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DISEASE DETECTION USING VOICE ANALYSIS

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Abstract - *Disease detection is one of the most vital research topic in biomedical engineering. It is also very easy to use, reliable, and time consuming method. It also helps to detect disease at an early stage. Disease detection is recognized with the parameters of voice. Each person's voice is different because of vocal cavity, vocal cord is specific to individual. The method to extract features of voice is based on MFCC. It is to technique to differentiate two speech signal. Then the MFCC for the parameter of the speech signal is stored in the database. The stored data is then match with the reference signal through Dynamic Time Wrapping (DTW).The purpose of this work is to discriminate whether the patient has Asthma or non-Asthma.*

Key Words: **Biomedical Engineering, MFCC, DTW, Voice Analysis**.

1. INTRODUCTION

Asthma is an inflammatory disease of the airways to the lungs. It makes breathing difficult and can make some physical activities difficult or even impossible. Asthma symptoms occur when the lining of your airways swell and the muscles around them tighten. These conditions then bring on an asthma attack the coughing and tightness in your chest that is typical of asthma. The larynx where the sound is produced has several different frequencies. In voiced speech the vocal folds vibrate, that permits passage of air puffs that produces waves of sound during asthma, the folds of vocal does not vibrate during whispering, but come done together[1].

Bronchial asthma, wheezing and allergies can also harm the throat in form of inflammation over the vocal cords. Many methods are introduced for assessing speech variations. In general voice is a time varying signal that has all signal information present in the time variable characteristics. Voice analysis consist of transformation of speech signal into a set of parameters in order to extract the voice feature which helps to differentiate voice or speech of different patients. This also helps to develop various voice based applications. Speech quality is normally measured in form of time, spectral or spectral domain. In method of spectral analysis developers require to keep tract of speech signal variations like bandwidth, amplitude and frequency of formants. There are many DSP techniques to extract voice feature such as pitch, jitter, shimmer and signal to noise ratio but we found MFCC is easy and excellent tool for recognizing voice disorder. Mel-frequency Cepstral coefficient have generally been used for speaker identification applications. The voice samples as inputs are used in development of MFCC. After processing, it calculates coefficients unique to a particular sample. In this project, MATLAB software is used for MFCC performed. The simplicity of the procedure for implementation of MFCC. Dynamic time wrapping method is used to match the MFCC of patient voice to MFCC of reference voice. This will help us to differentiate between asthmatic patients and non-asthmatic patient [2].

2. LITERATURE REVIEW

Asthma disease caused inflammation in airways of lungs which lead to problem in breathing.

Around 18.9 million adult and 7.1 million children are suffering from asthma as per Center of disease control and prevention. Asthma is very expensive to treat, the burden of economic on society, providers, and prayers is considerable. In 2007 the total annual direct and indirect of expense of asthma was 56 billion dollars. Even advancement in asthma care and management the disease remain uncertain or unpredictable with profound public health insinuation.

Thus underline the need for upgrade in the management and central of asthma. For this literature review first report managed care identified too studies. The inspect portable new treatment options for asthma and come up with an overview of finding, as well as the recently FDA-approved. The add on continuance treatment of patients which is the interleukin (IL)-5 antagonist with severe asthma which are of 12 years or older with an eosinophilia phenotype.

Disease detection using voice analysis is a needed research topic in biomedical engineering. This method is reliable

economic and easy to use. With this is be easy to identify the disease in its earlier stage. The feature of voice are extracted using some DSP Technique. It includes information of condition of voice tract and organs related in speech production. Their voice parameter are used to represent the particular voice and also used to differentiate voice of healthy and unhealthy persons. The voice extraction methods are the time domain analysis, cestrum analysis, glottal waveform analysis, spectrum analysis. There are different technique to classify these feature is to various groups using vector quantization, dynamic time wrapping, Gaussian mixture model, support vector machine and artificial neural network [3].

