Automated Inference of Cognitive Stress in-the-Wild

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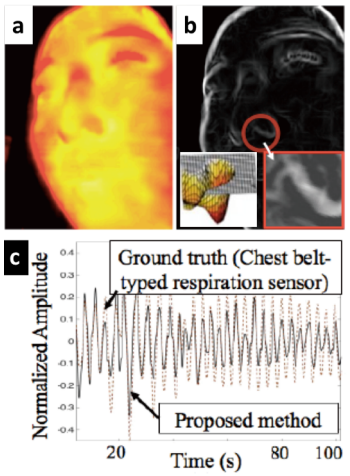

Figure 1: Robust Respiration Tracking using mobile thermal imaging (adapted from [1]): (a) thermal image, (b) Thermal Gradient Flow and Thermal Voxel, (c) breathing tracking.

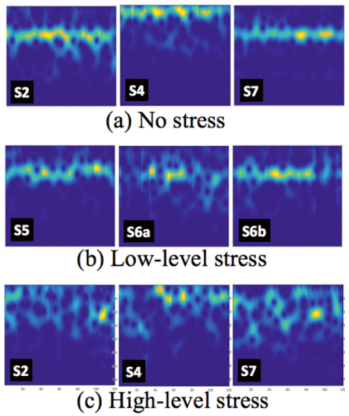

Figure 2: Examples of Respiration Variability Spectrograms clustered along with stress levels (adapted from [2]).

Project Description

We aim to build technology that combines mobile sensing systems to automatically infer a person's cognitive stress to provide better and continuous stress management support. Our main innovation is the use of low-cost mobile thermal camera integrated in smartphone or other devices to produce new stress measures. We have developed a robust mobile based tracking system that tracks a person's breathing pattern by measuring temperature changes around a person's nostrils region while the person is facing the smartphone (Figure 1). Stress levels are automatically assessed by capturing breathing pattern dynamics through a novel signature based on time and frequency values (Figure 2) and using convolutional neural networks (e.g., [1,2]) to reduce the need to hand craft higher level features. We are now extending the system to integrate multiple sensors (e.g., PPG and GSR) and behavioral information (context). The system is being also adapted to be applied in the context of industry workfloor within the EU H2020 HUMAN research project (http://www.humanmanufacturing.eu/) to support workers during stress inducing tasks. Evaluations are being conducted both in the laboratory and in-the-wild (e.g., industry workfloor).

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Lead Author Short Biography

Youngjun Cho is currently a 3rd year PhD student at the UCL Interaction Centre, University College London. He is investigating the use of mobile and biomedical imaging and thermography as described above for both mental and physical stress management. He has published more than 10 papers and 50 patents in areas related to HCI, multimodal sensing and feedback.

References

[1] Youngjun Cho, Simon J. Julier, Nicolai Marquardt, and Nadia Bianchi-Berthouze. 2017. Robust tracking of respiratory rate in high-dynamic range scenes using mobile thermal imaging. Biomedical Optics Express 8, 10: 4480–4503.
[2] Youngjun Cho, Nadia Bianchi-Berthouze, and Simon J. Julier. 2017. DeepBreath: Deep Learning of Breathing Patterns for Automatic Stress Recognition using Low-Cost Thermal Imaging in Unconstrained Settings. In the 7th International Conference on Affective Computing and Intelligent Interaction, ACII 2017, 456–463.