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Voice Pathologies Detection and Classification Using EMD-DWT Based on Higher Order Statistic Features

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Abstract : The voice is a prominent tool allowing people to communicate and to change information in their daily activities. However, any slight alteration in the voice production system may affect the voice quality. Over the last years, researchers in biomedical engineering field worked to develop a robust automatic system that may help clinicians to perform a preventive diagnosis in order to detect the voice pathologies in an early stage.

I.INTRODUCTION

The voice occupies a prominent role in social and professional life of people; it allows them to communicate and to change information. Furthermore, due to the voice abuse and the unhealthy lifestyle, around 25% of people in the world suffer from voice problems. People who use excessively their voices and whose jobs require them to speak loud (*e.g.*, teachers, lawyers, singers, actors, etc.) are especially at risk of being affected by several kinds of voice problems
In order to detect these disorders, physicians usually used the classic methods which are the invasive techniques aiming to explore the laryngeal system. For instance, stroboscopy, endoscopy and laryngoscopy are widely used as mainly techniques to diagnose people with voice problems.
In addition, non-invasive techniques are also applied like electroglottography (EGG) and subjective method based on the perceptual assessment of voice. However, these methods require expert to use them, and also it may cause discomfort to the patients.
In order to avoid these issues, researchers have developed several patterns based on automatic system for pathological voices detection and classification. These systems are considered as assistive tools that may be helpful to physicians in Ear, Nose and Throat Department (ENT).

II.RELATED WORK

The following section presents a brief literature survey on existing system.
Alnasheri et al...[1] Concentrates on developing an accurate and robust feature extraction for detecting and classifying voice pathologies by investigating different frequency bands using autocorrelation and entropy.

Patrizia vizza et al.[2] presents method to perform voice analysis of neurologically impaired patients affected by MS aiming to early detection, differential diagnosis, and monitoring of disease progression.

Laura Verde et al [3] focus on dysphonia, an alteration of the voice quality that affects about one person in lifetime. It investigates and compares the performance of several machine learning techniques useful for voice pathology detection.

Mazin Abed Mohammed et al [4] aims to develop a powerful feature extraction voice pathology detection tool based on Deep Learning and also proposes a distinguished training method combined with various training strategies related to voice disorders.

G. Muhammad et al [5] developed a VDP, which extract features from vocal tract area, which is connected to the glottis. This irregular pattern is quantified in the form of different moments across the frames to distinguish between normal and pathological voices.

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Catherine Middag et al [6] built a novel methodology that utilizes phonological features, automatic speech alignment based on acoustic models, context-dependent speaker feature extraction, and intelligibility prediction based on a small model that can be trained on pathological speech samples.

III.PROPOSED MODEL

Fig 1 depicts the architecture for voice pathology detection system, based on Empirical mode feature set and Discrete wavelet coefficients.

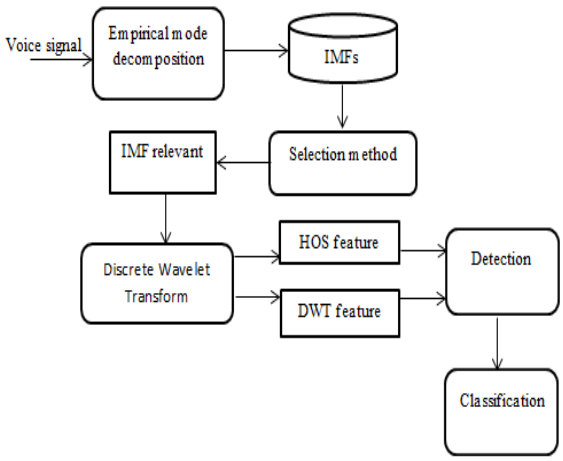

Fig 1: Block Diagram

Empirical mode decomposition (EMD): It partitions the series of non-stationary signals into modes without leaving time domain.
Discrete wavelet transforms (DWT): intrinsic mode functions from EMD decomposed to provide sets, where each set is time series of coefficient.
Detection and Classification: two features vectors include six HOSs parameters, and six DWT coefficients are used with Random Forest classifier.

IV.ALGORITHM

The dataset contains wide subset of voice signal collected from SVD and Parkinson's dataset. We use pitch() function to extract 12 features of voice subject like jitter, shimmer, harmonic noise ratio.
We use SelectkBest algorithm for feature selection and Random Forest, SVM and Logistic Regression algorithm for classification.

