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Effect of Signal to Noise Ratio on Male-Female Speech Signal

Akshay Kumar[1], Randhir Singh[1], Parveen Lehana[2#]
[1]Sri SAI College of Engineering and Technology, Punjab, India
[2]Dept. of Physics & Electronics, University of Jammu, Jammu
[#]Email address:pklehanajournals@gmail.com

***Abstract*—**This study assessed the acoustic and perceptual effect of noise on male/female speech. Acoustic analysis are carried out on the Hindi language female/male speaker. Various levels of noise ranging from 0 dB to 20 dB are added with the original recorded speech signal. An standard HNM parameters are used to synthesis the noise added signal. Perceptual experiments were also conducted to assess the intelligibility of synthesized speech with in noise. In the experiment, synthesized speech of female with increasing level of noise showed increment in the PESQ score, while a reverse phenomenon is observed in case of male speaker.

***Keywords*—**Synthesis; Noise; SNR; PESQ.

I. INTRODUCTION

Speech is the primary vehicle of human social interaction. Speech communication occurs under an enormous range of different environmental conditions. Speech is a highly efficient and robust medium for conveying information under adverse conditions because it combines strategic forms of redundancy to minimize the loss of information. Speech is an acoustic signal produced from a speech production system. Figure 1 shows the human vocal mechanism [1]. The vocal tract begins at the opening of the vocal cords, or glottis, and ends at the lips. The vocal tract consists of the pharynx and the mouth, or oral cavity. In the average male, the total length of the vocal tract is about 17 cm. The cross-sectional area of the vocal tract, determined by the positions of the tongue, lips, jaw, velum, varies from zero (complete closure) to about 20 cm^2. The nasal tract begins at the velum and end at the nostrils. When then velum is lowered, the nasal tract is acoustically coupled to the vocal tract to produce the nasal sounds of speech. Air enters the lungs via the normal breathing mechanism [2-4]. As air is expelled from the lungs through the windpipe, the tensed vocal cords within the larynx are caused to vibrate by the air flow. The air flow is chopped into quasi-periodic pulse which is then modulated in frequency in passing through the pharynx, the mouth cavity, and possibly the nasal cavity. Depending on the positions of the various articulators (i.e., jaw, tongue, velum, lips, mouth), different sounds are produced. Speech is mainly consists of two components voiced and unvoiced signals. Figure 2 shows excitation system to generate speech, if the input excitation is nearly periodic impulse sequence, then the corresponding speech produced is voiced [5-7]. During the production of voiced speech, the air exhaling out of lungs through the trachea is interrupted periodically by the vibrating vocal folds. Due to this, the glottal wave is generated that excites the speech production system resulting in the voiced speech. Also unvoiced speech is produced when air exhaling out of lungs through the trachea is not interrupted by the vibrating vocal folds. However, starting from glottis, somewhere along the length of vocal tract, total or partial closure occurs which result in obstructing air flow completely or narrowly. This modification of airflow results in stop or frication excitation and excites the vocal tract system to produce unvoiced speech [8-9].

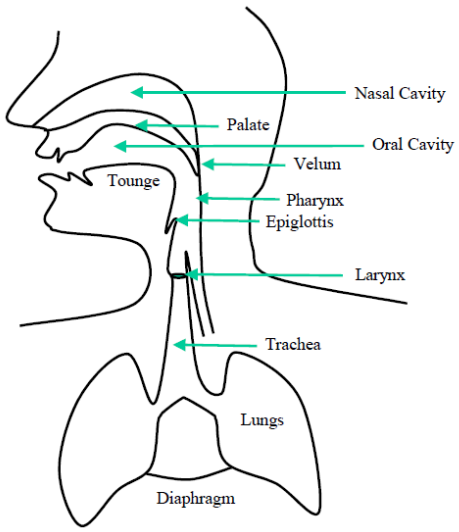

Fig. 1. Human vocal system anatomy.

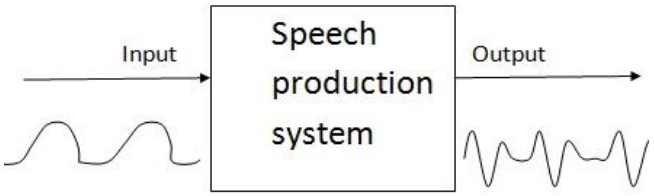

Fig. 2. Block diagram representation of voiced speech production.

