

Application for Speech Recognition Help to Search Government Policies – Based on MFCC with Gammatone Filter

Mugdha Parande, Shanthi Therese, Vinayak Shinde

Abstract: Speech is a natural mode of communication for people. Yet people are so comfortable with verbal skills rather than writing. Today’s digital world needs to interact with the computers via speech which can be easier and fast. Outstanding work in speech recognition and feature extracting has produced the commercial speech recognition systems for speech driven computing and word-processing systems. This paper deals with an application to make an easy search to retrieve Government Policies from system database by using the techniques of speech recognition. For developing application we use hybrid feature extraction technique i.e. MFCC with Gammatone Filter Bank and for recognition Vector Quantization is used.

I. INTRODUCTION

There are various ways to communicate with each other such as writing, speaking etc. Speech is the most desirable medium of communication. As we know Government of India facilitates tones of policies and scheme for development and growth but every person cannot take benefits from it because lack of policy reaches. This is the main huddle which resists our India to reach at the top of the world. This paper proposes recognition application to interact with system to get Government of India’s policies and schemes. In recent decades, speech recognition systems have significantly improved. Nevertheless, obtaining good performance in noisy environments still remains a very challenging task. Therefore, in proposed application Gammatone Filter used as a pre-process for reducing noise distortion and then Mel Frequency Cepstral Coefficient (MFCC) is used for extracting features. At the end Vector Quantization is one of the techniques for recognition.

II. WHAT IS SPEECH GENERATION?

Speech recognition system which recognizes whatever the user said. But for recognizing speech one needs to understand how speech generates and what features can make more accurate perception of speech. Some messages or ideas come to one’s mind and then it converts into language code for example you know English and Marathi then first you decide which language you want to use. Now you convert a message into phonemes sequence of corresponding language.

For example in English there are 45 phonemes. Now muscular like tongue, lips and vocal tract produce an acoustic waveform. Most of time, same word of acoustic wave may differ because of duration, loudness and pitch of sound. When this acoustic waveform comes to ear then ear’s basilar membrane works like a Spectrum Analyzer. Different points on basilar membrane respond to different frequencies. In acoustic waveform, different features are found like pitch period, loudness, and formant frequencies. Depending on extracted features, your mind decides phoneme in a sequence corresponding to acoustic waveform reaching one’s ear. From those phonemes, word and sentences are generated and then one’s mind studies that message.

III. SPEECH RECOGNITION PROCESS

Process of Speech Recognition: Figure [1] shows Block diagram of speech recognition. Speech is the input to Automatic Speech Recognition (ASR) system. Speech is divided into sequence of 10- msec frames for faster processing. In many cases, the math assumes that the signal is periodic. However, when it take a rectangular window

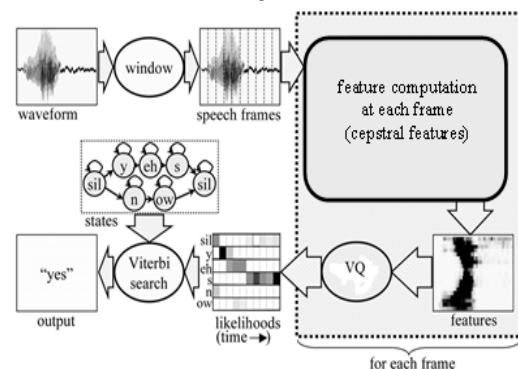


Fig [1] Block diagram of Speech Recognition

to extract an observation at one frame, It discontinuities in the signal at the end. So window of signal can be of other shapes, making the signal closer to zero at the end. Window size does not have equal frame size.

Output of pre-emphasis phase is given to feature extractor for feature computation at each frame. There are many feature extraction algorithms such as PLP, LPC, MFCC, and PNCC. Those algorithms generate (features) cepstral coefficient values. Vector Quantization (VQ) is a method of automatically partitioning a feature space into different clusters based on training data. A “codebook” lists central locations of each cluster, and gives each cluster a name. This can be used for data reduction or for probability estimation. At the end Viterbi search algorithm which gives recognized words from the given speech.

