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Identification of Bacterial Throat Infection Using WT and ANN

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Abstract: Because of unhealthy habits, nature of Job and Voice abuse the peoples are affected by the voice problems. In this modern life the vocal or vocal disorder is one of the risky factor because it changes our acoustic voice signal. So that we have to diagnosed and treated at an early stage. Although to diagnosis these more objective techniques are considered as invasive and cause discomfort to patients because of the instruments like light source, endoscopic and video cameras. The non-invasive technique based on the digital signal processing of the speech signals. An idea to characterize signals of healthy and disorders voice based on the tool, Wavelet transform and Neural Networks. Based on the time - Frequency multi-resolution property of wavelet transform, the input speech signal is decomposed into various frequency channels. For capturing the characteristics of the signal the minimum and maximum co-efficient of the wavelet's channels are calculated. We know the speech disorder can be divided into many categories here we are not taken all the type of disorders. We take only cyst and neurogenic voice disorder. In this paper Multilayer Neural Networks are used to classify the disorder voice and normal voice. The speech sample are collected from the hospital and is used to test the recognition accuracy of this system. The result accuracy of the system will be compared to the given statement of the speech therapist doctor. Besides, the proposed system had higher percentage scores 90 % than those 83% of SVM. Finally, the proposed system has confirmed the effectiveness of the identification of bacterial throat infection using WT and ANN methods.

Key words: Speech Processing · Feature Calculation · Wavelet Transform · Neural Networks · Voice Disorder

INTRODUCTION

The speech signal analysis in frequency domain are the importance in studying the nature of speech signal and its acoustic properties [1]. Speech is the most natural form of human communication. It is an information-rich signal exploiting frequency-modulated, amplitude-modulated and time-modulated carriers to convey information about words, speaker identity, accent, expression, style of speech, emotion and the state of health of the speaker. The speech signal is produced from the vocal tract system by varying its dimension with the help of articulators and exciting with a time varying source of excitation. The physical structure and dimension of the vocal tract, as well as of the excitation source, are unique for each speaker [2-3]. Speech processing is the study of speech signal and the processing methods of these signals.

Voice is multidimensional signal and its creation is related to anatomic, physiological, emotional, organic, environmental and behavioural features. Voice evaluation, therefore, must be based on these principles, with mapping of voice production and correlation with such features for one to take a truly comprehensive view of dysphonic [4].

The purpose of voice evaluation is to analyse voice quality, that is, whether the voice is healthy or not; to diagnose voice disorders, to monitor any disease or function progression, to evaluate prognosis, pathology recognition and to identify possible risks to reduce the disorder [5].

The rest of the paper has been designed as under: chapter 2 provides a summary of the types of disorders, in chapter 3 provides a summary of the research efforts already done, chapter 4 describes over all architecture of the proposed system, chapter

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5 6, deals with devices and method. Chapter 7 deals with result and discussion and chapter 8 presents conclusions.

Types of Disorders: Voice disorders fall into three main categories: organic, functional, or a combination of the two. Organic voice disorders fall into two groups: structural and neurogenic. Structural disorders involve something physically wrong with the mechanism, often involving tissue or fluids of the vocal folds. Neurogenic disorders are caused by a problem in the nervous system. A functional disorder means the physical structure is normal, but the vocal mechanism is being used improperly or inefficiently.

Cysts: A cyst is a growth that forms beneath the surface layer of the vocal fold mucosa (Learn more about the structure of the vocal fold). It causes a gap between the two vocal folds (Also called vocal cords; refer to our explanation of this (Terminology) and prevents normal vibration. Or it may cause some portion of the vocal fold mucosa to become stiff, which would also prevent normal vibration, affecting the voice quality and ease of vocal production. Due to cyst, the main complaints and symptoms are following:

Sound of Voice: The voice may have a range of sound from normal to breathy to very rough and hoarse.

Complaints: Abnormal Voice Quality, Vocal Fatigue, Discomfort after Extensive Talking.

