International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-9 Issue-1, May 2020

A Phonetic Level Analysis of Dysarthria in Kannada Language

Latha M, M Shivakumar, Manjula.R

Abstract*: Dysarthria is a motor speech disorder and the most common neurodegenerative disease characterized by low volume in precise articulation, poor coordination of respiratory and phonatory subsystems, irregular pauses and so on. The challenging factor in improving the communication with dysarthria is speech intelligibility. The intelligilibility of speech can be determined by measuring the acoustic characteristics and phonetic structures of speech. In our analysis, we have concentrated on bisyllabic words in the Kannada language. The analysis is carried out with respect to basic acoustic parameters and spectrogram to extract fundamental frequency, formant frequency, jitter, shimmer, HNR and Standard Deviation using PRAAT tool. These results are helpful to identify and differentiate the complex natural frequency of the vocal tract functions with respect to normal subjects and dysarthria subjects. This study provides inputs to increase efficacy in the clinical assessments for monitoring and diagnosing the speech disorders for improving communication among human beings.

Keywords : Dysarthria, Speech production, Spectrogram, Acoustic Parameters.

I. INTRODUCTION

The primary mode of communication between human beings is speech. Even when we are at a distance we can interact with each other via phone, but the mode of communication is speech. Human beings use speech which is an acoustic signal to exchange the thoughts and feelings. Speech is the primary pre-requisite in all day to day communication.

Speech production is the mechanism in which thoughts and feelings are translated in to spoken language. The process of speech begins inside the brain for each and every type of communication whether it is verbal or non verbal. It is then further translated into speech sounds for articulation. The three central mechanisms which are responsible for speech production are Respiration, Phonation and Articulation. In the Respiration process, lungs produce the necessary energy in the form of air stream. In the Phonation process, larynx serves as a modifier to the air stream and is responsible for phonation. In the Articulation process, where vocal tract modifies and modulates the air stream by means of several articulators[1].

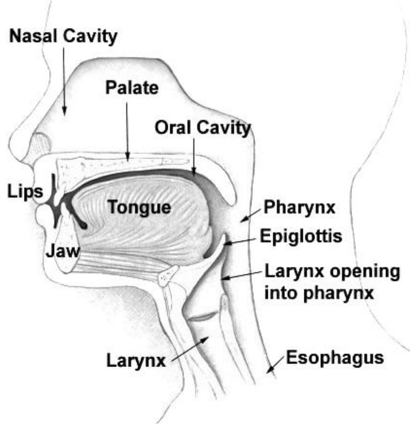


Fig.1. Speech organs associated in the production of sound.

Figure 1 describes the organs associated in the production of speech sounds. The Diaphragm is the most important organ of the articulatory system in which the productions of sounds take place. The different organs of speech which help in the speech production are the mouth, lips,tougue,teeth,nasal cavity, pharynx, larynx, alveolar ridge, hard and soft palate(Velum),uvula and glottis.

The most common speech problem found in these days is unclear speech. When any individual is subsisting or omitting a couple of sounds or not able to pronounce specific sounds properly he/she is suffering from a speech disorder. Speech disorders can affect children or adults irrespective of age and gender. The different types of speech disorders are stuttering, apraxia and dysarthria. Each type of the speech disorder depends on the symptoms, cause and the severity of the disorder on any individuals. There are many causes for the occurrence of speech disorder which includes muscles weakness, brain injuries, degenerative diseases, autism, and hearing loss[2].

Dysarthria is a motor speech disorder caused by the weakness of the muscles of the face, mouth and breathing. Person with this disorder exhibits difficulty in producing or forming of speech or in raising the voice. This difficulty depends on the severity of the problem. Their speech may have the following characteristics such as mumbling,breathy / whispering like voice,poor rhythm, stress, and intonation,poor intelligibility / articulation,hypo-nasality , hyper-nasality,hoarseness of voice and gurgly voice. Speech may be fast or very slow,unnatural and poor control on the loudness of the voice[3].

Revised Manuscript Received on April 15, 2020.

