Digital Health – Connected Healthcare

Prof. Dr. Bert Arnrich

Master's Thesis Proposal

EEGEMO: Online Learning for Emotion Classification using Multimodal (EEG, PPG, EDA) Sensors

Starting date: immediately

Background:

Patients with epilepsy can report self-prediction of their seizures by observing their affectivity. A pre-emptive therapy can be incorporated by objectively analyzing the affective states associated with the premonitory symptoms. Electroencephalogram (EEG) has been the gold standard for seizure detection. Lately, EEG-based system is also used for emotion classification due to the availability of non-invasive EEG devices. In addition to the usability of such devices in daily life, developing a lightweight classification pipeline that can reliably operate in real time is essential. Therefore, this thesis will mainly explore EEG data to develop emotion classification models that can operate in live settings. The analysis will be supported by multimodality including Photoplethysmogram (PPG) and Electrodermal Activity (EDA) sensors.

Our Approach:

In this thesis project, you will work on validating the concept study from [1] and extending the work done in [2]. You will be using EEG data and labels from the previous project to train the model, which is publicly available. One of the major tasks will be to improve the classification pipeline to predict emotions in live (real-time) settings by providing a feature-oriented approach. Figure 1 depicts the summary of the thesis work. Additionally, the real-time emotion classification has to be supported by extending to include multimodality, i.e., PPG and EDA sensors. The literature on online learning for emotion classification shows promising insights to explore [3, 4].

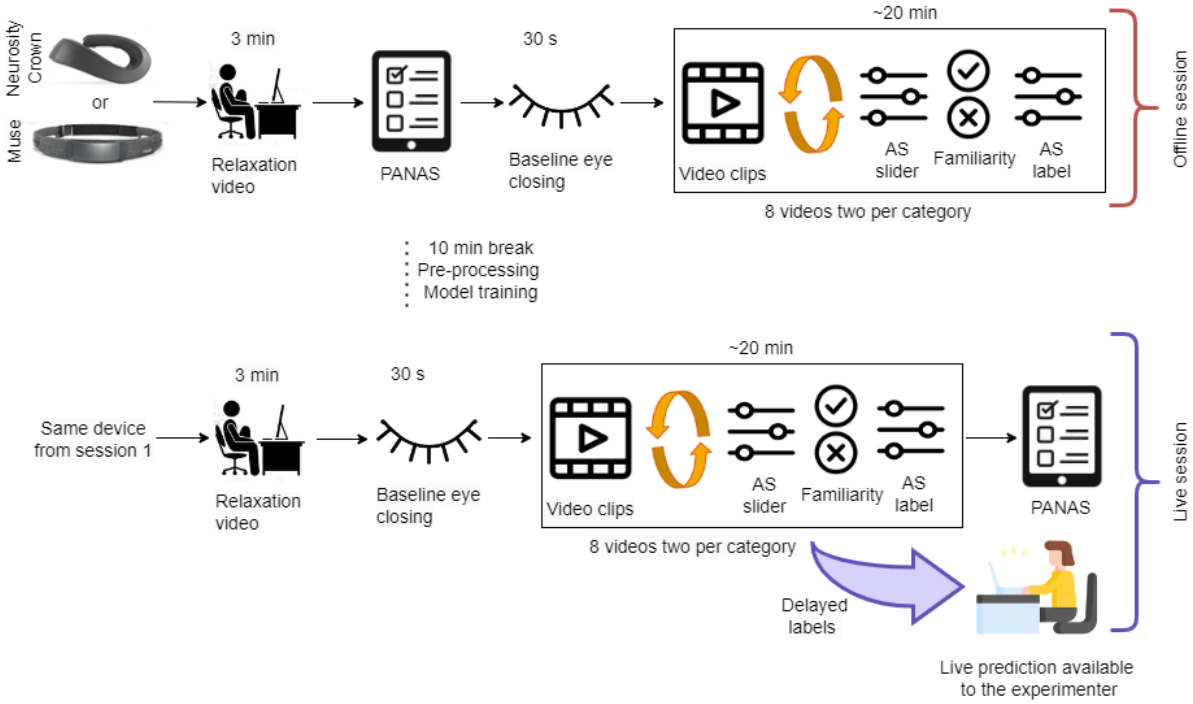

Figure 1: Visualization of the emotion classification pipeline.

What you will learn:

- Data acquisition from wearable sensors
- Data analysis of physiological signals and pattern recognition
- Signal processing of time series data
- Machine learning: online learning
- Deep neural networks

What you bring in:

- Experience in data science
- Experience in programming skills (Python, MATLAB)
- Communication skills in English
- Willing to work in teams and collaborate

What you will be doing:

- Analyzing the available data and extracting specific features
- Modifying existing online learning pipeline for better prediction results
- Collecting more data if needed

References:

1. Moontaha, S., Steckhan, N., Kappattanavar, A., Surges, R., & Arnrich, B. (2020, May). Self-prediction of seizures in drug resistance epilepsy using digital phenotyping: a concept study. In Proceedings of the 14th EAI International Conference on Pervasive Computing Technologies for Healthcare (pp. 384-387).

2. Moontaha S, Schumann FEF, Arnrich B. Online Learning for Wearable EEG-Based Emotion Classification. *Sensors*. 2023; 23(5):2387. doi: https://doi.org/10.3390/s23052387

3. Bajada, J., & Bonello, F. B. (2021). Real-time EEG-based Emotion Recognition using Discrete Wavelet Transforms on Full and Reduced Channel Signals. arXiv preprint arXiv:2110.05635.

4. Nandi, A., Xhafa, F., Subirats, L., & Fort, S. (2021). Real-time emotion classification using eeg data stream in e-learning contexts. Sensors, 21(5), 1589.

Interested? Please contact us for any further details.

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