Affective Computing through Thermograpghy

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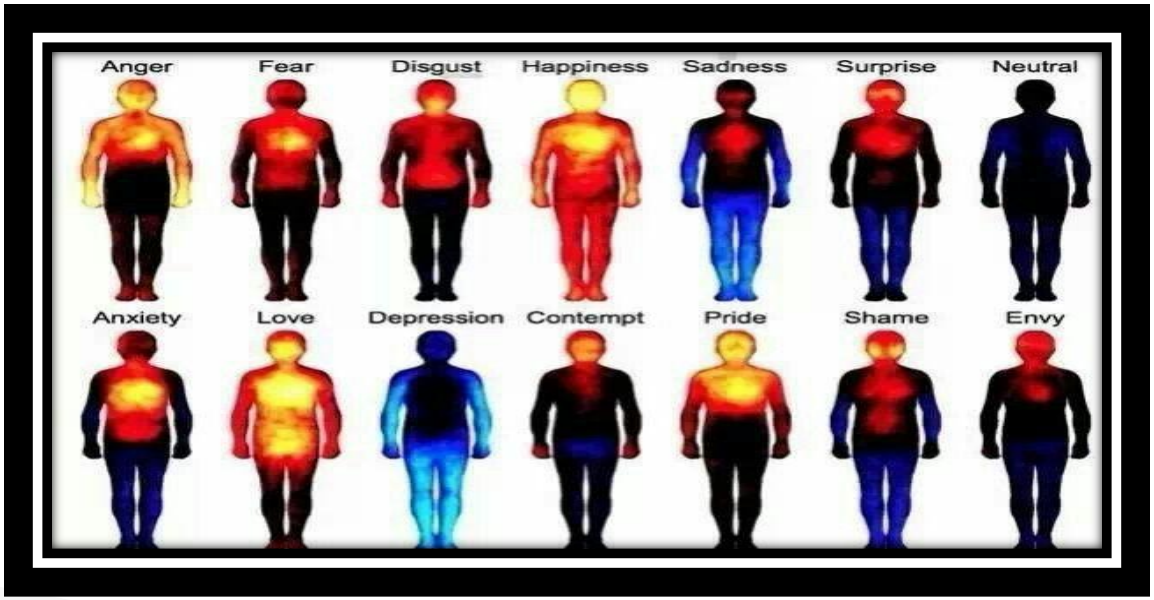
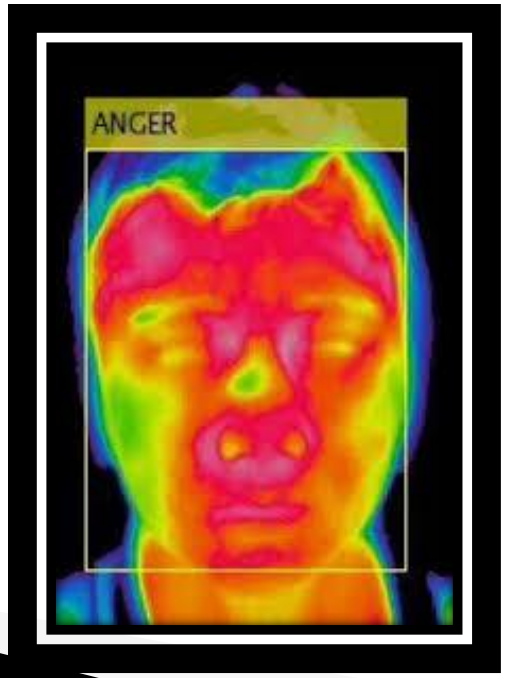
Abstract

- Thermal imaging-based psychological and affective computing is an emerging research area enabling technologies to monitor our bodily functions and understand psychological and affective needs in a contactless manner.
- However, up to recently, research has been mainly carried out in very controlled lab settings.
- For the establishment of computational and methodological pipelines from thermal images of the human skin to affective states can be tackled to make ubiquitous real-life thermal imaging-based affect monitoring a possibility.

