nano-tera.ch
swiss scientific initiative in health / security / environment systems

BodyPoweredSenSE RTD 2013

FNSNF

Wearable System for Real-Time Emotion Analysis

Fabio Dell'Agnola, Francisco Rincon, David Atienza

Embedded System Laboratory (ESL), EPFL

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

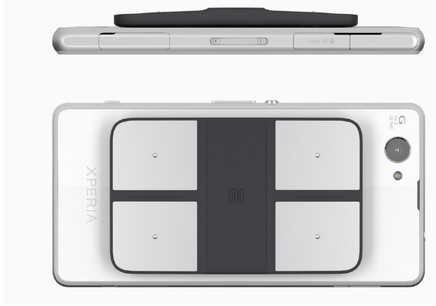
INTRODUCTION

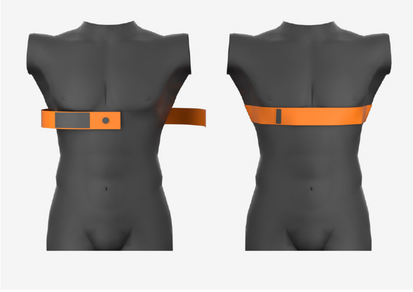
What is Embedded Real-Time Emotion Classification?

- Distinguishing one human emotion from another.
- Making the distinctions at the same time as they occur.
- Embedded on a device which collects physical data.

Why is it Important?

- Continuous monitoring for Alzheimer's disease [1] (Agitation, Disorientation, and Stress).
- Recognition of stress levels in drivers [2], etc.



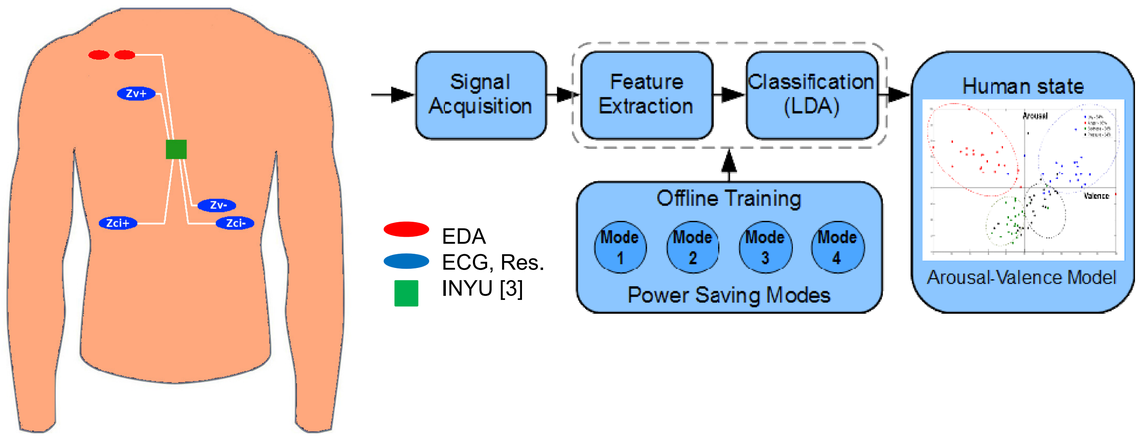


Wearable devices measure multiple physical signals:

- Electrocardiogram (ECG)
- Breathing
- Electrodermal activity (EDA)

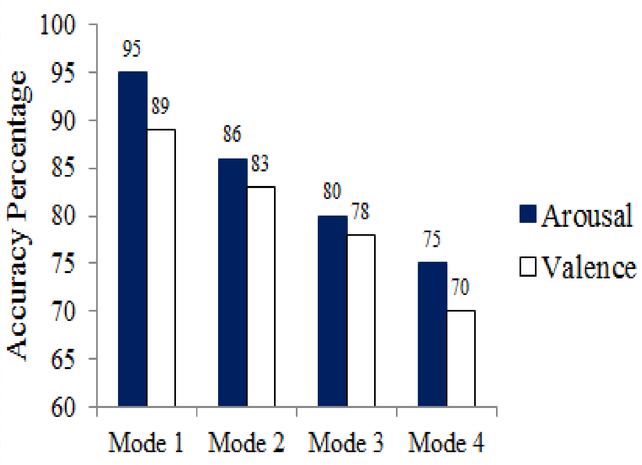
METHODOLOGY & PRELIMINARY RESULTS

Overview of the Classification System

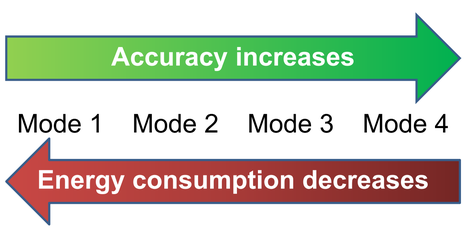


- Optimal sensor placement to reduce artefacts.

