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RESEARCH ARTICLE

Analysis of Speech Signals

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Abstract— Speech Sounds are vastly information-rich signals that impart knowledge about the words, accent, and style of speech, loudness of speech, speaker's identity, expressions and the state of voice of the speaker. In this research, we have investigated the fundamentals of speech, its production and its perception. Database of speakers of different age groups have been dissected in this investigation with the help of which the spectrum analysis and the acoustic feature (pitch) analysis have been performed. Younger children show an increased value of pitch as compared to the value of pitch extracted from the speech samples of adults. With the procession of age, the pitch seems to be abating and sometimes shows a varying value in accordance with the gender of the speaker. In this paper, we have presented a comparative speech study of speakers of varying age groups by analysing their voice samples which were recorded by us.

Keywords—Acoustic; Pitch; Spectrum; Speech synthesis; Speech Signal; Waveform

I. INTRODUCTION

Prosodic Parameters need to be considered in speech synthesis. Pitch extraction is one of the major prosodic parameters of speech with the help of which we can compute the fundamental frequencies of the vibration of vocal cords of a speaker. [1]Moreover, the Spectrum analysis helps us in evaluating several other features of speech which contributes helps in further speech studies. Most of the speech processing applications exploit certain feature or properties and how to extract them from a speech signal. The reliable information in a speech signal is exemplified quite efficiently. Speech signal extracts various features that are pertinent for various speech applications. Analyzing a speech signal in frequency domain help us to extract the most profitable features of speech analysis.[2] Under elaborative introspection, a waveform can be classified in two main paradigms-(a) A quasi-periodic portion (repetitive over a small period of time) (b) a noise-like portion (random shape). For the quasi-periodic part of the waveform, the period is known as fundamental or pitch period which contribute in calculating the pitch values. Typical pitch for an adult (male) varies from 85Hz-155Hz, which in case of adult (female) varies from 165Hz-255Hz. Likewise, for a child the value of pitch varies till 500 Hz. In this research paper, a database of 83 children of different age groups has been collected.[3] During the recording procedure, the speakers were not given with any specific kind of directions for pronouncing the words. They were just made familiar with the way they have to participate in the recording

session. . The voice samples of these children have been analyzed by considering its spectrum analysis and maximum pitch duration for different age groups on the behalf of which children have been classified according to the range of their pitch values. With the speech analysis, at an early each we are able to predict how much the articulatory features of a child has developed and if there is any kind of language delay or speech disorder in the speech pronunciation of the child when asked to utter some words or phrases. [4] It is quite clear by analyzing the spectrum of different speech samples that how the amplitude or the value of pitch ranges varies with the articulatory development of a human when his voice is analyzed in the frequency domain. Therefore, it becomes quite interesting to analyze the speech signals of the speakers of varying age groups to get the most useful information out of this which contribute in analyzing the other acoustic features and other speech related parameters of that particular speech signal. Pitch estimation is one of the most interesting and information rich feature of the speech in accordance to which we need to calculate the fundamental frequency and the different formant frequencies. In this research paper, the spectrum and the pitch analysis is performed in order to perform a comparative studies for the people of varying age groups. This comparative study leads to analyze some other acoustic features of speech on the behalf of which we can judge the development of a child's way of uttering words

II. MATERIALS AND METHODS

A. Database

Speech samples of speakers of various age groups have been collected for this investigation. A total of 83 speech samples were recorded. Children are learning English sequentially over a period of time. Children have been asked to utter some words phrases .They have not been provided with any sort of special instruction about pronouncing the various words and phrases and simultaneously they are not forced to utter the words frequently. They have been instructed that they need to utter the words the way they get them.[5] The samples were collected with parents consent and the children were diagnostically sound and no speech disorder has been observed in any of the child.

