Learning to Rank Authenticity from Facial Activity Descriptors

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The Task – Real or Fake?

Dataset statistics

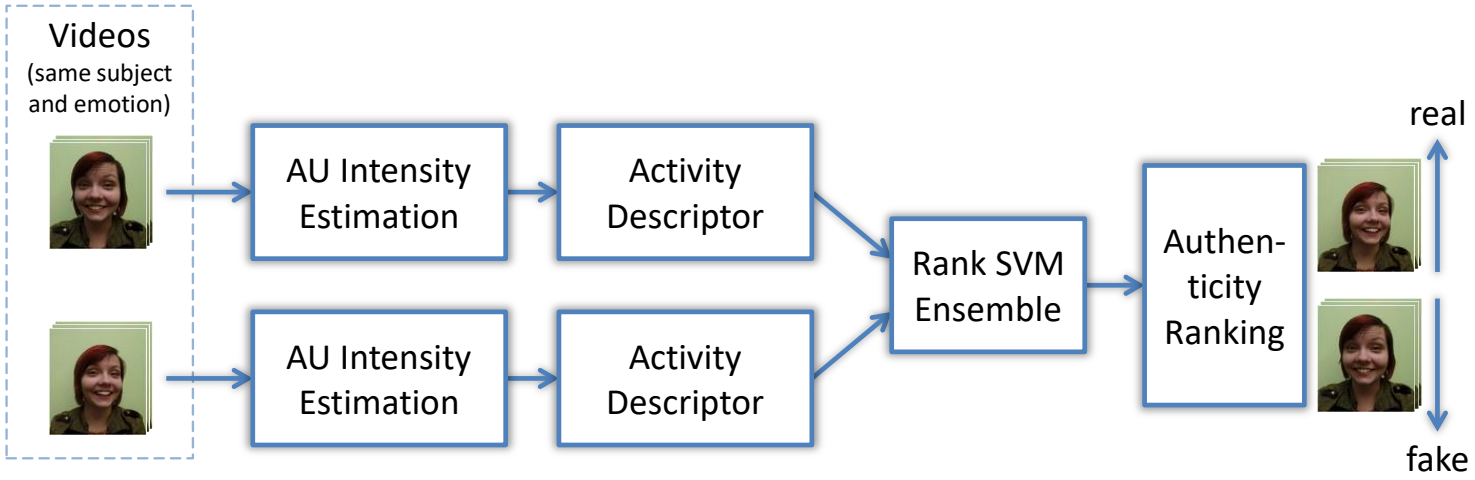
- Training set
  - 40 Subjects
  - 6 Emotions
  - 480 Videos
- Validation set
  - 5 Subjects
  - 6 Emotions
  - 60 Videos
- Test set
  - 5 Subjects
  - 6 Emotions
  - 60 videos
- One real and one fake video per emotion and subject

The Task – Real or Fake?

We changed the rules:

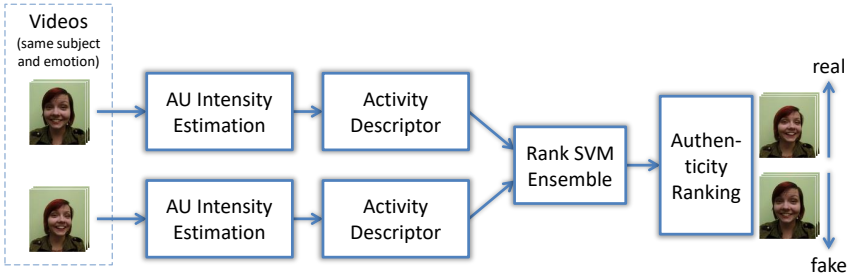
- Which one is more real than the other?

Our Approach



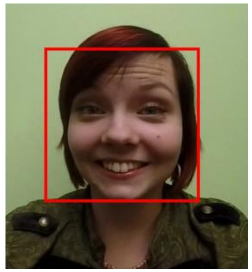
1. Face Detection
2. Face Recognition
3. Landmark detection
4. Action Unit Intensity Estimation
5. Facial Activity Descriptor
6. Rank SVM Ensemble

Our Approach



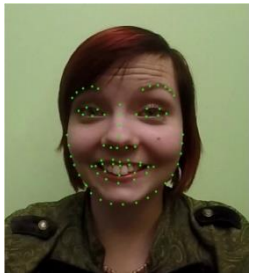
1. **Face Detection**
   - CNN resnet with dlib [1]
2. **Face Recognition**
   - CNN resnet with dlib [2]
3. **Landmark detection**
   - Ensemble of regression trees with dlib [3]
4. Action Unit Intensity Estimation
5. Facial Activity Descriptor
6. Rank SVM Ensemble

1.



