

Construct a phonetic database and develop a phonetic transcription in Gujarati language

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Abstract— Last few decades are witness of development of phonetic transcription as a part of linguistic research in various languages like American English, Spanish, and Japanese etc. Few amount of work has been done for Indian languages by researchers. So this paper particular focuses in Gujarati Language which is official regional Indian language. This research paper mainly contains two important parts as far as linguistic research is concern first one is creation of phonetic database and second is to develop a phonetic transcription in Gujarati language. For better analysis for bilingual and multilingual analysis phonetic transcription of Gujarati language has been compared with American English.

Keywords— Phonetic database, Phonetic Transcription, Gujarati Language, International Phonetic Alphabet (IPA), PRAAT Software

I. INTRODUCTION

Introduction Human do communication by various ways but best way of communication is speech and hence it is worth to say human could not become human except by language. With rapid development of human being language has become an integral part of any society, country and world by itself. Different flavours in language is purely depends on group of peoples, atmospheric conditions, physical structure of human being and so analysis of language is always an interesting topic. The scientific study of language is called as a phonetics and the way of writing phonetic is called phonetic transcription. [1, 2]

For example in English language two words Heart (muscular organ) / Heard (past tense of hear) spelt almost similar but pronounce differently phonetic transcription play vital role to understand this. Phonetic Transcription is discernible representation of sounds, other synonym are phonetic script or phonetic notation. Generally phonetic transcription is written based on though that any sounds are demarcation in to discrete words which are represented inform of symbols, commonly it is written using phonetic alphabet namely International phonetic alphabet (IPA)[3]. It help us to scrutinize distinction in pronunciation between dialects within a given language.

The other important aspects of creating and understanding the phonetic transcription is that it can be useful in other linguistic research area like to develop text to speech

synthesiser (TTS) [4], implementation of phonetic engine, machine learning ,Speech recognition etc. [5].That's it is very important to have phonetic transcription for a every language.

In last decades lots of researcher has provide their contribution for various linguistic area in languages like English, German, Chinese, and Spanish etc. So, it is highly recommended to carry out some work in Indian regional languages because India is very strong in terms of number of languages and dialects of languages as mention below.

This paper has been organized as 1) Introduction 2) Related work in Gujarati Language 3) Methodology which includes Constructing a Database of Gujarati Characters for Speech Synthesis and Phonetic Transcription of Gujarati Language and finally results and analysis Phonetic Comparison between Gujarati and English language has been mention.

II. RELATED WORK IN GUJARATI LANGUAGE

India is Asian country which holds second highest no. of languages, multicultural peoples and environmental differences study of languages is always an interesting. Gujarati is the one of the official language in India which is spoken in majority western part of India [6]. Author has prepared database at syllable level in Gujarati language which can be utilized for text to speech synthesizer using Concatenative synthesis approach and also highlights some issues regarding phonetic transcription Gujarati language.

Table-1 Consonants and vowels in Gujarati Language

Consonants									
ક	ખ	ગ	ઘ	ચ	છ	જ	ઝ	ટ	ઠ
ડ	ઢ	ણ	ત	થ	દ	ધ	ન	પ	ફ
બ	ભ	મ	ય	ર	લ	વ	શ	ષ	સ
હ	ળ	ક્ષ	જ્ઞ						
Vowels									
અ	આ	ઇ	ઈ	ઉ	ઊ	એ	ઐ	ઓ	ઔ
અં	અઃ								

Gujarati regional Indian language which is majority spoken in western part of India like state Gujarat. Apart from it is spoken by approximately 55 million people, making it the twenty-third most widely spoken language in the world today which makes Gujarati language to study of interest. With this understanding the importance of phonetic transcription for Gujarati language is highly recommended and hence work for it is not just logical but profound. Gujarati language is morphologically rich language which has its own basic set of 34 consonants and 12 vowels as shown in table -1 [7, 8].

