



A Study on Dyslexia Using Machine Learning - Review

Jincy Dhas and Subha Hency Jose

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Ms. J Jincy

*Department of Biomedical engineering
Karunya Institute of Technology and Sciences
Coimbatore -641114,India
jincy587crtjwel@gmail.com*

Abstract- Learning disabilities are existing among preschoolers disrupting their growth in school education . Scientific understanding of dyslexia is mandatory towards uplifting their future . This progress emphasizes on the cause of this dyslexia based on neuropsychological approach and importance of an inter disciplinary perspective of understanding dyslexia. Dyslexia not being a disease it is a mild disorder which is related to their family background, brain injury, factors during pregnancy .Many techniques are there to identify learning disorder which can be identified using data mining techniques . Kids with dyslexia begin to experience tortures which is unexplainable from the beginning of their schooling, because of the complexity of their difficulties. They are unable to perform typical or academic tasks accurately, so they face setbacks demotivating them mentally .Lack of awareness on dyslexia among parents is a major disadvantage in the life of children towards their success. Families must be alarmed of their children's actual condition as soon as possible so that control action can be taken without regretting later. The aim of the research is collecting all the information necessary for early identification of children at risk of literacy problem , ensuring that appropriate assistance is provided by parents and schools using cloud computing .

Key words: *Dyslexia, Literacy problem, Parents Awareness, Learning disorder*

I.INTRODUCTION

Dyslexia referred as a learning disorder, that cannot be identified prominently. Its after effects can be seen in old & young. Identification in childhood can be done at the earliest in their primary school education since their difficulties & talents can be exhibited in lime light. Dyslexic children are subjected to hurdles in learning, speaking along with difficulties in articulation of sounds and spellings. In addition to the facts a dyslexic control may experience poor phonetic memory and lexicon performance leading to poor social life and lack of attention . The word "Dyslexia" was the word conceived by a doctor from Germany in 1887 to explain this disorder that originated from two Greek

Dr. P Subha Hency Jose

*Department of biomedical engineering
Karunya Institute of Technology and Sciences
Coimbatore -641114,India
hency20002000@karunya.edu*

words "Dys" as difficult and "Lexia" defined with words .Dyslexia is a reading and learning disorder caused by improper connection in the brain cells during processing of graphic symbols that interfere the way in which the brain work on written text. It is related with the peculiar structure and function brains left hemisphere which is key for of the left hemisphere brain that is involved in the reading and language networks. Difficulties in word recognition, spelling, decoding and reading comprehension are the inabilities of dyslexic children. Inferiority complex in dyslexic readers is exhibited as poor handwriting. Other significant features will be struggling to read, write and speak along with difficulty in manipulation of sounds and spellings reduced performance in phonological memory and vocabulary. Efforts are taken many countries in diagnosis and treatment of this disability and build the nation towards success by motivating the young upcoming generation[29].

The aim of our paper is to briefly discuss the various qualitative approaches towards the identification of dyslexia at the earliest.

II. CAUSES OF DYSLEXIA

Dyslexia is a type learning disorder which is due to environmental factors and genes.

The nature & type of delivery of a child highly alters the brain development of an individual. Certain families are highly under the risk of dyslexia .The complication leading to dyslexia includes low self-esteem ,depression, backing from society, aggression, inferiority complex.

Brain is made of fundamental units called neurons .These establishes connection between many neurons when there is activity like thoughts,emotions,touch. These activites have greater impact on brain wave causing them to vary.Left hemisphere of the brain is related to reading & vocabulary. Scan,MRI shows the statergic variations in the footprint of dyslexic brain from a normal brain.Multiple numbers of study reveal various notable changes in dyslexic and normal subjects which can discussed in detail.

III. RELATED STUDY

Sundus Khaliq, Imran Ramzan [18] did a descriptive study on the problems of dyslexic children in elementary under developed country. Study measured the different methods they adopt in identification & treatment of dyslexic children. Study concluded that school teachers have understood about dyslexia and successfully able to identify in their class and able to manage correctly.

Hacène Fouchal, Estelle Perrin, Paul Renson [3] conducted a study on thought pattern of dyslexic children when they read/write. A structured systematic study to detect personal reading/writing routine pattern in distributed manner. A gadget that can gather information while reading or writing while playing at home with out the supervision of medical staff which reduces cost & time.

Muhamad Risqi Utama Saputra and Kuntoro Adi Nugroho [11] designed and developed learn-to-read application for dyslexic children based on Indonesian language. The application is developed in desktop computer and it presented a idea for the therapist to conduct intervention program for children between 5-7 years.