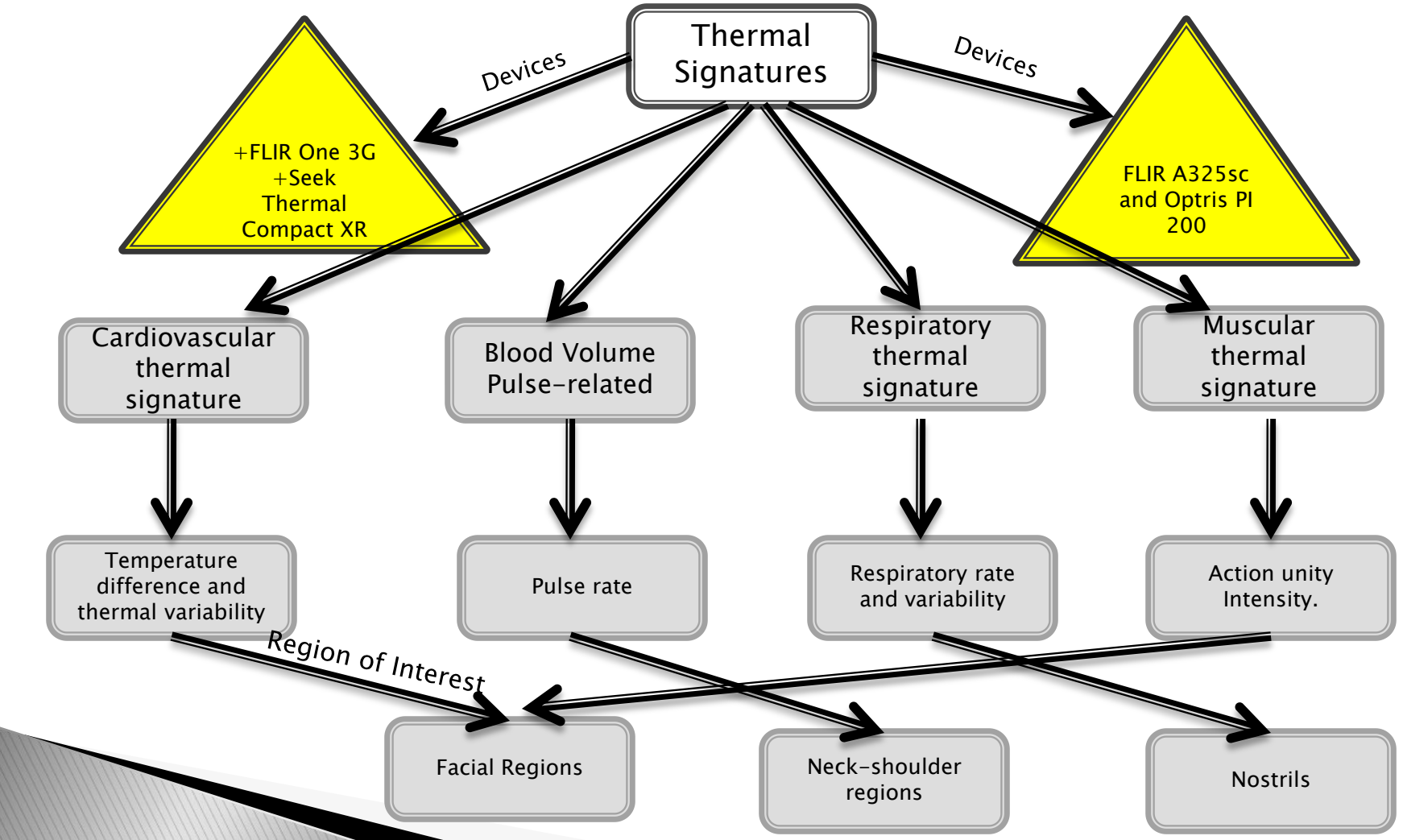


Scientific usage of affective computing through thermograpghy

- Humans are warm-blooded being, self-regulating their own body core and skin temperatures to address environmental changes or internal needs.
- As this regulation process involves numerous physiological activities, the temperature has acted as a lens to understand the human body and mind.
- With advances in infrared thermal imaging, a contact-free temperature measurement technique, studies have explored the relation of the skin temperature with other types of physiological activities, psychological and affective states, opening a new pathway to contact-less psychological and affective computing.