***** Correspondence Author

Latha. M *, Research Scholar, Department of Electronics and Communication Engineering, GSSS Institute of Engineering and Technology for Women, Mysuru, Karnataka, INDIA, Affiliated to VTU, Belagavi, Karnataka, INDIA.. Email: latha@gsss.edu.in.

Dr. M. Shivakumar, PRINCIPAL, GSSS Institute of Engineering and Technology for Women, Mysuru, Karnataka, INDIA, Affiliated to VTU, Belagavi, Karnataka, INDIA. Email: drshivakumarm@gsss.edu.in

Dr. Manjula.R, Former Professor, All India Institute of Speech and Hearing,Mysuru. Email: rmanjula08@gmail.com

This study attempts an investigation on acoustic analysis using PRAAT tool on the desired male subjects in Kannada language. The numerous studies have been made on identifying the acoustic parameters based on which some of the parameters are limited to our approach. The acoustic parameters used for the study are formant frequency, pitch intensity and duration. The acoustic analysis is helpful to find the differences between normal and dysarthria speech subjects, based on which evaluation is performed.

II. RELATED WORK

Many authors have described in their research work that there are several ways of analysing the speech signals. Some of the them rely on understanding the frequency spectrum and others on the spectrogram analysis. In the acoustic analysis, frequency spectrum provides the general view of sound wave and displays the linear sequence of acoustic information over time, whereas, spectrogram is considered to be the most important display of sound wave information for the analysis of any linguistics sounds. In recent studies, authors have discussed that, with the use of modern visualization techniques, frequency spectra and the spectrogram can be modified in order to extract detailed temporal features of the sound information from the spectrum[4].

A great deal of research work has been carried out in the area of speech signal processing to analyze and extract the significant speech features for various applications of speech recognition. Many researchers working in the field of linguistics have identified that the acoustic analysis is the fundamental tool to evaluate the speech characteristics found in the normal and dysarthria speech subjects[5]. Authors in [6] suggested that the common acoustic parameters used in the acoustic analysis are the fundamental frequency, jitter, shimmer and harmonic to noise ratio (HNR). The researchers have used different approaches to carry out their study; therefore acoustic parameter can be varied based on their approach.

From the survey, it is obvious that many software tools have been developed for acoustic analysis. The following are the software tools namely, SPRO, JULIUS, HTK, COOL EDIT PRO, STRAIGHT, VIVACO, PRELINGUA, Vigmi, Multi Dimensional Voice Program (MDVP) and PRAAT[7]. Out of these tools available, PRAAT is the most common tool used for acoustic analysis. All these contributions from the researchers have resulted that acoustic analysis is very useful in diagnosing any kind of the Parkinson’s diseases or speech disorders.

III. CONSTRUCTION OF DATABASE

The Kannada Bisyllabic words were selected with the combination of dental, bilabial and retroflex components in available speech consonants. The male speech subjects in the age group between 16 to 25 years are used in our analysis. The pre-recorded samples of following bisyllabic words for both Normal subjects and Dysarthria subjects are as shown in the Table.I. Initially, the speech data are converted to .Wav format. Then the corresponding data samples are fed to PRAAT software to evaluate acoustic parameters such as Fundamental frequency, standard deviation, jitter, shimmer, Harmonic to noise ratio, the formant frequency, pitch, intensity and the duration. These observations are useful in improving the intelligibility of the dysarthric speech.

Table-I: Speech Database

SL NO	Normal Subjects	Dysarthria Subjects
1.	/ಪದ/	/ಪದ/
2.	/ಪಟ/	/ಪಟ/
3.	/ದಪ/	/ದಪ/
4.	/ತದ/	/ತದ/

IV. METHODOLOGY

The speech analysis is the fundamental step carried out in any of the applications of speech processing technologies. The information of nature of the sound waves, the experimental techniques used in this domain and availability of software tools are very much necessary to carryout any kind of analysis. The analysis of sound waves includes several ways of presenting the information about the soundwaves such as waveform view, the spectrogram, and frequency spectrum for linguistic analysis.