3. MATERIAL AND METHOD

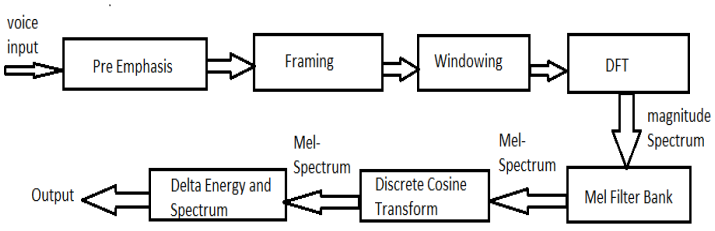

Fig -1: Block Diagram MFCC

A. PRE EMPHASIS

In a high pass filter the speech signal x (n) is sent. The equation y (n) = x (n) - a * x (n - 1) where output signal is the y (n) and the range of value a is normally between 0.9 and 1.0. H (z) = 1 - a * z-1 transform. The aim of Pre-emphasis is to reimburse the high frequency part which was repressed during the production of sound mechanism of humans, However it helps to amplify the importance [4].

B. FRAME BLOCKING

The signals of input speech is division into different frames of 15-20 ms with overlay of 50% of the frame size. Normally the size of framed (in terms of sample parts) are equal to power to two in order the case the use FFT. In some way this is not the case, to the closest length of power to two zero padding is done. If the sample rate of 16 KHz and size of frame is 256/16000=0.016 sec = 16 ms. In addition for 50% overlay means 128 points, then the frame rate is 16000 (256-128=125) frames per second. In order to produce continuity within frames overlaying is used [4].

C. HAMMING WINDOW

In order to keep continuity of starting and ending parts the frame. Every frame must be multiplied with a Hamming Window. X (n), let be denoted as the signal in a frame, where n = 0…N-1, subsequently the signal after Hamming Windowing is, X (n) * W (n) where w (n) is the Hamming window defined by W (n) [5].

W (n) = 0.54 - 0.46 * cos (2πn/ (N-1)) where 0 ≤ n ≤ N-1.

D. DISCRETE FOURIER TRANSFORM

In this block, Discrete Fourier Transform is apply N triangular band pass filter output. In order to gain L Mel-scale Cepstral Coefficients. The formula for DCT is, C (n) = Σ Ek * cos (n * (k - 0.5) * π/40)) where n = 0, 1 …..To N where N is the number of triangular band pass filters, where L is the number of Mel-scale Cepstral Coefficients and N is triangular band pass filter. In this work, there are L = 13 and N = 40.Following use had carry out FFT. DCT convert the frequency domain into a domain of time-like called quefreuency domain. The acquired features are same to cestrum, thus it is mention as the Mel-Scale Cepstral Coefficient or MFCC. MFCC done can be used as the feature for Speech Recognition [5].

Dynamic Time Wrapping

DTW algorithm is based on dynamic programming techniques as describes in. We used DTW to compare two MFCC matrix. By comparing two matrix we are going to find minimum distance. Similar audio will have less distance in between them [6].

4. METHODOLOGY

1) Database of 21 asthmatic patients (13 Male, 8female) undergoing treatment in the military hospital and 21 non-asthmatic person, is collected.
2) Vowels uttered by each person are extracted from the sentence with sampling frequency 16 KHz.
3) Programming is done in Mat lab to calculate MFCC as feature extraction and DTW as feature matching.
4) Voice features of asthmatic patient and non-asthmatic persons are compared.
5) Dynamic time wrapping is an algorithm for measuring similarity between two time series which may vary in time or speed.

This project focuses on the matter of increasing the accuracy as well as identification of more than one disease at early stage. This is flow diagram of the system. In voice

analysis method, the main drawback is lack of efficiency and also the system not able to identify accurate result. However to overcome this the following process is very effective. The given flow chart helps to understand the methodology of proposed work. The process begins with creation of database. They include different voice samples of different patient. The first block shows data set on moving forward, The block shows input voice signal of person who want to check whether he or she is suffering from asthma or not.

