March - April 2020
ISSN: 0193-4120 Page No. 9953 - 9956

An Intelligent Parkinson's Disease Diagnostic System using EEG

T.S.Aravinth[1], E.Arunkumar[2], P.Archana[3]
[1]Asst Prof,Dept of ECE ,Karpagam Academy of Higher Education,India
[2]Asst Prof,Dept of EIE, Karpagam College of Engineering, India..
[2]Asst Prof,Dept of ECE, Karpagam College of Engineering, India
aravinth.ts@kahedu.edu.in

Article Info
Volume 83
Page Number: 9953 - 9956
Publication Issue:
March - April 2020

Article History
Article Received*: 24 July 2019*
Revised*: 12 September 2019*
Accepted*: 15 February 2020*
Publication*: 11 April 2020*

Abstract: Parkinson's disease (PD) one of the movement disorders which occur in the neurological activities, but the diagnosis of disease is quite challenging. Sometimes the diagnosis methods are difficult at the time of considering a motor and non-motor symptoms in PD patients. But it is highly risk to manage PD patients in medical management. To enhance that lot of research are focused on Machine Learning algorithmsfor long term approaches. Further this paper contributes different classification algorithms like K- Nearest Neighbour and Random Forest for continuous analysis of Parkinson's disease using accuracy, sensitivity, and specificity. Also, it concluded that Radom Forest gives 10% accuracy than KNN algorithm.

Keywords: *Machine Learning, Parkinson's disease, K – Nearest Neighbour, Random Forest*

I. INTRODUCTION

Parkinson's disease (PD) is a neurological disorder which cause serious disability and reduce the quality of life [1].The features of cardinal motor and the response to the dopaminergic therapy are the characteristic signs of PD. The neuro physiological characters related toParkinson's disease (PD) are studied the whole brain using magneto encephalography within the motor system. The accuracy of clinical diagnosis is around 80 to 90 % [2]. In the analysis of MEG the aim of motor networks are spatially limited to the motor cortex which is performed in the source space. The MEG helps the frequency-specific neural oscillations for PD patients and analysing the mechanisms of hallucinations in PD patients. The MEG with unimodel Visual Hallucination (VH) and compared with multimodal hallucination and without hallucination PD patients. The MEG data of PD patients are recorded using 306 channels (102 magnetometers, 204 gradiometers) with the sample frequency range of 1250Hz [3].

II. LITERATURE REVIEW

Abbasi et.al [4],proposes the spectral analysis measures in unilateral DBSfor both 130 Hz and 340 Hz. It leads to reduce the power of alpha and beta over both sensor motors. These recordings aredone by the day after surgery when the eyes are in closed condition and motor improvement was analysed without correlation. Luoma et.al[5],assigns the alpha lowering and beta band during DBS ON, it occurs when the eyes are open at the rest state.

Airaksinen et.al[6], suggests the modified STN-DBS coherence of CMC with inconsistent

March - April 2020
ISSN: 0193-4120 Page No. 9953 - 9956

correlation motor improvement, and large inter individual variability. Hirschmann et.al[8],analyse the PD DBS patients in the age of 11 to 26 for retinal sources coherent with oscillations. It consists of two bands alpha band and beta band. In Alpha band, the Ipsilateral temporal regions are located, in beta band Ipsilateral adjacent premotor cortex and sensor motors are located. HeinrichsGraham et.al[9], proposes the PD (DRT OFF) vs. controls with the help of spectral analysis significantly at lower beta band in bilateral motor regions. The FC get increased significantly between the motor and cortices are partially normalized by DRT. HeinrichsGraham et.al[10],suggests the amplitudes response which affects severely to the PD patients who are all affected from right-dominant disease.