A. The waveform view

It provides the general view of the sound view and displays amplitude information over time. It also represents various portions of silence in the acoustic phonetics. The small portions of silence in the signal can be viewed as some sort of closure during articulation. Longer portion of silence will occur most obviously between words in the acoustic phonetics. Clearly visible portions of friction noise will be associated with fricatives and even the most complex periodic sound waves can be identified and analyzed under this approach.

B. The frequency spectrum

It is the two dimensional plot of the sound wave for a given time. Horizontal axis shows the frequency information and the vertical axis shows the amplitude of each frequency line.

C. The spectrogram

The most important technique for speech acoustic analysis is spectrogram. It displays the exact formant structure of the speech sound. The patterns in the spectrogram enable us to differentiate the vowels from one and other. They help us to identify the character information available in the consonants.

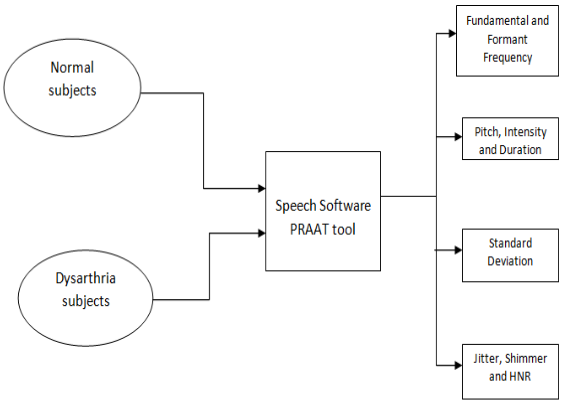


Fig.2.Process Model for Acoustic Analysis using PRAAT

This research study focuses primarily on the basic principles used in the acoustic analysis and to compare the normal subjects with the dysarthria subjects using PRAAT. PRAAT is the most versatile system program for phonetic analysis and is freely available on web. Loading the recorded speech subjects with the PRAAT will allow us to recognize and understand about many aspects of spoken language. Any Sound analysis is performed in PRAAT tool using a spectrogram.

A Spectrogram basically displays the spectral data over time with the amplitude. In particular, the horizontal axis displays the duration of the sound in seconds or milliseconds. The vertical axis shows the frequency values. And most importantly, it is possible to identify the intensity of the various resonant frequencies, the formants, by means of degree of darkness or in terms of coloured spectrograms.

All the speech subjects have a formant structure hence spectrogram is the common representation technique in acoustic phonetics since it contains the almost all data necessary for analysis and acoustic description of speech allowing the precise analysis of vowels and consonants in terms of acoustics extraction. The numerical calibration of acoustic parameters is performed on the recorded samples using the freely available software PRAAT tool in order to extract the basic fundamental frequency, formant frequencies, pitch, intensity, duration, standard deviation, jitter, shimmer and harmonic to noise ratio.

D. Fundamental Frequency

Fundamental frequency is the frequency in which one glottal cycle is completed. That is, the number of times the vocal folds complete oscillations in one unit of time. Fundamental frequency is specific to the speaker and vocal folds produce a set of infinite frequencies such as fundamental and a set of harmonics. The harmonic sounds are the integral multiples of the fundamental frequency. The Fundamental frequency is the lowest frequency in the spectrum of energy that the vibration of the vocal folds produces. It is denoted as F0.

E. Formant frequency

Formant frequency is the characteristic of the vocal tract. It is the function of the shape that oral cavity takes when pronouncing a particular speech sound. Formants are specific to the speech sound, and are a determining characteristic of the identity of the speech sound. The computation of the formant frequencies is performed on the recorded speech subjects. The four formant frequencies such as F1, F2, F3 and F4 are identified from the recorded samples. The results are then compared with the normal and dysarthria subjects. The observations made during the analysis are mentioned in the results section.

E. Pitch

Pitch can be expressed as the measure of sound frequency in terms of Hertz. Higher the frequency, higher the pitch. For Instance, male speech subjects have low pitch compared with the female speech subjects. The pitch values are calibrated on the recorded speech database. The values obtained are examined, averaged and compared between the normal subjects and dysarthria subjects. These values are tabulated in the results section.

