WISE: Web-based Interactive Speech Emotion Classification

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Motivation

- Fully automatic speech emotion classification systems may not reflect the user’s perceived emotions
- Manual speech emotion classification is costly and not efficient
Introduction

- WISE: a web based interactive speech emotion classification system
  - WISE has an automatic speech emotion recognition module, which is trained by a user’s choices over time
  - WISE gives suggestions to users, which can be accepted or corrected by the user
The WISE System Overview

Web-based Interface

Server Processes
Automatic Speech Emotion Classification Module

- **Training Dataset**
- **Testing Sample**
- **Feature Extraction**
  - **Feature Selection**
  - **Emotions Subsystem**
    - 6 binary SVMs Threshold Fusion
    - Emotion Label or Rejection
  - **Arousal Subsystem**
    - 3 binary SVMs Threshold Fusion
    - Arousal Label or Rejection
  - **Valance Subsystem**
    - 3 binary SVMs Threshold Fusion
    - Valance Label or Rejection
Features

- All features and their 1st order derivatives (except speaking rate) are calculated in **overlapping frames**

- Statistical values are calculated using all frames
  - min, max, mean, standard deviation and range (max-min)
  - Support Vector Machine (SVM) Recursive Feature Elimination

<table>
<thead>
<tr>
<th>Feature name</th>
<th>#</th>
<th>Feature name</th>
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</thead>
<tbody>
<tr>
<td>Fundamental Frequency (f0)</td>
<td>10</td>
<td>Spread</td>
<td>10</td>
</tr>
<tr>
<td>Energy</td>
<td>10</td>
<td>Skewness</td>
<td>10</td>
</tr>
<tr>
<td>Frequency and bandwidth for the first four Formants</td>
<td>80</td>
<td>Kurtosis</td>
<td>10</td>
</tr>
<tr>
<td>12 Mel-frequency Cepstral Coefficients (MFCCs)</td>
<td>120</td>
<td>Flatness</td>
<td>10</td>
</tr>
<tr>
<td>Zero-cross rate</td>
<td>10</td>
<td>Entropy</td>
<td>10</td>
</tr>
<tr>
<td>Roll-off</td>
<td>10</td>
<td>Roughness</td>
<td>10</td>
</tr>
<tr>
<td>Brightness</td>
<td>10</td>
<td>Irregularity</td>
<td>10</td>
</tr>
<tr>
<td>Centroid</td>
<td>10</td>
<td>Speaking Rate</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Size of Feature Vector:</strong> 331</td>
<td></td>
</tr>
</tbody>
</table>
Automatic Emotion Classifiers

• System uses binary SVM classifiers with RBF kernel for each emotion
  • 6 binary SVMs for first sub-system:
    • anger, disgust, panic, happy, neutral, sadness
  • 3 binary SVMs for second and third sub-systems:
    • Arousal Categories: active, passive and neutral
    • Valence Categories: positive, negative and neutral
  • Total of 12 binary SVMs
LDC Dataset

- 15 Emotions
- Speakers: 4 actresses and 4 actors
- Total of 2433 utterances
- Acted dataset
- In our experiments
  - 6 Emotions: anger, disgust, panic, happy, neutral and sadness
  - Speakers: 4 actresses and 3 actors
  - 727 utterances
Experiments

- Simulating user interactions:
  - Divide dataset into training, validation and testing subsets
  - Steps of simulation:
    1. Classification module is trained with initial training subset
    2. Models are evaluated on testing subset
    3. A single sample from validation subset is added to training subset
    4. Models are evaluated on testing subset
    5. Repeat until validation subset is empty

- In high level, user uploads a new sample in each iteration and models are evaluated to see if they are adapting to new data or not
Experiments

- Scenario 0 – *baseline – no adaptation*:
  - 6 out of 7 speakers’ data are used for training and validation data
  - Testing data is chosen from the remaining speaker
  - This is repeated for all speakers and results are averaged over 7 speakers and 200 trials
  - Validation data is known to the system

- Scenario I – *simulation of “system adapting to user upload data”*:
  - Same setting as scenario 0, except validation data is chosen from the remaining speaker
  - Validation data is unknown to the system
Experiments

- Scenario II – *simulation of “system requesting ground-truth from user”*:
  - Same setting as scenario I, except the validation data is ordered in according to their classification confidence level in the system, and the least confident sample is added to the system in each round:
    - The system chooses a sample which it has least information on from the validation subset
    - Adds it to training subset
    - The models are evaluated on testing subset
    - Repeat until validation subset is empty
  - This scenario is beneficial when adding more data is costly
Experiments – Emotion Category

- $N$ is the number of samples for each class in training
- Validation data has 2 samples from each class, total of 12
Experiments – Arousal Category

- $N$ is the number of samples for each class in training

- Validation data has 3 samples from each class, total of 9
Experiments – Valance Category

- $N$ is the number of samples for each class in training
- Validation data has 3 samples from each class, total of 9
WISE WEB ACCESS

http://system.wise.audio
Conclusion

- In this study, The WISE system is introduced and evaluated
- The WISE system is available for the community to use
- Evaluation results show that the system can adapt to a user’s emotional choices over time
  - Future work: user study
The End…

Thank you!