HUMAN DISEASE ASSESSMENT FROM AMBULATORY RECORDINGS OF NON-SPEECH HUMAN ACOUSTICS

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Abstract: Human diseases can be assessed from the basic symptoms like cough, sneeze and snore. The evaluation of its intensity and frequency of occurrence could provide valuable clinical information in the assessment of patients with chronic diseases. The digital audio recordings of these signals are spectrally analyzed using Discrete Wavelet Transform (DWT) in Feature Selection process. Occasionally the noise that may produce from the environmental disturbances could also automatically eliminate with the help of Median Filter. It disclose the use of Hidden Markov Model (HMM) to automatically detect the sample signal from continuous ambulatory recordings . In former experiments they have extracted and differentiated various emotions of subject's sounds such as Feature Extraction for emotion recognition, abnormal sound detection and classification for surveillance applications. This system have improvised in extracting the subject's sound using Gray Level Co-occurrence Matrix (GLCM) in detecting the type of human diseases which are processed with the help of MATLAB and are trained with the Probabilistic Neural Network (PNN) for classification.

Index Terms: **Acoustic nonspeech signals, Harr wavelet transform, probabilistic neural network, Obstructive Sleep Apnea, discrete wavelet.**

I INTRODUCTION

Technological computation has resulted in the development of novel applications in the medical field. In these days the number of population in the world is increased at the rate of 1.09% per year down from 1.07% in 2018, 1.12% in 2017 and 1.14% in 2016. Out of 7.7 billion world's population more than 11 million people have been diagnosed by only COPD (Chronic Obstructive Pulmonary Disease) diseases, but millions may have the disease without even acknowledging it. The number of disease in this world also increased at a rapid rate which is equal to the rate of growth in population. The rapid increasing rate of disease also leads to the death of millions of people everywhere. Among this few commonly known disease affects the people even without their concern which would turn into life killing disease in future. Children at the age group of 12-16 are more vulnerable to these types of diseases and are affected very easily. This could affect their routine life in long term, if not being treated properly.

To find the kind of disease the subject must be identified with the kind of infection or the disease, the subject is affected. Previous experiments on Humans were made for other basic purpose alone. The existing system has been experimented for testing the emotions of the subject, type of sounds and their origin. In environmental sound classifying and detection of the sleep destruction, there are no previous analyzation and detection that is used to identify the disease. This is the reason for this project to detect the type of disease and to make the subject aware about the problems which could be lead because of the type of infection. Through this project the non-human speech sounds of the affected people such as Asthma, OSA, Allergy/Flu, etc. are processed with the help of MATLAB and then these signals are trained with the probabilistic neural network (PNN). Whenever an input signal is given to the system, these signals are being processed by Discrete Wavelet Transform (DWT), noises if any, are also removed automatically by using Haar Wavelet Transform (HWT) and the features are extracted with the help of Grey- Level Co-occurrence Matrix (GLCM). These features are then sent to the Probabilistic Neural Network for the purpose of classification and the types of diseases are detected.

II DISEASE DETECTOR DIAGRAM

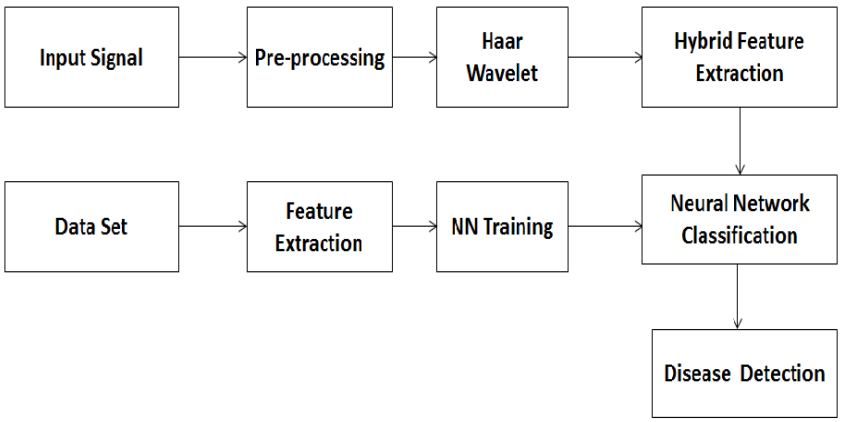

Fig.2.1 Disease Detector

2.1. DISEASE DETECTOR DESCRIPTION

- Obtaining filtered signals and wavelet transformed signals using Haar wavelet Transform
- Extracting features from these data set using Hybrid Feature Extraction Method
- Training the neural network tool with Hybrid Feature Extraction Method which is plotted from wavelet transformed signals and detection of various diseases by comparing input data sets with the trained data set.