Neurogenic Disorders: Benign Essential Tremor is a disorder that causes shaking of the voice. Benign means that the disorder will not harm your health. Essential means that the tremor is not associated with any other disease state, such as the tremor associated with Parkinson's disease. When Benign Essential Tremor affects the voice, vocal fold vibration is normal, but the entire larynx shakes slightly, causing an extra vibration, or tremor, at about 5-7 cycles per second. Sometimes the larynx can be seen to tremor even at rest, but usually the tremor begins when the person begins to speak. Benign Essential Tremor tends to occur in older persons, though persons in their 50's may also be afflicted. Neurogenic disorder has the main complaints and symptoms are following:

Sound of Voice: A steady shaking or wobbling of the voice, ranging from gentle and continuous to a staccato, almost hiccupping sound. The easily-recognized sound of Katherine Hepburn is a famous example of Benign Essential Tremor. The tremor is rhythmic and steady, at 5-7 cycles per second and it occurs in all speech contexts. It may vary in intensity with changes in pitch or volume and, like all voice disorders, tends to get worse in stressful situations.

Complaints: Poor voice quality, with "Old-sounding" characteristics, Vocal weakness and low volume, Vocal fatigue increasing with voice use, Embarrassment.

Existing System: To develop a computerized technique that uses speech recognition as a helping tool in speech therapy diagnosis for early detection. The system will use SVM as the statistical analysis tool in recognition disorder voice and generic algorithm is used as Feature Extraction (FE) technique for front end parameterized of input speech signal [4]. The process is begin with training the sample voice in the system. This will describe the phones of SVM acoustic model for the mapping process to form a word for both training and decoding purpose [4].

In Empirical Mode Decomposition we analysis the speech signal based on AM and FM level to detect the normal and pathological voice disorder. But for non linear voice is not properly detected using this method [6].

In computerized method for analysing the disorder voice is identified by using the Hidden Markov Model. In this training involves rapid iteration method to solve and also which can be quit slow process [7].

Proposed System: The block diagram of proposed system as shown Fig 1.In this system we uses wavelet analysis decomposition technique to extract a feature vector from speech samples, which is used as input to a Multilayer Neural Network classifier. Wavelet analysis provides a two-dimensional pattern of wavelet coefficients. The energy content of Wavelet coefficients at various level of scaling is used to formulate a feature vector of speech sample. Attempt is made to use this feature vector as a diagnostic tool to identify disorders in the larynx. A three layer feed forward network with sigmoid activation is used for classification of disorder voice. The voice signal is recorded by using microphone at the rate of 8000 Hz. Then we apply the wavelet transform.

Fig. 1: Cyst

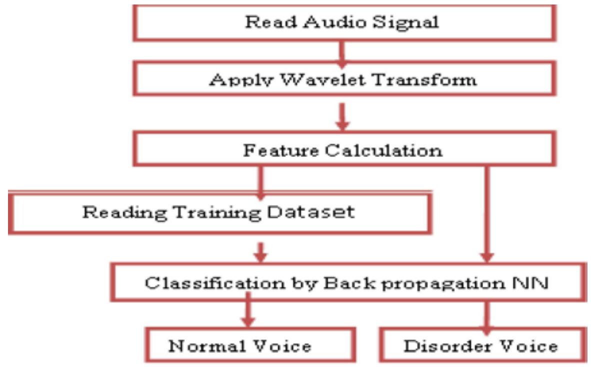

Fig. 2: Block Diagram

Wavelet Transform: Wavelet analysis is an exciting new method for solving difficult problems in mathematics, physics and engineering, with modern applications as diverse as wave propagation, data compression, signal processing, image processing, pattern recognition, computer graphics, the detection of aircraft and submarines and other medical image technology. Wavelets allow complex information such as music, speech, images and patterns to be decomposed into elementary forms at different positions and scales and subsequently reconstructed with high precision. Signal transmission is based on transmission of a series of numbers. The series representation of a function is important in all types of signal transmission. The wavelet representation of a function is a new technique. Wavelet transform of a function is the improved version of Fourier transform. Fourier transform is a powerful tool for analysing the components of a stationary signal. But it is failed for analysing the non stationary signal where as wavelet transform allows the components of a non-stationary signal to be analysed.

w (a, b) = □ f(t)Ø □,□(t) dt (1)

1Ø □,□(t) is the transforming function, f(t) is the speech signal function, a means scale and b means translation factor. Wavelet Transforms are improved version of the Fourier Transform. In HMM model to find the articulation disorder but the accuracy is just 50% only [8].

