International Research Journal on Advanced Engineering Hub (IRJAEH)
e ISSN: 2584-2137
Vol. 02 Issue: 03 March 2024
Page No: 656 - 661
https://irjaeh.com
https://doi.org/10.47392/IRJAEH.2024.0095

Therapeutic Implications of Voiced Sounds in Children with Communication Needs

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Abstract

Children with hearing impairments, who do not receive auditory feedback eventually develop speech impairments. Children with hearing impairments lack the ability to talk even by having normal speech production mechanisms. The hearing-impaired child's articulation, accuracy, stress, and intonation patterns are all impacted even if he/she attempts to speak by visualizing lip movements because they are unable to distinguish vowels and consonants with tongue movement concealed in the mouth, nor they are able to understand variations in pitch or intensity of speech. Individuals with hearing impairments may receive auditory, tactile, or visual input, contingent on the degree of their disability. This research is dedicated for developing preliminary systems for teaching. These systems can be created using feedback of articulatory parameters or feedback of acoustic parameters, such as fundamental frequency, speech intensity, and spectral features. Data from speech language pathologists were collected from 20 children with and without speech impairments, aged 5 to 8 using picture naming tasks. The statistical analysis on voiced samples /pha/, /mha/, /tha/ relived the significant variation between children with and without hearing impairments.

Keywords: *Voiced sounds, auditory feedback, Intensity, Fundamental frequency*

1. Introduction

The disruption of speech development that typically results from congenital hearing loss is one of its most damaging impacts. Because of this, speech skills that typical hearing children naturally pick up in their early years of life must be taught to the majority of hearing children. While some children with hearing impairments grow to speak intelligibly, many do not. Pressure waves, which are fluctuations in pressure as a function of time, are produced as speech signals. Every human sound has a specific placement for each vocal tract articulator, including the tongue, lips, velum, teeth, and vocal folds. Given that they receive Both visual and auditory feedback, typical children can learn to manipulate these different articulators by the time they are four years old. Even though hearing-impaired children have a [1-4] functioning speech production mechanism, they become deaf due to their inability to receive auditory feedback. The youngsters with hearing impairments do not have an auditory loop or any independent speech memory. Since hearing-impaired people cannot discern vowels and consonants with tongue movement hidden in the mouth by merely perceiving lip motions, lip reading technique is not a solution they can be mute, but they could be able to hear what is being spoken. Losing all or part of your hearing is known as hearing impairment or hearing loss. The terms "deaf" and "hard of

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hearing" are also used to describe hearing impairment. [5, 6] The degree and kind of hearing impairments are used to categorize hearing impairments. The lowest sound that your better ear can detect is used to classify the degree of the hearing loss. A sound is louder when its decibel (dB) value is higher. The lowest sound that can be heard when one has minor hearing loss is between 25 and 40 dB. [7] Individuals at this level may find it difficult to follow talks in noisy environments because they cannot hear quiet sounds. With a modest. The lowest sound that can be heard when suffering from mild hearing loss is between 40 and 70 dB. Unless they wear a hearing aid, people at this level may have difficulty hearing mild or moderately loud noises. The lowest sound that can be heard when suffering from acute hearing loss is between 70 and 95 dB. Even with the use of a hearing aid, people at this level are unable to hear the majority of noises and may rely on lip reading and/or sign language. With profound hearing impairment, the minimum sound heard is 95 dB and over. People at this level may only hear very loud noises and rely solely on lip-reading and/or sign language. Hearing aids are not effective. Severity of hearing loss classification is shown in Table 1. [8]

Table 1 Classification of Severity of Hearing Loss

Severity of hearing loss	Hearing impairment range in dBHL
Mild	20 to 40dBHL
Moderate	41 to 40dBHL
Moderately severe	55 to 40dBHL
Severe	71 to 40dBHL
Profound Deafness	91dBHL
Total Deafness	Above 91dBHL

2. Methodology

The method of implementation is as shown in Figure 1 below.

