this paper is to highlight the algorithms used in different neuro development disorders and to discuss most constructive learning types, dynamic data mining algorithms, important challenges and limitations involved in selecting the machine learning techniques.

Section 2 dealt with the Introduction about machine learning, Section 3 reviews the types of neuro developmental disorders dealt in machine learning, Section 4 discusses the Learning abilities of Neuro Development disorder research articles, Section 5 algorithms used in detecting Neuro developmental disorder and Section 6 concludes the entire work..

II. INTRODUCTION TO MACHINE LEARNING

Machine learning is a subsidiary of computer science that accords with study of computational learning theory in artificial intelligence and also in pattern recognition. Machine learning explores the study and construction of algorithms that can learn from and make predictions on data.

Artificial intelligence also one of the category of machine learning that provides computers with the capability to be trained without being explicitly programmed. It strengthens on the development of computer programs that can teach themselves to develop and change when exposed to new data. Machine learning technique is similar to that of data mining. Both systems explore data to look for patterns. However, instead of extracting data for human perception - as is the case of data mining applications machine learning uses the data to enhance the program's own understanding. Machine learning programs recognize patterns in data and adjust the program actions accordingly. Machine learning studies computer algorithms for learning to do stuff. So in general, machine learning is about erudite to do better in the future based on what was experienced in the past.

The fundamental goal of machine learning research is to develop general purpose algorithms of practical value. These algorithms should be efficient. As usual we computer scientists, we care about time and space efficiency. But in the context of learning, we also accord about another precious resource, namely, the amount of data that is required by the learning algorithm. Learning algorithm should also be as general purpose as possible.

III. NEURO DEVELOPMENTAL DISORDERS DEALT IN MACHINE LEARNING

Neuro developmental disorders are of many types .Here we dealt only three types of disorders, From the published research articles under machine learning. Dyslexia – learning disability, Autism and WMS –Williams Syndrome.

Dyslexia - Learning disability (LD) is a disorder that disturbs the ability to interpret what one sees and hears or the ability to connect the information from different parts of the brain. It manifested as disorders of listening, thinking, reading writing, spelling or performing calculations, in spite of the person having normal intellectual abilities.

Learning disability can be mainly classified into three types: Dyslexia is difficulties in learning with respect to read, Dysgraphia is difficulties to write and Dyscalculia difficulty to do elementary mathematics [2]. Learning disability cannot be cured forever by medication and there is also no definite method for diagnosing it [3]. Hence a computational approach to diagnose LD is suggested.

Autism Spectrum Disorders are complicated neurological disorders that have a lifelong effect on the event of diversified talents and skills. The autism spectrum disorders belong to an “umbrella” class category of childhood-onset Conditions called pervasive developmental disorders. As a result of each are extremely rare genetic diseases, they are sometimes thought to be of separate medical conditions that do not really belong on the autism spectrum.

Williams Syndrome is congenital disorder resulting in mild to moderate mental retardation. The syndrome is caused by the deletion of genetic material on the seventh chromosome, and they possess IQs averaging about 60

The main objective of the Machine Learning approach to these above stated disorders are to support the affected children and special educators and doctors.

IV. LEARNING METHODOLOGIES

Neuro developmental disorders can be dealt in Data mining, ANN, Fuzzy Logic, Text Mining. It also dealt with supervised and unsupervised. To the best of our knowledge most of the machine Learning approaches are supervised. Unsupervised learning is mostly used with quirk detection methods.

Neural network, Digital Image Processing, Fuzzy Expert System in identifying potential Neuro development disorder is explored. Knowledge Based system uses learned knowledge and heuristics to evaluate child in its process using gaming strategies[19].

V. ALGORITHMS USED IN DETECTING NEURO DEVELOPMENTAL DISORDER

The data mining techniques, which is used here are decision trees and clustering. Statistics will also be studied to see if there is any other patterns seen with the data mining tool Envisioner, developed by Neurosoft for identifying dyslexia.[2]

For the prediction of learning disability two well known classifiers, viz. fuzzy and neuro fuzzy are used. Neuro fuzzy system is a combination of artificial neural network and fuzzy systems. Neuro fuzzy system combines the learning capabilities of neural networks if the linguistic rule interpretation of fuzzy inference system. An advantage of neural network is it has high tolerance of noisy data as well as its ability to classify patterns on which they have not been trained. They can be used when we have a little knowledge of the relationship between attributes and classes. [3]

Support Vector Machine (SVM) learning algorithm with fMRI data from a single patient whose data were partitioned into many discrete time points of the fMRI scan. We show that the resulting classifier has an average of 92% accuracy on the final test partition of the dataset [5]. In machine learning, support vector machine are supervised learning method associated with learning algorithms. It analyzes the data and acknowledges patterns. It is primarily used for multivariate analysis and classification. An SVM training algorithmic program builds a model that assigns new samples of data into one class or the other, using it as the non-probabilistic binary linear classifier. It reveals that Support Vector Machine is best than that of different algorithms employed in the study.[6]

