COMPUTIONAL DIAGNOSIS OF PARKINSON DISEASE USING SPEECH SIGNAL

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Abstract

Accurate diagnosis is highly essential for treatment planning which can minimize the fatal results. Diagnosis of Parkinson disease using clinical results lead to unwanted biases, errors and excessive medical costs which affect the quality of services provided to patients. Accurate results can be obtained through Artificial Neural Network(ANN). Parkinson disease is a neurological disorder that affects about 2% of the people older than 65 years. It is caused by loss of dopamine producing cells in the substantia nigra of the midbrain. The majority of patients with PD have some voice and speech impairments like reduced loudness, monopitch, monoloudness, hoarse voice quality and imprecise articulation. We compared the performance of nine types of neural training algorithms in feed forward neural network. In Proposed work achieve the best performance on the basis of mean square error, accuracy and confusion matrix of the classification.

Index Terms: **ANN, Confusion matrix, Feed Forward Network, Mean square error, PD.**

I. INTRODUCTION

Parkinson's disease is degenerative neurological disorder of the central nervous system mainly affecting the motor system. The motor symptoms of Parkinson's disease result from the death of dopamine producing cells in the substantia nigra, a region of the midbrain. The main symptoms are shaking, rigidity, slowness of movement and several speech impairments. In the normal human brain, nerve cells produce dopamine-producing cells are damaged or death. Parkinson's disease is common in older people with most cases occurring after the age of 50. Approximately 7 to 10 million people worldwide are living with Parkinson's disease. In 2013 PD resulted in about 103,000 deaths globally, up from 44,000 death in 1990.The disease is named after the English doctor James Parkinson, who published the first detailed description in an Essay on the Shaking Palsy, in 1817.Because of Parkinson's early work in identifying symptoms, the disease came to bear his name.

II. IMPORTANCE OF WORK

A. Review Stage

The majority of patients with PD have some voice and speech impairment. However, people with Parkinson can lose up to 70% of susceptible brain cells in the midbrain. Without these dopamine generating cells, the brain's ability to control movement is progressively reduced. Day-to-Day the number of patients suffering from PD is increasing. Hence early detection of Parkinson's disease is needed.

III. OBJECTIVE

To diagnosis of Parkinson disease using speech signal and compare the performance of feed forward neural network training algorithms.

IV. FEED FORWARD NETWORK

Feed forward networks have one way connections from input to output layers. They are most commonly used for prediction, pattern recognition, classification and nonlinear function fitting.

Specialized versions of the feed forward network include fitting(fitnet) and pattern recognition (pattern net) networks. A variation on the network is the cascade forward network (cascade forward net) which has additional connections from the inputs to every layer, and each layer to all following layers.

Feed forward net (hidden Sizes, trainFn) takes these arguments,

Hidden sizes - row vector one or more hidden layers (by default=10)

TransFn-Training function (By default='trainlm') and returns a feed forward network. MATERIALS USED

A. Parkinson Dataset

The Parkinson record used in this paper is taken from the University of California at Irvine (UCI) machine learning repository .The dataset was created by Max Little of the University of Oxford.

This dataset is composed of a range of biomedical voice measurements from 31 people, 23 with Parkinson's disease (PD). Each column in the table is a particular voice measure, and each row corresponds one of 195 voice recording from these individuals ("name" column). The main aim of the data is to discriminate healthy people from those with PD, according to "status" column which is set to 0 for healthy and 1 for PD. The data is in ASCII CSV format. The rows of the CSV file contain an instance corresponding
to one voice recording.