Jha et.al [11], contributes the coherence between alpha and beta band at the age of 9 to 25. In Alpha band, the coherence occur in between the posterior brain stem and PPN. In Beta band the coherence appears between SMA and primary motor cortex, PPN and medial frontal wall. Krause et al[12], proposes the tACS motor cortex with 20 Hz beta frequency, but it does not supported for 10 Hz, because it attenuates the beta band during isometric contraction and reduced the amplitude performance of a finger tapping in PD patients. Further, the performance of PD patients controls on motor sequence acquisition and there is no difference in beta power band during random presentation. In addition, theta activity are very less training data which related toinference susceptibilityand cortical motor regions [13].

Oswal et.al[14], describe thealpha band are located in between the temporal cortical areas and STN to reduce thecontinuous movement of eye in PD patients. Then the degree of suppression is significantly high at the stage of ON DRT than OFF DRT.TeWoerd et.al, have demonstrated the comparable auditory entrainment as controls for PD patients. Hence, the defect of PD patients are concerns with the help of motor circuits only.

III. DATA COLLECTION

In this study, the dataset are collected by various sources from 84 patients. In that, 64 patients are male and 20 are female. In 20 control subjects - 8are male and 12 are female. Likewise, each datasets are converted intopattern of time series and the training datasets are worked throughmachine learning algorithms. Finally, it acquires in terms of accuracy, sensitivity and specificity was observed with respective datasets.

IV. MACHINE LEARNING ALGORITHMS

K – Nearest Neighbour (KNN)

K – Nearest Neighbour (KNN) is a simplest classificationalgorithm that can able to analysedifferent objects that related to the nearest training samples and it classifies new datasetsbased on the similar values. These training data are labelled and their classes can be specified. In the tested stage, unlabelled data aregiven as input and the classifier generates the list of the k nearest data points tothe testing point which there is no need to distribution of data.

Random Forest

Random Forest is a supervised learning method. It has capability tomerge the data for high stabilityand accurate results are obtained with multiple decision trees. It has ability to reduce the over fitting, then it handlesthe capability of missing data also it can manage the huge amount of datasets with dimensional values.

V. RESULTS AND EXPERIMENTAL ANALYSIS

The experimental analysis of Parkinson's disease was observed by various algorithms like KNN and Random Forest using number of iterations. Finally, the accuracy, sensitivity, and specificity are done through respective datasets that are tabulated as below.

March - April 2020
ISSN: 0193-4120 Page No. 9953 - 9956

Table. I Experimental analysis of KNN and Random Forest Algorithms

Algorithms	Number of Iterations	2	4	6	8	10	Average
KNN	Accuracy	85	88	89	90	92	83
	Sensitivity	63	75	90	89	85	85.2
	Specificity	**50**	**89**	**95**	**92**	**100**	**88.7**
Random Forest	Accuracy	90	90	90	91	90	90.2
	Sensitivity	95	92	95	100	96	92.5
	Specificity	**100**	**93**	**98**	**95**	**100**	**97.1**

Fig. 1 Performance analysis of Parkinson's disease using Machine Learning Algorithms

The performance analyses graph as shown in Fig.2. It observes the values of accuracy, sensitivity, and specificity which obtained from the machine learning algorithms like KNN and Random Forest. Hence, Random Forest gives 10% more accurate results than KNN.

VI. CONCLUSION

Parkinson's disease (PD) is one of the movement disorder which occur in the neurological activities, but the diagnosis of disease is quite challenging. However, this paper represents the experimental analysis on PD using machine learning algorithms such as K – Nearest Neighbour and Random Forest.From the results, it can observed that random forest gives better accuracy than KNN. Further, in terms of sensitivity and specificity the radom forest performs better than the conventional algorithms. Finally, the Random forest reports 10% accuracy than KNN algorithm. Developed intelligent Parkinson's disease Diagnostic System using EEG has an accuracy of 95%.

REFERENCES

[1]. Gómez, Carlos,Dubbelink, Kim ,Stam, Cornelis,Abásolo, Daniel,Berendse, Henk, Hornero, Roberto, Complexity Analysis of

Resting-State MEG Activity in Early-Stage Parkinson's Disease Patients,Annals of biomedical engineering,Vol.39.2011.