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Proposed Speech Recognition Approach

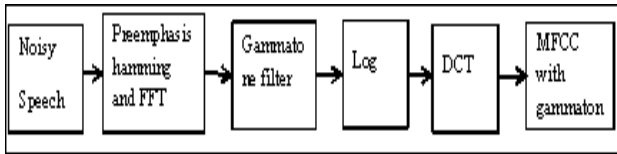


Fig [2] Proposed feature extraction approach

The figure shown proposes approach of speech recognition. It differs from traditional MFCC technique for feature extraction that involves Gammatone Filter. It is a linear filter, described by an impulse response. Which is supports the product of a gamma distribution and sinusoidal tone. It's mainly used in proposed system for preprocessing phase which helps to discard distortion occurred by noise. An impact of Gammatone filter shown in figure [1] and [2], both figures represents wav files. In fig [1] "whatsapp" is a word spoken by a person that wav file has noise distortion because of environment therefore, it gives output as "wh@at\$%sup". The same word spoken by the same person, that wav file represents in fig [2] but it gives clean wav file compared with fig [1] because of Gammatone filter which reduces noise distortion.

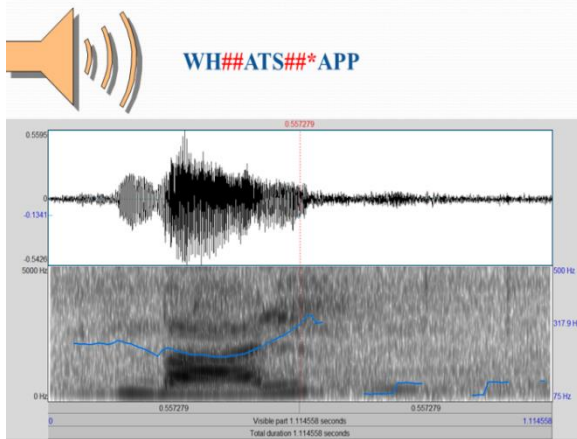


Fig [3] Audio wave with noise distortion

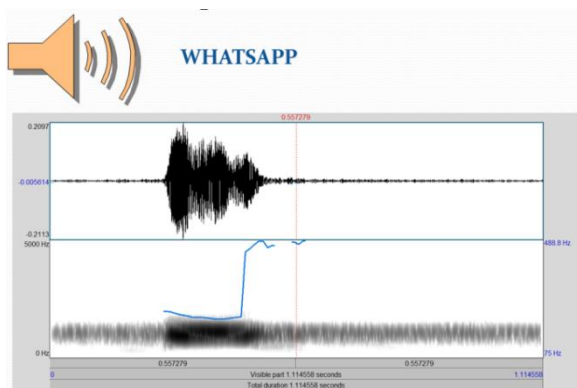


Fig [4] Audio Wave with Gammatone Filter

Preprocess of Gammatone Filter and Feature Extraction of MFCC is composed of the following steps:

1. Pre-emphasis
2. The impulse response of a Gammatone filter centered at frequency f is given by

$$s'_n(m) = s_n(m) - 0.97 \cdot s_n(m-1)$$
3. Hamming Window

$$g(t) = at^{n-1}e^{-2\pi bt} \cos(2\pi ft + \phi)$$

$$h(n) = 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right)$$

4. Power Spectrum (not db scale)

$$S = (Xr^2 + Xi^2)$$

5. Mel Scale Filter Banks (Triangular Filter)

$$\text{Mel}(f) = 2595 \log_{10}\left(1 + \frac{f}{700}\right)$$

6. Compute log Spectrum from filter banks

$$10 \log_{10}(S)$$

7. Convert log energies from filter banks to cepstral coefficients

$$c_i = \sum_{j=1}^N m_j \cos\left(\frac{\pi i}{N}(j-0.5)\right) \quad \begin{matrix} m_j = \log \text{energy values} \\ N = \text{number of filter banks} \end{matrix}$$

8. Weight cepstral coefficients

$$c'_n = \exp(n \cdot k) c_n \quad k = 0.6$$

Proposed Application of Speech Recognition

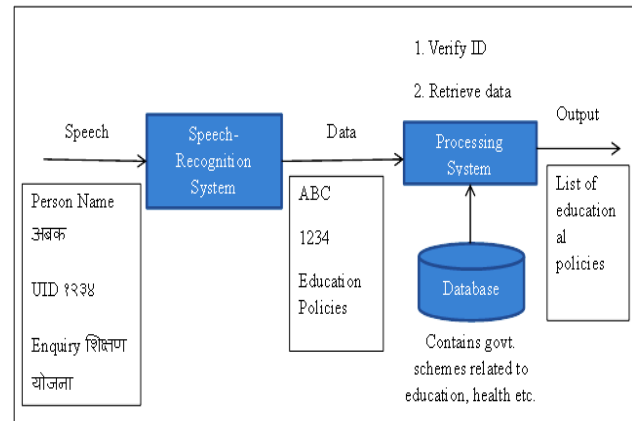


Fig [5] Proposed application

Figure shows flow of application. There are two modules

- 1) Speech Recognition system to recognize sound data and convert it into text data which uses proposed speech recognition approach as mentioned above.
- 2) Processing System to perform Retrieval function which retrieves Government of India's policies and schemes from database. Finally displaying the output as per the user requires.

