Speech Emotion Recognition

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Syllabus

- Introduction
- Dataset
- Feature Extraction
- Classification
- Results
- Conclusion
- Reference

1 Introduction

Emotion Recognition

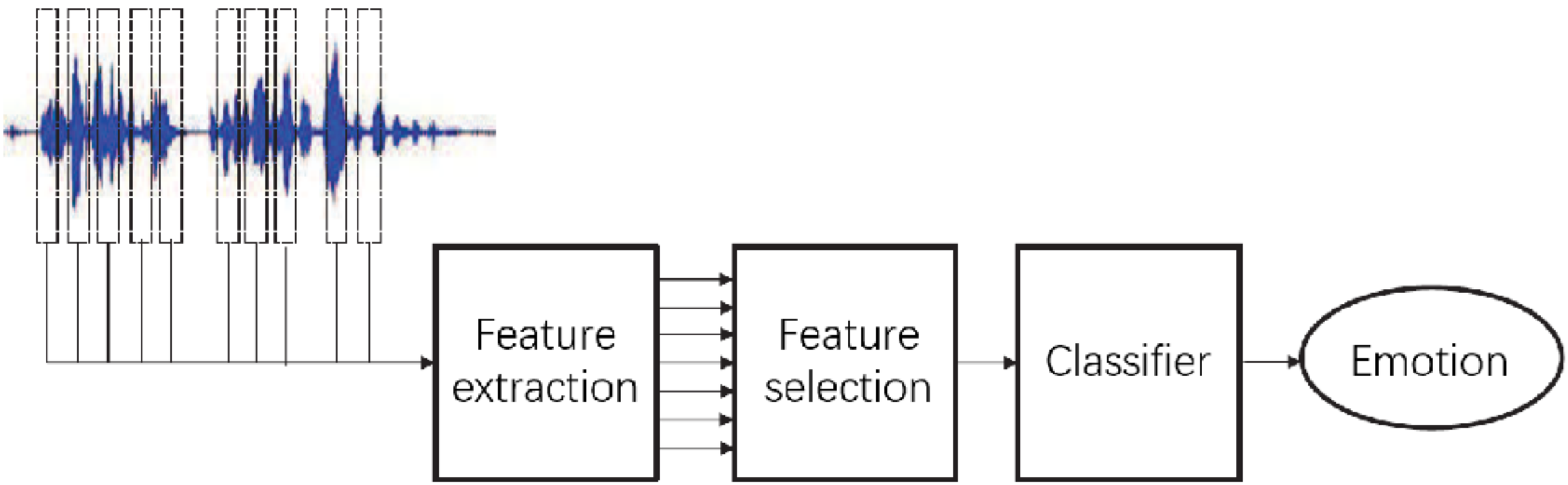
- Classify method: fear, surprised, happy, neutral, sad, angry, disgust.
- Active topic in human-computer interaction

Main Idea

- Extract features from human speech audio
- Preprocessing and select features
- Use machine learning network to recognition

1 Introduction

Framework



2 Dataset

- **RAVDESS**: Ryerson Audio-Visual Database of Emotional Speech and Song
  24 actors (M&F) reading 2 sentences;
  1,248 recordings in total.

- **TESS**: Toronto Emotional Speech Set
  2 actors (F) reading different words;
  1,370 recordings selected.

- 7 emotions: neutral, happy, sad, angry, fear, surprised and disgust.

- Sample rate and number of channels should be unified.

Feature Extraction

- Lots of parameters for emotional characteristics

- Calculated short-term features: pitch, energy, MFCC, ZCR, spectral centroid (and gender)
  Feature Matrix: audioNum * featureNum * windowNum

- Implemented with MATLAB API and LibROSA.
  BUT matlab engine was 100 times slower!

- Trimmed or zero-padded to a fixed length

4 Classification

- SVM
- Pre-trained network (vgg16…)
- Convolutional neural network (CNN)

Pre-processing

- Normalize: Center to the mean and scale to unit variance for each feature
- One hot coding: encode label
  select the class with max probability

SVM

- Support Vector Machine
- non-linear classifier by transforming the input feature vectors into a higher dimensional feature space using a kernel mapping function.

- SVC: based on libsvm, use one versus one method to solve e multi-class problem

VGG16

- Many pre-trained networks in Keras
- Deep learning network used for Image but also can extract features
- Slow, no better performance

CNN

Layer (type)	Output Shape	Param #
batch_normalization_1 (Batch	(None, 56, 57, 1)	4
conv2d_1 (Conv2D)	(None, 54, 55, 32)	320
max_pooling2d_1 (MaxPooling2	(None, 27, 27, 32)	0
dropout_1 (Dropout)	(None, 27, 27, 32)	0
conv2d_2 (Conv2D)	(None, 25, 25, 32)	9248
max_pooling2d_2 (MaxPooling2	(None, 12, 12, 32)	0
dropout_2 (Dropout)	(None, 12, 12, 32)	0
flatten_1 (Flatten)	(None, 4608)	0
dense_1 (Dense)	(None, 256)	1179904
dropout_3 (Dropout)	(None, 256)	0
dense_2 (Dense)	(None, 7)	1799

Total params: 1,191,275
Trainable params: 1,191,273
Non-trainable params: 2

Feature Selection Method

- Use SVM: fast and high performance
- Important features: MFCC, pitch, gender

5 Results

- SVM: 88.5% (20 MFCCs)
- Pre-trained network: bad performance (~66%)
- CNN: around 84% (50 MFCCs)
- SVM and CNN are suitable for emotion recognition with higher accuracy and faster operation

6 Conclusion

- Use both prosodic and spectral features to realize analysis on emotion with accuracy over 80%
- Dataset small and not random speech
  TESS: 99%, RAVDESS: 64%
- Difficulty in features determine
- More work needed for real-time recognition, try LSTM

7 Reference

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Thank you !