DOMINANT AND COMPLEMENTARY MULTI-EMOTIONAL FACIAL EXPRESSION RECOGNITION USING C-SUPPORT VECTOR CLASSIFICATION

Christer Loob, Pejman Rasti, Iiris Lusi, Julio C. S. Jacques Junior, Xavier Baro, Sergio Escalera, Tomasz Sapinski, Dorota Kaminska and Gholamreza Anbarjafari

Introduction

- Facial expressions are one of the most effective ways for humans to communicate due to the fact that they contain critical and necessary information regarding human affective states.

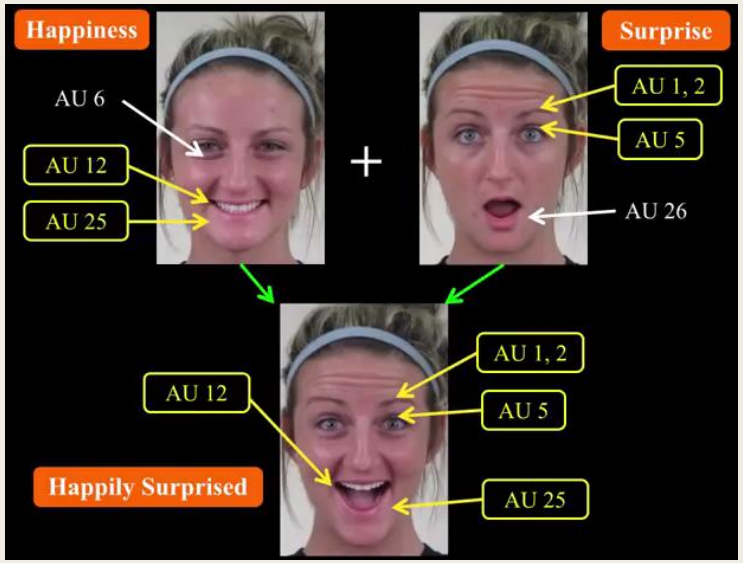
- Automatic facial expression analysis is very challenging
  - *high variation in the physiognomy of faces with respect to person's identity*
  - *illumination conditions, pose variation, etc.*

- Facial expression recognition systems have a wide range of possible applications
  - *robotics, human-computer interaction, human emotion analysis, etc.*

Introduction

- Most research works are focused on classical emotions which are ***anger***, ***contempt***, ***disgust***, ***fear***, ***happiness***, ***sadness***, and ***surprise*** as well as an eighth emotion referred to as ***neutral***

Current state-of-the-art models also focus on the analysis of facial action units [1] (e.g., FG'17 talk given by Aleix M Martinez). **"compound emotion categories"**: *combination of basic emotions* (21 distinct categories)



[1] S. Du, Y. Tao, A.M. Martinez. Compound Facial Expressions of Emotion. Proceedings of the National Academy of Sciences, 2014.

Proposed method

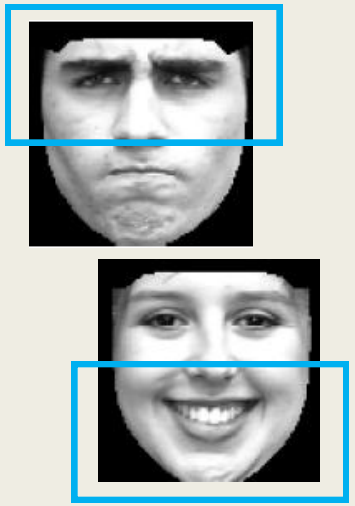
- In this work we are proposing a step forward to the classical definition of emotions, as well as extending the concept "*compound emotions*", by dividing the facial expressions into two main categories, namely, **dominant** expressions and **complementary** expressions, which are combinations of the seven basic expressions.

- Experimental results shows that not all 49 multi-emotional expression exists. However, it states that the proposed model was able to recognize **30+** emotions.