IV. EXPERIMENTAL RESULTS

The proposed approach gives more accurate result than traditional MFCC because of Gammatone Filter Bank. Experimental Results are shown in the figure [1] and [2]. Those results generated by MATLAB program which distinguish the impact of pre-process with gammatone filter bank and without gammatone filter bank. Figure[1] has more dark blue color than Figure[2] it means figure[1] has more noise distortion than the other. This was visual comparison used before implementing speech recognition application with Gammatone Filter as pre-process.



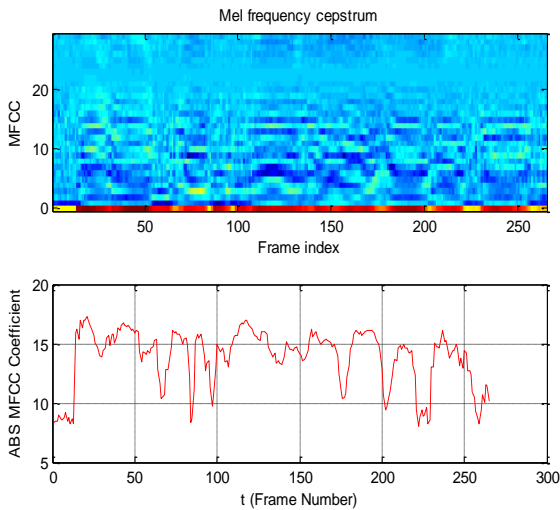


Fig [6] Result of Mel Frequency cepstral Coefficient

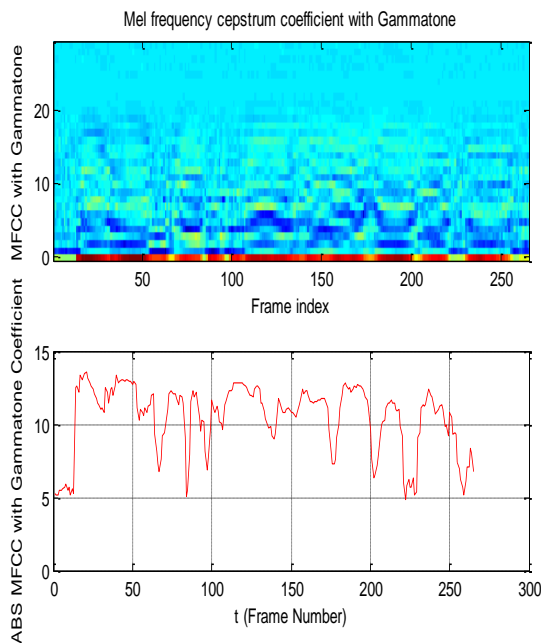


Fig [7] Result of Mel Frequency Cepstral Coefficient With gammatone filter Bank

The Speech Recognition Application composes the following steps

1. Need to Train dataset.
 2. Creates dictionary for mapping codebook.
 3. After training of dataset, Vector Quantization generate text file which contain features.
 4. Start the application with Login Username and Password (To administer for security purpose).
 5. Search Indian Government policies and schemes with one's voice input.
 6. Retrieve Indian Government policies and schemes.
- Speech Recognition Application can train Marathi language to generate VQ codebook file. This application now mainly focuses on rural citizen in Maharashtra therefore application converts Marathi language into English and then retrieve function call for displaying Indian Government policies and schemes. In Training Phase, each word needs to train; every training dataset contains 20 samples. Those samples consist of 10 male samples and 10 female samples for multiple user purpose. In the application, Dictionary is needed for mapping purpose. This contains 50 words in Marathi

language. After login to application any one can take benefits from application through simple input as voice. Click 'Record Button' and speak name of the policy or the scheme. Automatically spoken voice converts into text and displays into the text area. Click 'Retrieve Button' to display the policy or the scheme file on the application screen. Snapshot of Application

