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Assessment of Respiratory Disorders Using Speech Parameters

Poonam Shrivastava[1], Neeta Tripathi[2],Bikesh Kumar Singh[3]
[1] Department of Electronics and Telecommunication, SSTC(SSGI), Bhilai, India
[2] Department of Electronics and Telecommunication, SSTC (SSEC), Bhilai, India
[3] Bio Medical Department, NIT, Raipur, India

Abstract: In today's scenario detection of diseases using voice analysis has become one of the important research topic. In order to determine if the person is suffering from some kind of illness, the information extracted by voice analysis about the person's health can be helpful, as a number of pathological disorders are related with nasal, neural, respiratory and larynx diseases etc. In this paper, the analysis of voice parameters is done in order to differentiate between normal and affected person. The speech samples are recorded and Pitch , formant frequencies, intensity was extracted from the speech signals. The mean values variation of these parameters is used in identifying the difference between normal and affected person.

Keywords— *Pitch, Formant,*

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I. Introduction:

The production of speech is a highly complex motor task that involves approximately 100 orofacial, laryngeal, pharyngeal and respiratory muscles. Speech production requires airflow from the lungs (respiration) to be phonated through the vocal folds of the larynx (phonation) and resonated in the vocal cavities shaped by the jaw, soft palate, lips, tongue and other articulators (articulation).It was found that the volume of lungs and breathing pattern during the speech is differed than during the quite respiration and may also be expected to change with different lungs diseases. As a complex motor act, speech requires close neuromuscular coordination of the articulatory process and the phonotory and respiratory process. The latter regulates the subglottal pressure and glottal airflow needed to drive the sound generator.

The two functions of the respiratory system can be differentiated as: one provides for the gas exchange necessary for life purpose; other the constant air pressure and air flow required for the production of speech sounds. Speech respiration occurs as long as the primary function, the physiologically required oxygen, and corbondioxide exchange are maintained.

Thus the main function of speech respiration is to provide the driving forces necessary for the generation of sounds i.e. to enable the oral communication. Some acoustic voice parameters like fundamental frequencies, Pitch, Intensity, Jitter, Shimmer, maximum phonation time, HNR, NHR and mean autocorrelation can be used for the comparison of normal and affected person. [1].

Chronic obstructive pulmonary disease (COPD) impacts life in many ways. Frequent wheezing and coughing, trouble breathing, coughing up mucus and shortness of breath are just a few COPD symptoms [2]. Also, Vocal cord dysfunction (VCD) is a condition in which the larynx exhibits paradoxical vocal cord adduction during inspiration, resulting in extra-thoracic variable airway obstruction [3]. Bronchial asthma labored breathing & wheezing and allergies can also cause a sore throat & inflammation around the vocal cords. So the voice sound becomes hoarse or scratchy when swollen inflamed cords don't vibrate efficiently.

A breathing pattern is an oscillatory event having parameters like Force vital capacity (FVC), forced expiratory volume in one second (FEV1) forced expiratory volume in one second/forced vital capacity (FEV1/FVC), peak expiratory flow (PEF). The variation in these parameters from standard value can also lead to the discrimination between healthy and unhealthy person [4].

The present work shows the assessment of respiratory disorders with the help of voice parameters.

II. Literature review:

Gursimarjot Singh Walia et al [5], developed a method to differentiate five categories of people i) healthy people, ii) people suffering from intermittent asthma, iii) people suffering from mild asthma, iv) people suffering from moderate asthma, and v) people suffering from severe asthma, based on their voice analysis. The method involved the development of a numerical formula using the voice parameters, like Fundamental Frequency, Jitter, Shimmer and Maximum Phonation Time.Thus to determine the Level of Asthma in a person by their voice analysis.