Energy-Aware Operating Modes Design



Mode	Average Current (mA)	Lifetime (h)
1	4.86	146.1
2	1.69	420.1
3	1.09	651.3
4	0.63	1126.9



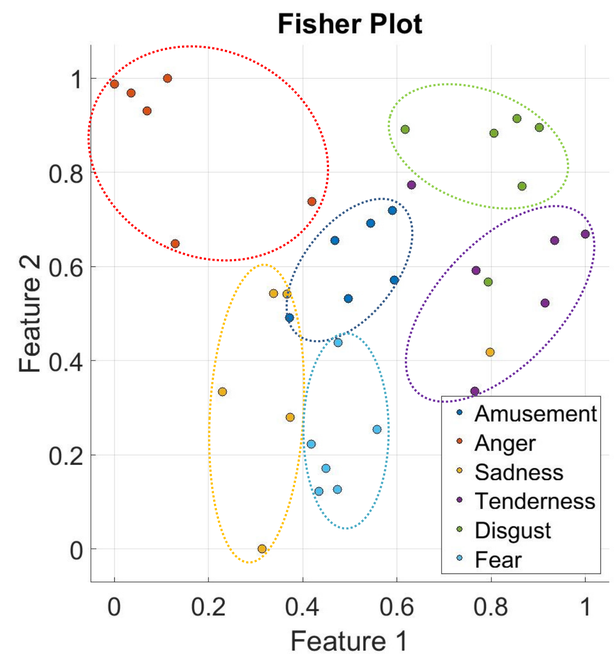
- The features are smartly extracted based on a given energy budget.

Preliminary tests of the classifier

- Emotion classification.

Protocol of the experiment:

- A database of emotion-eliciting films is used to test the classification [4].
  - 18 video clips (~120 s each)
  - 3 video clips per emotion
  - 6 emotions
- Features of the physiological signals are extracted.
- A 2D Fisher projection of the data is displayed.

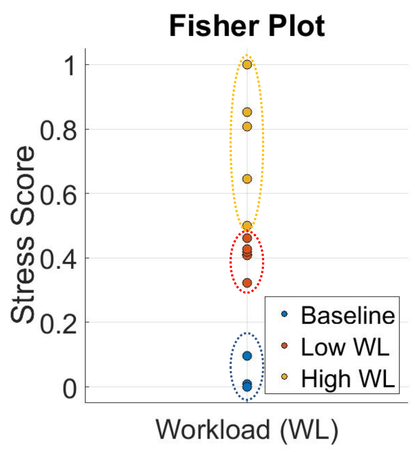


Link of features with emotions in real conditions

- Stress level monitoring based on workload changes.

Protocol of the experiment:

- Baseline recording.
  - The subjects stay in a sitting position.
- Low workload recording.
  - The subjects play a video game.
- High workload recording.
  - The subjects play a video game and do mathematical operations in parallel. Example equation: 12+19 = 31 (double + double digits, carry).



CONCLUSIONS

- Artefacts reduction by using a combination of thorax and abdominal electrodes placement.
- Shown stress level variations using workload changes.
- Accuracy range between 95% - 75% and 89% - 70% for arousal and valence classification respectively.

REFERENCES:

[1] Samuel Pedro et al., "Sensor-Based Detection of Alzheimer's Disease-Related Behaviors", The Int. Conf. on Health Informatics IFMBE Proceedings, vol. 42, pp. 276-279, 2014.

[2] J. Healey and R. Picard, "Detecting stress during real-world driving tasks using physiological sensors," IEEE Trans. ITS, vol. 6, no. 2, pp. 156-166, 2005.

[3] "SMARTCARDIA." [Online]. Available: http://www.smartcardia.com

[4] A. Schaefer et al., "Assessing the effectiveness of a large database of emotion-eliciting films: A new tool for emotion researchers." Cognition and Emotion 24(7): 1153-1172, 2010. Available: http://nemo.psp.ucl.ac.be/FilmStim/