1. SelectkBest Algorithm

- We use SelectkBest algorithm for calculating highest score.
- SelectkBest(f_classif,k=12).fit(signal_x, signal_y) , here f_classif function used for classification purpose and k selects top featires.
- Train_test_split() method used to split dataset into training data and testing data, we give 20% for testing and other 80% for training purpose.
- We create data frame using panda libraries here data is UnHealthy and columns are jitter_rel, shim_loc, hnr15, hnr25.

2. Random Forest, SVM and Logistic Regression

- Random Forest, SVM and Logistic Regression are used for classification; here we give training data to these algorithm trains the algorithm.
- These algorithms choose data points in dataset.
- Next step is to test algorithms for accuracy.
- We use for loop, for algo in algorithm: it indicated we have 3 algorithms used for classification and clf = algorithm[algo] here algo indicated interaction used for giving at a time input to all three algorithms.
- These three algorithms fits for both trained and test data. It generates score, algorithm that generates maximum score considered as winner and print result.

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V.APPLICATIONS

Proposed system can be used various application and few are listed below:

- Assistive tool for physicians.
- Being able to have personal voice testing tool.

VI.RESULTS

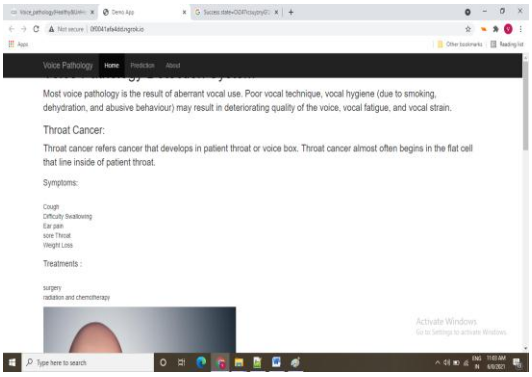

Fig 2: Home page of the user

After submission of the entire details user gets the Home page shown in Fig 2. Here user can gain the information about the pathology and symptoms.

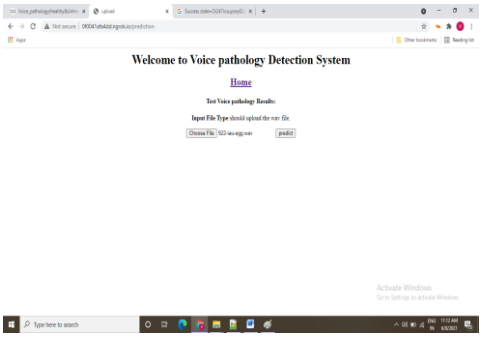

Fig 3: Prediction page

Once the user entered into prediction page, user can give his/her voice as input shown in Fig 3 and click predict button for prediction.

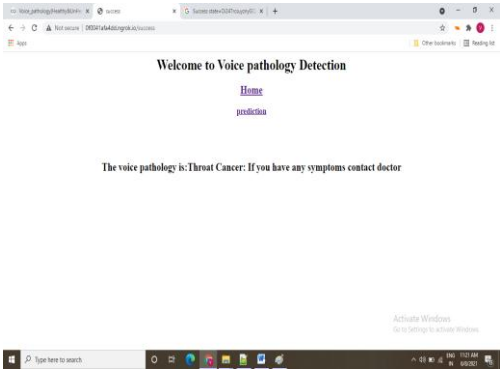

Fig 4: Output page of user

User can enter the audio in wav format. Once predict button is clicked system will provide the output weather user has healthy voice, voice of throat cancer or Dysphonia voice as shown in Fig 4.

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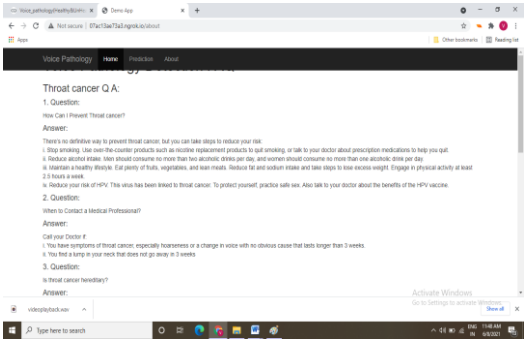

Fig 5: About Page

To help the user in order to solve their quires about page is having set of questions and respective answers as shown in Fig 5.

VII.CONCLUSION

The focus of this study is to evaluate the performance of high order statistic features extracted form wavelet. The voice signals were decomposed via two stage analysis process, EMD-DWT before we extracted the features vectors. Classical features such Mean Wavelet Value, Mean Wavelet Energy and Mean Wavelet Entropy is also tested.

Feature Enhancement

- It can be developed as android application in which user can test their voice.
- Doctors can connect to assist the patient and add precaution here itself.
- Accuracy can be improved.

VIII.REFFERENCES

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