Khushboo Batra et al [6] , presented an acoustic analysis of healthy and asthmatic patients voices. Speech recorded for 25 healthy and asthmatic patients between the age of 40 to 65yrs, making them to speak vowels at least five times and the parameters such as jitter, HNR & NHR were taken out and compared for both, in which it was found that Jitter was high for each vowel in case of asthmatic patients and low for healthy persons whereas HNR was high for healthy person and low for asthmatic ones, only vowel 'i' has no result and NHR was high for asthmatic patients and low for healthy ones.

Rachna et al,2014[7],applied a feature extraction technique for extracting similar features in asthmatic patients and normal human being. Mel – Frequency Cepstral Coefficient technique was used for feature extraction process. Thus providing a startup for diagnosing asthma in initial stages, so

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that it can be controlled. MFCC is calculated using PRAAT and MATLAB for feature extraction process. Further, these extracted coefficients will be analyzed for finding similarities between patients and normal persons. After analyzing all extracted features for both asthmatic and normal persons it had been observed that there was a large variation in coefficients of asthmatic persons as compared to normal persons especially in the 1st and 2nd coefficients

Vikas Mittal et al [8], stated the voice patterns of patients affected by certain common medical conditions in evidence to leading research studies that had verified the voice alterations as diagnosis symptom in respective medical conditions. As well as, a comparative study of voice analysis techniques will be presented and special emphasis was given to certain prominent biomedical tools that were commercially available and were fundamentally based on voice analysis technology.

Saloni, et al [9] described different techniques of features analysis. Different feature extraction and classification methods have been discussed. Cepstral analysis separates the speech signal into excitation source and vocal track information. Residue features also proved good for discrimination between healthy and pathological voices. LDA, PCA, ICA were used for feature selection which improves the classifier performance. For pattern recognition, various template and stochastic methods have been discussed. HMM, and ANN was the most widely used methods.

Ahmad Abushakra et al [10], focused on a portion of the overall VR framework that deals with classifying the acoustic signal of respiration movements. The inhale and exhale phases are differentiated using the sixth MFCC order, which carries important classification information. The overall accuracy, which was calculated after segmentation, MFCC and thresholding was proven to be very efficient in breathing movement detection and classification.

III. Methods And Methodology

For identification of healthy and the persons suffering from respiratory disorders, there is a need of a database. The database is generated by the recording of the speech signal of 10 normal and 10 respiratory disorder affected persons. The recording and segmentation were done by Gold wave software. The sampling rate of recorded sentences was 11025Hz. The total number of speakers involved were 20 including males and females, between the age of 18-65.Each participant were asked to utter the numerals 1, 2, 3 repeatedly for five minutes. Then the result for both the group was compared. A database was prepared which consist of sustained phonation. For voice analysis, PRAAT software was used**.** The following parameters were analyzed: Formant frequencies (F1, F2, and F3), Pitch and intensity.

1. **Input**: The recording of male and female was performed for the numeral 1, 2, 3. These voices are recorded at the sampling rate of 11025 Hz.
2. **Feature extraction:** The various voice parameters like Formant frequencies (F1, F2, and F3), Pitch and Intensity of normal and affected persons were extracted from different voice samples by using PRAAT software.

- Formant Frequencies: Formant frequencies are resonant frequency. Formants are distinctive frequency components of the acoustic signal produced by speech. The formant with the lowest frequency is called F_1, the second F_2, and the third F_3.F1 is correlated with tongue height, which affects pharyngeal space. F2 is correlated with changes within the oral cavity, primarily tongue retraction.F3 responsive to front versus back constriction
- Pitch: Pitch is a perceptual property of sounds that allows their ordering on a frequency-related scale, or more commonly, the pitch is the quality that makes it possible to judge sounds as "higher" and "lower" in the sense associated with musical melodies.
- Intensity: Sound intensity is defined as the sound power per unit area. The usual context is the measurements of sound intensity in the air.

