Special Issue Published in International Journal of Trend in Research and Development (IJTRD), ISSN: 2394-9333, www.ijtrd.com

Identifying Parkinson's disease Using Speech Processing

[1]Eunice Daphne J [2]Gayathri J and [3]Deepa B B
ECE, Students, R.M.K. College of Engineering and Technology, Chennai, India

***Abstract*—** Parkinson's disease is a degenerative disease of the central nervous system caused by progressive degeneration of dopamine containing cells (neurons) which gradually causes the patients to have difficulty in walking, talking or completing other simple tasks. There have been many contributions in the field of detecting, monitoring and diagnosis of Parkinson's disease. Speech processing and neural networks have been widely in the diagnosis of Parkinson's disease. In this paper we have studied various techniques that have been used in the detection, classification and diagnosis of Parkinson's disease. The features from the extracted voice samples of patients are analyzed using various classification models. The major classification models that are commonly used are Random Tree (RT), Support Vector Machine (SVM) and Artificial Neural Network (ANN). This has great potential to increase the healthcare facilities in the remote areas where effective diagnosis is difficult.

***Keywords*—** *Support Vector Machines, Artificial Neural Network, Parkinson's disease.*

I. INTRODUCTION

Parkinson's disease (PD) affects the nerve cells in the brain that produce dopamine. Parkinson's disease symptoms include muscle rigidity, tremors, and changes in speech and gait. Parkinson's disease can affect a person's voice, causing them to speak softly or have difficulty forming sounds clearly. It is the second most common neurodegenerative disease after Alzheimer's disease. It is expected to increase in the years to come therefore it is necessary to develop detection systems for effective analysis and on-time treatment. As the symptoms of PD occur gradually and mostly the elderly people, monitoring of the disease using measurements of dysphonia (vocal features) has a vital role in its early diagnosis as it is difficult for them to physically visit the clinic.

II. LITERATURE SURVEY

C. Okan Sakar el al.[1] have proposed a system of tele-monitoring of the disease by extracting features from the voice as it can be easily differentiated from a normal person's voice. Their study was to select minimum features from the voice samples that have maximum relevance to PD and also to construct a model so that work can be done with future samples. A permutation test on Mutual Information (MI) to rank the various features according to their relevance with the PD-score was done. The MI is a information theory measure to select the features and sort them according to maximum relevance. Then, a Support Vector Machine (SVM) based classification model was built to work with unseen datasets. SVM was implemented in LIBSVM version developed by [2]. This tele diagnosis of PD using measurement of dysphonia is most useful for elderly and would help in predicting the disease at an early age.

Ipsita Bhattacharya et al. [3] have used a data mining tool, Weka to pre-process the dataset and to classify the people affected from PD and the normal people using one of the data mining algorithm called Support Vector Machines (SVM). The best accuracy from the dataset on different Kernel values by applying LIBSVM was made. By pre-processing the dataset jitter and shimmer is reduced drastically. After processing using Weka it is seen that the best possible result for classification was obtained for linear kernel which was found to be 65.217%.

An analysis was conducted based on two training algorithms to diagnose Parkinson's disease by [4]. The two algorithms were Levenberg-Marquardt (LM) and Scaled Conjugate Gradient (SCG) of Multilayer Perceptron (MLP) Neural Network. Once the PD dataset is loaded, classification using Levenberg-Marquardt (LM) and Scaled Conjugate Gradient (SCG) algorithms is made. Both the algorithms are compared based on accuracy rate, MSE and Iteration and finally PD and non-PD patients are identified. Their results have shown that Levenberg-Marquardt (LM) had a accuracy of 92.95% while Scaled Conjugate Gradient (SCG) had an accuracy of 78.21%.

A total of 16 features were extracted from the voice data and were used as input to the artificial neural network (ANN) for classification. In their work Uma Rani et al. [5] have used two types of ANN for classification namely the multilayer perceptron (MLP) network and radial basis function (RBF) network. The RBF and MLP had 90.12% and 87.5% respectively for training set whereas for test the were 86.66% and 83.33% respectively.

An effective diagnosis system using fuzzy k-nearest neighbour (FKNN) for the Parkinson's disease was proposed by Hui-Ling Chen et al. [6].They have compared the proposed system with the Support Vector Machines (SVM) based approaches. The principle component analysis was used to construct a unique feature sets to improve the accuracy of the diagnosis of the disease. The FKNN model was constructed on this feature set. Experimental results proved that the FKNN-based system had a classification accuracy of 96.07% which is far more effective than the SVM-based approaches.

In their paper R. Arefi Shirvan et al. [7] have extracted features from voice samples collected from both healthy people and from people suffering from Parkinson's disease. A generic algorithm was used to detect the optimized features. The data classification was done based on these optimized features using k-nearest neighbor (KNN) classification method. A classification accuracy of 93.7, 94.8 and 98.2 per 4, 7 and 9 optimized features were obtained respectively.

Mohammad S Islam et al. [8] have used three classifiers namely Random Tree (RT), Support Vector Machine (SVM) and Feedforward Back-propagation based Artificial Neural Network (FBANN) to conduct a comparative analysis for effective detection of Parkinson's disease. A 100 times repeated 10-fold cross validation analysis was carried out to validate the overall classification. The FBANN classifier had outperformed all the other classifiers with a accuracy of 97.37%. Their system could be used as a technique for non-invasive decision support system (DSS) for the remote diagnosis of the disease at an early stage.