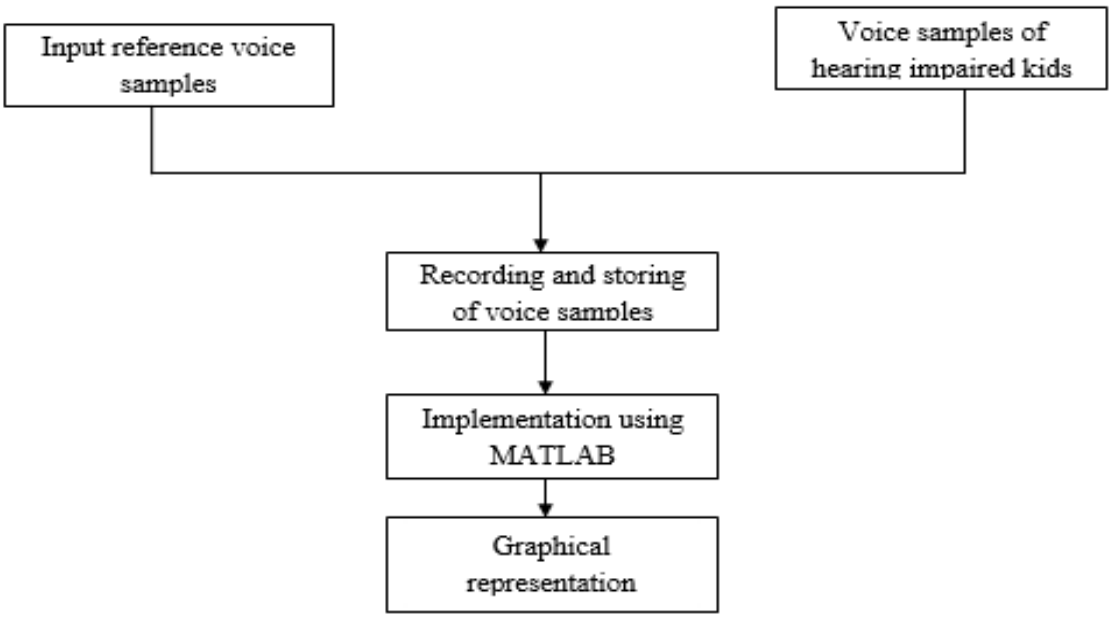

Figure 1 Block Diagram for Therapeutic Implications of Voiced Sounds in Children

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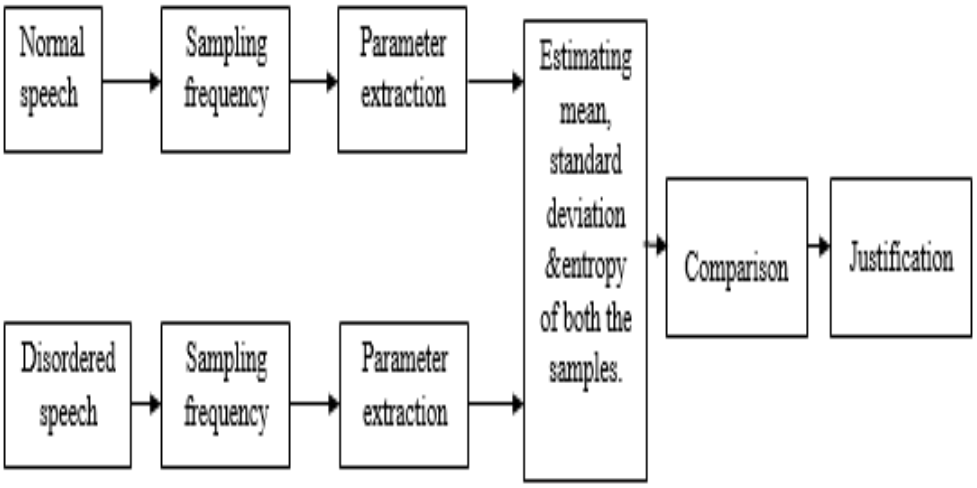

