Isolated Word Lateral Phonetic Class Speech Recognition in Malayalam Language

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Abstract— For Speech recognition in the selection of text corpus commonly some phonemes will never likely to occur and the words which includes such phonemes will never be recognized properly. Therefore special care to be taken to include all phonemes of a language in maximum word positions(Start, end , middle). Our aim in this paper is to develop a speech recognizer for lateral class of words of Malayalam Language.

Keywords— Automatic speech recognition, Malayalam, lateral

I. INTRODUCTION

Malayalam is one among the 22 official languages spoken in India with about 38 million speakers. It belongs to the Dravidian family of languages and is one of the four major languages of this family with a rich literary tradition[1]. The majority of Malayalam speakers live in Kerala, one of the southern states of India and in the union territory of Lakshadweep. The language has 37 consonants and 16 vowels. There are different spoken forms in Malayalam although the literary dialect throughout Kerala is almost uniform[2].

Many efforts have been made in other Indian languages however, Malayalam is in its infancy stage in speech recognition research. Since speech technology depends on the spoken language, each and every sound and its phonetic realization has to be explored, for a robust speech recognition system. Hence in this thesis, the unique phonetic features of the Malayalam language has been explored by analyzing its auditory, acoustic and speech recognition performance. Moreover, speech recognizers for different domains like continuous speech, connected speech and isolated speech has also been developed. In addition to this we could succeed to develop a phonetic class wise speech recognizer.

In this paper we discuss the results of the phonetic class wise speech recognition performance of Malayalam language. The words have been collected in such a way that, each word contains at least any of the phonemes of each class. Maximum care has been taken in the selection of words, so that all phonemes of the particular class is occurred in all the word positions.

II. PHONETIC CLASSES AND PHONES IN MALAYALAM LANGUAGE RELATED WORK

Malayalam language has 5 category of phonetic classes, they include stops (aspirated and un-aspirated), Nasals, fricatives, lateral and rhotic[3]. Table 1 list the phones in each category. Each phoneme classes are explained in detailed in the following section.

Table 1: Category of Phones

Phonome classes	*Malayalam Phonemes*
Unvoiced unaspirated stops	പ p , ബ b , ത t , ദ dh , ഠ t't' , ട d , ഡ ḍ' , ച ch , ജ j , ക k , ഗ g
voiced aspirated stop	ഫ ph , ഭ bh , ഥ th , ധ dh , ഠ d'h , ഢ ḍh' , ഛ ch' , ഝ jh , ഖ kh , ഘ gh
Nasals	മ m , ന n , ന n1 , ണ ṇ' , ഞ ñ , ങ ṅ
Frivatives	ഫ f , സ s , ഷ ṣ'h , ശ sh , ഹ h
Lateral	ല l , ള l' , ഴ zh
Rhotic	റ r' , ര r
semi vowels	വ v , യ y

III. LATERAL CLASS

Laterals are consonants formed by allowing the air to escape around the sides of the tongue[4]. In Malayalam there are three laterals. Their allophonic distributions are given below: [l] Alveolar lateral occurs initially, medially and finally[5]. eg: /laabham/ `profit' , /kalam/ `season' , /kadaL'/ `sea' [l'] Retroflex lateral occurs medially and finally.

Eg: /val'a/ `bangle' , /avaL/ `she'

[zha] palatal lateral
[!] prepalatal retroflex lateral with slight friction occurs medially.
Eg: /kaziv>/ `ability'

IV DATABASE DESIGN

We have collected words in such a way that each phoneme should occur   in initial or , medial or final positions in the word. In all the positions the phonemes are succeeded by the maximum possible vowels. As an example for the phoneme /l/ , in the initial position, we have the words as shown below.

- /lakkam'/ - succeeding vowel 'a
- /laabham'/ - succeeding vowel 'aa'
- /lipi /   - succeeding vowel 'i'
- /liila/ - succeeding vowel 'i'
- /luptam'/ - succeeding vowel 'u'
- /luun'a / - succeeding vowel 'uu'
- / lehal'a/ - succeeding vowel 'e'
- / le'panam'/ - succeeding vowel 'e"
- / laila / - succeeding vowel 'ai'
- / lo'ham'/ - succeeding vowel 'o'

Position wise listing of   number of words of each phoneme is detailed in table 2. Pronunciation dictionary[6] of some of the words are shown in table 3.

Table 2: Position wise listing

	Number of words with phonemes in			total
	Initial position	*Medial position*	*Final position*	
alveloar lateral ല	10	14	3	27
palatel lateral ഴ		14		14
retroflex lateral ള	1	12	2	15
Total				56

Table 3: Pronunciation dictionary

Word	Pronunciation dictionary	Meaning
lakkam'	l a clk kk a m	'number'
laabham'	l aa clp bh a m	'profit'
Lipi	l i clp p i	'letter'
Liila	l ii l a	'a female name'
luptam'	l u clp p clt t a m	'very less'
luun'a	l uu n' a	'name of a fish'
lehal'a	l e h a l' a	'riot'
le'panam'	l e' clp p a n1 a m	'paste'
Laila	l ai l a	'a female name'
lo'ham'	l o' h a m	'metal'

V. DESIGN AND DEVELOPMENT

speech recognizer for the above classes of words have been developed. Semi continuous, Context dependent tied state HMM's with 3 state per HMM[7] and 8 Gaussian per state were used for modeling. MFCC[8] were used for feature extraction and trigram models used for language modeling. In each phonetic class wise recognizer, speech corpus contain 25 speakers' data, out of which training is performed by 20 speakers' data and testing by 5 speakers' data. The experiment was conducted using 5 fold validation test and the results were analyzed using   the performance metric WER[9] using sclite from NIST[10].

IV. RESULTS OF SPEECH RECOGNTION OF PERFORMANFE OF LATERAL CLASS WORDS

Lateral class words contains words 15 in palatal lateral category, words 15 in retroflex lateral category and words 24 in alveolar lateral category The accuracy of lateral class speech recognizer is given in table 4 in testing and training environment. During training, an average of 96.4% accuracy is obtained while during testing the accuracy was only 72.3%.

Table 4 : speech recognition results words having of lateral class phonemes

	Training	*Testing*
1	96.34	72.22
2	95.21	71.43
3	97.2	73.1
4	96.87	72.68
Average	96.41	72.36

VI SUMMARY

In this paper we have presented our effort of developing recognizers for Lateral class category of words.   This work would be contribution to the   domain of Isolated word recognizers of Malayalam language. .

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