Phonetic transcription for Gujarati language has been carried by several researchers according to their knowledge some of them are mention in references.

III. METHODOLOGY

Constructing a Database of Gujarati Characters for Speech Synthesis: For a development of Concatenative based speech synthesis techniques, development of Gujarati language speech engine it is very important to create database in Gujarati Language and hence it has been generated as mention further [4, 9]. For preparing speech database speech samples were taken from YouTube videos and after that it has been converted in to wave file with sample rate 44100 Hz and mono channel. Database is of female speaker with around 25 year’s age. Total 46 different wave files has been created including 34 consonants and 12 vowels each (mention in Table-1).

Phonetic Transcription of Gujarati Language: It forms of three subfields describe as 1) how speech is produced (articulatory phonetics) 2) how speech sounds are propagate from speaker to listener (acoustics phonetics) 3) how speech sounds are perceived (Perceptual phonetics) [10].

Phonetic Transcription is developed by two different approach 1) Manual Approach 2) Automatic Approach. Manual transcription refers to the process of speech files are transcribed and phonetically labelled manually. Generally Manual transcriptions act as evaluating parameter for examining the acceptable accuracy and validity of automatic transcription and phonetic labelling. In Automatic approach, engine is trained using few words from the specified language and then parameters will be extracted. Ground truth is that manual phonetic transcription is always retain its

higher values [11]. To do scientific analysis of speech in phonetics, free computer software package are required and it is fortune to have various software like PRAAT software, Pro-edit software, Wave surfer etc. are available to view, analysis and modify speech signal.

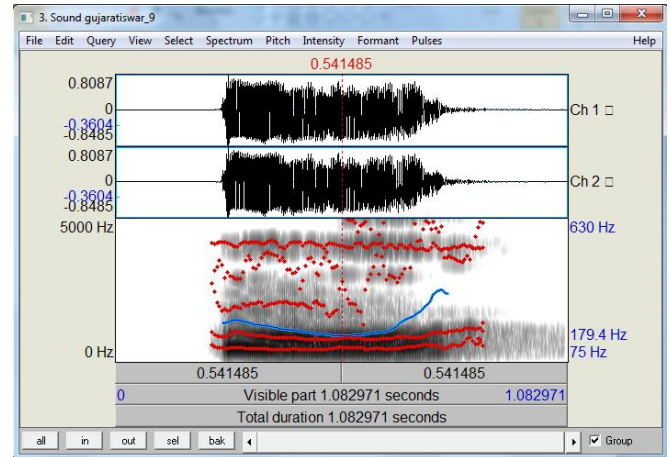


Figure-1 Time domain and frequency domain (spectrogram) waveform of vowel /o/ ‘ઓ’

The presented phonetic transcription has been performed by PRAAT software. The reason to choose PRAAT software is because it is easy to operate and it can run on all operating systems and commonly acceptable by all research scholars. Each phonemes are stored separately as mention previously and analyse in time domain and frequency domain (using spectrogram) and separately as shown in figure-1. Presented phonetic transcription has been build up using International Phonetic Alphabet (IPA) Symbols.

As shown in Table-2 Phonetic transcription for consonants has been carried out. As mention in table it is identified mainly based on two things one is place of articulation and second is manner of articulation and further place of articulation is subdivided in to bilabial, labiodental, Dental, Alveolar, Post Alveolar, Retroflex, Palatal, Velar, Uvular, Pharyngeal and Glottal. And Manner of articulation is subdivided in to Plosive, Nasal, Fricatives, Affricates, Lateral, Trill, and Approximants [12, 13]. Each consonant has been spoken and placed at right place as per author knowledge and practice and references. During distribution some problems has been identified which has been mention as remarks in Table-3.