2.

3.

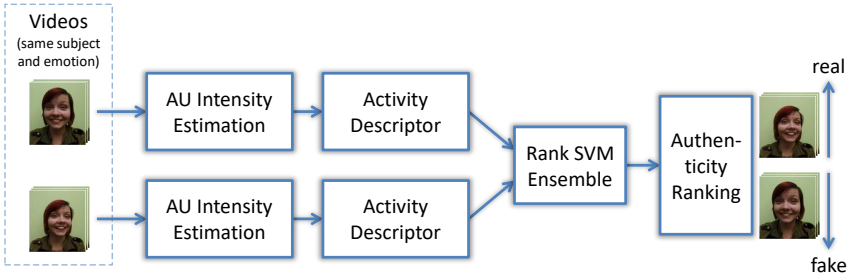


[1] D. King. Easily create high quality object detectors with deep learning, 2016. http://blog.dlib.net/2016/10/easily-create-high-qualityobject.html.

[2] D. King. High quality face recognition with deep metric learning, 2017. http://blog.dlib.net/2017/02/high-quality-face-recognition-withdeep.html.

[3] D. King. Real-time face pose estimation, 2014. http://blog.dlib.net/2014/08/real-timeface-pose-estimation.html.

Our Approach



1. Face Detection
2. Face Recognition
3. Landmark detection
4. **Action Unit Intensity Estimation**
   - Using previous work [4]
   - Affine face transform
   - LPB + shape features
   - Ensemble of SVR (Support Vector Regression)
5. Facial Activity Descriptor
6. Rank SVM Ensemble

Source: [5]

Action Unit 12:
Lip corner puller

Source: [5]

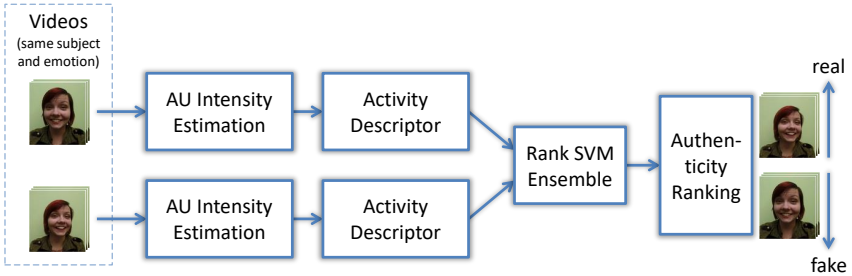
Action Unit 4:
Brow lowerer

List of used Action Units:
1: Inner Brow Raiser
2: Outer Brow Raiser
4: Brow lowerer
6: Cheek Raiser
9: Nose Wrinkler
12: Lip corner puller
25: Lips part

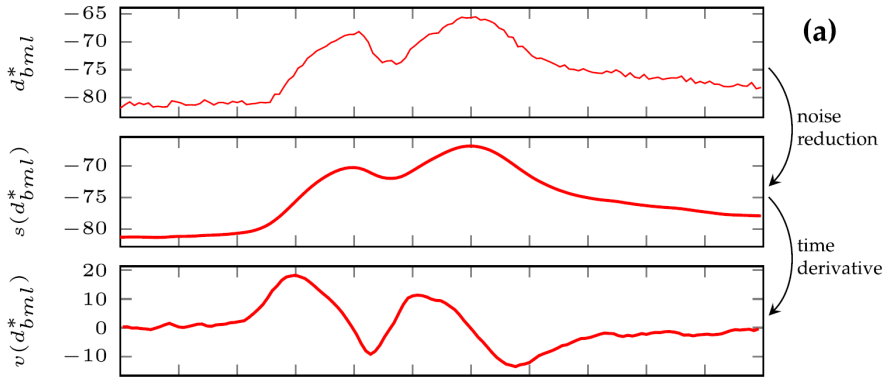
[4] P. Werner, F. Saxen, and A. Al-Hamadi. Handling data imbalance in automatic facial action intensity estimation. In X. Xie, M.W. Jones, and G. K. L. Tam, editors, Proceedings of the British Machine Vision Conference (BMVC), pages 124.1–124.12. BMVA Press, 2015