Support vector machine (SVM) classification techniques and Artificial neural network (ANN) gained a lots of attention within AI world, but never appeared for diagnosis of kids with LDs. Several experimental runs demonstrated that SVM results were consistent and independently of the size of the training data set. ANN by itself wasn't giving high accuracy in general. Hybrid techniques gives good results, but still were lacking some accuracy in diagnosing kids with LDs [7]

Perceptron based artificial neural network model for diagnosing learning disability using curriculum based test conducted by special educators in medical environment. This model comprises of a single input layer with eleven units which correspond to different sections of a conventional test and one output unit. Perceptron based Learning Disability Detector (PLEDDOR), is introduced. From the data set of 40 records onwards the system stabilizes with 90% diagnosis rate.[8]

Two machine learning approaches are used here Rough Sets and Decision Trees, for the prediction of Learning Disabilities (LD) in school-going children, with an emphasis on applications of data mining. The LEM1 algorithm is used to derive minimal sets of rules covering all the objects from learning sets. This algorithm generates six rules for the prediction of the learning disability.

The first part is the determination of core attributes using Johnson's reduction algorithm and second part is the classification of data to predict LD as *yes* or *no* using Naive Bayes batch classifier algorithm using the Rosetta tool.[9]

Prediction system to identify the learning disability for the autistic patients. The medical disease prediction is an application of expert system, that we here defining by using an intelligent soft-computing approach called probabilistic neural network and Fuzzy Logic The work presented was carried out by using MATLAB environment[14].

Text Mining is a term which is currently being used to mean various things by various people. In its broadest sense it may be used to refer to any process of revealing information – regularities, patterns or trends – in textual data, and includes more established research areas such as information extraction (IE), information retrieval (IR), natural language processing (NLP), knowledge discovery from databases (KDD).[18]

TABLE - 1 ASSESSMENT OF NEURO DEVELOPMENTAL DISORDER ARTICLES USING MACHINE LEARNING

Neuro developmental Disorders	Algorithms used	Benefits	References
Dyslexia Prediction	Data Mining tool Envisioner, developed by Neurosoft. The data mining techniques decision trees and clustering		[2]
Autism Prediction	Classification Algorithms used	Accuracy is poor	[3]
Prediction of Learning Disabilities in School-age Children	Dimensionality reduction method through Fuzzy and Neuro Fuzzy classifiers	An advantage of neuralnetwork is their high tolerance of noisy data as well as ability to classify patterns on which they have not been trained	[4]
Classifying Brain states for Dyslexia	Support Vector Machine(SVM) learning algorithm with FMRI data from single patients whose data were partitioned into discrete time points of the FMRI scan	Classifier has an average of 92% accuracy	[5]
TO predict Learning Skills of Autism	Support Vector Machine in Supervised learning method used	Support Vector Machine is best than that of different algorithms	[6]

TABLE - 1 (Continuation)

Neuro developmental Disorders	Algorithms used	Benefits	References
Diagnosing Dyslexia	Artificial Neural Network model and Perceptron based learning disability dedector (PLEDDOR) is used	The system stabilizes with 90% diagnosis rate	[8]
	The LEM 1 algorithm is used , two machine learning approaches – Rough Sets and Decision trees are used	The Rough set is better in terms of classification and accuracy	[9]
	Decision Trees and clustering for classification and prediction in Data Mining	Decision Tree correctly classified 77.6% of instances	[10]
	Machine learning techniques non – linear classification s through supervised or unsupervised training	Achieving a success rate of 94.8718%	[11]
	Multi layer perceptron (MLP) Neural Network Architecture	Maximum accuracy of 75% was obtained	[12]
	Fuzzy Expert System	Decrease in diagnosis process time and increase in accuracy	[13]
Study of Autism	Prediction System used in the application of expert system in MATLAB		[14]
	Decision Tree and association rule used	Help to evaluated children early and help to adjust the therapy at the earliest stage	[15]
	Classification algorithm in Data mining is used	Considerably predict	[16]
	data-mining Twitter is used	Automatically retrieving and analyzing the content of ASD-related tweets.	[17]
Williams Syndrome (WMS)	Text Mining, information extraction (IE), information retrieval (IR), natural language processing (NLP), knowledge discovery from databases (KDD),	The text mining functionality in this model is so far limited,	[18]

From the entire survey of articles, we have found that Support Vector Machine, ANN with Perceptron based and Linear classification gives high accuracy.

VI. RESEARCH FINDINGS

- Exploration of Machine Learning is extensive in the field of Neuro developmental disorders.
- Even though many Machine Learning algorithms which yields less misclassification and takes less time to process, it depends on the data set at hand.
- Most of research work concentrated on improving to detect neuro developmental disorders more accuracy, time and cost

- It has been noted that when appropriate algorithm is used we can predict the neuro developmental disorder more accurately.

VII. CONCLUSION

Concern over the people who are suffering from neuro developmental disorders, we have presented a survey on the available research articles related to neuro developmental disorders. This initial work highlights the algorithms used their limitations, challenges and important aspects effectively

As a future work, the performance will be enhanced by taking appropriate machine learning techniques for the detection of neuro developmental disorders.

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