B. Elicitation Procedure

Speech studies comprise of collecting various voices and analysis those to extract the most profitable features of the speech signal. For the purpose of elaborated speech analysis, we have collected voices of children and adults of age varying from 4 years to 20 years. These samples were recorded in a sound treated room using a dell laptop and a microphone. The children were instructed about the recoding procedure and the digitization of sample has been performed at 44.1 kHz. [6] Post the recording procedure, the speech samples were extracted which were relevant for the speech studies.

III. PROPOSED WORK

The speech samples collected have been analyzed in a frequency –domain. The spectrum of each of the samples of various age groups has been drawn using a scientific tool for analyzing speech signals, Praat. A comparative study of these spectrums drawn for voices of speakers belonging to different age groups have been analyzed in order to distinguish the development of various articulatory features in different age groups. In early age groups, children tend to show a high pitch while uttering different words and phrases while the elder ones shows a falling range of pitch values. Moreover, by just having a look on the spectrums for children of different age group, we will be able to distinguish their age groups and the development of their speech organs and the frequency of the vibration of the vocal words while uttering some words. The spectrum of different voice samples have been analyzed in this research in order to estimate the difference in the range of their pitch values that varies with the advancement in age. This way the speech studies help us in studying the development of various features in children.

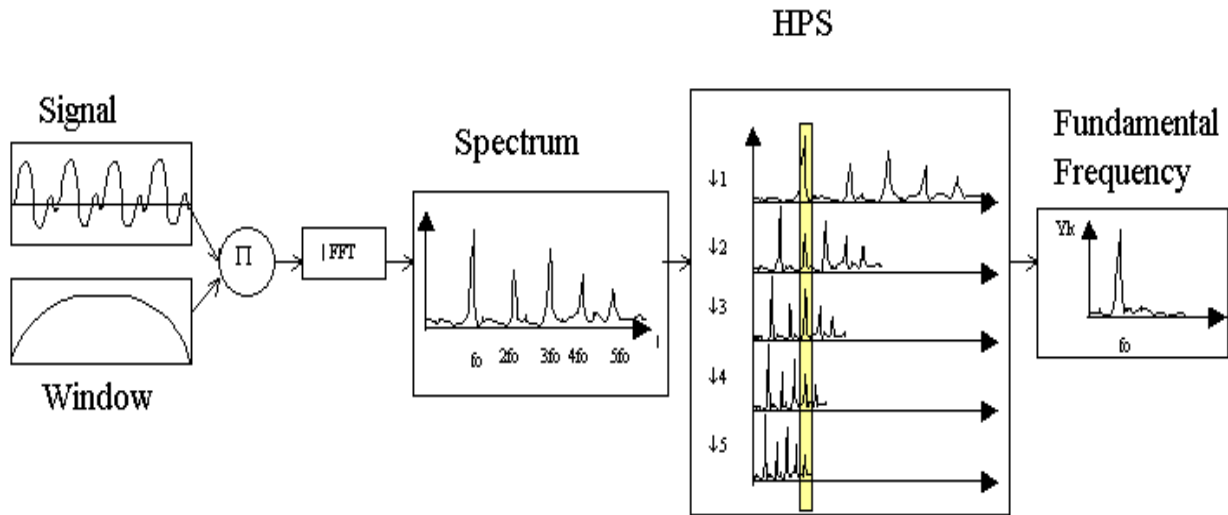


Fig 1 Analysis of a speech signal to calculate fundamental frequency

IV. RESULTS

(A) Spectrum Analysis

The Speech samples were analyzed by drawing the spectrums for speakers of various age groups [7]. As the speech signal is measured in frequency domain, it can be visually analyzed the varying amplitude and the pitch values as the speaker grows in age. As it is quite clear from the given Fig. how the sound pressure level varies for speakers of different age groups. In order to distinguish more clearly, we can elaborate the spectrums of a child of age 4 years and the spectrum drawn for the voice sample of an adult.