F. Intensity

Intensity is measured as the amount of energy utilized in the production of speech sounds. The unit used for measuring the intensity is the Decibel. Intensity of the speech signal depends on the loudness or amplitude of the speech signal. Intensity of the signal increases when the amplitude of the signal is high. The computation of the intensity is performed on the desired samples.

G. Duration

The selected speech data was recorded for duration of 30 seconds. The utterances of each syllable were taken into the examination, based on the quality of the spectrogram displayed. The numerical calculations were performed on desired samples and values are tabulated.

H. Standard Deviation

Standard Deviation is measured as the square root of the variance and represented by the Greek letter sigma. The formula used for calculations is as follows.

Variance is defined by

$$S2=\sum (xi-\bar{x})\ 2/n-1 \quad \text{.............(1)}$$

Mean is defined by

$$\bar{x}=\sum xi/n \quad \text{.............(2)}$$

Standard deviation is given by

$$S=\sqrt{\ } \text{ variance} \quad \text{.............(3)}$$

Where n=1, 2, 3…..Finite values
Xi =Observation on

horizontal and vertical axes.
$\bar{x}$=Mean of the sample.
n=Size of the sample.

I. Jitter and Shimmer

It is the common disturbance found in an acoustic analysis. Jitter is defined as a measure of frequency instability.

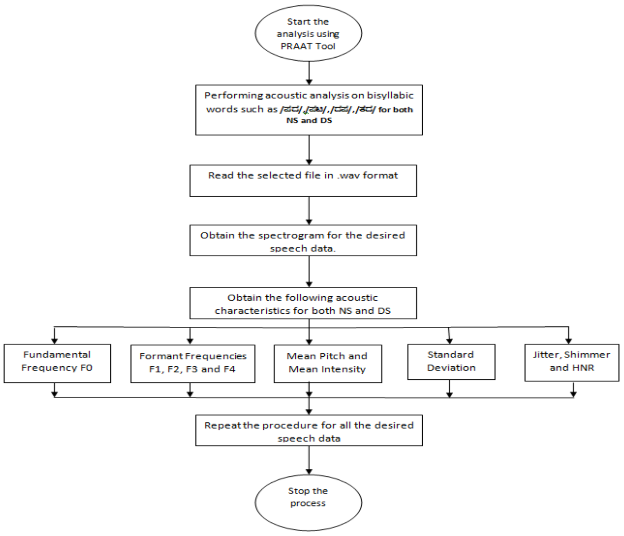
The instability occurs in the speech due to lack of control in the vibration of vocal folds. Similarly, shimmer is defined as a measure of amplitude instability. In both the acoustic parameters, Dysarthria subjects will have a high value compared to normal subjects.

J. Harmonic to Noise Ratio

The HNR reflects the efficiency of speech. Normal subjects will have higher value of HNR compared to dysarthria subjects. It is expressed in dB. The formula used for calibration is as follows:

HNR = 10x log10(HarmonicEnergy/NoiseEnergy)dB ………(4)

V. IMPLEMENTATION



NS:Normal subjects,
DS:Dysarthria Subjects

Fig.3. Flowchart of acoustic analysis of Bisyllabic words using PRAAT tool

The following steps specified in the flowchart indicate the procedure of execution using PRAAT Tool. Initially speech database is created by recording in the closed room for the following bisyllabic words for both NS and DS. We then convert the pre- recorded speech data into .wav format and then further used for the analysis. We select the correct portion of the syllable utterance for acoustic analysis and obtain the spectrogram for desired speech data. Later we extract the acoustic parameters such as fundamental frequency f0, formant frequencies F1, F2, F3 and F4, standard deviation,jitter,shimmer intensity, pitch and the harmonic to noise ratio (HNR). Procedure for all the speech data used for analysis is repeated.