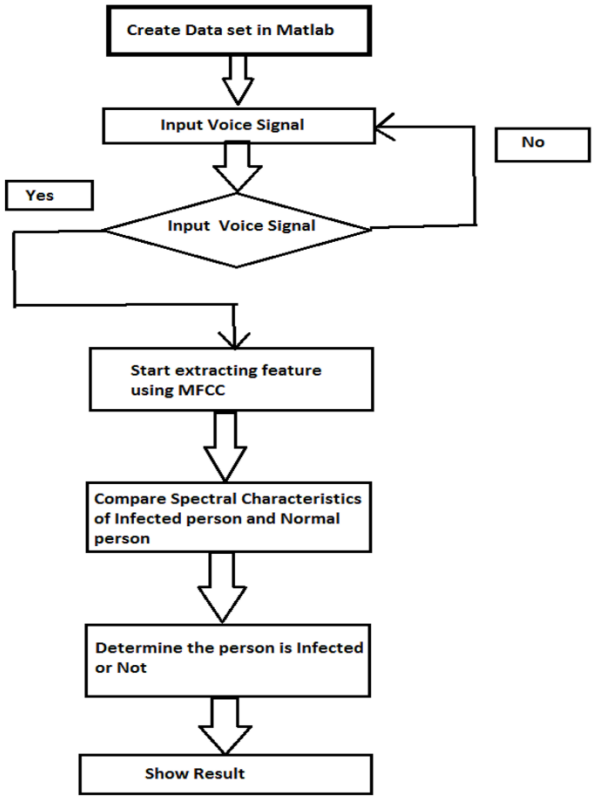

Fig -2: Proposed Flow Chart

Next block is extracting feature using MFCC. This is main block where voice Signal can be differentiated. Now next block is comparing the input voice signal with the data set. Which we have created. There the input voice signal is compared and determines the person is infected or not. This is further showed on command window of Matlab.

5. RESULT

In this experiment database is used for reference audio. The audio inside the database are taken from asthmatic patients of different age groups. This are the graph of input audio of 46 year old non-asthmatic and asthmatic patient.

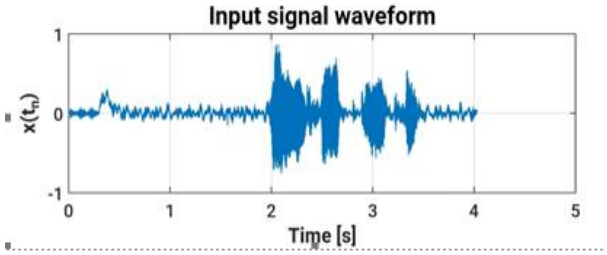

Fig- 3: Non-Patient Input signal waveform

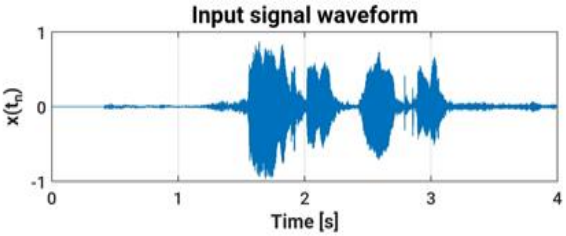

Fig- 4: Patient Input signal waveform

After following the procedure first 13 MFCC's are extracted for each given input. In the given graphs the X axis represents the number of frames or can say the number of MFCCs extracted from the given input. Signal And Y axis represents the feature vector values for each frame.

MFCC features represent phonemes (distinct units of sound) as the shape of the vocal tract (which is responsible for sound generation) is manifest in them. Each row of MFCC matrix represents one frame after calculating MFCC of input wave we compare it with reference audio stored in database.

