Deep Learning based Emotion Recognition System Using Speech Features and Transcriptions

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Introduction

This paper proposes a speech emotion recognition method based on speech features and speech transcriptions (text).

- **Problem**: Speech Emotion Recognition

- **Proposed Solution:**
- Speech features such as Spectrogram and Mel-frequency Cepstral Coefficients (MFCC) help retain emotion related low-level characteristics in speech whereas text helps capture semantic meaning, both of which help in different aspects of emotion detection.
- The combined MFCC-Text Convolutional Neural Network (CNN) model proved to be the most accurate in recognizing emotions in IEMOCAP data. .
- Achieved almost 7% increase in overall accuracy as well as an improvement of 5.6% in average class accuracy when compared to existing state-of-the-art methods.

Methods

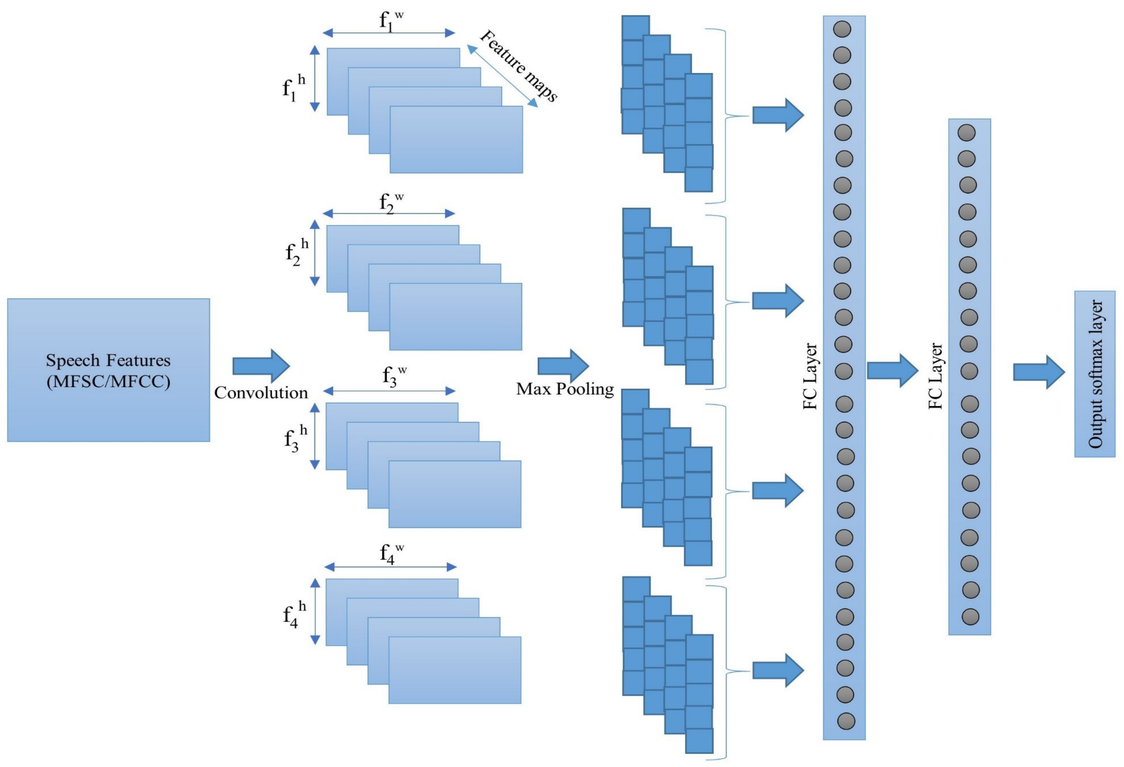


Fig. 1. Spectrogram/MFCC based CNN model

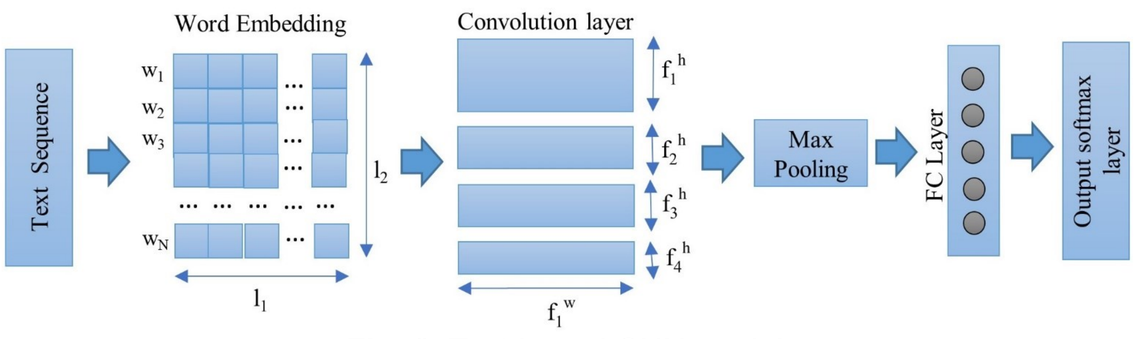


Fig. 2. Text-based CNN model

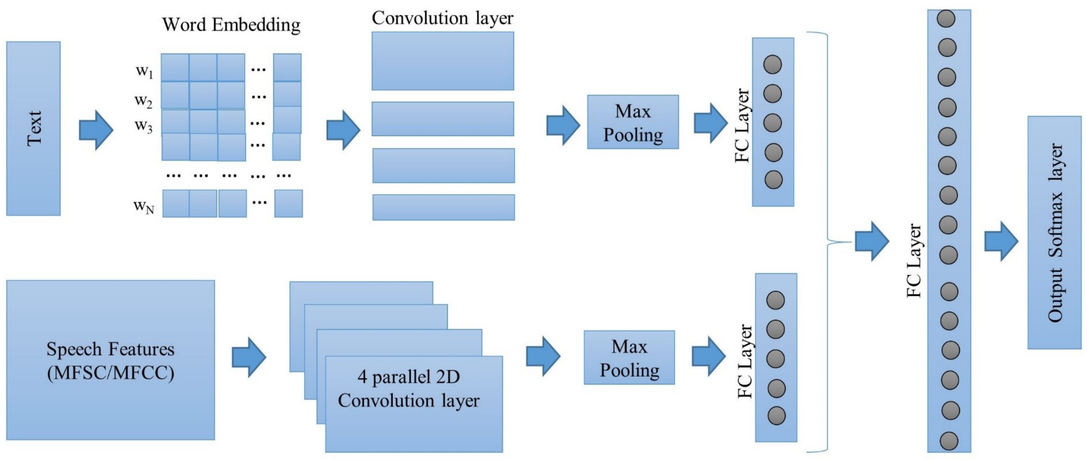
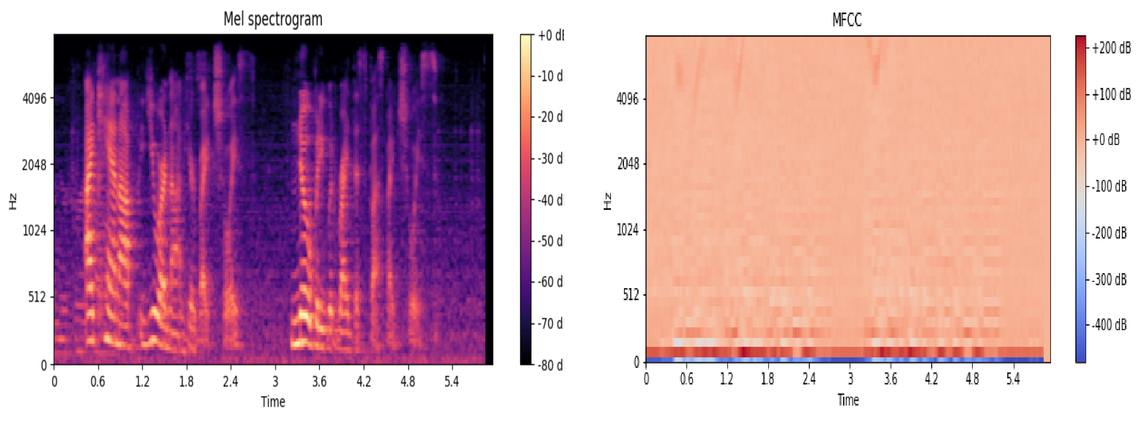


Fig. 3. Representative CNN architecture for emotion recognition using Speech Features and Transcriptions

Speech Features



Results

Methods	Input	Overall Accuracy	Class Accuracy
Lee [1]	Spectrogram	62.8	63.9
Satt [2]	Spectrogram	68.8	59.4
Model 1	Text	64.4	47.9
Model 2A	Spectrogram	71.2	61.9
Model 2B	Spectrogram	71.3	61.6