Attribute	Meaning
Name	ASCII subject name and recording number
MDVP:Fo(Hz)	Average vocal fundamental frequency
MDVP:Fhi(Hz)	Maximum vocal fundamental frequency
MDVP:Flo(Hz)	Minimum vocal fundamental frequency
MDVP:Jitter(%), MDVP:Jitter(Abs), MDVP:RAP,MDVP:PP, Jitter:DDP.	Several measures of variation in fundamental frequency
MDVP:shimmer,MDVP:Shimmer(db),MDVP:APQ, Shimmer:DDA,Shimmer:APQ3, Shimmer:APQ5	Several measures of variation in amplitude
NHR,HNR	Two measures of ratio of noise to tonal components in the voice
Status	0-healthy 1-people with Parkinson
RPDE,D2	Two nonlinear dynamical complexity measures.
DFA	Signal fractal scaling exponent.
spread1,spread2,PPE	Three nonlinear measures of fundamental frequency variation

A. System Design

4. Module Description

4.1 Preprocessing

It is the process of transform the data into a format that will be more easily and effectively processed for the purpose of the user. In Neural network 4 Methods used for preprocessing such as sampling, transformation, denoising and normalization. Here we did only denoising. Denoising means remove noise from data.

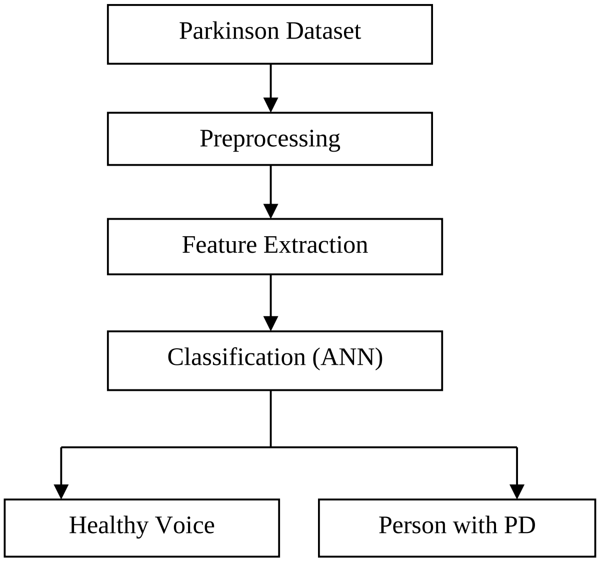
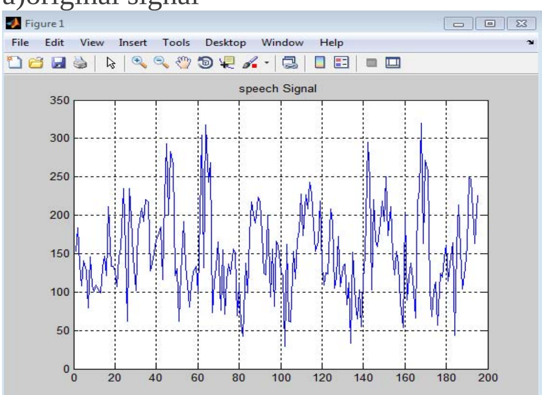
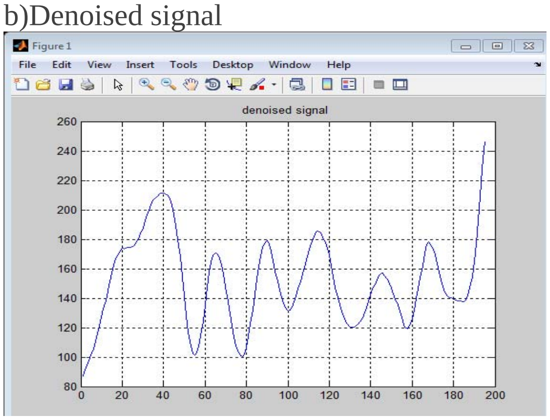


Fig 2: Preprocessing

a)original signal



b)Denoised signal



4.2 Feature Extraction

Taken out specified data that is significant in some particular context. Various traditional measures and nonstandard measures are extracted. The risk of misinterpretation is reduced and dignity of the diagnosis is retained.

