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Automatic stress detection evaluating models of facial action units

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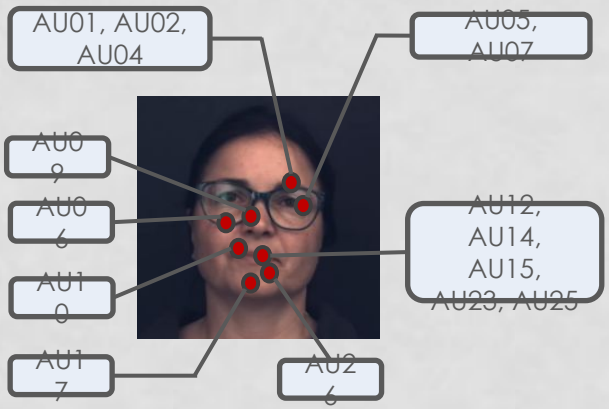
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Problem position

Input



Facial Action Units



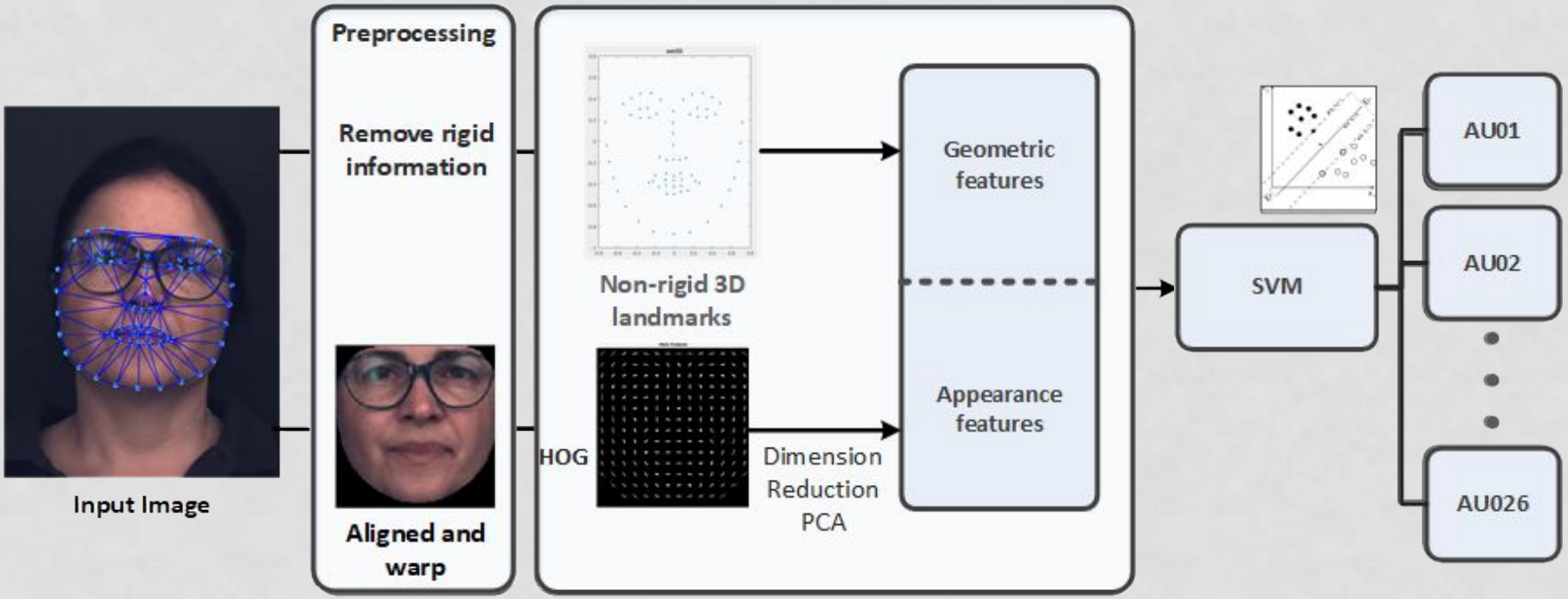
Computational stress model



Output

No stress
Stress

System flowchart



Stress model training

- FACS Annotated Facial Datasets
  - UNBC Pain Expression Archive Database (UNBC) [1]
    - 200 sequences/25 subjects (48,398 image
    - AU [6, 7, 9, 10, 12, 25, 26]
  - Bosphorus database [2]
    - 105 subjects (4666 images)
    - AU [1,2,4,5,6,7,9,10,12,14,15,17,20,23,25,2
- Combined model using both datase