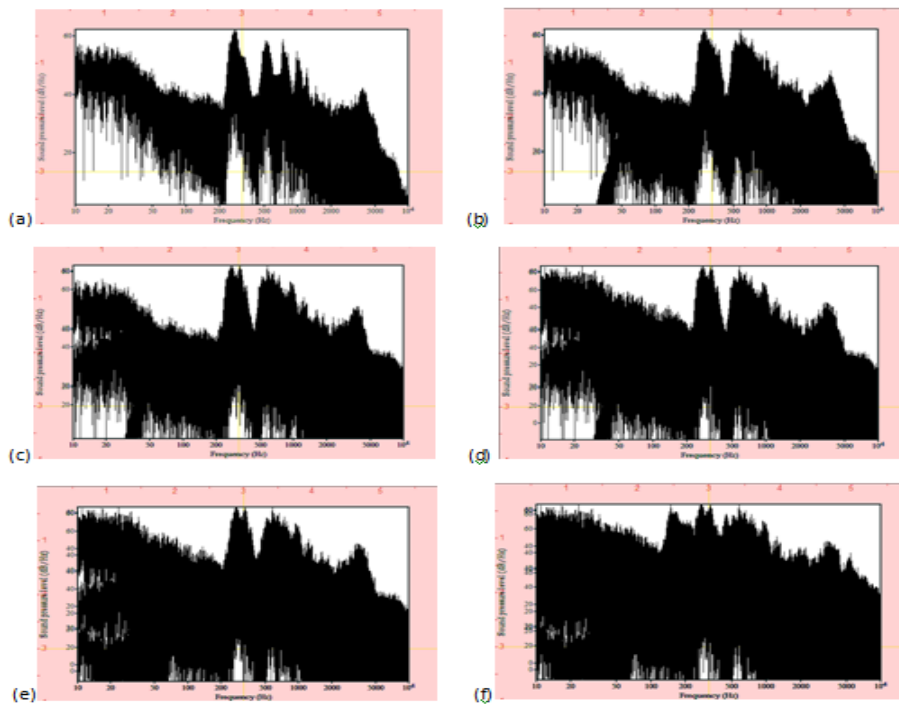


Fig.2 Spectrum Analysis for a speech signal (a) 4 year (b) 5 year (c) 6 year (d) 7 year (e) 8 year (f) Adult

(B) Pitch Estimation

Pitch is estimated for the voice samples collected for the children of different age groups. [8]A comparative speech study for these samples have suggested that the youngest children indicated the highest value of pitch range when asked to utter the same words or phrases as pronounced by an adult.[9] With the physical growth of the children, the articulatory features of the children get developed and the child tends to speak the words in a fluent manner.