2.2. FLOW MECHANICS OF DISEASE DETECTOR

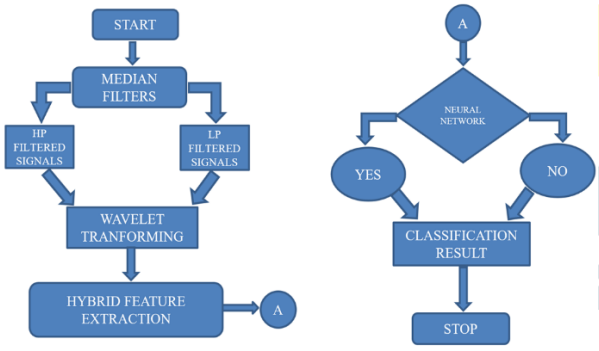

Fig 2.2 Flow diagram

2.3. HAAR WAVELET TRANSFORM

Haar wavelet transform implementation is theoretical invertible. Due to the finite length of the computer system, inversion errors could happen and it fails to produce the successful image reconstruction. In practical events, the wavelet components will be rounded to the nearest integer in the discrete transformation This makes the lossless compression impossible. This makes it as simplest possible wavelet transform.An enhanced algorithm called Haar wavelet transform which is based on the wavelet theory is used here. It needs significantly less number of arithmetic and memory compared to the convolution based discrete wavelet transform (DWT).

The Haar -based DWT separates the high-pass and low-pass wavelet filters into a sequence of many filters. These decomposed filtered signals are then converted into a sequence of upper and lower triangular filters. This technique is also used to separate the component present in the spatial image. The signals are decomposed into different sub band images, namely,

Low Low, Low High, High-low, and High High with LWF for embedding the messages in the pixel coefficients of sub bands. Haar scheme is a technique which is used to convert DWT coefficients to Integer coefficients without destruction of any information. Low Low sub bands contain the significant part of the spatial domain image. The edge information of given signal is in the High-frequency sub band. For hiding the text these coefficients are selected as reserved space.

Forward in DWT

Step1: Processing can be done by column wise to get H and L

H = (Co-Ce) and L = (Ce+ [*H/2]*)

Where Co is the odd column and Ce is the even column wise pixel values

Step2:Processing can be done by row wise to get LowLow, LowHigh,

HighLow and HighHigh,

The odd and even rows of High and Low are seperated

Namely, Highodd – odd row of High, Lowodd- odd row of Low

Heven- even row of H, Leven- even row of L

LowHigh= Lowodd-Loweven ,LowLow = Loweven + [*LH / 2]*

HighHigh = Highodd – Higheven ,HighLow = Higheven + [*HH / 2]*

- This technique is used to separate the component present in the spatial image. The signals are decomposed into different sub-band images, namely, Low-Low, Low-High, High-Low, and High-High with LWF for embedding the messages in the coefficients of sub-bands.
- Haar scheme is a technique to convert DWT coefficients to Integer coefficients without losing information.
- Low-Low sub-bands contains the significant part of the spatial domain image. The edge information of input signal is contained in the High-frequency sub-band. These coefficients are selected as reserved space foe hiding the text data

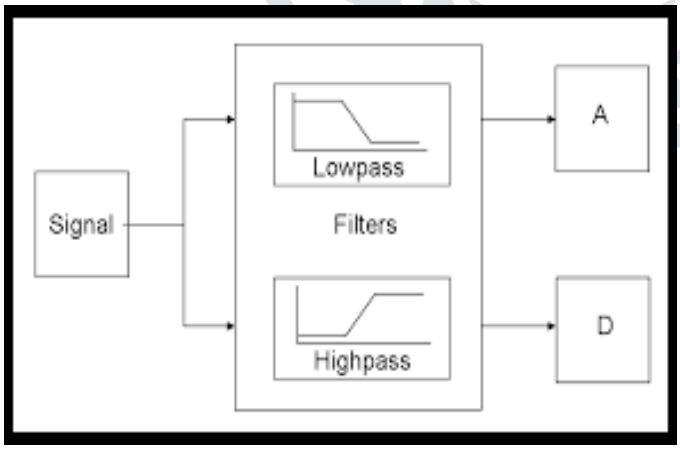

Fig.2.3 Discrete Wavelet Transform

2.4. PROBABILISTIC NEURAL NETWORK (PNN):

A probabilistic neural network (PNN) is a forward feed neural network which is broadly used in classification and pattern recognition. The main advantage of using neural network is it can handle large amount of data sets and it has ability to detect all possible interactions between predictor variables. In the PNN algorithm, the parent probability distribution function of each class is approximated by a Parzen window and a non-parametric function. By, using PDF of each class, the probability of a new input data is estimated. In a PNN, the operations are organized into a multilayered network with four different layers:

- Input layer
- Hidden layer,
- Pattern or summation layer
- Output layer.