VI. EXPERIMENTAL RESULTS

The acoustic analysis has been performed using PRAAT tool on the normal subjects and dysarthria subjects. The results are tabulated in the following tables. The following parameters such as fundamental frequency, standard deviation, fundamental frequency, jitter, shimmer, formant frequency, pitch, intensity and harmonic to noise ratio (HNR) have been extracted for normal subjects and dysarthria subjects. All these parameters are useful in differentiating the normal subjects with respect to dysarthria subjects and also to determine the vocal features. These vocal features are used for future analysis in order to improve the intelligibility of pathological subjects.

The spectrogram represents the acoustic information on following bisyllabic words such as /ಪದ/,/ಪಟ/,/ದಪ/,/ತದ/ for normal subjects and dysarthria subjects as shown in the figure 4. This illustrates the extraction of acoustic parameters such as formant frequencies F1, F2, F3 and F4 indicated in red colour, mean pitch in blue colour and Intensity in yellow colour. Each formants is represented in dark grey colour indicating different bands and results are tabulated as shown in the table.

The formant frequency estimation is performed on following bisyllabic words such as /ಪದ/,/ಪಟ/,/ದಪ/,/ತದ/. The analysis is carried out with respect to normal subjects and dysarthria subjects. Each formants are associated with individual band of frequencies namely F1,F2,F3 and F4.The lowest frequency is represented as F1,Nearby higher frequencies are denoted as F2,F3 and F4.The results are computed and tabulated as shown in the Table.II,Table.III,Table.IV and V. From this analysis, we are able to depict that dysarthria subjects will have higher formant frequencies compared with normal subjects.

The pitch estimation performed on following bisyllabic words such as /ಪದ/,/ಪಟ/,/ದಪ/,/ತದ/. The analysis is carried out with respect to normal subjects and dysarthria subjects. The periodicity of the signal is analyzed easily through time domain approach. The computation of the pitch based on time domain approach, is calibrated using a spectrogram. The mean pitch values are tabulated as shown in the Table.III.

