Digital Health – Connected Healthcare

Prof. Dr. Bert Arnrich

Master's Thesis Proposal

Multitask Learning Between Stress and Epileptic Seizure using Physiological Data

Starting date: immediately

Background:

Epilepsy is a neurological disorder that affects millions of people worldwide. One of the main challenges in epilepsy management is predicting epileptic seizures in advance to prevent or mitigate their impact. Stress has been identified as a trigger for seizures and detecting stress levels in real-time can improve seizure prediction. Multitask learning can be used to simultaneously predict seizures and stress levels using physiological data, but few studies have explored this approach.

Objective:

Multitask learning is a machine learning technique that allows multiple related tasks to be learned simultaneously, with the goal of improving the performance of each task. The objective of this thesis is to develop a multitask learning framework to detect stress and epileptic seizure events in physiological signals during the pre-ictal phase of epileptic seizure.

Methodology:

The proposed framework will use physiological signals, such as electroencephalography (EEG), Photoplethysmogram (PPG) and Electrodermal Activity (EDA), to detect stress events. The framework will be designed to simultaneously learn multiple related tasks, including stress event detection, seizure prediction, and feature extraction. The framework will be evaluated on publicly available datasets of physiological signals from epilepsy patients: My Seizure Gauge and CHB-MIT database. The stress related events will be obtained from a dataset obtained within the chair.

Conclusion:

The proposed thesis aims to develop a novel approach to predict epileptic seizures from a multitask learning model which is trained to predict stress and seizure from physiological signals. We expect the proposed multitask learning framework will provide insights into the relationship between stress events and seizure onset, which can inform the development of more effective seizure prediction and management strategies.

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)
- Communication skills in English
- Willing to work in teams and collaborate

What you will be doing:

- Develop a seizure prediction pipeline from state-of-the-art
- Develop multitask framework between stress events and seizure onset.

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. Shoeb, A. H., & Guttag, J. V. (2010). Application of machine learning to epileptic seizure detection. In Proceedings of the 27th international conference on machine learning (ICML-10) (pp. 975-982).
3. Nasseri, M., Pal Attia, T., Joseph, B., Gregg, N. M., Nurse, E. S., Viana, P. F., ... & Brinkmann, B. H. (2021). Ambulatory seizure forecasting with a wrist-worn device using long-short term memory deep learning. Scientific reports, 11(1), 21935.

Interested? Please contact us for any further details.

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