

The Extended Cohn-Kanade Dataset (CK+): A complete dataset for action unit and emotion-specified expression

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Introduction

- Emotion classification is a popular research topic since decades.
- One of the most used datasets used for study and development of facial expression detection was the Cohn-Kanade (CK) database.

This paper talk about:

- Expansion and proper labeling of the CK
- Emotion classification and Action Units (AU)

Extended Cohn-Kanade

- Cohn-Kanade
 - was composed by 486 FACS-coded sequences from 97 subjects
- Cohn-Kanade + expanded it to
 - 593 sequences from 123 subjects!
 - FAC coder revision for the sequences
 - Validated emotional labeling for the sequences

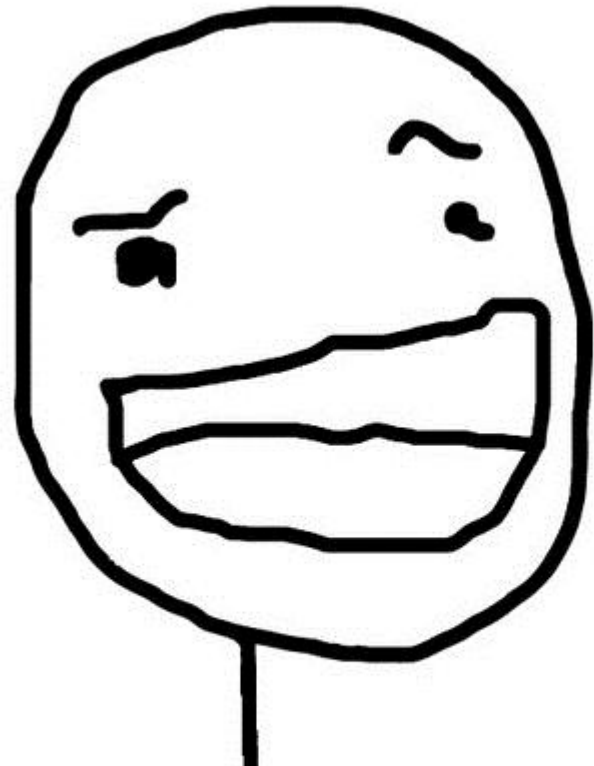
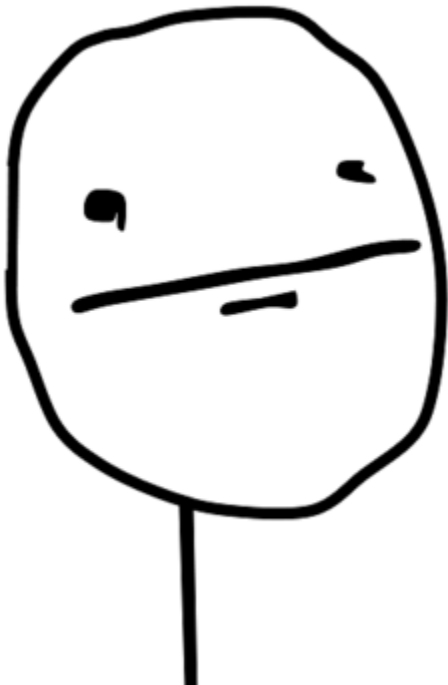


Emotion Validation

- First label, subject's impression of each of the 6 basic emotion categories plus contempt
 - Anger
 - Disgust
 - Fear
 - Happy
 - Sadness
 - Surprise
 - Contempt