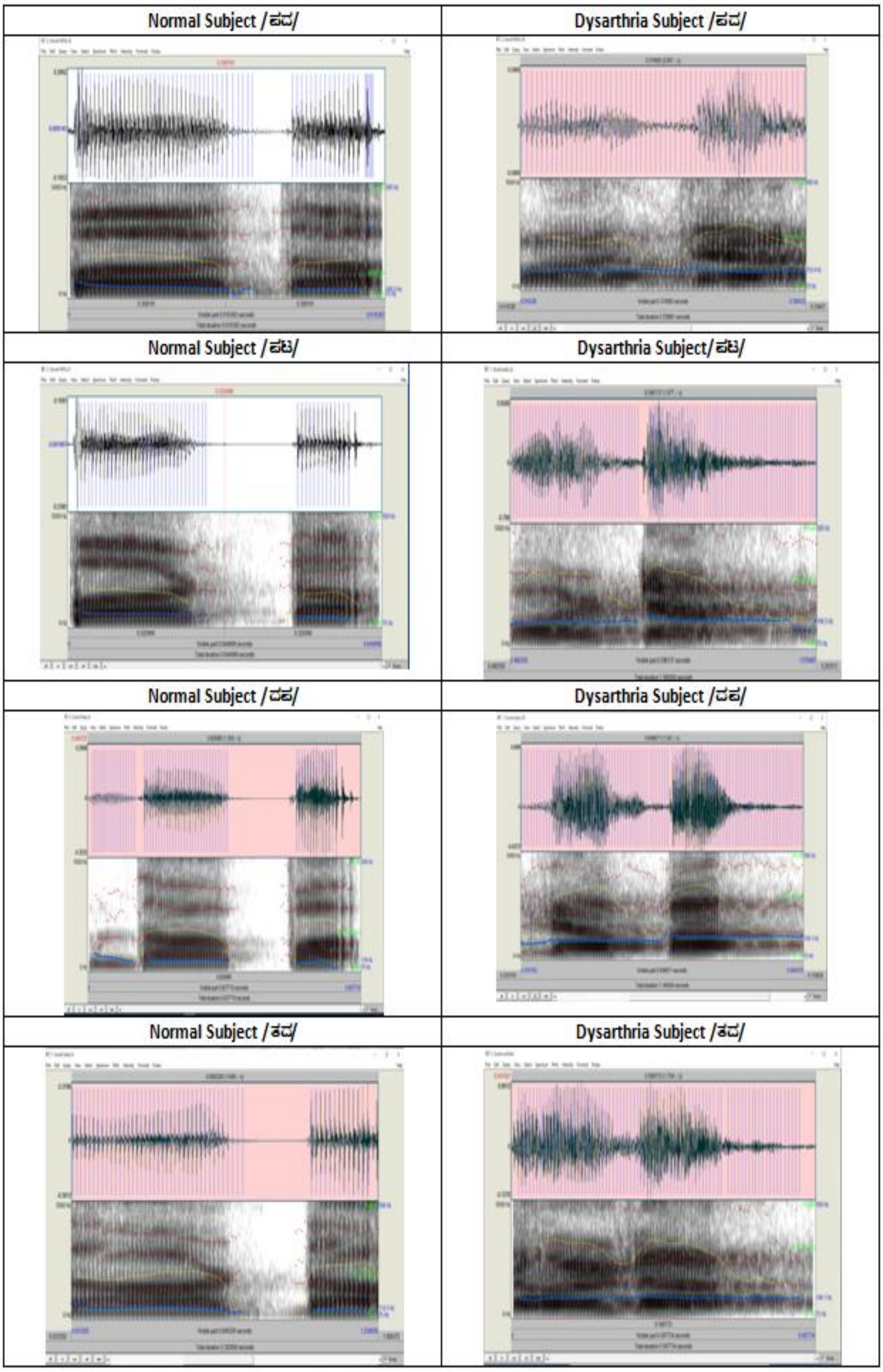


Fig.4. Spectrogram of Normal Subjects and Dysarthria subject

Table- II: Estimation of Formant Frequency

Speech Data	Estimation of Formant Frequency							
	Normal Subject				Dysarthria Subject			
	F1	F2	F3	F4	F1	F2	F3	F4
/ಪದ/	597.14 Hz	1316.22 Hz	2862.75 Hz	3688.75Hz	617.01 Hz	1377.18Hz	2249.001 Hz	2714.21 Hz
/ಪಟ/	609.68 Hz	1387.92 Hz	2499.25 Hz	3397.59Hz	615.17 Hz	1413.28Hz	2204.22 Hz	2770.07 Hz
/ತದ/	602.03 Hz	1369.98 Hz	2450.78 Hz	3534.66 Hz	642.79Hz	1429.45 Hz	2323.84 Hz	2837.88 Hz
/ದಪ/	626.29 Hz	1283.04 Hz	2734.21 Hz	3654.25Hz	602.373 Hz	1312.99Hz	2304.21Hz	2673.15Hz

Table- III: Estimation of Pitch

Speech Data	Estimation of Pitch					
	Normal Subject			Dysarthria Subject		
	Minimum Pitch	Mean Pitch	Maximum Pitch	Minimum Pitch	Mean Pitch	Maximum Pitch
/ಪದ/	90.310 Hz	123.035 Hz	344.152 Hz	146.90 Hz	151.436 Hz	159.019 Hz
/ಪಟ/	99.60 Hz	121.89 Hz	129.56 Hz	130.85 Hz	166.53 Hz	185.50 Hz
/ತದ/	98.847 Hz	114.274 Hz	134.374 Hz	141.579 Hz	149.067 Hz	157.166 Hz
/ದಪ/	85.862 Hz	116.047 Hz	140.388 Hz	138.908 Hz	158.121 Hz	176.732 Hz

Table- IV: Estimation of Intensity

Speech Data	Estimation of Intensity					
	Normal Subject			Dysarthria Subject		
	Minimum Intensity	Mean Intensity	Maximum Intensity	Minimum Intensity	Mean Intensity	Maximum Intensity
/ಪದ/	43.69 dB	66.22 dB	70.62 dB	44.51 dB	71.50 dB	79.67 dB
/ಪಟ/	21.95 dB	62.99 dB	66.69 dB	57.10 dB	77.348 dB	83.81dB
/ತದ/	37.71dB	69.17 dB	74.15 dB	58.85dB	79.50 dB	83.52 dB
/ದಪ/	19.63 dB	67.24 dB	73.30 dB	57.54 dB	79.77 dB	84.73 dB

