UNIVERSITÄT BIELEFELD

Technische Fakultät

Last updated 27.10.23

Project Proposal

Predicting Breathing Rates from Smartphone Front-Camera Videos of the Digital Stress Test (DST)

Background: In an on-going laboratory study[1] we're currently using our recently developed Digital Stress Test (DST)[2] for the induction of psychosocial stress. Participants perform the test with a smartphone while their faces are recorded via the front-camera. At the same time, we continuously monitor various physiological signals (i.e., breathing rate, heart rate, blood volume pulse). With this machine learning project, you will analyze how well breathing rates can be detected based on the front camera videos. You will explore several pre-existing algorithms (e.g., [3–5]) for video-based breathing detection, implement and evaluate them on our dataset. Further, you will implement your own algorithms for predicting breathing rates based on the experiences with existing algorithms and try to improve their performance.

- **Dataset**:
  - ~ 40 DST Math Task videos (1.5 minutes, .webm, 25fps) of the DST study
  - Labels: - Continuous signals of breathing chest belt stored as csv

- **Machine Learning Tasks:**
  - Regression Task 1: Predict continuous breathing signal values based on video features
  - Regression Task 2: Predict mean breathing rates for certain intervals based on video features

- **Challenges:**
  - Movement artifacts
  - Inconsistent face alignment in videos across participants
  - Some preprocessing required (Breathing signal synchronization to DST Video based on markers, metaData information; missing data)

- **Incentives:**
  - Interesting machine learning project, relevant for ongoing research and applicability for various use-cases
  - Interdisciplinary group environment with close supervision
  - Access to unique dataset

References:

1. Norden, M., Mayer, A., Molkenthin, D., Stubenvoll, C. & Drimalla, H. Validation of a Digital Stress Test (DST) for the induction of acute stress responses. (2022) doi:10.17605/OSF.IO/XWU9A.
2. Norden, M. *et al.* Inducing and Recording Acute Stress Responses on a Large Scale With the Digital Stress Test (DST): Development and Evaluation Study. *Journal of Medical Internet Research* **24**, e32280 (2022).
3. Lee, Y.-C. *et al.* A real-time camera-based adaptive breathing monitoring system. *Med Biol Eng Comput* **59**, 1285–1298 (2021).
4. Bae, S. *et al.* Prospective validation of smartphone-based heart rate and respiratory rate measurement algorithms. *Commun Med* **2**, 1–10 (2022).
5. Janssen, R., Wang, W., Moço, A. & De Haan, G. Video-based respiration monitoring with automatic region of interest detection. *Physiol. Meas.* **37**, 100–114 (2016).

Contact: mnorden@techfak.uni-bielefeld.de