Emotion Validation

- Unreliable



Emotion Validation

1. FACS codes with emotion prediction table
2. Second FACS filtering
3. Visual inspection

Emotion Validation

AU	Name	N	AU	Name	N	AU	Name	N
1	<i>Inner Brow Raiser</i>	173	13	<i>Cheek Puller</i>	2	25	<i>Lips Part</i>	287
2	<i>Outer Brow Raiser</i>	116	14	<i>Dimpler</i>	29	26	<i>Jaw Drop</i>	48
4	<i>Brow Lowerer</i>	191	15	<i>Lip Corner Depressor</i>	89	27	<i>Mouth Stretch</i>	81
5	<i>Upper Lip Raiser</i>	102	16	<i>Lower Lip Depressor</i>	24	28	<i>Lip Suck</i>	1
6	<i>Cheek Raiser</i>	122	17	<i>Chin Raiser</i>	196	29	<i>Jaw Thrust</i>	1
7	<i>Lid Tightener</i>	119	18	<i>Lip Puckerer</i>	9	31	<i>Jaw Clencher</i>	3
9	<i>Nose Wrinkler</i>	74	20	<i>Lip Stretcher</i>	77	34	<i>Cheek Puff</i>	1
10	<i>Upper Lip Raiser</i>	21	21	<i>Neck Tightener</i>	3	38	<i>Nostril Dilator</i>	29
11	<i>Nasolabial Deepener</i>	33	23	<i>Lip Tightener</i>	59	39	<i>Nostril Compressor</i>	16
12	<i>Lip Corner Puller</i>	111	24	<i>Lip Pressor</i>	57	43	<i>Eyes Closed</i>	9

Table 1. Frequency of the AUs coded by manual FACS coders on the CK+ database for the peak frames.

Emotion	Criteria
Angry	AU23 and AU24 must be present in the AU combination
Disgust	Either AU9 or AU10 must be present
Fear	AU combination of AU1+2+4 must be present, unless AU5 is of intensity E then AU4 can be absent
Happy	AU12 must be present
Sadness	Either AU1+4+15 or 11 must be present. An exception is AU6+15
Surprise	Either AU1+2 or 5 must be present and the intensity of AU5 must not be stronger than B
Contempt	AU14 must be present (either unilateral or bilateral)