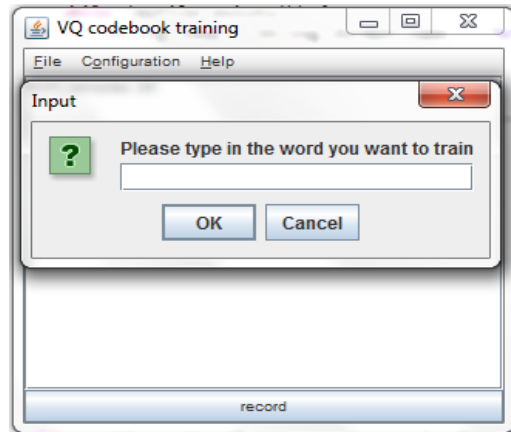


Fig [8] Training dataset dialogue box

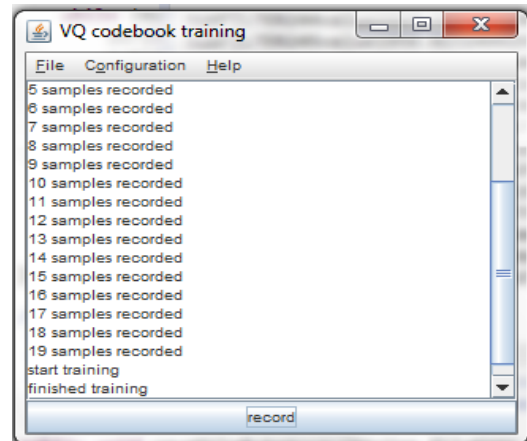


Fig [9] Finishing Training dataset

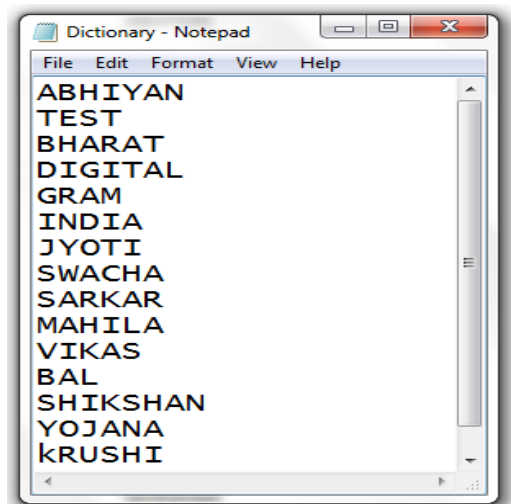


Fig [10] Screen of dictionary

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Fig [11] Login Page of application

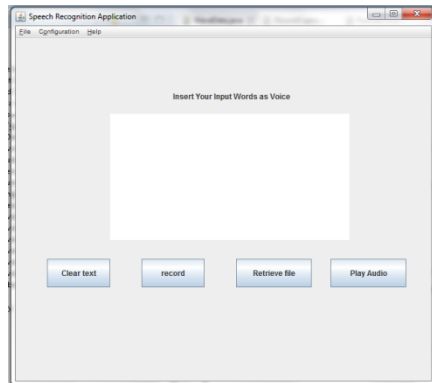


Fig [12] Screen of recognition in application

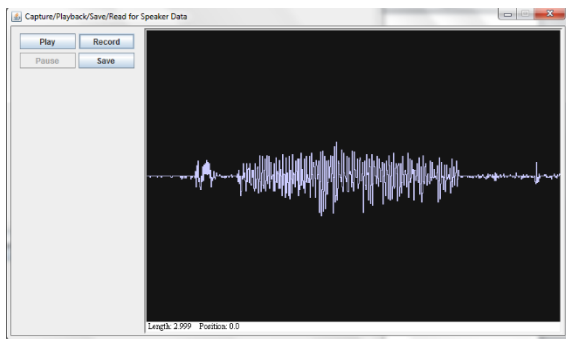


Fig [13] Screen of recording in application

V.CONCLUSION

The Speech recognition application can effectively be used in public sector. This application is very useful to illiterate people in respect to being familiar with Indian Government policies and schemes. Implementation of application based on MFCC with Gammatone Filter Bank as pre-process which helps to improve accuracy of recognition.

There are some drawbacks like need to wide search area and to improve more accurate probability of getting search estimation.

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