Table- IV: Estimation of Acoustic Parameters

Speech Data	Normal Subject					Dysarthria Subject				
	Average Fundamental Frequency	Standard Deviation	Jitter	Shimmer	HNR	Average Fundamental Frequency	Standard Deviation	Jitter	Shimmer	HNR
/ಪದ/	128.89 Hz	47.36 Hz	1.714 %	6.830%	13.644 dB	151.43 Hz	3.020 Hz	1.726%	20.171%	6.519 dB
/ಪಟ/	121.898176 Hz	6.023 Hz	1.237 %	3.965%	14.272 dB	167.329174 Hz	8.847 Hz	2.986%	19.892%	5.440 dB
/ತದ/	113.733216 Hz	6.392 Hz	1.171 %	4.046%	14.339 dB	149.067486 Hz	3.011 Hz	3.885%	11.618%	8.163 dB
/ದಪ/	116.046703 Hz	9.464 Hz	1.614 %	4.530%	13.979 dB	158.120514 Hz	9.314 Hz	1.797%	12.832%	10.572 dB

The perception of the intensity is performed on the following bisyllabic words such as /ಪದ/,/ಪಟ/,/ದಪ/,/ತದ/ and the analysis is carried out with respect to normal subjects and dysarthria subjects. The physical metric used for measurement is dB.The minimum,maximum and mean values are tabulated as shown in the Table.IV. The results show an increased value in dysarthria subjects compared with normal subjects.Table.V represents the values of fundamental frequency F0 both for normal and dysarthria subjects. The results show an increase of the F0 average in dysarthria subjects, instead, F0 average decreases in normal subjects. The jitter and shimmer values are expressed in percentage indicating possible lack of control in the vocal cord vibration for dysarthria subjects. An increase of shimmer value in the dysarthria subjects is due to the mass lesions on vocal cords. The efficiency of the speech can be encountered in HNR.

Greater efficiency indicates an increase in the HNR ratio. A decrease in the HNR value confirms the reduction in the efficiency of the speech signal.

Retrieval Number: A1524059120/2020©BEIESP
DOI:10.35940/ijrte.A1524.059120

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

VII. CONCLUSIONS

The purpose of this research work is to extract the acoustic characteristics of bisyllabic words in Kannada language using PRAAT tool.The results are tabulated based on the spectrogram obtained for the prerecorded samples used in the analysis. The analysis performed on the acoustic parameters is fundamental frequency,standard deviation,HNR,shimmer,intensity,pitch and formant frequency.These resultant values highlights the distinguishing factors between normal subjects and dysarthria subjects as indicated in the section VI.This study is also helpful in improving the intelligibility of the dysarthria subjects by comparing the desired values of the normal subjects and can be used in clinical assessments for diagonising and monitoring the other types of neurodegenerative diseases.