4.3 Classification

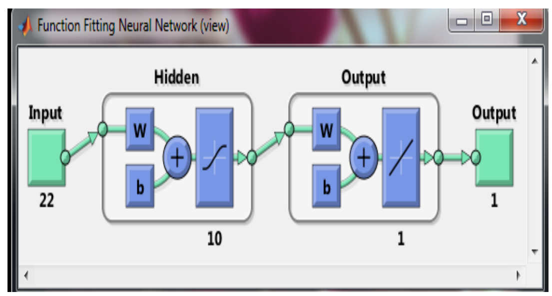
Artificial Neural Network(ANN) classifier used for performance comparison. In feed forward neural network structure, Generic algorithm is undertaken for selecting optimized features from all extracted features and train the neural network to classify the healthy and people with Parkinson.

5. ARTIFICIAL NEURAL NETWORKS CLASSIFIER (ANN)

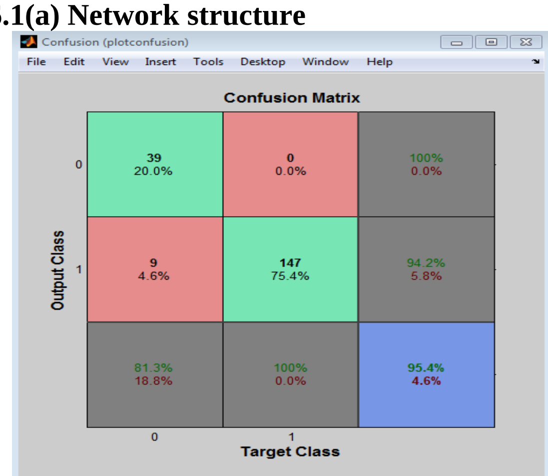
In machine learning, artificial neural networks (ANNs) are a family of statistical learning algorithms resembles like biological neural networks. A neural network is a network of simulated neurons that can be used to recognize instances of patterns. Neural networks learn by searching through a space of network weights. It is used to estimate or approximate functions that can depend on a large number of inputs and are generally unknown. Artificial neural networks are generally presented as systems of interconnected "neurons" which can compute values from inputs/output and are capable of machine learning as well as pattern recognition

6. Sample Output

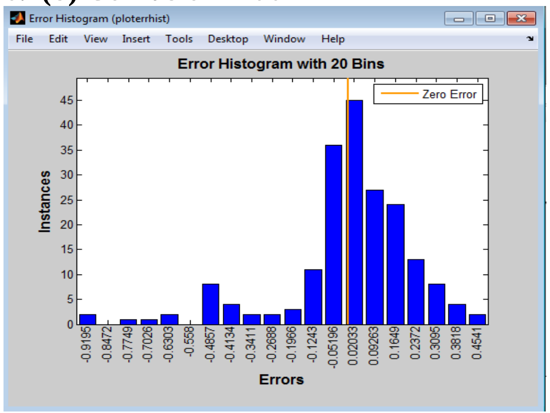
6.1 Levenberg-Marquardt Algorithm



6.1(a) Network structure



6.1(b) Confusion Matrix



6.1(c) Error Histogram

Results

The central aim of this paper was to recognize how dissimilar classifiers would perform when come across the selected data
and to evaluate their performance. ANN is used for classification of Parkinson's disease. To get better accuracy in Levenbreg-Marquardt Algorithm is 95.4%.The accuracy and performance of the results for each algorithm is shown below table 1.2

Training Algorithm	Performance	Accuracy
Levenberg-Marquardt	**0.0571**	**95.4%**
BFGS Quasi-Newtons	**0.1102**	**85.1%**
Resilient Backpropagation	**0.0715**	**90.8%**
Scaled Conjugate Gradient	**0.1049**	**89.7%**
Conjugate Gradient with Powell/Beale Restarts	**0.1042**	**86.7%**
Fletcher-Powell Conjugate Gradient	**0.0896**	**88.2%**
Polak-Ribiére Conjugate Gradient	**0.1051**	**85.6%**
One Step Secant	**0.1062**	**87.7%**
Variable Learning Rate Backpropagation	**0.1185**	**87.7%**

Table 1.2

Future Work

In this project we take only speech signal based Parkinson disease classification. In future we would like do muscle related (Emg Signal) and movement related(Gait analysis).Here the classification result based on ANN and SVM classifier. Further we enhance the idea using KNN and Naïve Bayes classifier.

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