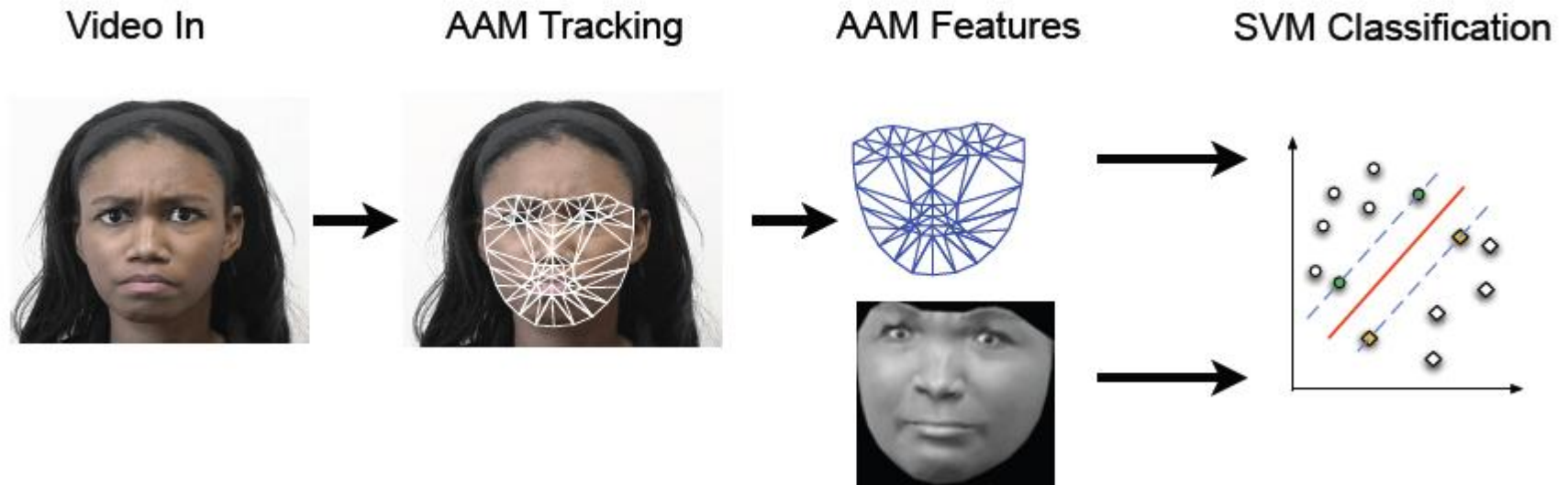
Emotion Validation



Figure 1. Examples of the CK+ database. The images on the top level are subsumed from the original CK database and those on the bottom are representative of the extended data. All up to 8 emotions and 30 AUs are present in the database. Examples of the Emotion and AU labels are: (a) Disgust - AU 1+4+15+17, (b) Happy - AU 6+12+25, (c) Surprise - AU 1+2+5+25+27, (d) Fear - AU 1+4+7+20, (e) Angry - AU 4+5+15+17, (f) Contempt - AU 14, (g) Sadness - AU 1+2+4+15+17, and (h) Neutral - AU 0 are included.

The automatic System

- Overview



The automatic System

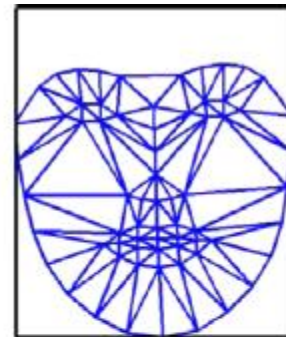
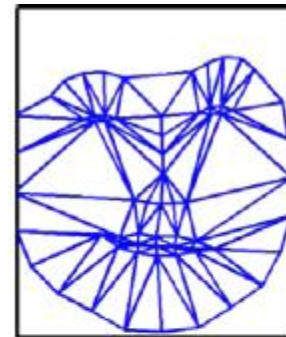
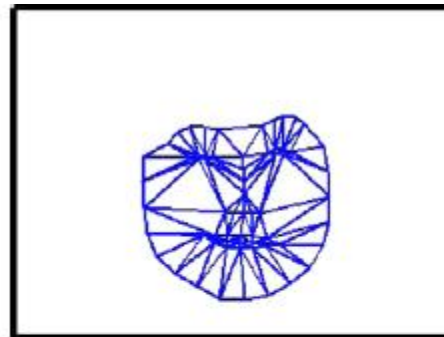
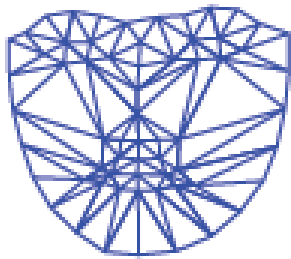
- Active Appearance Models (AAM):
 - Defined by a 2D triangulated mesh
 - Contains rigids and non-rigids geometric deformations
 - Similarity parameters for simple transforms
 - Keyframes within each sequence manually labelled

AAM Tracking



The automatic System

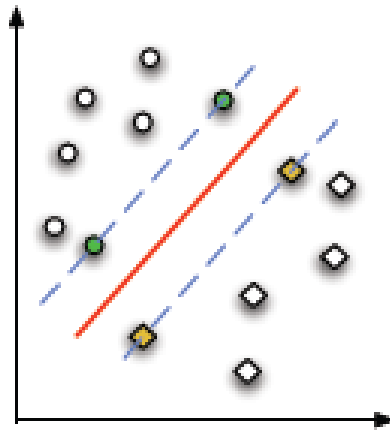
- Feature Extraction
 - AMM 2D points (68 vertex points)
 - Canonical normalized APPearence (APP)



The automatic System

- Support Vector Machine

SVM Classification



Results

- Results methods for AUs
 - SVM classification
 - Supervised Learning
 - 1 vs others
- Results methods for Emotion
 - SVM classification
 - Supervised Learning
 - Multimodal system (all vs all)