Model 3	MFCC	71.6	59.9
Model 4A	Spectrogram & MFCC	73.6	62.9
Model 4B	Text & Spectrogram	75.1	69.5
Model 4C	Text & MFCC	**76.1**	**69.5**

Conclusions

- Multiple architecture have been proposed to work with speech features (MFCC or Spectrogram) and speech transcriptions for emotion recognition.
- Spectrogram/MFCC based 2D CNN model provided enhanced accuracy which is further enhanced when combined with text.
- The combined MFCC-Text model also gives a class accuracy of 69.5% but an overall accuracy of 76.1%, thereby achieving a 5.6% and an almost 7% improvement over current benchmarks respectively.
- The proposed models can be used for emotion-related applications such as conversational chatbots, social robots, etc. where identifying emotion and sentiment hidden in speech may play a role in the better conversation.

References

1. *Lee, J., Tashev, I.: High-level feature representation using recurrent neural network for speech emotion recognition. In: INTERSPEECH (2015).*
2. *Satt, A., Rozenberg, S., Hoory, R.: Efficient Emotion Recognition from Speech Using Deep Learning on Spectrograms. In: INTERSPEECH, Stockholm (2017).*
3. *Kim, Y.: Convolutional Neural Networks for Sentence Classification. In: Proceedings of the 2014 Conference on EMNLP, pp. 1746–1751 (2014).*
4. *Tripathi, S., Beigi, H.: Multi-Modal Emotion recognition on IEMOCAP Dataset using Deep Learning. In: arXiv:1804.05788 (2018).*

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