Wavelet Decomposition: Wavelet Transform is applied for selected signal to manipulate harmonics at different DB levels as shown in Fig 2. Wavelet analysis is similar to Fourier analysis in the sense that it breaks a signal down into its constituent parts for analysis. Whereas the Fourier transform breaks the signal into a series of sine waves of different frequencies, the wavelet transform breaks the signal into its "Wavelets", scaled and shifted versions of the "Mother wavelet"[9].

Based on the Daubechies-N wavelet is the popular wavelet used for speech recognition. Its properties are used for support length of wavelet function and also dbN is not Symmetrical [10]. In this method we used to decompose the speech signal.

Neural Networks: Some NNs are models of biological neural networks and some are not, but historically, much of the inspiration for the field of NNs came from the desire to produce artificial systems capable of sophisticated, perhaps intelligent, computations similar to those that the human brain routinely performs and thereby possibly to enhance our understanding of the human brain. Most NNs have some sort of training rule.

The neural computer adapts itself during a training period, based on examples of similar problems even without a desired solution to each problem. After sufficient training the neural computer is able to relate the problem data to the solutions, inputs to outputs and it is then able to offer a viable solution to a brand new problem. Other than neural network we have several methods to train and process the speech signal by SVM, HMM and GMM but its performance of speech signal is less compared to Neural Network. In HMM model the output based on the sequence of vector dimension. The trained model scores of HMM is 81%. In this they taken the content of dataset based on the DNA, amino acids [11]. In HMM main drawback is the viterbi algorithm is expensive, both in terms of memory and compute time. The training involves repeated iterations which can be quite slow to identify the vocal fold disease and normal voice [12].

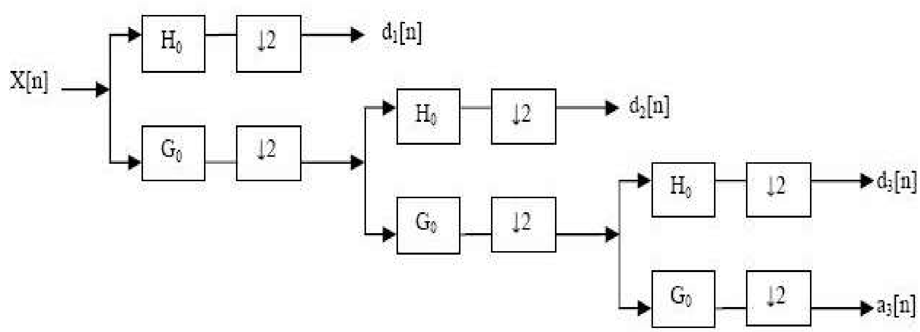

Fig. 3: Wavelet Decomposition

This investigation refer one paper in that we see the comparisons of SVM and RBNN. The aim of study was to analyse the performance of both the system based on the training model. Based on the result we select the Neural Network to give the classification of disorder voice signal [13].

Back Propagation Algorithm: A back propagation network, proceed in the following fashion. First, take a number of neurons and array them to form a layer. A layer has all its inputs connected to either a preceding layer or the inputs from the external world, but not both within the same layer. A layer has all its outputs connected to either a succeeding layer or the outputs to the external world, but not both within the same layer.

Next, multiple layers are then arrayed one succeeding the other so that there is an input layer, multiple intermediate layers and finally an output layer, as in Figure 3. Intermediate layers, that is those that have no inputs or outputs to the external world, are called hidden layers. Back propagation neural networks are usually fully connected. This means that each neuron is connected to every output from the preceding layer or one input from the external world if the neuron is in the first layer and, correspondingly, each neuron has its output connected to every neuron in the succeeding layer.