In this paper investigations are carried out analyze the effect of various level of noise on male and female speech perception. Perceptual evaluation of speech quality (PESQ) method [10] is used to evaluate quality of the speech.

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II. METHODOLOGY

The research work is divided into two main sections. In first section speaker selection, speech recording and segmentation is done, while in the second part analysis of noise on the speech quality is carried out. Phrase in Hindi language are recorded using Audacity software at the sampling rate of 16,000 KHz. The speech of female and male speaker was recorded in an acoustically treated environment. An algorithm shown in Fig. 3 is designed to add noise ranging from 0-20 dB to recorded signal. The reconstructed speech is compared with original recorded speech signal. The deviation between synthesized speech and original speech is evaluated using PESQ method.

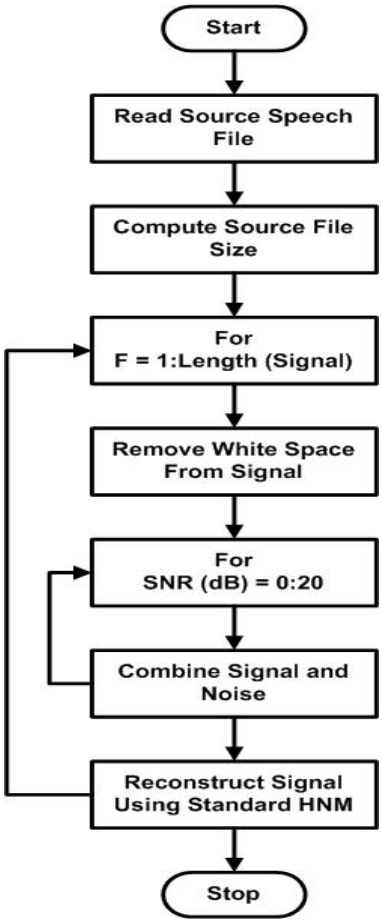

Fig. 3. Designed algorithm for reconstructing speech with added noise.

III. RESULTS AND DISCUSSION

Normalized female and male speech and their spectrogram are shown in Fig. 4 and 5. Table I shows the computed PESQ score of synthesized speech having various SNR level of 0 dB to 20 dB with respect to original recorded speech signal of female and male speaker. Figure 6 shows the PESQ core of female and male speaker. The x-axis shows the SNR level in dB and y-axis PESQ score. PESQ histogram result it is concluded that for female speaker as the noise level is added the score increases till the level is 5 dB, further increasing the noise level degrades the PESQ score. It is contrary for male speaker, as the noise level is increased the PESQ score decreases.

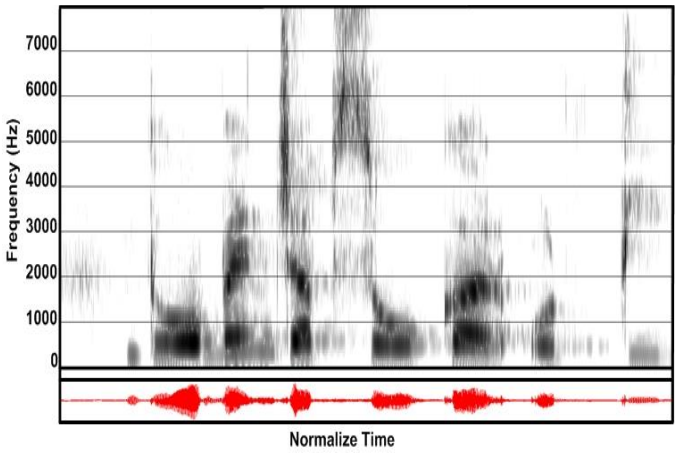

Fig. 4. Female speaker normalized speech signal and spectrogram.