Figure 2 Implementation Therapeutic Implications of Voiced Sounds in Children

Effective production of voiced sounds is an important aspect in speech. The main purpose of this paper is to demonstrate how to pronounce the words and encourage the use of voiced sounds with the help of visual cues for hearing impaired children. This paper demonstrates the use of MATLAB for therapy in effective and economical way. As shown in the Figure 2, voice samples of normal children from age 4 to 10 years and the voice samples of the children with hearing impaired was collected, stored and converted into wave files. [9-12] the estimation of sampling frequency is done for the voice samples. Sampling frequency signals must be filtered prior to sampling. Theoretically the maximum frequency that can be represented is half the sampling frequency. To estimate the sampling frequency, the voice samples should satisfies the Nyquist criteria that is fs<2fmax. The signal is now represented at multiples of the sampling period, T, as s (NT). [13] Telephone speech is sampled at 8 kHz, 16 kHz is generally regarded as sufficient for speech recognition and synthesis. The audio standard is a sampled at a rate of 44.1 kHz (Compact Disc) or 48 kHz (Digital Audio Tape) to represent frequencies up to 20 kHz. The features are extracted from the sampled speech signal. The features extracted are Mean, Median, Standard deviation, Pitch, Formant frequency, PDF, MFCC and Entropy. This is accomplished by taking voice samples of normal children from age 4 to 10 years which are taken as the reference samples. Once the reference sample is recorded with the help of mobile application, then recording of voice samples of the children with hearing impaired is collected and saved as wave files. On running the program two waveforms are displayed on the screen. [14] One the reference and the other will be the client's sample, along with the readings like mean, median which are displayed on the screen. This visual helps the therapist to give visual feedback to the client and helps them to know how good they can articulate voiced sound. This is the easiest tool where the therapist can keep track of their client's improvement record in articulating voiced sound and can be retrieved when required from the file stored in the system. [15]

3. Results and Discussion

The voiced sounds are collected using mobile application called voice recorder. Recording is done in a sound treated room and recorded audio samples are converted into wave format and further samples are processed. [16] Figure 3 indicates the voice print of normal kid which was recorded using a mobile application called voice recorder. A graphic representation of a person's voice, showing the component frequencies as analyzed by a sound spectrograph. The higher standard deviation indicates that the data points are spread out over a wide range of values. [17]

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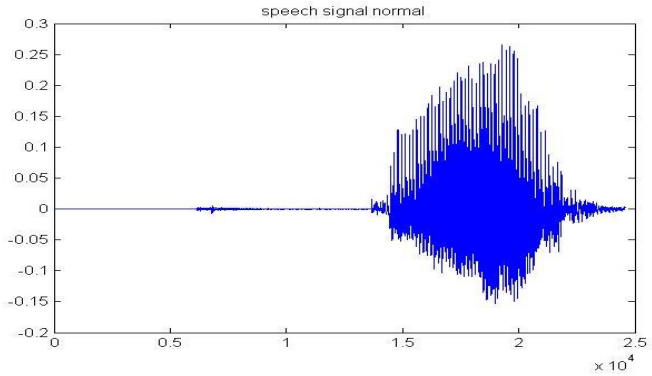

Figure 3 Normal Speech

Figure 4 indicates the voice print of speech disordered kid which is recorded using a mobile application voice recorder. A graphic representation of a person's voice, showing the component frequencies as analyzed by a sound spectrograph. A low standard deviation indicates the data points tends to be close to the mean.

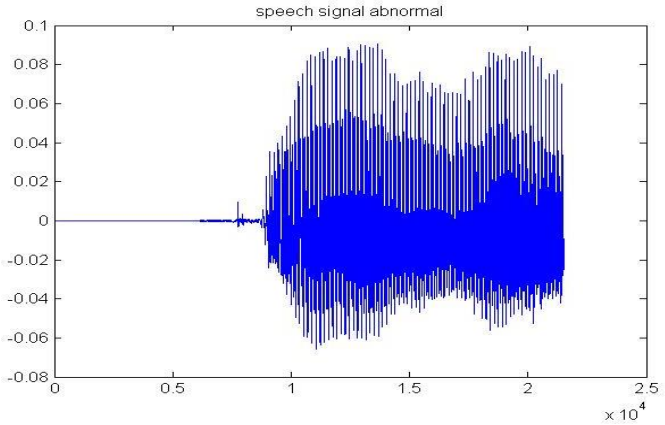

Figure 4 Disordered Speech

Figure 5 indicates the frequency response graphs for input abnormal kids voice sample and filtered abnormal kids voice sample. For an audio system, the objective is to reproduce the input signal with no distortion. The input signal is obtained by performing FFT (Fast Fourier Transform) and the filtered sequence of this input signal is passed through a filter to obtain a filtered sequence. Filtered sequence obtained is delayed with respect to the input signal. .Digitally sampled data in time domain, is broken up into chunks, which usually overlaps, and Fourier transformed to calculate the magnitude of the frequency spectrum for each chunk, then corresponds to a vertical line in the image; a measurement of magnitude versus frequency for a specific moment in time. Frequency response is obtained by plottting magnitude versus frequency.