Generally, the input layer is considered a distributor of the signals from the external world. Hidden layers are considered to be categorizers or feature detectors of such signals. The output layer is considered a collector of the features detected and producer of the response. While this view of the neural network may be helpful in conceptualizing the functions of the layers, you should not take this model too literally as the functions described may not be so specific or localized the back propagation

Table 1: Performance Calculation of Neural Networks

Collected Voice	Training Voice	Correct Identification	Rate of Identification
20	20	19	90%

Back Propagation Algorithm:

F(x) = '(w1F1(x) + w2F2(x) + • • • + wmFm(x))   (2)

The derivative of F at x is thus

F0(x) = '0(s) (w1F01 (x) + w2F02 (x) + • • • + wmF0m(x))   (3)

Where s = '(w1F1(x) + w2F2(x) + • • • + wmFm(x))   (4)

Algorithm is used to compute the necessary corrections. The algorithm can be decomposed in the following four steps:

- Feed-forward computation
- Back propagation to the output layer
- Back propagation to the hidden layer
- Weight updates.

Neural Network Results: We collect some 20 number of words with different persons. And its used for the training of neural networks. After trained the neural network based on the back propagation algorithm. The results are found the correct identification of the voice signal what we give to the input of the neural networks. Table 1 shows that the performance calculation of neural networks.

RESULTS AND DISCUSSION

The database contains the speech files were recorded by using the microphone. The collected samples are