PNNs are much faster and more accurate than multilayered perceptron networks. PNN networks are relatively insensitive to outliers. It approaches Bayes optimal classification

2.4.1. Network nodes of PNN

Input layer

Each nerve in the input layer represents a predictor variable. In categorical variables, *N-1* neurons are used when there are N more categories. It fixes the range of the values by subtracting the median and dividing by the interquartile range. Then the input nerves feed the values to each of the neurons in the non-seen layer.

Hidden layer

This layer has one nerve for each case in the training data set. It collects and stores the values of the predictor variables for the case along with the target value. A hidden neuron does the Euclidean distance of the test case from the neuron's mid-point and then applies the kernel function using the sigma values.

Summation layer

For PNN networks there is one pattern neuron for each category of the expected variable. The original target category of each training case is stored with each hidden neuron. The weighted value coming from the hidden neuron is given only to the pattern neuron that corresponds to the hidden neuron's category. The pattern neurons collects and adds the values for the class they represent.

Output layer

The output layer checks the weighted votes for each target category dumped in the pattern layer and uses the largest vote to guess the target category.

III DETECION OF DISEASE RESULTS

3.1. Cold cough

The common cold and the flu may seem very similar at first. They are indeed both respiratory illnesses and can cause similar symptoms. However, different viruses cause these two conditions, and the symptoms will gradually help to differentiate between the two. Fig.3.1 shows the cold cough signal.

