CHAPTER 5

STATEMENT OF PROBLEM AND MEASUREMENT

5.1 STATEMENT OF PROBLEM :

From the literature survey of research work reported by other authors, it is evident that the phonetic study of non-pregnant / pregnant lady has not been undertaken so far. Though scanty studies are being reported for acoustical behavioural studies like speech theraphy, speech pathological ailments etc.

Therefore it is proposed to investigate and analyse the phonetic sounds acoustically under the title "Extraction of phonetic parameters for status recognition of pregnant woman using linguistic segmentals". The pregnancy and its developments are related with status of foetus. They are of paramount importance in the gynaec field as it is related with life and death of foetus / mother. Though C-T scan / X-ray / Gynaecological investigations do indicate the status but they are costly as well as harmful to both foetus and mother.

An attempt of this kind relating the phonetic parameters on one part, medical science and engineering on the other part, is an inter-disciplinary research work, which justifies the present venture.

The proposed work will be the first of its own kind in India and abroad. It is hoped that it will help the Gynaecologists / medical mass care taking unit in bringing out the status of pregnant lady at each stage of pregnancy noninvasively and it will help the bio-medical engineers for further development of proposed analog model.

The ultimate aim of present venture is the development of set of phonetic parameters which could be characterising the development of foetus during pregnancy using formant frequency, formant amplitude, time duration etc.

The electrical/mechanical model of womb will be developed. From the model parameters we can realise the state of pregnancy, quality factor of amniotic fluid (η) and the behaviour of foetus under dynamic conditions.

5.2 MEASUREMENTS :

The linguistical utterances of all the fifty two alphapets of Hindi language representing vowels and consonants uttered by many non-pregnant / pregnant women having different pregnancy status, have been recorded on a good quality cassettes using National Panasonic tape recorder, in a room free from external noise. For the purpose of analysis the samples of utterances of same level of pregnancy and for same linguistical segmental, were dubbed together with sufficient pause between them.

The observations were made regarding amplitude, frequency, time duration, energy including formant measurement for both non-pregnant / pregnant women and are tabulated. The instrumental techniques used by Zadgaonkar [1] for speech recognition has been utilised.

5.2.1 FREQUENCY MEASUREMENT :

The sounds are produced by acoustical excitation of vocal tract by a source. The configuration of vocal tract plays a role in the resonant frequencies and vice-versa. The lengthening of vocal tract tends to lower the frequency of resonance.

The phonetic identity of speech sound to some extent depends on the formant frequencies (peak of harmonics), within a sound segment. The relation between configuration of vocal tract and resonant formant frequencies have been subject of study for many years [2, 3, 4, 5, 6].

The qualitative comparison indicates that the F-pattern (F_1, F_2, F_3, F_4, etc.) seems to be most adequate technique for acoustical featuring of speech and speaker. The analysis is carried out by using 4-5 filtering circuit [7].

In the present work the peak frequency (without using any filter) has been measured using frequency meter. The details of which have been

shown in Appendix II, III. The formant frequencies have been measured using the same frequency meter but with appropriate filters. The observations are recorded as F_1, F_2, F_3, F_4. The details of filters used with its frequency response curve has been shown in Appendix I. The standard mean variation (σ) has also been calculated and shown in the respective observation tables.

5.2.2 AMPLITUDE MEASUREMENT :

The generally accepted theory of speech production views these speech wave as the result of acoustic excitation of the vocal tract by one or more sources [8]. Such a source can be considered as a differential pressure source usually located in the vicinity of vocal tract. The speech sound can be described completely in physical terms with its amplitude and phase spectrum. Normally the phase spectrum is overlooked. All practical experience shows that a detail specification of all harmonics is unnecessary, and main quality is correlated with formants [9, 10, 11].

All measurement of speech, by any method of measurement, involve specification of amplitude and or intensity measurement [12].

In the present work the recorded speech on tape is fed to bank of filters and formant amplitude is measured using peak detector and voltmeter. Same is checked by using storage C.R.O. The details of which have been appended in Appendix IV. The observed values of amplitude have been recorded and is shown through observation tables.

Further the dB meter was not available as such the dB value [13, 14] could be calculated using standard relationship

$$dB = 20 \log_{10} \frac{V_2}{V_1} \qquad [5.1]$$

where V_2 = Voltmeter reading under phonetic condition

V_1 = The voltmeter reading under non-speaking condition (which was recorded as 0.01 V)

5.2.3 TIME DURATION MEASUREMENT :

The segmental duration carries prosodic [15, 16] and temporal features of speech [17]. The rate of change of spectral feature is an important factor in the phonetic assessment. The time duration of sound may be determined by the phonetic environment and such durational changes may become cues for identification of changes.

In the present work the time duration has been measured using storage oscilloscope which is the highest accurate method [18, 19] for time duration measurement (Fig 5.1). The details of which have been appended in Appendix V.

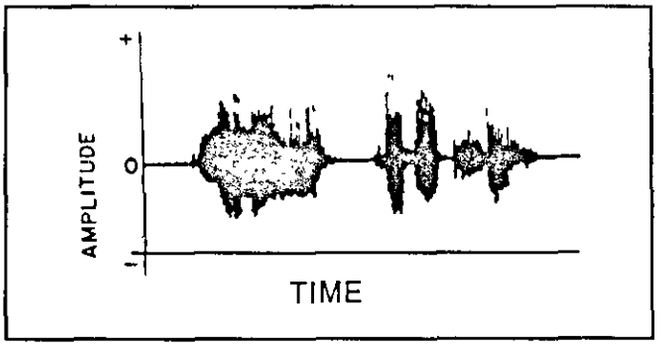

Fig. 5.1 Time domain representation of 'च'

The observations have been recorded and are tabulated for different formant signal inputs and are reported through observation tables.

5.2.4 ENERGY MEASUREMENT :

The non-availability of energy meter for such a low acoustical energy has forced us to calculate the energy level during phonation [20, 21] by using mathematical relationship, i.e.,

$$E = \text{power} \times \text{time duration}$$

$$= \beta \text{ dB} \times \text{time duration}$$

where β is conversion factor converting dB in to watt.

The time duration and dB values are known for different formant frequencies and the same has been used for making calculation of energy

at appropriate place.

Further the preliminary scanning of these observations reveal that the characteristic patterns of amplitude, frequency, time duration, energy for non-pregnant / pregnant woman shows the similar pattern of behaviour in all the fifty two alphabets. As such only few representative examples will be reported instead of all the fifty two alphabets, to avoid the repeatability of observations.

5.3 REFERENCES :

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