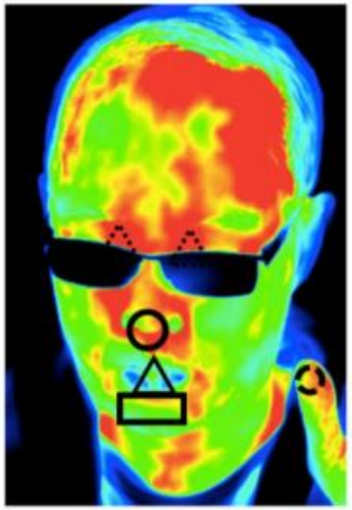


Different aspects of thermal signatures



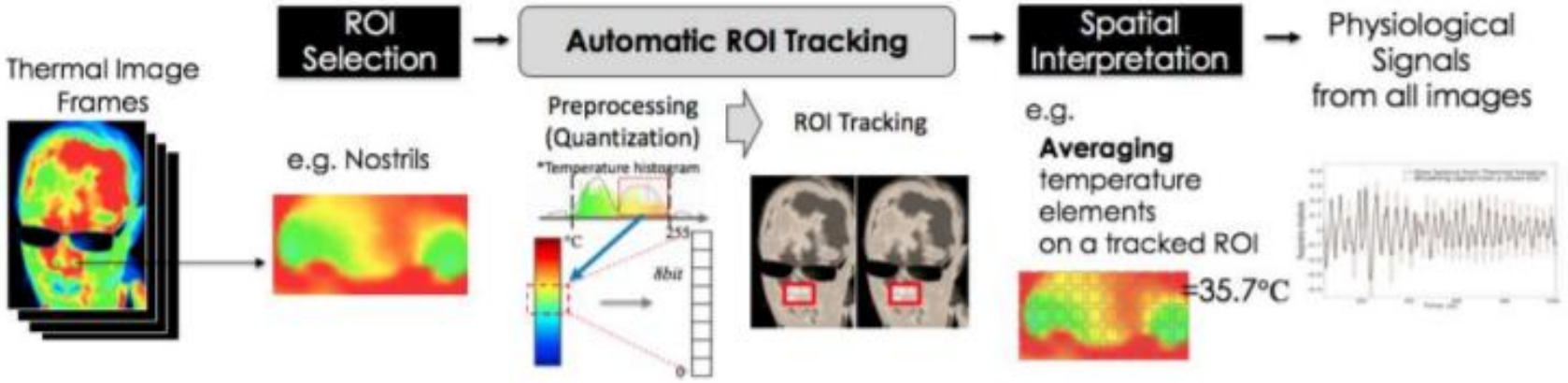
Thermal imaging as a measure of affective states

- Amongst psychological thermal signatures, the vasoconstriction/dilation-related cardiovascular and sweat gland activation-related respiratory responses induce increases or decreases in temperatures of ROIs, which could be quantified with a simple metric such as the temperature difference between data at two temporal points.
- Studies have investigated the relationship between thermal directional changes and affective states ranging from mental stress and fear to arousal and maternal empathy in contexts of social interaction.



- **Mental Stress / Workload**
  - Nose tip ↓
- **Fear**
  - Finger tip ↓
  - Nose tip ↓
- **Startled**
  - Upper lip ↓
  - Periorbital ↑
- **Arousal**
  - Mouth, Nose tip, Periorbital ↑ Hahn et al. (2012)
- **Love**
  - Whole face ↑ Salazar-López et al. (2015)