Eye tracking technology is one of the ancient technology for analysis of dyslexia which was demonstrated by Suraj Shrestha and Pietro Murano [16]. The eye pattern while reading varies greatly for dyslexic children and development of a prototype which can actively monitor or track the eye movements of a reader and based upon the above mentioned eye movements such as fixations, saccades, fixation durations and reading time. The two parameters of reading time & number of fixations can be used to detect dyslexia.

Motivation paves a path way for success, this foundation was laid by Ewa & Agnieszka [3] resolved the influence of special academic motivation by therapist on dyslexic children. This positive motivation gained by the child helps that he or she can overcome the problem, this knowledge provides contentment to work for a reward, thus motivating them to undertake similar actions in the future.

Suzanne M. Adlof, Joanna Scoggins, Allison Brazendale, Spencer Babb, and Yaacov Petscher [17] did a short study on second grade children who are under the risk of learning disability for a small group of children and to examine the awareness of parents towards their children's future. A associated study for a class of children with dyslexia or learning disability provided good classification with satisfied result.

A study in prospective analytical study carried out in Bethesda hospital erode from august 2016 to December 2017 on antenatal, post natal, childhood adolescent risk factor were analysed

using EEG, urine metabolic screening in dyslexic children had significant changes. [12].

Genetics play a major role in dyslexia which can be understood by family studies, twin studies, linkage & association study, neuroanatomical findings. Bullentin of Phycology explains how biological risk factors, partial performance deficit, reading & writing problems, emotional & behavioural disorder are related to dyslexia. [2]

Nurul Anis Mohd Yuzaidey, Normah Che Din, Mahadir Ahmad, Norhayati Ibrahim, Rogayah A. Razak, Dzalani Harun, [14] suggested the various methods or treatments to identify cognitive abilities of children with dyslexia to improve the literacy rate of their country. This is the foremost method of this which is a consolidation of cognitive function & linguistic literacy deficit. It is pressing that researchers play a fantastic role by extending their boundaries by considering cognitive function as a key factor for literacy which aims towards supporting reading & writing dyslexic children of Malaysia.

Nur Izzah Rahmiah Ab Llah, Khadijah Hanis Ahmad Firdaus, and Jamaludin Ibrahim [13] did a study on decision support systems (DSS) towards expanding the horizons of diagnosing dyslexia by identifying dyslexia at different stages before & after at an early age. This discernment helps in application of DSS for dyslexic children in future.

Ronaldi Saleh, and Nor Aziah Alias [15] reported the development of a comic mobile app as a partial process. The purpose of this study is to gather information for the comic App. Mobile communication is an advanced tool used for dyslexics.

Athira Amira Abd Rauf, Maizatul Akmar Ismail, Vimala Balakrishnan & Khalid Haruna [1] Studied how that dyslexic children undergo pressure educational institutions were they study and criticisms from society.

Fang Hou, Ling Qi, Lingfei Liu, Xiu Luo, Huai Ting Gu, Xinyan Xie, Xin Li, Jiajia Zhang and Ranran Song [4] studied on developmental dyslexia (DD) has developed in the past decades. Early screening of developmental dyslexia (DD) could be an effective remedy for timely intervention.

Hassanin M. Al-Barhamtoshy, Daa M. Motaweh [8] developed a working model to address the read & write dispute which is the effects in comprehensions. Study of kindergarten child conclude that electrical activity in brain pattern vary for dyslexic children when they either read or write

N. Aresti Bartolomé, A. Méndez Zorrilla, B. García Zapirain[22] suggested a system to pave the way for diagnosis of tradition dyslexia in an informal environment without putting them to pressure comfortably by a set of activities or games. Thus this journey progress to conclusion to ensure a correct diagnosis and continuously monitoring is made by the children in future.

Yolanda García Chimenó, Begonya García Zapirain, Ibón Saralegui Prieto and Begonya Fernández-Ruanova [23] used Functional Magnetic Resonance Imaging (fMRI) and Diffusion Tensor Imaging (DTI) to a group of children with a patch in one eye. They obtained the brain activation pattern, is not known & segregated it into two control groups of dyslexic & typical readers. This new software tool allows users to interact with all the classifiers available.

Salwani Mohd Daud and Hafiza Abas [24] developed a mobile app which helps children to distinguish between the letters 'b' and 'd'. It is an app developed in Malay language. The speciality of this module is that it helps in alphabet recognition in an exciting way without under pressure. This conducive environment helps children learn in an environment suitable for dyslexics.

Sami Ghazzai Alsulami [16] did a literature survey regarding the linkage between dyslexia and memory deficiencies. Memory plays an important role in dyslexics, educators may be well trained at assisting and implementing early intervention for those children who need it. Short-term memory impairment is a research area going on and no of articles are being published recently in journals.

T. V. Prasad [24] introduces a biologically inspired technique inherited from biological neurons for identifying dyslexia using ANN. Its role in dyslexia analysis is to separate dyslexic and non-dyslexic. The results provided an eye opener in the field of education and medicine eliminating unnecessary tests which are cumbersome and uncomfortable among school children.