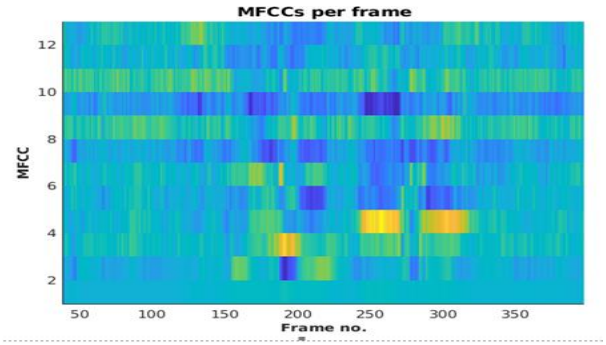

Fig- 5: MFCC per Frame 1

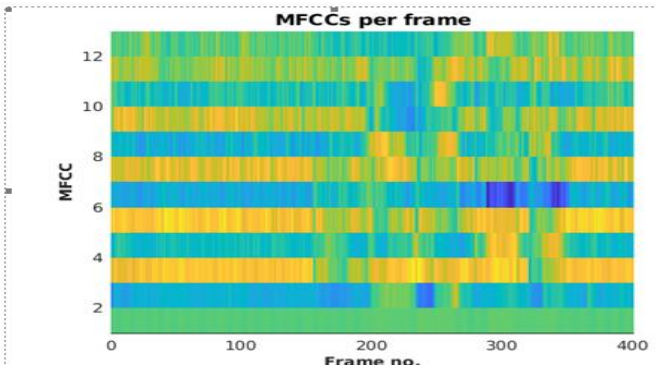

Fig- 6: MFCC per Frame 2

For the C1, the zero coefficient indicates the average power of the input signal.

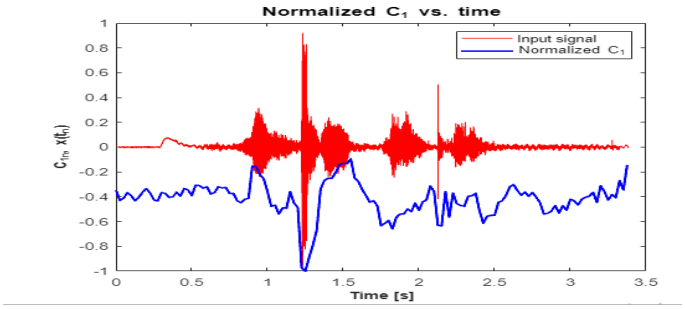

Fig- 7: C1 vs. time graph

For the C2, the first order coefficient represent the distribution spectral energy between low and high frequencies.

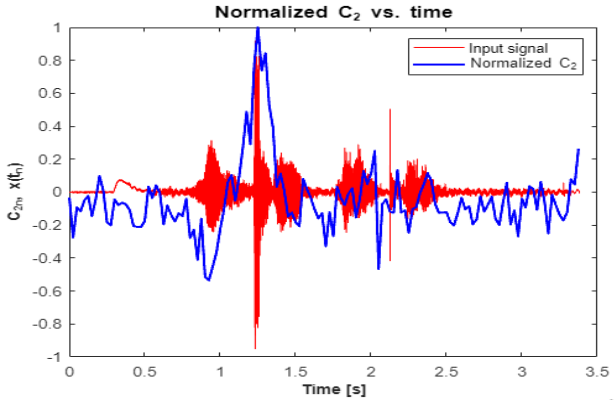

Fig- 8: C2 vs. time graph

6. CONCLUSIONS

This paper has represented a feasible method for Disease detection using voice analysis. In this work the given input are converted from audio signal to Mel frequency Cepstral coefficients. We select the first 13 MFCCs coefficients. Various voice analysis techniques are presented in this project which are implemented for tracking characteristics variation in voice of patients. We verify this voice analysis techniques.

This techniques are not suitable for different patterns identified in voice of patient. Here we got opportunity to develop standard voice analysis tool and method for clinical assessment and code of clinical practice. This new system is high in accuracy, easy for patient, economical and less time consuming in predicting the symptoms in early stage.

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