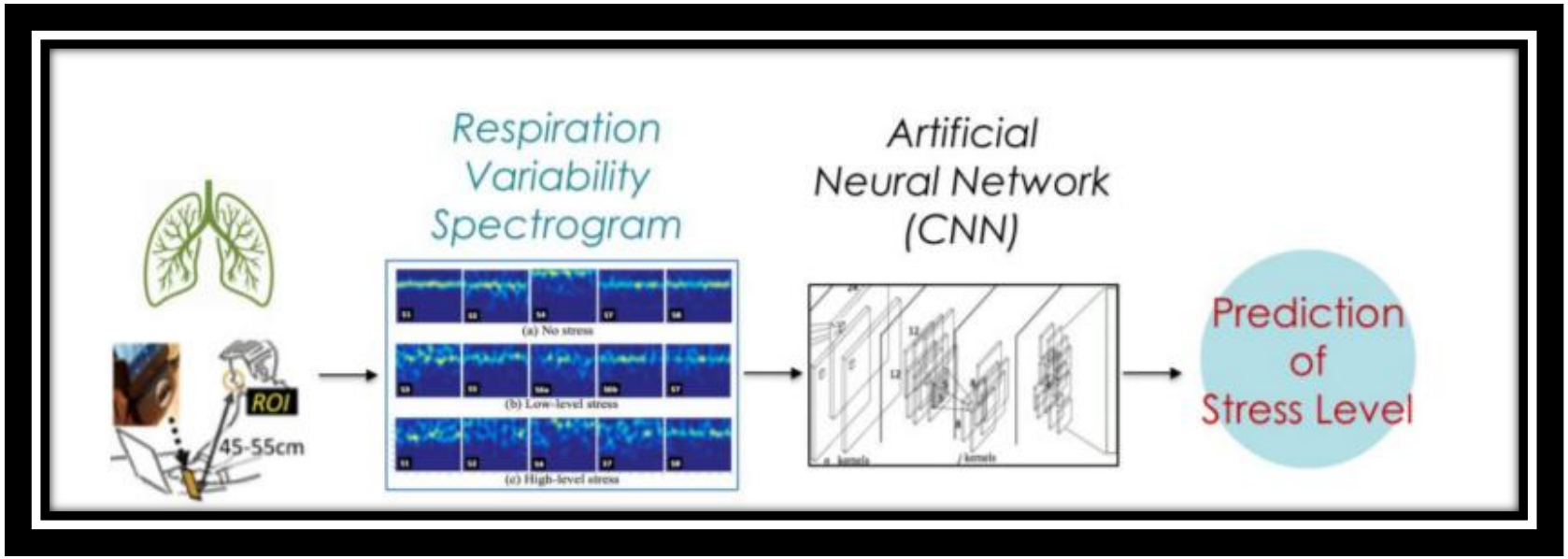
How it works?



*ROI – Region of Interest

Automated affect recognition

- Automatic feature learning is a power centralised in most successfully and widely used deep learning approaches in computer vision and pattern recognition. This helps automatically find good features during the machine learning process. As even carefully hand engineered-feature extractors could fail to generalise to unseen data sets, this could be a potential solution to improve our understandings of physiological and behavioural patterns in relation to a person's affective states.



Challenges

- Challenges and opportunities The ability to monitor physiological vital signs and affective states is becoming more important in human computer interaction. Such functions are being integrated into systems aimed to address real world problems (e.g. health monitoring, educational support, entertainment) in both research and commercial products.
- In many of these situations, mobile approaches are required to enable the users to undertake their activities.
- Mobile thermal imaging has greater potentials in its use as a multimodal psychological and affect sensor for ubiquitous real-world settings.

- Beyond thermal directional changes: Diversifying metrics for real world applications.
- ROI tracking and Ambient temperature effect.
- Evaluation, Datasets and Toolkits.

Conclusion

- Thermal imaging of the human skin can be of use in monitoring a person's psychological responses: cardiovascular, respiratory and perspiratory, muscular responses. In particular, vasoconstriction, vasodilation and sweat gland activation can lead to a directional change in temperature (rise or drop).
- This technique could provides a new pathway, addressing limitations of static thermal imaging in highly constrained settings - which has been dominantly used in affective state area - and in turn providing practical solutions that work in HCI and in mobile contexts.

Thank you

- Do you have any questions ?