REFERENCES

1. Lam, J., Tjaden, K., & Wilding, G. (2012). Acoustics of clear speech: Effect of instruction. Journal of Speech,Language, and Hearing Research, 55, 1807-1821. doi: 10.1044/1092-4388(2012/11-0154)
2. K L Lansford and J M Liss. Vowel acoustics in dysarthria: Speech disorder diagnosis and classifi-cation. Journal of Speech, Language, and Hearing Research, 57(1):57–67, 2014.
3. Kim, Y-J., Kent, R.D., &Weismer, G. (2011). An acoustic study of the relationships among neurological disease, dysarthria type, and severity of dysarthria. Journal of Speech, Language, and Hearing Research, 54, 417-429.
4. J Rusz, R Cmejla, H Ruzickova, and E Ruzicka. Quantitative acoustic measurements for charac-terization of speech and voice disorders in early untreated parkinsons disease. The journal of the Acoustical Society of America, 129(1):350–367, 2011.
5. Shaoa, J K. MacCallumb, Y Zhangb, A Sprecherb, and J J Jianga. Acoustic analysis of the tremulous voice: Assessing the utility of the correlation dimension and perturbation parameters. Journal of Communication Disorders, 43(1):35–44, 2010.
6. J P Teixeira, C Oliveira, and C Lopes. Vocal acoustic analysis - jitter, shimmer and hnr pa-rameters. CENTERIS 2013 - Conference on ENTERprise Information Systems / HCIST 2013 - International Conference on Health and Social Care Information Systems and Technologies, pages 1112–1122, 2013.
7. Y Maryn and D Weenink. Objective dysphonia measures in the program praat: Smoothed cepstral peak prominence and acoustic voice quality index. Journal of Voice, 29(1):35–43, 2015.
8. Mallamma V. Reddy, Hanumanthappa M, Kannada Phonemes to Speech Dictionary: Statistical Approach, Int. Journal of Engineering Research and Application www.ijera.com ISSN : 2248-9622, Vol. 7, Issue 1, (Part -4) January 2017, pp.77-80.
9. Sarika Hegde · K. K. Achary · Surendra Shetty Statistical analysis of features and classification of alphasyllabary,sounds in Kannada language, © Springer Science + Business Media New York 2014, Int J Speech Technol,DOI 10.1007/s10772-014-9250-8
10. Nag, S., Treiman, R., & Snowling, M. J. (2010). Learning to spell in an alphasyllabary: The case of Kannada. Writing Systems Research, 2,41–52. doi:10.1093/wsr/wsq001.
11. Hemakumar G, Acoustic Phonetic Characteristics of Kannada Language, IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 6, No 2, November 2011 ISSN (Online): 1694-0814.
12. Anil Kumar C, Shiva Prasad KM, Manjunatha MB, KodandaRamaiah GN. Basic Acoustic Features Analysis of Vowels And C-V-C of Indian English Language. ITSI-TEEE. 2015; 3(1): 20–3.
13. Shiva Prasad KM, Anil Kumar C, Manjunatha MB, KodandaRamaiah GN. Gender based Acoustic Features and Spectrogram analysis for kannada Phonetics. ITSI-TEEE. 2015; 3(1): 16– 9.
14. Jurafsky, D. & Martin, A.Speech and Language Processing: an introduction to natural language processing, computational linguistics, and speech recognition, 2nd Edition. Upper Saddle River, N.J.: Prentice Hall, 2008.
15. E. Singer, P. A. Torres-Carrasquillo, T. P. Gleason, W. M. Campbell, and D. A. Reynolds, "Acoustic, phonetic, and discriminative approaches to automatic language identification," in Eurospeech03, Sept. 2003.

AUTHORS PROFILE

Latha M, did her M.Tech in 2013 and pursuing Ph.D. in the area of Speech signal processing from VTU. At present, she is working as Assistant Professor, Dept of Telecommunication Engineering, GSSS Institute of Engineering & Technology for Women, Mysuru. Her areas of interest include Speech signal processing, networking and communication.

Dr M ShivaKumar, did his M.Tech in 1998 and Ph.D. in 2011 from University of Mysore. He has a teaching experience of more than 20 years. At present, he is working as Principal & Professor in the department of Electronics & Instrumentation Engineering of GSSS Institute of Engineering and Technology for Women, Mysuru. He has published several papers in international conferences and journals. His areas of interest include Speech Signal Processing and Mobile Robotics.

Dr R Manjula, did her M.Sc in 1979 and Ph.D. in 1998 from University of Mysore. She has a teaching and clinical experience more than 30 years She worked as a Professor of Speech Pathology in the Department of Speech – Language Pathology at All India Institute of Speech & Hearing, Mysuru. She guided Ph.D for more than 12 students and published several papers in international conferences and journals. Her area of interest include Neurogenic communication disorders ,Prosody and its disorders,Augmentative and Alternative communication, Phonological disorders and Dysphagia