AU	FACS name	Muscular basis
AU1	Inner brow raiser	frontalis (pars medialis)
AU2	Outer brow raiser	frontalis (pars lateralis)
AU4	Brow lowerer	depressor glabellae, depressor supercilii, corrugator supercilii
AU5	Upper lid raiser	levator palpebrae superioris, superior tarsal muscle
AU6	Cheek raiser	orbicularis oculi (pars orbitalis)
AU7	Lid tightener	orbicularis oculi (pars palpebralis)
AU9	Nose wrinkler	levator labii superioris alaeque nasi
AU10	Upper lip raiser	levator labii superioris, caput infraorbitalis
AU12	Lip corner puller	zygomaticus major
AU14	Dimpler	buccinator
AU15	Lip corner depressor	depressor anguli oris (triangularis)
AU17	Chin raiser	mentalis
AU23	Lip tightener	orbicularis oris
AU25	Lips part	depressor labii inferioris, or relaxation of mentalis or orbicularis oris
AU26	Jaw drop	masseter; relaxed temporalis and internal pterygoid

[1] P. Lucey, J. F. Cohn, K. M. Prkachin, P. E. Solomon, and I. Matthews, "Painful data: The unbc-mcmaster shoulder pain expression archive database," in IEEE International Conference on Automatic Face Gesture Recognition and Workshops (FG 2011)
[2] A. Savran, N. Aly¨uz, H. Dibeklio˘glu, O. C¸ eliktutan, B. G¨okberk, B. Sankur, and L. Akarun, "Bosphorus database for 3d face analysis," in European Workshop on Biometrics and Identity Management. Springer, 2008, pp. 47–56.

Model performance

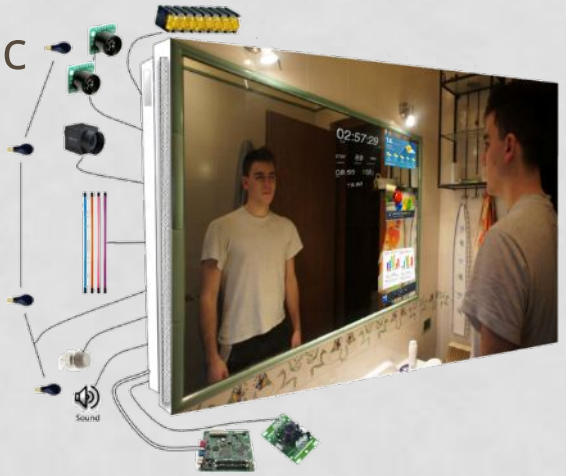
TABLE III

ACCURACY MEASURE USING 10-FOLD CROSS VALIDATION TECHNIQUE FOR THE UNBC, BOSPHORUS, AND THE COMBINED MODEL (UNBC+BOSPHORUS)

Model	AU01	AU02	AU04	AU05	AU06	AU07	AU09	AU10	AU12	AU14	AU15	AU17	AU23	AU25	AU26
UNBC					0.78	0.87	0.91	0.99	0.78					0.79	0.69
BOSPHORUS	0.74	0.74	0.87	0.75	0.82	0.77	0.95	0.80	0.92	0.88	0.75	0.82	0.79	0.78	0.92
Combined model	0.77	0.75	0.88	0.82	0.62	0.82	0.88	0.86	0.74	0.82	0.84	0.81	0.91	0.82	0.65

Study Population

- The dataset was collected during a research project related to contactless cardiometabolic assessment (among parameters: stress assessment)



- Semeoticons Reference Dataset for Stress Assessment (SRD'15) [1]
- 24 subjects
  - (16 males, 7 females)
  - age 47.3±9.3 years old





[1] Y. Andreu et al., "Wize mirror - a smart, multisensory cardio-metabolic risk monitoring system," Computer Vision and Image Understanding, vol. 148, pp. 3–22, 2016.