The learning disability in children is connected with the left hemisphere of the brain which contributes in the disfigured handwriting of dyslexic individuals. EEG plays a vital role in obtaining the pattern of brain waves such as alpha, beta, theta waves and analysis their frequencies using nonlinear analysis methods such as approximate entropy, cross approximate entropy [21]. High frequency beta waves are obtained as a writing pattern of dyslexics.

EEG recorded in resting condition provides a smooth sail into analysis brain activities during eye closure and eye opening for dyslexic and normal children. EEG signals extracted using KDE (Kernel Density estimation) and classified using multilayer perceptron [22]. Clear distinction can be obtained using dyslexic & control group with more than 90% accuracy.

Alteration in brain wave pattern is a key in the dyslexic individuals. This learning disability changes the electrical activity of three groups of children based on different cognitive profile [23]. These children were from an elementary school with a poor academic background.

Z. Mahmoodin [28] & His Colleague from Malaysia have identified changes and variations in EEG for various artifacts & noises they did the feature extraction, theta & beta band power ratio [24] used for classification of normal & dyslexic children. They concluded that a high theta/beta wave ratio is related to learning disabilities.

Inability of brain to process numbers and alphabet leads to learning disabilities. Classification of EEG based on machine learning is an efficient tool for segregating normal, poor, capable dyslexic children. The study on the performance of k-nearest neighbour (KNN) with correlation distance function and extreme learning machine (ELM) [25] with radial basis function (RBF) classifiers provided a satisfied result for identification through writing.

Shahriar Kaiser [21] compares on the different machine learning techniques for different age groups which helps to identify dyslexia. Being a selective abnormality in connection with brain cells it is found that it has widely affected a population from old to young. The classification of the disorder can be done effectively using different machine learning with high degree of accuracy, specificity, sensitivity.

G. Fraga González [5] and his colleagues from Netherlands put forth a mixed pattern using graph metrics to characterize dyslexia based on EEG and concluded that minimum connections in brain cells for dyslexic than normal controls. Thus adding a new angle to this field of study by enlarging the horizon towards understanding dyslexia.

A bunch of professors [29] from the university of Amsterdam did a study on women controls between 18-21 years and achieved structural changes in grey matter using neuro scans and classified the same using SVM to obtain a 59% performance accuracy for this classifier.

Dyslexia also being caused by genetic disorder was studied by John D. Eicher, Jeffrey R. Gruenin [10] in school children who had reading impairment. This study highlighted that risk genes lead to abnormalities in white/grey matter causing impairment in reading pattern.

IV SCREENING METHODOLOGIES

This study aims to discuss the various methods which are related to the identification & classification of dyslexia in young school children

4.1 Questionnaires':

Questionnaire are set by a expert panel on a deep continuous evaluation of the scenarios, so that valuable information can be obtained with high degree of precision & reliability. The group taken for the distribution of questionnaire will be a control group, picked up by the panel who can provide unbiased nominal data.

4.2 Eye Tracking:

There have been two major focus areas in terms of eye detection technologies: one is eyelocalization in the image and the other is the gaze estimation [9]. There are three major aspects of eye detection: the first is to find out the existence of eyes, the second is to determine the location and position of eyes using the center of the pupil or iris and the third is to track the eye throughout the video images from frame to frame. Thus detected eyes are used to estimate and track the direct visual scope of a person or the line of sight.

4.3 Genetic Research:

Any type of learning disorder is related to changes in genes, i.e. dyslexia is caused by the combination of many genes in a different patterns [9]. Genetic variations can be during the birth of individual which cannot be compensated rather inherited from parents. Depending on the changes in the gene structure the severity of dyslexia varies from high to low.

4.4 Artificial Neural Networks:

Multilayer perceptron (MLP) neural network architecture is an excellent classifier used to solve real time problems. Thus mapping of real time problems can be done efficiently and more accurately. The training of data set is done using back propagation algorithm. Using this method real time data can be analysed for a fairly accurate result. However classification using neural network is the booming field towards obtaining reliable results.

4.5 Correlation Analysis:

The bivariate relationships between the different variables, can be analysed by finding correlation analysis. Hierarchical regression analysis, backward regression analysis, can be analysed by finding the statistical parameter like mean, standard deviation & skewness.

4.5 EEG Diagnosis:

Apart from normal screening test for dyslexia EEG is found to be a precise non invasive method used for studying electrical activity of brain based on normal and in capable individuals [11]. Enormous study, is under taken towards the study of change in pattern of brain waves in neurological point of view.

4.6 Neuro imaging :

The dyslexic controls can be distinguished from the normal controls based on imaging investigations on left or right hemisphere of the brain. These study shows that the reading and writing pattern of dyslexic controls varied in higher degree showing noticeable changes.

