Title: Combining wearables and nearables for patient state analysis

Abstract:
Recently, ambient patient monitoring using wearable and nearable sensors is becoming more prevalent, especially in the neurodegenerative (Rett syndrome) and sleep disorder (Obstructive sleep apnea) populations. While wearables capture localized physiological data such as pulse rate, wrist acceleration and brain signals, nearables record global passive data including body movements, ambient sound and environmental variables. Together, wearables and nearables provide a more comprehensive understanding of the patient state.

The processing of data captured from wearables and nearables have multiple challenges including handling missing data, time synchronization between sensors and developing data fusion techniques for multimodal analysis. The research described in this thesis addresses these issues while working on data captured in the wild. First, we describe a Rett syndrome severity estimator using a wearable biosensor and uncover physio-motor biomarkers. Second, we present the applications of an edge computing and ambient data capture system for home and clinical environments. Finally, we describe a transfer learning and multimodal data fusion based sleep-wake detector for a mixed-disorder elderly population. We show that combining data from wearables and nearables improves the performance of sleep-wake detection in terms of the F1-score and the Cohen's kappa compared to the unimodal models.

Committee:
Prof. Gari D. Clifford (Advisor)
Prof. David V. Anderson
Prof. Omer T. Inan
Prof. Thomas Ploetz
Prof. Ali Bahrami Rad