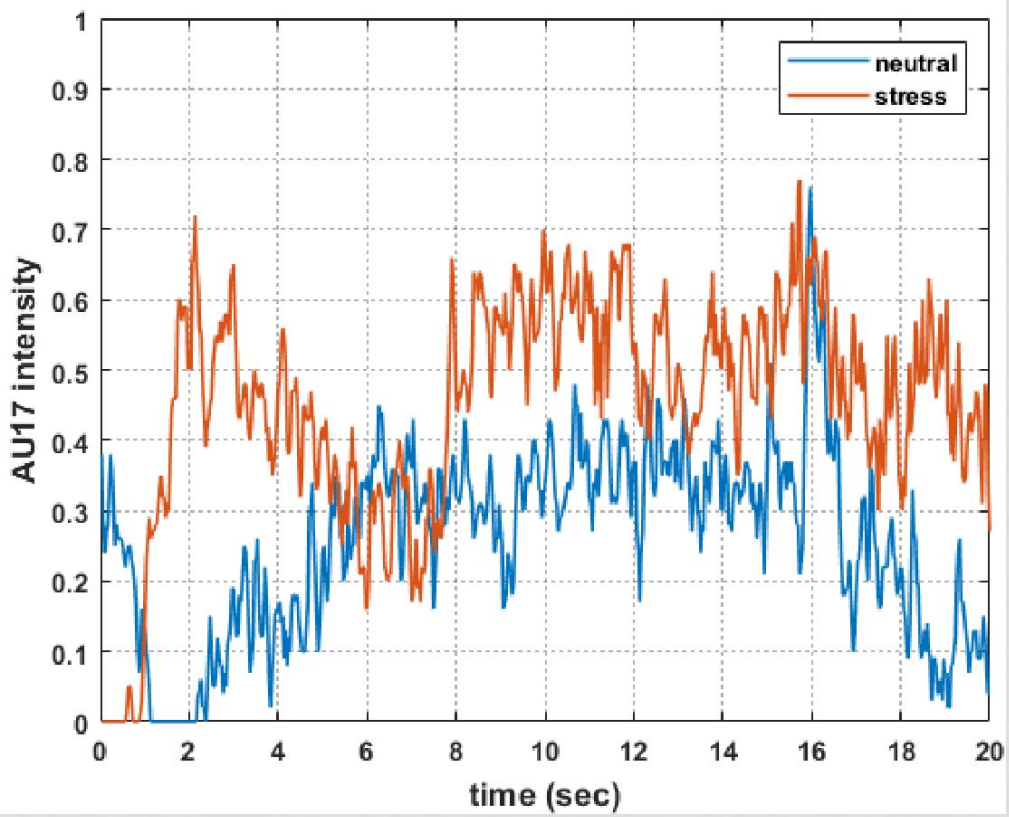
Experimental protocol

- A thorough experimental protocol
  - wide variety of external and internal stressors
- Each subject performed 11 tasks
  - 3 neutral
  - 7 stress
  - 1 relaxed

Experimental task		Duration (min)	Affective State
1. Exposure phase	1. Reference period	1	N
	2. Self describing	1	S
2. Emotion recall phase	1. Reference period	1	N
	2. Anxiety	1	S
	3. Stress	1	S
3. Image Sequences	1. Neutral/stressful images	2	S
	2. Stroop test	2	S
4. Stressful videos phase	1. Reference period	1	N
	2. Relaxing video	2	R
	3. Adventure film	2	S
	4. Psychological pressure film	2	S

Note: Intended affective state (N: neutral, S: stress, R: relaxed).

Stress AU behaviour



Performance results

TABLE VII

CLASSIFICATION RESULTS OF THE 10-FOLD CROSS VALIDATION SVM METHOD ON THE COMBINED TRAINED MODEL (UNBC+BOSPHORUS) APPLIED ON THE EXPERIMENTAL DATASET (SRD'15)

Classifier	Classification Accuracy (%)	Sensitivity (%)	Specificity (%)
KNN	68.2	92.3	61.5
GLM	69.7	88.6	37.5
Naïve Bayes	57.7	72.7	40.0
LDA	58.0	83.3	40.0
SVM	**74.6**	83.3	50.0

Thank you for your attention