Results

- Au detection
 - SVM: 1 vs all
 - ROC curve as result TP/FP
 - Logical Linear Regression to combine scores

AU	N	SPTS	CAPP	SPTS+CAPP
1	173	94.1 ± 1.8	91.3 ± 2.1	96.9 ± 1.3
2	116	97.1 ± 1.5	95.6 ± 1.9	97.9 ± 1.3
4	191	85.9 ± 2.5	83.5 ± 2.7	91.0 ± 2.1
5	102	95.1 ± 2.1	96.6 ± 1.8	97.8 ± 1.5
6	122	91.7 ± 2.5	94.0 ± 2.2	95.8 ± 1.8
7	119	78.4 ± 3.8	85.8 ± 3.2	89.2 ± 2.9
9	74	97.7 ± 1.7	99.3 ± 1.0	99.6 ± 0.7
11	33	72.5 ± 7.8	82.0 ± 6.7	85.2 ± 6.2
12	111	91.0 ± 2.7	96.0 ± 1.9	96.3 ± 1.8
15	89	79.6 ± 4.3	88.3 ± 3.4	89.9 ± 3.2
17	196	84.4 ± 2.6	90.4 ± 2.1	93.3 ± 1.8
20	77	91.0 ± 3.3	93.0 ± 2.9	94.7 ± 2.6
23	59	91.1 ± 3.7	87.6 ± 4.3	92.2 ± 3.5
24	57	83.3 ± 4.9	90.4 ± 3.9	91.3 ± 3.7
25	287	97.1 ± 1.0	94.0 ± 1.4	97.5 ± 0.9
26	48	75.0 ± 6.3	77.6 ± 6.0	80.3 ± 5.7
27	81	99.7 ± 0.7	98.6 ± 1.3	99.8 ± 0.5
AVG		90.0 ± 2.5	91.4 ± 2.4	94.5 ± 2.0

Results

- Emotion detection
 - 2D features
 - Texture
 - Both

	An	Di	Fe	Ha	Sa	Su	Co
An	35.0	40.0	0.0	5.0	5.0	15.0	0.0
Di	7.9	68.4	0.0	15.8	5.3	0.0	2.6
Fe	8.7	0.0	21.7	21.7	8.7	26.1	13.0
Ha	0.0	0.0	0.0	98.4	1.6	0.0	0.0
Sa	28.0	4.0	12.0	0.0	4.0	28.0	24.0
Su	0.0	0.0	0.0	0.0	0.0	100.0	0.0
Co	15.6	3.1	6.3	0.0	15.6	34.4	25.0

	An	Di	Fe	Ha	Sa	Su	Co
An	70.0	5.0	5.0	0.0	10.0	5.0	5.0
Di	5.3	94.7	0.0	0.0	0.0	0.0	0.0
Fe	8.7	0.0	21.7	21.7	8.7	26.1	13.0
Ha	0.0	0.0	0.0	100.0	0.0	0.0	0.0
Sa	16.0	4.0	8.0	0.0	60.0	4.0	8.0
Su	0.0	0.0	1.3	0.0	0.0	98.7	0.0
Co	12.5	12.5	3.1	0.0	28.1	21.9	21.9

	An	Di	Fe	Ha	Sa	Su	Co
An	75.0	7.5	5.0	0.0	5.0	2.5	5.0
Di	5.3	94.7	0.0	0.0	0.0	0.0	0.0
Fe	4.4	0.0	65.2	8.7	0.0	13.0	8.7
Ha	0.0	0.0	0.0	100.0	0.0	0.0	0.0
Sa	12.0	4.0	4.0	0.0	68.0	4.0	8.0
Su	0.0	0.0	0.0	0.0	4.0	96.0	0.0
Co	3.1	3.1	0.0	6.3	3.1	0.0	84.4

Conclusion

- This paper contributes with an improved dataset, that may improve several works on emotion detection and AU detection.
- Raw SVM + texture classification results.

Questions?

Thanks for watching.