Phonetic Transcription for Vowels are defined by Position of Tongue and Height of Tongue. Position of the tongue have a strong correlation with F2 formant and Height of tongue have strong correlation with F1 formant. Additionally lower value of F2 formant means back position of tongue and lower value of F1 means greatest is the height of tongue. With this basic understanding for each vowels F1 and F2 formants have been identified using PRAAT software as shown in Table-4 and then graph has been prepared as shown in figure-2. If the table-4 and Figure-2 is repeated using

multiple speaker we can plot average value and error can be reduced and get accurate plot.

Table-2 Phonetic Transcription for Consonants in Gujarati Language

		Bilabial		Labiodental		Dental		Alveolar		Post Alveolar		Retroflex		Palatal		Velar		Uvular		Pharyngeal		Glottal	
		U	V	U	V	U	V	U	V	U	V	U	V	U	V	U	V	U	V	U	V	U	V
Plosive	UA	/p/	/b/			/t/	/d/					/ʈ/	/ɖ/			/k/	/g/						
	A	/pʰ/	/bʱ/			/tʰ/	/dʱ/					/ʈʰ/	/ɖʱ/			/kʰ/	/gʱ/						
Nasal			/m/						/n/				/ɳ/										
Fricatives			/f/				/s/		/ʃ/													/h/	
Affricates							/tʃ/	/dʒ/			/tʃʰ/	/dʒʱ/	/ks/	/gn/									
Lateral							/l/					/ɭ/											
Trill							/r/																
Approximants				/w/									/j/										

Table-3 some issues during phonetic Transcription [14, 15]

Sr. No.	Gujarati Phonetic	Remarks
1	ઙ	“ઙ” can be pronounce as /pʰ/ or /f/ If /pʰ/ then it is Plosive, Bilabial, Aspirated, Unvoiced, If /f/ then it is Fricative, Labiodental, Unvoiced
2	ત, ઇ, ઘ, ઢ	/tʰ/, /tʃʰ/, /dʱ/, /dʒʱ/ can be considered as an dental / Retroflex
3	ન	/n/, “ન” can be considered either Dental/ Alveolar
4	સ, ઝ	“સ” /ɳ/, “ઝ” /ʒ/, Dilemma to consider this two phoneme as nasal phoneme or not
5	હ	“હ”, /h/ Dilemma to consider this as fricative sound or not
6	ચ, જ	“ચ”, /tʃ/, “જ”, /dʒ/ can be considered as either Alveolar or Post Alveolar
7	ર	“ર”, /r/ can be treat as trill or tap/flap

IV. RESULTS AND DISCUSSION

Phonetic Comparison between Gujarati and English language. The comparison between English and Gujarati

Table-4 F1 and F2 formants for each vowels **Error! Not a valid link.**

	F2 (Hz)	F1 (Hz)
અ(ə)	1347.961	690.5287
અ(ɑ)	1418.69	942.579
ઇ(ɪ)	1763.504	339.387
ઈ(i)	2838.805	374.1887
ઉ(U)	625.469	359.191
ઊ(u)	638.607	349.286
એ(e:)	2448.868	418.951
ઐ(əj)	905.475	316.285
ઓ(o:)	791.591	436.311
ઔ(əu)	769.923	399.064
અ:(əh)	973.719	254.7988
ઋ(ru)	1385.802	761.435

Language has been done as mention in Table-5 which may useful in multilingual engine or speech conversion [16, 17]. As shown in table-5 fricative voiced and approximants



Figure-2 Phonetic Transcription for vowels for Gujarati Language

voiced phonemes are not available in Gujarati language but English have the other fundamental differences are clearly shown.

V. CONCLUSION AND FUTURE SCOPE

In this paper Phonetic database has been created for Gujarati Language with an intention to make Gujarati synthesiser in future and phonetic transcription has been developed as per author knowledge. During development of phonetic transcription whatever the issues has been faced they are clearly mention so still there is a scope to do further research work. Overall some effort has been put in phonetic research for Gujarati language and untimely Indian regional language. Also phonetic transcription comparison has been done between Gujarati and English for multilingual application like multilingual phonetic engine.

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