Mehmet Fatih CAGLAR, et.al [9] have studied two types of Artificial Neural Networks, Multilayer Perceptrons (MLP) and Radial Basis Function (RBF) Networks. They have also used Adaptive Neuro-Fuzzy Classifier (ANFC) with linguistic hedges. Based on the recognition results the ANFC gave a 95.38% on training and 94.72% on test dataset.

Max A. Little, et.al [10] have published a paper on suitability of Dysphonic measurements. A non- standard measure in combination with traditional harmonics to noise ratios were best able to separate healthy people from Parkinson's disease affected people. The four extracted features include Harmonics to Noise Ratio, Recurrence Period Density Entropy, Detrended Fluctuation Analysis and Pitch Period Entropy. These were fed into the kernel support vector machine and an overall classification performance of 91.4% was obtained.

III. PROPOSED SYSTEM

The voice samples are collected from normal healthy people and those who are affected by the Parkinson's disease. The voice samples are filtered to remove the noise if any, present in them. Features are extracted from the voice samples and the optimal features are selected from them in order to increase the classification model accuracy. Any one of the classification model with high accuracy is applied on these features to obtain the required results. The results obtained can be used to classify whether the particular voice sample belongs to a normal person or to a person suffering from Parkinson's disease. Furthermore these details can be given to a hospital to help in immediate treatment of the disease.

IV. CONCLUSION

The field of speech processing and its recognition have been widely recognised for their diverse applications in the recent years. Most importantly in the detection, classification and diagnosis of Parkinson's disease, speech processing has great potential for growth. Several algorithms were discussed in this paper, after analysing many classifiers the Feedforward Back-propagation based Artificial Neural Network (FBANN) outperforms all other classifiers. The use of speech processing in the field of medicine has proved to be very efficient and effective.

References

[1] C. Okan Sakar & Olcay Kursun, Telediagnosis of Parkinson's Disease Using Measurements of Dysphonia, Journal of Medical Systems,August 2010, Volume 34, Issue 4, pp 591–599

[2] Hsu, C. W., Lin, C. J., A Comparison of methods for multi-class support vector machines. IEEE Trans. Neural Netw. 13:415–425, 2002. LIBSVM software available for download at http://www. csie.ntu.edu.tw/~cjlin/libsvm. doi:10.1109/TNN.2002.1000139.

[3] Ipsita Bhattacharya, M.P.S Bhatia, SVM Classification to Distinguish Parkinson Disease Patients, A2CWiC '10 Proceedings of the 1st Amrita ACM-W Celebration on Women in Computing in India,Article No. 14, ISBN: 978-1-4503-0194-7

[4] Zahari Abu Bakar, Nooritawati Md Tahir, Ihsan M. Yassin, Classification of Parkinson's Disease Based on Multilayer Perceptrons Neural Network, 2010 6th International Colloquium on Signal Processing & Its Applications (CSPA)

[5] Uma Rani K and Mallikarjun S. Holi, Analysis of Speech Characteristics of Neurological Diseases and their Classification, Computing Communication & Networking Technologies (ICCCNT), 2012 Third International Conference, 2012

[6] Hui-Ling Chen, Chang-Cheng Huang, Xin-Gang Yu, Xin Xu, Xin Sun, Gang Wang, Su-Jing Wang, An efficient diagnosis system for detection of Parkinson's disease using fuzzy k-nearest neighbor approach, Expert Systems with Applications, Volume 40, Issue 1, January 2013.

[7] R. Arefi Shirvan, E. Tahami, Voice Analysis for Detecting Parkinson's Disease Using Genetic Algorithm and KNN Classification Method, 18th Iranian Conference of Biomedical Engineering (ICBME),2011

[8] Mohammad S Islam, Imtiaz Parvez, Hai Deng, Parijat Goswami, Performance Comparison of Heterogeneous Classifiers for Detection of Parkinson's Disease Using Voice Disorder (Dysphonia), 3rd INTERNATIONAL CONFERENCE ON INFORMATICS, ELECTRONICS & VISION, 2014

[9] Mehmet Fatih CAGLAR, Bayram CETISLI, Inayet Burcu TOPRAK, Automatic Recognition of Parkinson 's disease from Sustained Phonation Tests using ANN and Adaptive Neuro-Fuzzy Classifier, International Symposium on Engineering and Architectural Sciences Of Balkan, Caucasus And Turkic Republics, At Isparta, TURKEY, 2010

[10] Little, M.A.; McSharry, P.E.; Hunter, E.J.; Spielman, J.; Ramig, L.O., Suitability of Dysphonia Measurements for Telemonitoring of Parkinson's Disease, IEEE Transactions on Biomedical Engineering , 2009

[11] Khondaker Abdullah Al Mamun, Musaed Alhussein, Kashfia Sailunaz, Mohammad Saiful Islam, Cloud based framework for Parkinson's disease diagnosis and monitoring system for remote healthcare applications, Future Generation Computer Systems, 2017