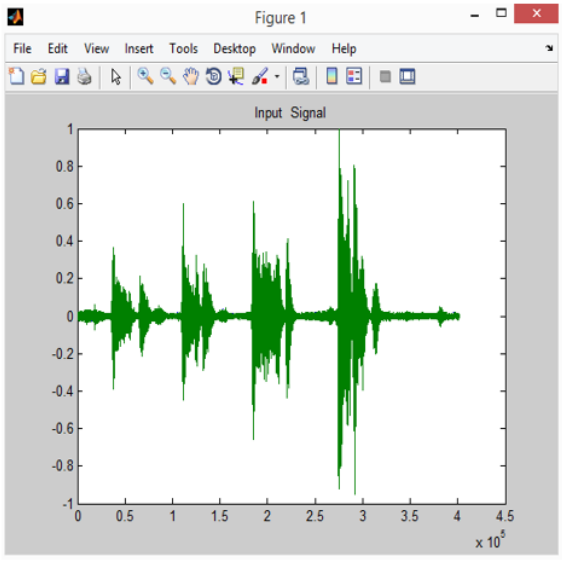

Fig.3.1.1 Preprocessed Signal

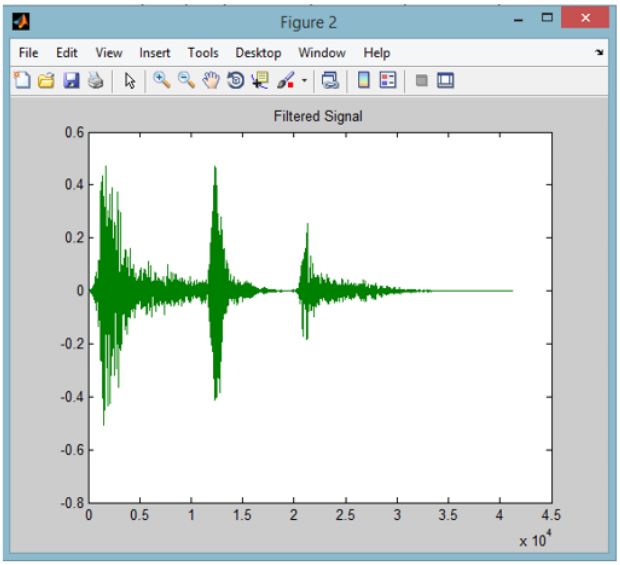

Fig 3.1.2 Filtered signal

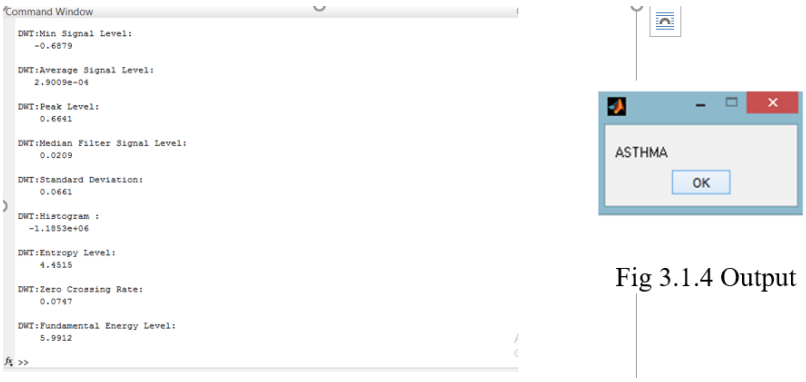

Fig 3.1.4 Output

3.2 Sneezing

A sneeze, is an expulsion of air from the lungs through the nose and mouth, usually caused by particles irritating or itching the nasal muscles. A sneeze expels air heavily from the mouth and nose in an explosive action resulting chiefly from irritation of the nasal muscles. Sneezing is possibly linked to sudden exposure to bright light, sudden change (fall) in temperature, breeze of cold air, a particularly full stomach, or viral infection, and can lead to the spread of disease. Fig.3.1.2. shows the sneezing signal.