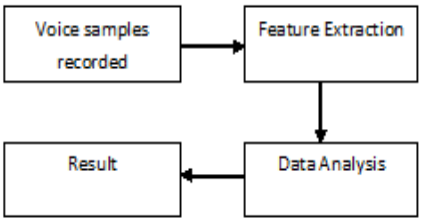

Figure 1 : Block Diagram

The block diagram shown above explains that for the voice analysis, first of all, voice samples were recorded (numerals 1, 2, 3). Then the voice parameters such as formant frequencies F1, F2, F3, Pitch, and intensity were extracted. Finally, the analysis was performed to compare the variation in parameters between the normal and affected persons.

IV. Result and Discussions

We recorded 20 phonations spoken by normal and affected persons. Following graph shows the result obtained by voice analysis using PRAAT software.

F1 for normal and affected person

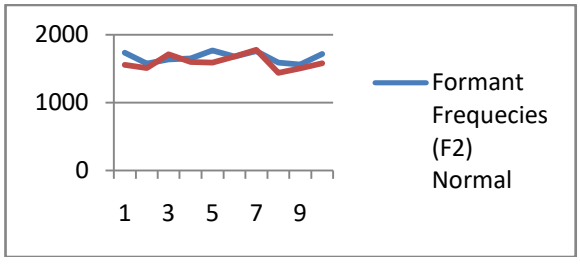

Figure 1

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F2 for normal and affected person