V COMPARITIVE STUDY ON DYSLEXIA

On comparing various research articles we can conclude that.

School teachers play the major role in the identification of dyslexia from their opinions & teaching experience. In addition to the teachers the School children can be motivated by providing proper counselling & awareness among parents. Actively involved in workshops and seminars on dyslexia help the children & parents motivated to become better individuals in the competitive society

The international dyslexia association IDA that supports education and research on behalf of people who learn differently. They conduct guidance & mentoring programs to promote the awareness of dyslexia and ways to grow into a successive individuals.

Multimedia has greater impact in the society which is used as a assisting aid for dyslexic learners. The focus of current research is not only about diagnosis of dyslexia but to provide a solid platform for experimental analysis using tools available in the market. Upgrading the products and programs is the heart of design & technological field.

The psychologist, technologist & medical specialist are working in unison jointly towards the various milestone of identification, treatment of dyslexia using rapid advanced technology so that strong foundation can be provided towards the budding children. Functional Magnetic Resonance Imaging (fMRI) and the Positron Emission Tomography (PET) are the other screening tools researchers can use in research for the neurological studies of dyslexia.

<i>Name of the author</i>	<i>Year of publication</i>	<i>Name of the Journal</i>	<i>method of identification</i>	<i>Inference</i>
Shahriar Kaisar	2020	Science direct	Comparative study on available methods	the significant bench marks in the field is discussed
Vani Chakraborty	2020	Kristu Jayanti Journal of Computational Sciences	Eye tracking	Hybrid classifiers can yield better accuracy
Gilles Richard and Mathieu Serrurier	2020	ARXIV	handwritten text pictures and audio recordings,	comparison between various classifier provide right understanding on dyslexia
Francisco J. Martinez-Murcia, Andres Ortiz*, Juan Manuel Gorriz, Javier Ramirez, Pedro Javier Lopez-Abarejo, Miguel Lopez-Zamora, and Juan Luis Luque.	2020	International Journal of Neural Systems	EEG	approach motivation&avoidance motivation methods provided varied result towards identification
A. Z.A. Zainuddin, W. Mansor, Khuan Y. Lee, and Z. Mahmoodin	2019	IEEE	EEG	KNN,ELM are 2 classifier providing good accuracy with ELM better accurate than KNN
Athira Amira Abd Rauf, MaizatulAkmar Ismail, Vimala Balakrishnan1 & Khalid Haruna	2018	JEHD	awareness towards learning disabilities	proper motivation and awareness can provide successful dyslexic groups
Fang Hou, Ling Qi, Lingfei Liu, Xiu Luo, HuaiTing Gu, XinyanXie, Xin Li, JiajiaZhang andRanran Song	2018	Frontiers in Psychology	dyslexia check list	Provided a good result with valid& reliable data
HarshaniPerera, Mohd Fairuz Shiratuddin and Kok Wai Wong	2018	IEEE	EEG while reading &writing	Provides a platform for analyzing the change in frequency of EEG for normal & dyslexic group
Moses.Pmorthy	2018	,International journal of scientific research	EEG and urine analysis	developing dyslexic children has a great change in while screening for urine & EEG
Hassanin M. Al-Barhamtoshy, Diaa M. Motaweh	2017	IEEE	using screening methods	using 3 classifiers gives high accuracy
Milene Roca-Stappung, ThalóÁaFernaÁdez, Jorge Bosch-Bayard, ThalóÁaHarmony,Josefina Ricardo-Garcell	2017	PLOS ONE	EEG	differences in resting EEG for the control groups
Ewa&Agnieszksa	2016	JOER	questionaries	effective method of explore the society's understanding on dyslexia
Yolanda García ChimenoBegonya García ZapirainIbone Saralegui Prieto andBegonya Fernandez-Ruanova	2014	Bio-Medical Materials and Engineering	fMRI images for dyslexic	result is obtained on relationship charts with more accuracy
Izzah Karim, Wahab Abdul	2013	springer	EEG	Classification can be done using machine learning algorithms
C.W.N.F. Che Wan Fadzal, W. Mansor, Khuan Y. Lee, S. Mohamad, S. Amirin	2012	ISCAIE	EEG while writing	frequency spectrum is more in beta band for dyslexic children

Table 1: Comparison of various articles of research

VI CONCLUSION & FUTURE WORK

In conclusion, this paper emphasizes on the need to suitable method for diagnosis .Machine learning tools are the best suited for classification of dyslexia providing optimal solution .Every individuals require basic education to become successful .Self esteem makes a man successful individual . Future enhancement can be done such that the dyslexia analysis can be made as a part of curriculum in teachers training which will bring better results for the school children who are the future pillars of our nation

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