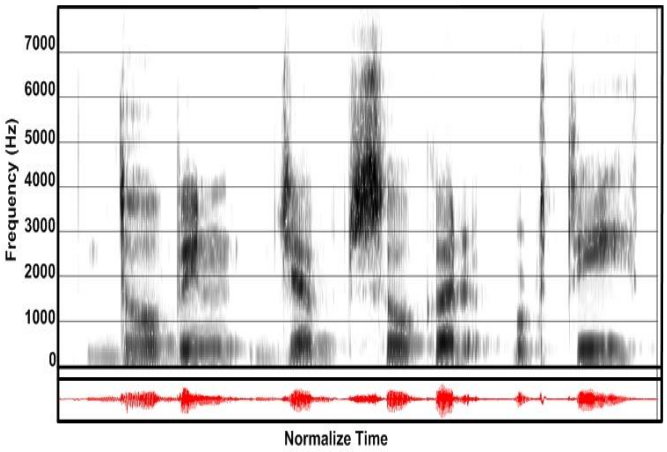

Fig. 5. Male speaker normalized speech signal and spectrogram.

Table I PESQ score of female and male speaker with added noise level.

SNR (dB)	PESQ	
	Female Speaker	Male Speaker
0	1.1247	1.1363
1	1.2186	1.1440
2	1.2401	1.2837
3	1.5126	1.1988
4	1.3416	1.0285
5	1.7315	1.1648
6	1.6359	1.1456
7	1.2932	1.1785
8	1.4529	1.1857
9	1.4946	1.0717
20	1.6393	1.0362

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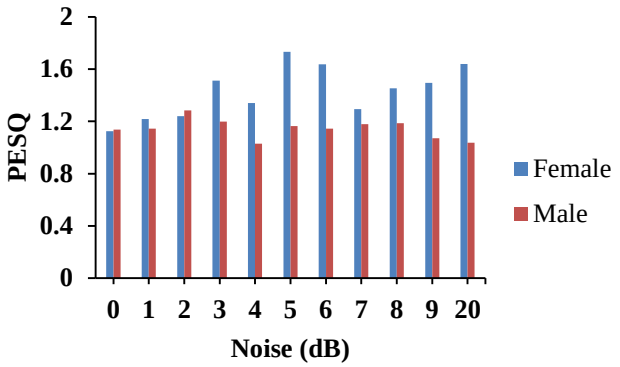

Fig. 6. PESQ score of female and male speaker.

IV. CONCLUSION

Research work is carried out to investigate the effect of SNR on male/female Hindi language speaker. A phrase is recorded using high quality system and professional sound recording software. An algorithm is designed to various level of noise ranging 0 dB to 20 dB and reconstructing speech using standard HNM parameters. PESQ score of 1.247 is obtained for 0 dB noise level and 1.639 for 20 dB noise level for female speaker. Similarly for male speaker the PESQ score comes out to be 1.1363 and 1.0362 at 0 dB and 20 dB respectively.

REFERENCES

[1] L. R. Rabiner and B. H. Juang, Fundamentals of speech recognition. prentice-hall, Englewood Cliffs, NJ, 1993.
[2] H. C. Mahendru, "Quick review of human speech production mechanism," *International Journal of Engineering Research and Development*, vol. 9, pp. 48-54, 2014.
[3] M. Honda, "Human speech production mechanism," selected papers, *NTT Technical Review*, vol.1, 2003.
[4] C. F. Hockett, "The origin of speech," *Scientific American*, vol. 203, pp. 88-96, 1960.
[5] W. T. Fitch, "The evolution of speech: a comparative review," *Trends in Cognitive Science*, vol. 4, pp. 258-267, 2000.
[6] P. K. Lehana and P. C. Pandey, "Speech synthesis in Indian languages," in *Proc. International. Conference on Universal Knowledge and Languages*, Goa, India. 2002.
[7] D. N. Kalikow, K. N. Stevens, L. L. Elliot, "Development of a test of speech intelligibility in noise using sentence materials with controlled word predictability," *Journal Acoustic Society America*, vol. 61, pp.1337–1351, 1977.
[8] M. T. Keurs, J. M. Festen, R. Plomp, "Limited resolution of spectral contrast and hearing loss for speech in noise," *Journal Acoustic Society America*, vol. 94, pp.1307–1314, 1993.
[9] K. D. Kryter, "Effects of ear protective devices on the intelligibility of speech in noise," *Journal Acoustic Society America*, vol. 18, pp.413–4, 1946.
[10] S. Pennock, "Accuracy of the perceptual evaluation of speech quality (PESQ) algorithm," in *Proc. Measurement of Speech and Audio Quality in Networks Line Workshop*, 2002.

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