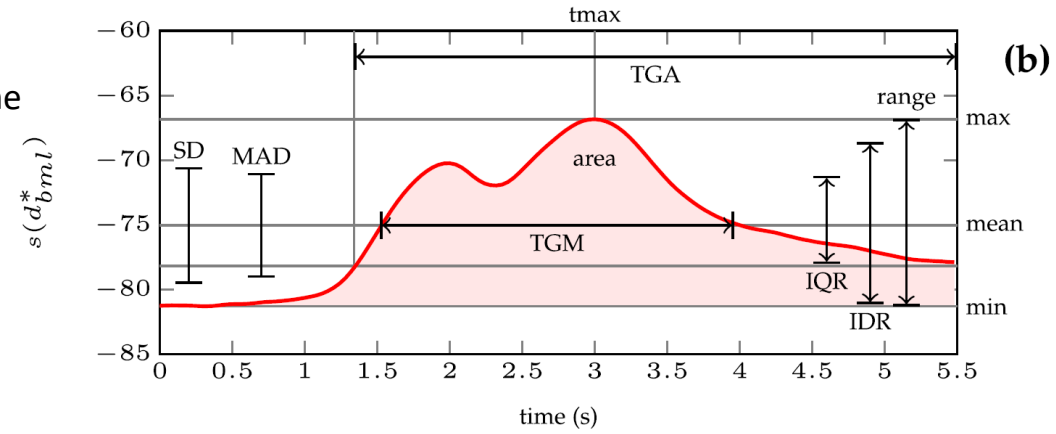
[5] Bryn Farnsworth. Facial Action Coding System (FACS) – A Visual Guidebook. Online. 2017-10-12. https://imotions.com/blog/facial-action-coding-system/

Our Approach



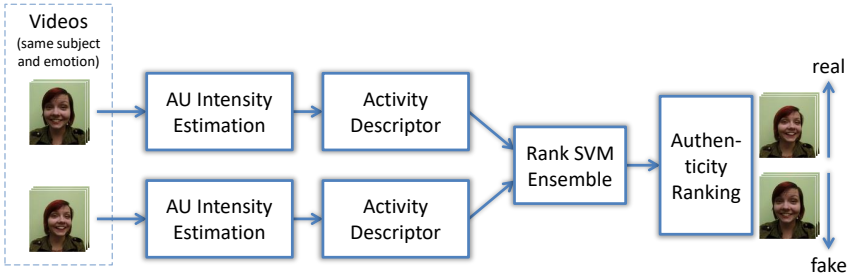
1. Face Detection
2. Face Recognition
3. Landmark detection
4. Action Unit Intensity Estimation
5. **Facial Activity Descriptor**
   - Based on previous work [5] with some additional statistics
   - Noise reduction with Butterworth filter
   - Filtered signal + derivative
   - Signal statistics (max, mean, …)
6. Rank SVM Ensemble





[5] P. Werner, A. Al-Hamadi, K. Limbrecht-Ecklundt, S.Walter, S. Gruss, and H. Traue. Automatic pain assessment with facial activity descriptors. IEEE Transactions on Affective Computing, PP(99):1–1, 2016

Our Approach



1. Face Detection
2. Face Recognition
3. Landmark detection
4. Action Unit Intensity Estimation
5. Facial Activity Descriptor
6. **Rank SVM Ensemble**
   - Learn the difference between two facial activity descriptors with libSVM [6]
   - Create an Ensemble of 75 Rank SVMs
   - Aggregate by counting the votes.