	Angry	Contempt	Disgust	Fear	Happy	Sadness	Surprise
Angry	**angry**	contemptly angry	disgustingly angry	fearfully angry	happily angry	sadly angry	surprisingly angry
Contempt	angrily contempt	**contempt**	disgustingly contempt	fearfully contempt	happily contempt	sadly contempt	surprisingly contempt
Disgust	angrily disgusted	contemptly disgusted	**disgust**	fearfully disgusted	happily disgusted	sadly disgusted	surprisingly disgusted
Fear	angrily fearful	contemptly fearful	disgustingly fearful	**fearful**	happily fearful	sadly fearful	surprisingly fearful
Happy	angrily happy	contemptly happy	disgustingly happy	fearfully happy	**happy**	sadly happy	surprisingly happy
Sadness	angrily sad	contemptly sad	disgustingly sad	fearfully sad	happily sad	**sad**	surprisingly sad
Surprise	angrily surprised	contemptly surprised	disgustingly surprised	fearfully surprised	happily surprised	sadly surprised	**surprised**

Proposed method

- Affective information is not distributed equally across the face and **different emotions utilize different parts of the face**.
- Some works suggest that the **eye region** is more informative for humans in recognizing *angry*, *fearful* and *sad faces*, whereas *disgust* and *happiness* appears to be mainly **guided by the mouth**. *Surprise* may be similarly recognized from **both regions**.



- Previous studies show that humans can recognize *happiness* from the bottom half of the face as accurately and even faster than from the whole face [2]

[2] N. Galvo, Fernandez-Martin, "Facial expression ecognition in peripheral versus central vision: role of the eyes and the mouth," Psychological Research, vol. 78, 2014.