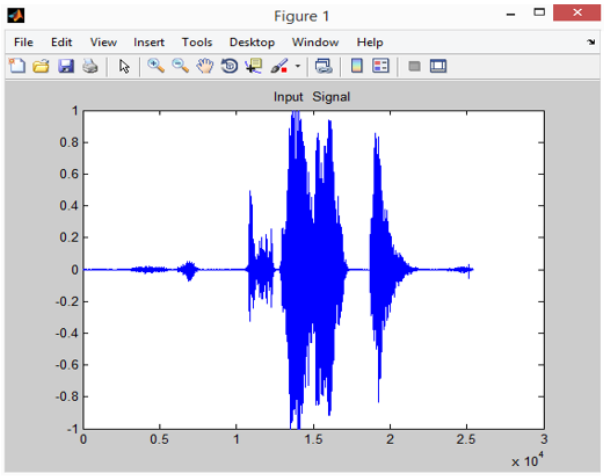

Fig.3.2.1 Preprocessed signal

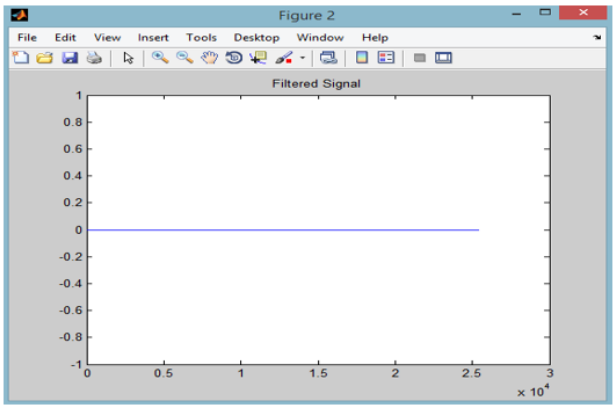

Fig 3.2.2 Filtered signal

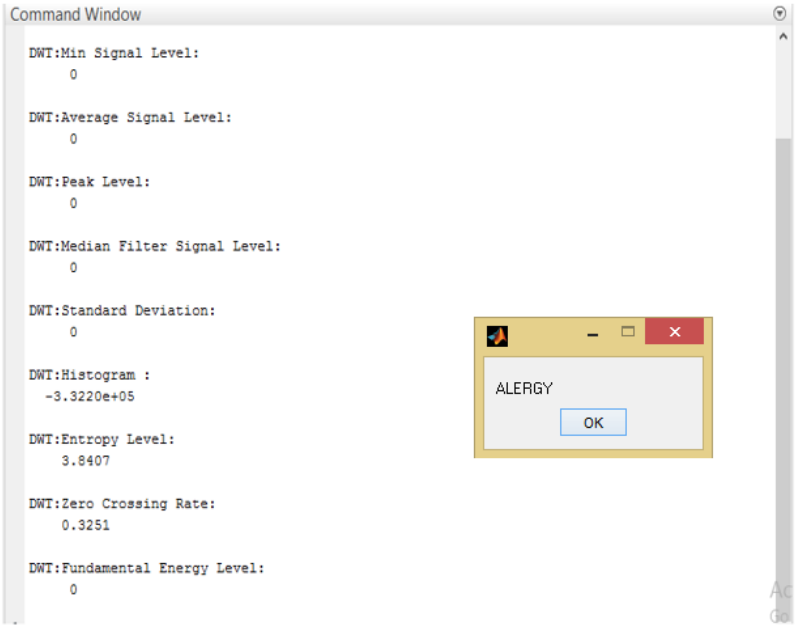

Fig 3.2.3 Feature Extracted Values

3.3. SNORE DISEASE ANALYSIS

About 90 million peoples suffer from snoring, in that as many as half of them have OSA. In several types of sleep apnea, OSA is common. A noticeable sign of OSA is snoring. There are several health risks associated with snoring and leads to serious health problems. Obstructive Sleep Apnea is characterized by multiple classes of breathing which pauses for greater than ten seconds at a time. OSA is caused due to upper airway narrowing or collapse. This results in lower amount of oxygen supply in the blood which causes the heart to work harder.

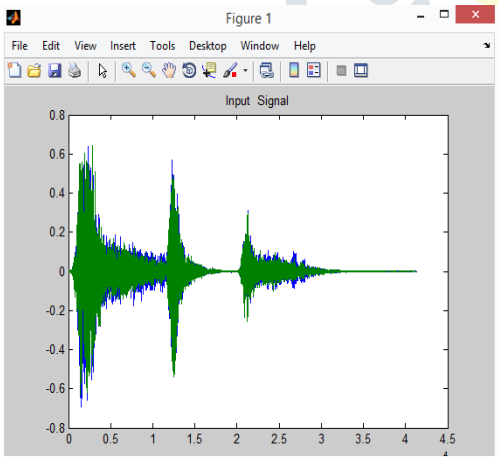

Fig 3.3.1 Preprocessed Signal

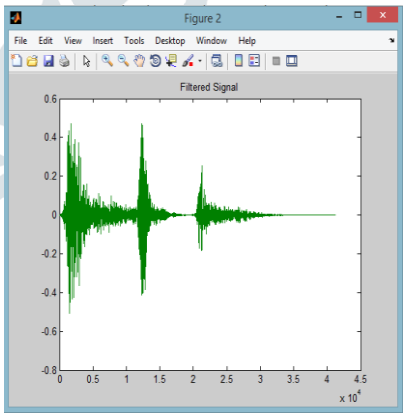

Fig 3.3.2 Filtered Signal

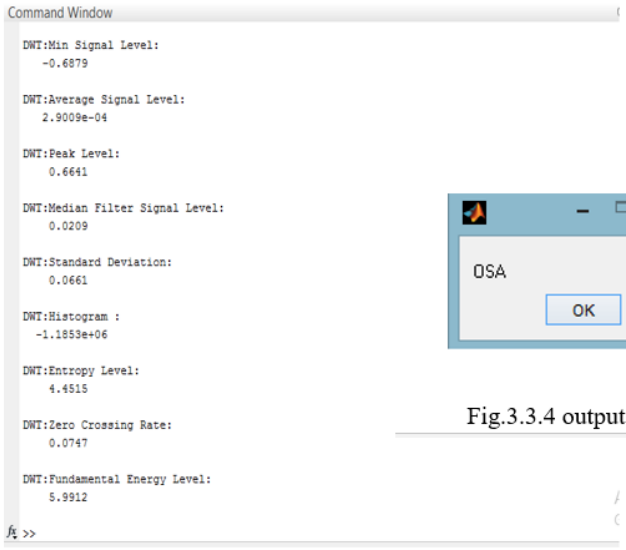

Fig 3.3.3 Feature Extracted Values

Fig.3.3.4 output

IV CONCLUSION

The non-speech human sounds such as cough, sneeze and snore are classified. Several types of features required for disease detection is extracted by using feature extraction method. The types of diseases were detected.

The diseases detected are Asthma, Flu, and Obstructive Sleep Apnea (OSA) which is detected based on the specifications derived from the input signal. Cough, sneeze, snore, screaming are the basic input signal. If the input signal does not coincide with the disease specification range then the result will appear as normal. Additionally the simulation process extracts the noises in the signals due to the environmental disturbances automatically by the use of the filters used.

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