Training:

$$feature \rightarrow label$$
$$x_R - x_F \rightarrow 1$$
$$x_F - x_R \rightarrow 0$$

Test:

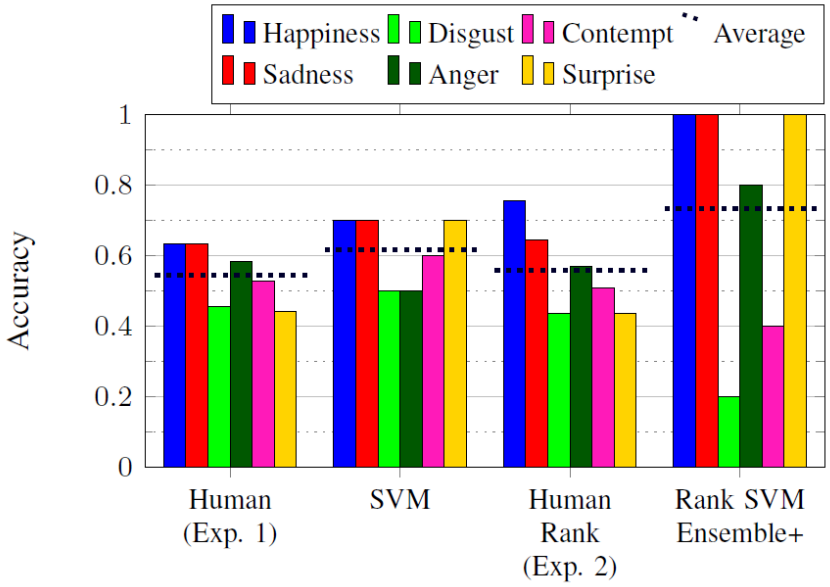
$$N_0 = \sum_{i}^{nEnsembles} pred_i\,(x_0 - x_1) == 1$$

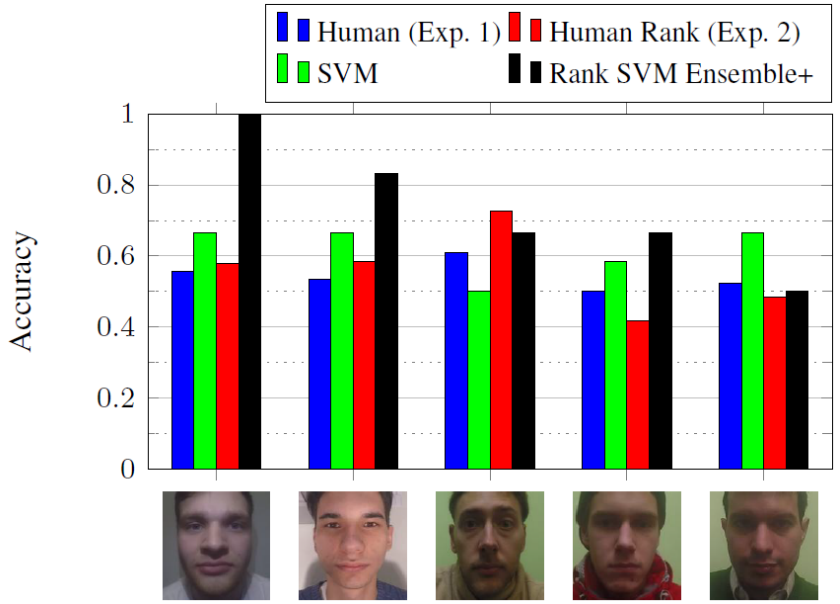
$$N_1 = \sum_{i}^{nEnsembles} pred_i\,(x_1 - x_0) == 1$$

$$y_0\ more\ authentic \leftarrow N_0 > N_1$$
$$y_1\ more\ authentic \leftarrow N_1 > N_0$$

[6] Chih-Chung Chang and Chih-Jen Lin, LIBSVM : a library for support vector machines. ACM Transactions on Intelligent Systems and Technology, 2:27:1--27:27, 2011. Software available at http://www.csie.ntu.edu.tw/~cjlin/libsvm