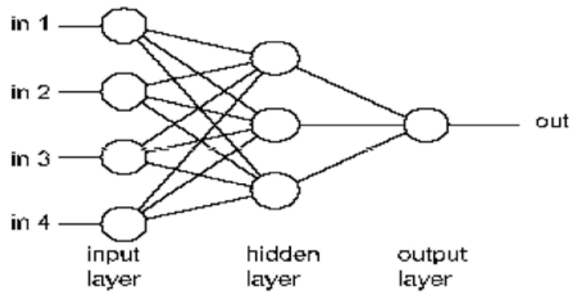

Fig. 4: Back Propagation Layer

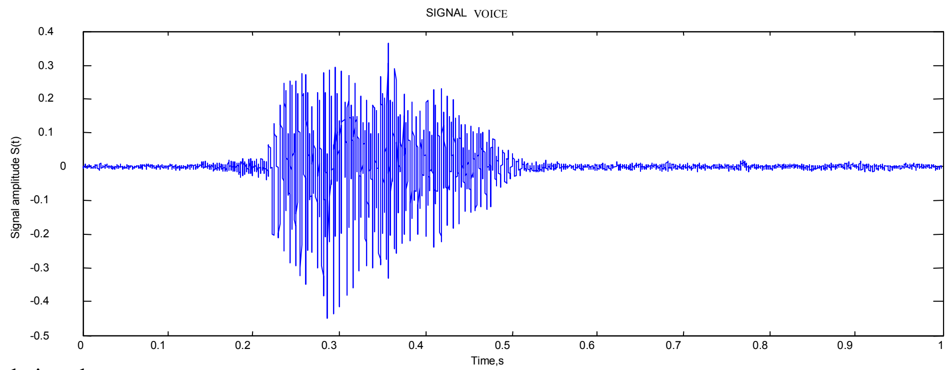

Fig. 5: Original signal

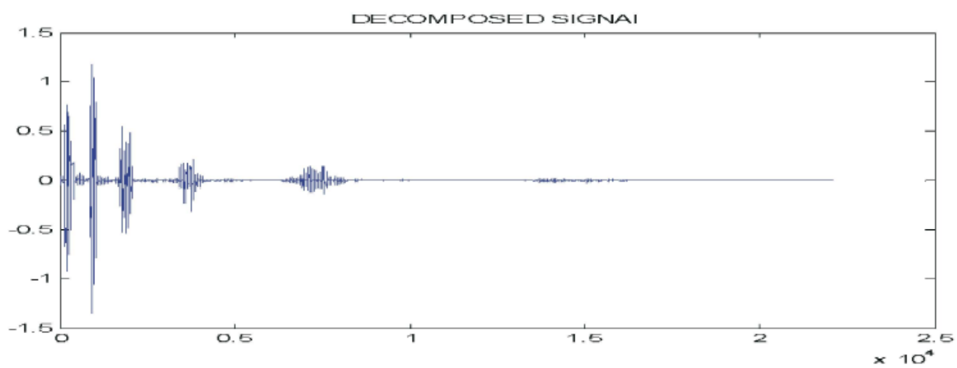

Fig. 6: Decomposed Signal

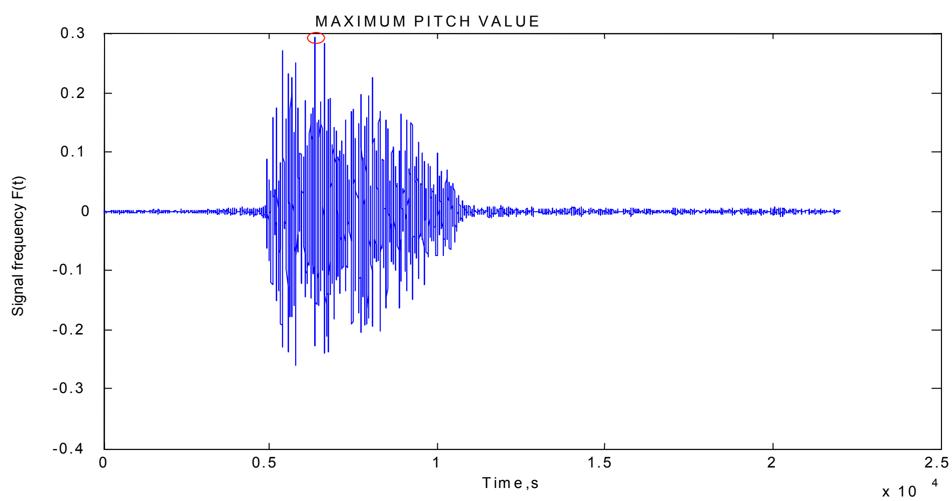

Fig. 7: Maximum Pitch Value

Table 2: Performance Comparison Measurements

	Back Propagation NN	SVM SMO
Training set	Out of 12 +waves	Out of 12+waves
Test set	10	10
Badly classified	9%	29%
Sensitivity	75%	40%
Specificity	81	75
Results	90%	83%

stored in Microsoft wave format with the sampling rate of 8000 Hz and Pulse Code Modulation is 16 bit. Wavelet transform is applied to the speech samples. The decomposition level of wavelet transform result shows that of better noise free feature extraction process. The feature extraction using the normalization vectors lie between minimum and maximum coefficients [14]. The simulation results will be shown in the Figure 4-6. Then that input signal is given to the input of neural network. And also the input is given to the SVM. The classification accuracy is compared and find the neural network is better accuracy than SVM as shown Table 2. First we give some collected samples to train the network. And then we compare it to the input and give classification of normal and disorder voice. The implementation of neural network is formed in the mat lab platform.

CONCLUSION

The main goal of this research is to help the clinics to identify the voice disorder to the patient without using discomfort instrument. This experiment was carried out to evaluate and test the performance of computerized technique in diagnosing the voice sample from articulation disorder patient. The dataset contains speech samples of distinct subjects. All the speech samples were recorded in the noise free environment using a microphone device. In this paper we propose the effective of decomposition level of wavelet transform for feature extraction. Then apply the wavelet transform method to extract the minimum and maximum co-efficient. The wavelet co-efficient of different speech samples were collected and find out the features for that selected samples. In the present case, the feature vector has only three components entirely based on wavelet coefficients. However, if additional parameters of speech sample - such as pitch, power and entropy are added to the feature vector, the training of the network may be more effective and the classification is likely to improve. We collect the trained dataset from some patients and then compare the available wavelet co-efficient in the Neural Network, based on the back propagation algorithm.Performance evaluation of the multilayer-feed forward network with BPA compared to SVM proves that it performs efficiently identify the disorder and normal voice.

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