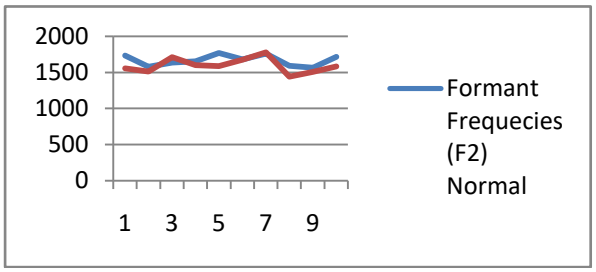

Figure 2

F3 for normal and affected person

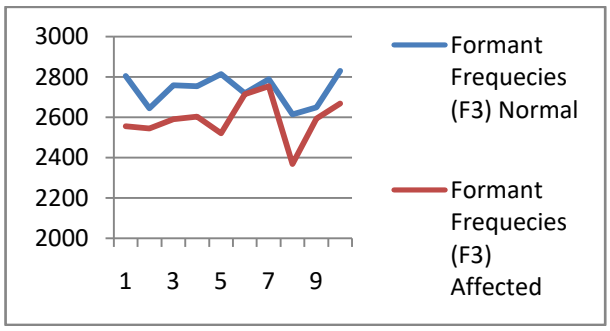

Figure 3

Pitch for normal and affected person

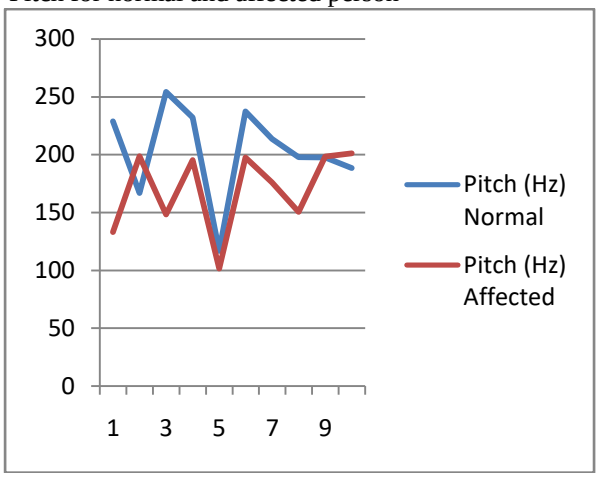

Figure 4

Intensity of normal and affected person

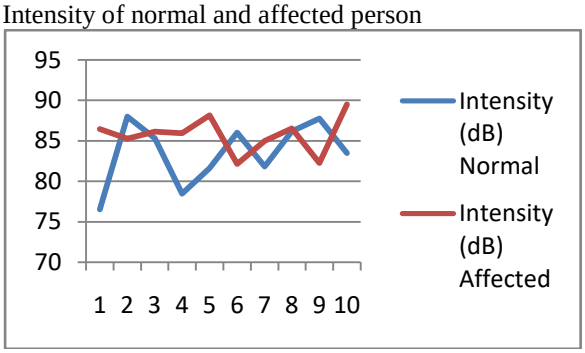

Figure 5

In the above graphs, the analysis of recordings is represented for various voice parameters like F1, F2, F3, pitch and intensity of the normal (healthy) and affected (Unhealthy) persons. It is observed from Fig. 1 that the formant frequency F1 of the normal persons is having values ranges from 430 to 542 and affected persons is having values ranges from 423 to 583. In Fig 2, it was observed that the formant frequency F2 of the normal persons is having values ranges from 1561 to 1767 and affected persons is having values ranges from 1437 to 1710.

Similarly, the rest of parameters are compared.

Statistical analysis has been performed on the utterance of numeral 1, 2 3 & mean value is given in Table 1.

Table 1:

s.no		Mean values	
	Parameters	Normal	Affected
1	F1	477	490
2	F2	1655	1593
3	F3	2738	2591
4	Pitch	201	170
5	Intensity	83	86

It has been observed from the table 1, that the mean value of formant frequency F1 and the intensity is higher for affected person as compared to normal. On the other hand the formant frequencies F2, F3, and pitch are having lower mean values for affected persons and higher for normal persons.

V. Conclusion:

In this presented paper voice analysis has been performed for identification of respiratory disorder. This analysis becomes an efficient tool for the diagnosis. In this analysis, some standard features such as formant frequencies F1, F2, F3, Pitch, and Intensity are considered. Pitch, Formant Frequencies, and Intensity features have been successfully extracted and it is observed that for the affected persons, the mean value of formant frequency F1 & intensity are having the higher value while F2 & F3 and pitch are having the lower value as compared to normal.

This theory reflects that the mean value of higher frequency becomes lower in the respiratory disease affected person. Thus help in the assessment of respiratory disorder using speech parameters.

Refrences:

[1]. Khushboo Batra, Swati Bhasin, and Amandeep Singh. "Acoustic Analysis of voice samples to differentiate Healthy and Asthmatic persons." 2015

[2]. Enas Elsayed Mohamed and Riham Ali EI maghraby "', Voice changes in patients with

[3]. chronic obstructive pulmonary disease" Egyptian Journal of Chest Diseases and Tuberculosis,2014

[4]. Majdy Idrees and J. Mark FitzGerald" Vocal cord dysfunction in bronchial asthma. A

[5]. review article" Journal of asthma, ISSN: 0277-0903,2014

 ISSN: 2454-4248
461 – 464

[6]. Nourane Y. Azab , Ibrahim I. El Mahalawy , Gehan A. Abd El, Aal Manar H. Taha" Breathing pattern in asthmatic patients during Exercise'Egyptian Journal of Chest Diseases and Tuberculosis

[7]. Gursimarjot Singh Walia and Dr. R.K. Sharma," Level of Asthma: Mathematical Formulation based on Acoustic parameters" Conference on Advances in Signal Processing (CASP),2016

[8]. Khushboo Batra *, Swati Bhasin, Amandeep Singh" comparison of asthma and healthy persons using voice analysis" IJESRT,2015

[9]. Rachna, Dinesh Singh, Vikas, "Feature extraction from asthma patient's voice using Mel-frequency Cepstral coefficients" volume 3, 2014.

[10]. Dixit, Vikas Mittal, and Yuvraj Sharma," Voice Parameter Analysis for the disease detection" Journal of Electronics and Communication Engineering (IOSR-JECE),2014

[11]. Saloni, R. K. Sharma, and A. K. Gupta. "Disease detection using voice analysis: a review." International Journal of Medical Engineering and Informatics 6.3 (2014):189-209

[12]. Ahmad Abushakra and Miad Faezipour" Acoustic Signal Classification of Breathing Movements to Virtually Aid Breath Regulation"IEEE journal of biomedical and health informatics, vol. 17, no. 2, March 2013