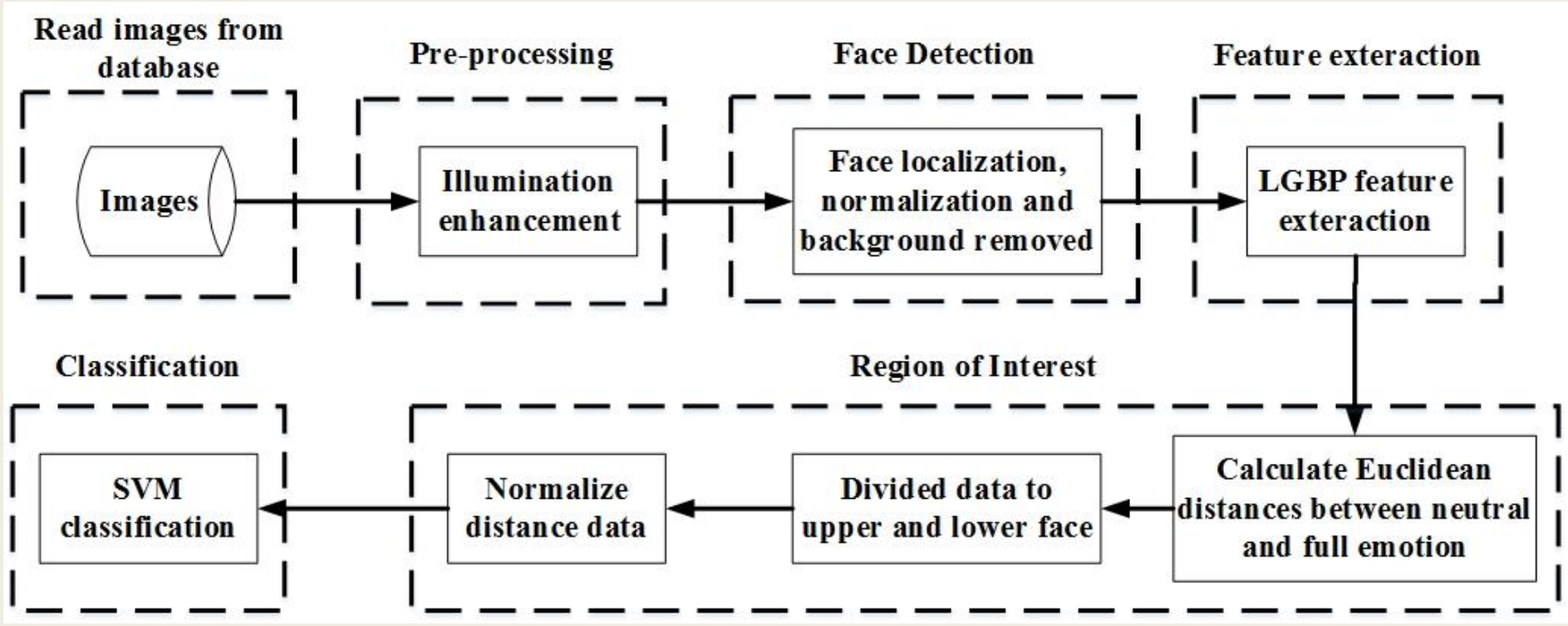
Proposed method

- In the proposed model, the **complementary** emotion is extracted from *either the lower or upper part* of the face, while the **dominant** emotion is extracted from *the whole face*.

- For example, if the dominant emotion is classified as one of the emotions that is mainly influenced by the upper part of the face (*anger, fear, sadness*), then we search for the complementary emotion in the lower part of the face, and vice-versa.

Proposed method

- As baseline, we propose the usage of a general approach to deal with facial expression recognition, which consists of 5 stages



Experimental Results

- **Cohn-Kanade AU-Coded Facial Expression (CK+)** database and on the **Japanese Female Facial Expression (JAFFE)** database.
  - *CK+* contains 327 samples of the 7 facial expressions (+neutral) of 100 individuals
  - *JAFFE* contains 213 images of 6 basic facial expressions (+neutral) of 10 different individuals

	Recognition Rate (%)
Angry	100
Contempt	89
Disgust	98
Fear	96
Happy	100
Sadness	89
Surprise	100

CK+

	Recognition Rate (%)
Angry	67
Disgust	55
Fear	84
Happy	87
Sadness	45
Surprise	73

JAFFE

Experimental Results

- Recognition rates of complimentary emotions

	Angry	Contempt	Disgust	Fear	Happy	Sadness	Surprise
Angry	**34**	3	1	2	1	2	2
Contempt	3	**8**	1	1	0	3	2
Disgust	7	2	**49**	1	0	0	0
Fear	3	1	1	**14**	2	1	3
Happy	3	2	4	5	**51**	2	2
Sadness	4	1	2	3	0	**15**	3
Surprise	5	2	3	3	2	3	**65**

CK+

	Angry	Disgust	Fear	Happy	Sadness	Surprise
Angry	**19**	3	1	0	2	1
Disgust	0	**18**	3	0	1	0
Fear	2	3	**15**	1	1	1
Happy	0	0	1	**25**	2	2
Sadness	4	0	0	1	**16**	2
Surprise	1	0	0	2	2	**20**

JAFFE

Experimental Results

- Sets of images with recognized labels were shown to 64 individuals, in order to evaluate the acceptance rate.
- They were asked to vote whether the recognized dominant and complimentary emotion have been recognized correctly or not.
- Results show that 73.88% of people agreed on the tagged dominant and complementary emotions.

Emotion	Agree	Disagree
Disgustingly angry	94.03	5.97
Angrily fearful	49.25	50.75

Conclusions

- A new methodology was developed for recognizing more than the seven classical emotions by extending the concept of *compound emotion categories* through the definition of complementary emotion (~50 complementary emotion categories).

- The methodology was evaluated on existing datasets, where we created labels with the help of psychologists.

- Our team also created a new and bigger dataset for this purpose, which were used in the FG challenge and can be used to help researchers to advance the research in the field (public available).

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