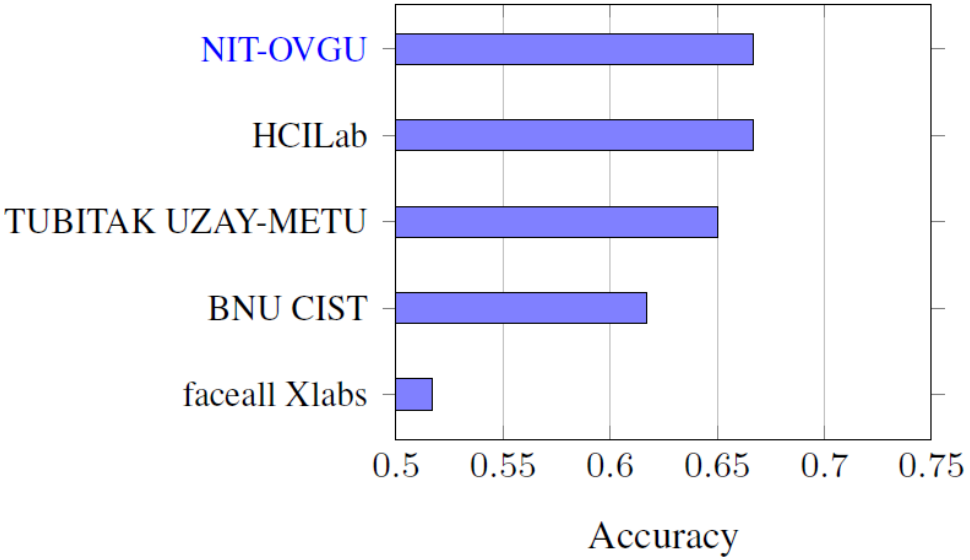
Results





- Validation set performance (5 subjects, 60 videos)
- Human performance conducted with 22 subjects

Results

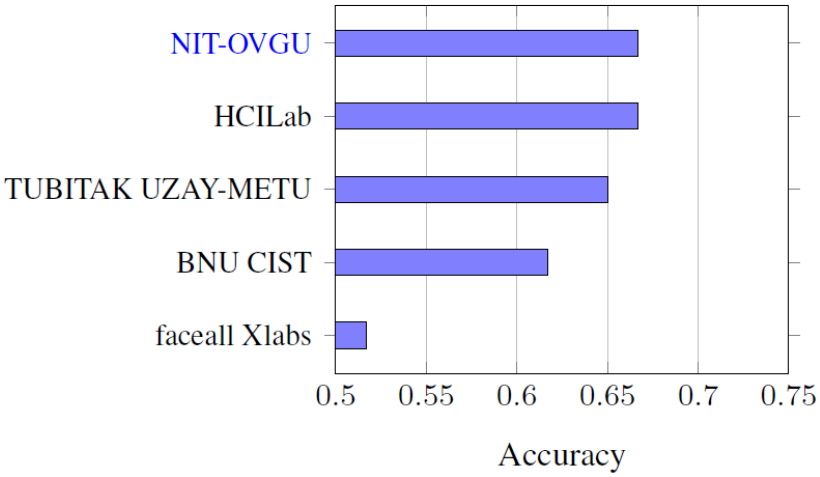


- Test set performance (5 subjects, 60 videos)

Final Remarks

- Professional organization team with quick and friendly response. Thank you!
- Challenge introduced us to a new research field.

- Validation and test set provided only 60 samples.
- Data acquisition is questionable:
  - Some humans reported that all videos look fake
  - Fake vs. Fake?



Final Remarks

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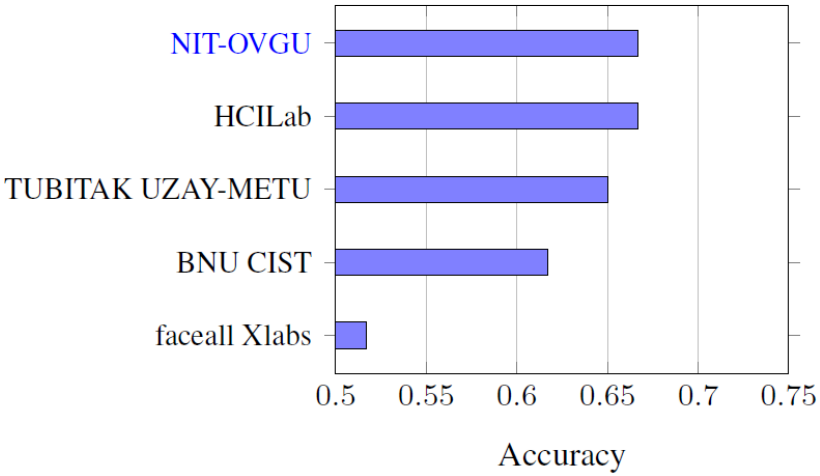

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