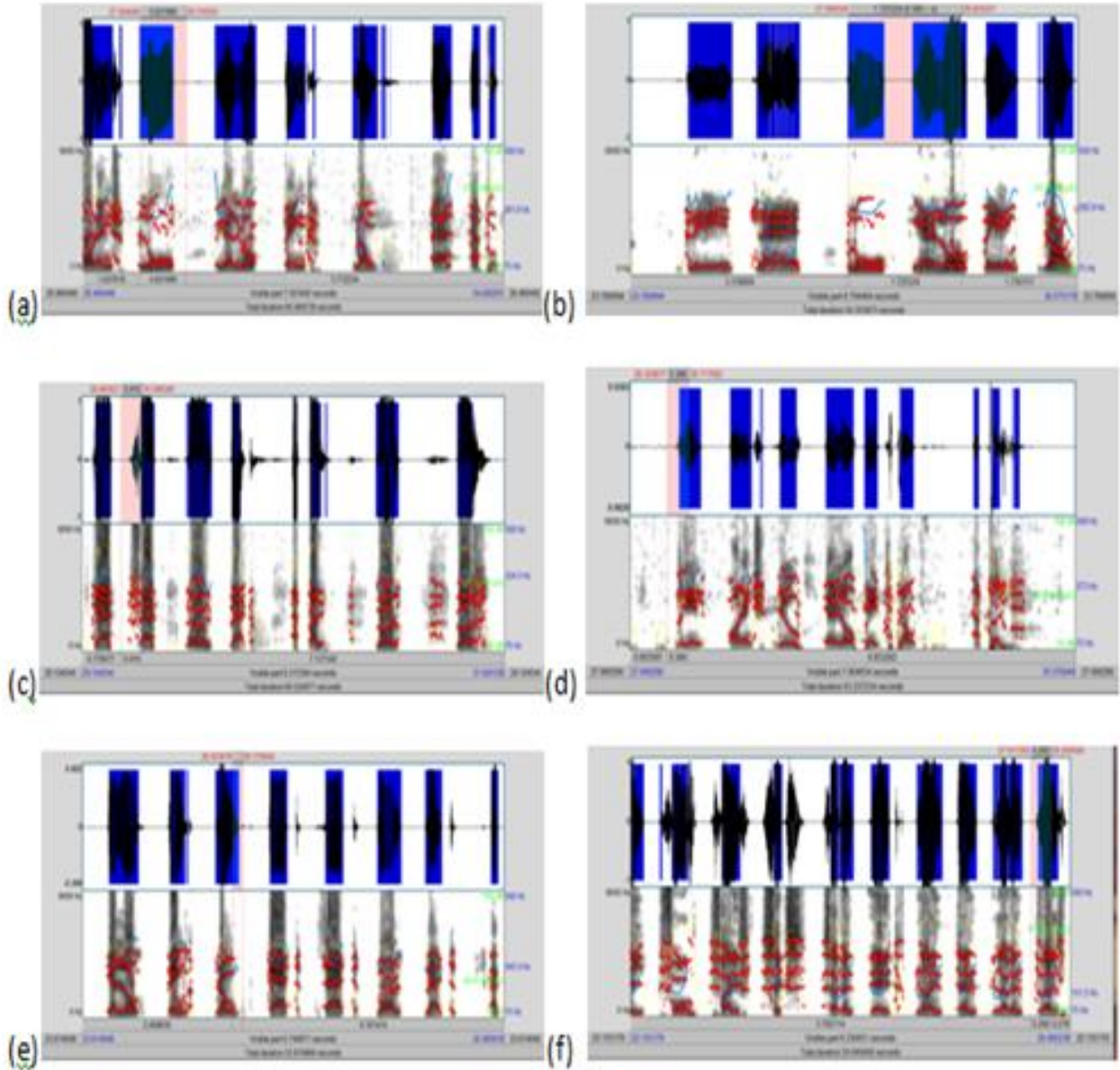


Fig 3 Pitch Estimation for Speech samples (a) 4 year (b) 5 year (c) 6 year (d) 7 year (e) 8 year (f) Adult

The pitch values for the voice samples are provided in the table given below from which it is quite clear that there is a decreasing range of pitch values as the children advances in age. The youngest child (Age-4years) has indicated the highest value of pitch, i.e., 364 Hz.[10] Simultaneously, when an adult was asked to pronounce the same word he tend to indicate a pitch value of 170 Hz.

Table 1.1
Pitch Estimation for Speech Samples

Age(Years)	Pitch(Hz)
4 year	364
5 year	337
6 year	333
7 year	286
8 year	250
Adult	170

V. CONCLUSION

Speech samples were analyzed in order to take into consideration the spectral analysis and the pitch estimation. This investigation contributes to the fact that as the children advances in age, he tends to develop his articulatory features, the way of pronouncing words and the fluency with which he utter words. As the spectrum is analyzed it becomes quite clear that as the age varies the amplitude and the sound pressure level also varies when considered in the frequency domain. Likewise, the calculation of pitch range for the voice samples of children of each age group (4 years- Adults) indicated that the pitch range lowers down as the children advances in age.

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