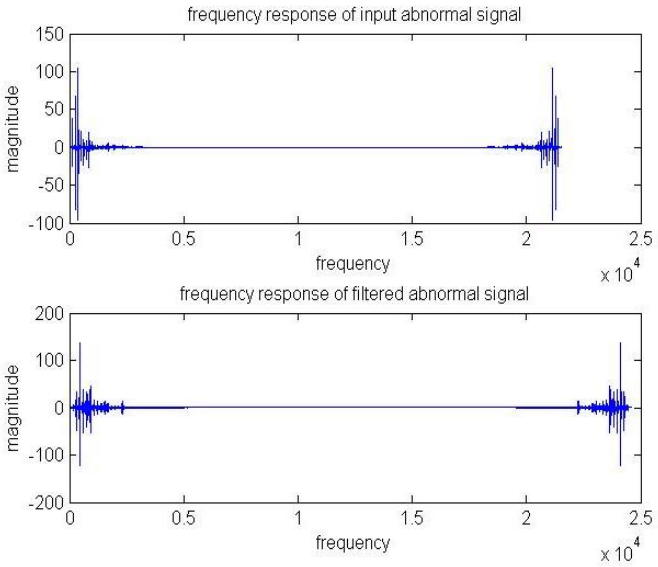

Figure 5 Frequency Response Graphs of (Abnormal Samples)

Figure 6 shows the output of filter visualization tool. It represents the magnitude response of Butterworth band pass filter. The frequency response of the Butterworth filter is maximally flat in the passband and rolls off towards zero in the stopband. [18]s

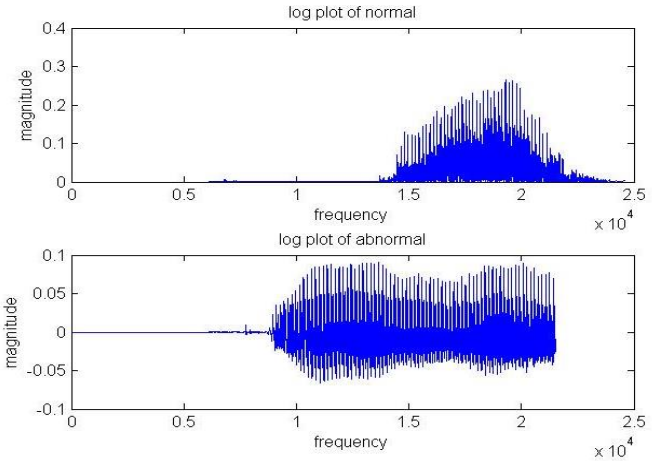

Figure 6 Log Plot

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Table 2 Values of Different Samples

Voiced samples	SD		M	Entropy		
	N	AN	N	AN	N	AN
Pha	0.03	0.02	5.22	4.15	14.43	14.27
Mha	0.01	0.00	5.54	4.83	14.41	14.46
Bha	0.10	0.11	5.39	4.27	14.72	14.69

N represents normal voiced speech sample, a represents abnormal voiced speech sample, SD represents standard deviation, M represents mean of the voiced sample. Table 2 indicates the statistical analysis on voiced samples /pha/, /mha/, /tha/, and this analysis revealed the significant variation between children with and without hearing impairments.

Conclusion

Children having difficulty in interacting, expressing, articulation disorder, hearing impaired and cleft lip pallet population are screened and treated. This helps the children to improve their effectiveness in producing the voiced sounds which helps them to achieve one of their milestones. This is the easiest tool where the therapist can keep track of their client's improvement record in articulating voiced sound and can be retrieved when required from the file stored in the system .Clinical implication of producing voiced sound with the help of this MATLAB program therapist can treat and train the clients very effectively.

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