[2]. Sanjay P Singh, 'Magnetoencephalography: Basic Principles', 2014.

[3]. Victor J Geraedts, Arjan Hillebrand, 'A systematic review of MEG-based studies in Parkinson's disease: The motor system and beyond', 2019.

[4]. M Dauwan, E M Vriens, 'Aberrant resting-state oscillatory brain activity in Parkinson's disease patients with visual hallucinations: An MEG source-space study', 2019.

[5]. Jarkko Luomaa, Eero Pekkonenb, 'Spontaneous sensorimotor cortical activity is suppressed by deep brain stimulation in patients with advanced Parkinson's disease', 2018.

[6]. Katja Airaksinen , Jyrki P Mäkelä , ' Cortico-muscular coherence in advanced Parkinson's disease with deep brain stimulation',2014.

[7]. Emma L. Hall, Siân E. Robson, Peter G. Morris, 'the Relationship between MEG and MRI: A Review Article for the Special Issue of NeuroImage on Multi-Modal Data Fusion ', 2014.

[8]. Hirschmann J, Ozkurt TE, 'Distinct oscillatory STN-cortical lopps revealed by simultaneous

within spatially and spectrally distinct resting state networks in Parkinson's disease', Vol.139, 2016.

[16]. Revathi, P., & Hemalatha, M. (2012, December). Classification of cotton leaf spot diseases using image processing edge detection techniques. In 2012 International Conference on Emerging Trends in Science, Engineering and Technology (INCOSET) (pp. 169-173). IEEE.

[17]. Perumal, P. C., Sowmya, S., Pratibha, P., Vidya, B., Anusooriya, P., Starlin, T., ... & Gopalakrishnan, V. K. (2014). Identification of novel PPARγ agonist from GC-MS analysis of ethanolic extract of Cayratia trifolia (L.): a computational molecular simulation studies. J App Pharm Sci, 4, 006-011.

MEG and local field potential recordings in patients with Parkinson's disease',2011.

[9]. Elizabeth Heinrichs Graham, Max J Kurz, 'Hypersynchrony despite pathologically reduced beta oscillations in patients with parkinson's disease: a pharmaco Magnetoencephalography study', 2014.

[10]. Elizabeth Heinrichs Graham, Pamela M Santamaria, 'The cortical signature of symptom laterality in Parkinson's disease', 2017.

[11]. Ashwani Jha, Vladimir Litvak, 'Functional Connectivity of the Pedunculopontine Nucleus and Surrounding region in Parkinson's Disease', Vol.27, 2017.

[12]. Vanessa Krause, Claudia Wach, 'Cortico muscular coupling and motor performance are modulated by 20 Hz transcranial alternating current stimulation (tACS) in Parkinson's disease', 2013.

[13]. Sarah Nadine Meissner, Vanessa Krause, 'the significance of brain oscillation in motor sequence learning: Insights from Parkinson's disease', 2018.

[14]. Ashwini Oswala b, Peter Browna , 'Synchronized neural oscillations and the pathophysiology of Parkinson's disease', 2013.

[15]. Ashwini Oswal, Martijn Beudel, 'Deep brain stimulation modulates synchrony

[18]. Suganya, S., Narmadha, R., Gopalakrishnan, V. K., & Devaki, K. (2012). Hypoglycemic effect of Costus pictus D. Don on alloxan induced type 2 diabetes mellitus in albino rats. Asian Pacific Journal of Tropical Disease, 2(2), 117-123.

[19]. Kumar, R. S., Ali, M. A., Osman, H., Ismail, R., Choon, T. S., Yoon, Y. K., ... & Manogaran, E. (2011). Synthesis and discovery of novel hexacyclic cage compounds as inhibitors of acetylcholinesterase. Bioorganic & medicinal chemistry letters, 21(13), 3997-4000.

[20]. Kalaiselvi, C., & Nasira, G. M. (2015). Prediction of heart diseases and cancer in diabetic patients using data mining techniques. Indian Journal of Science and Technology, 8(14), 1.