CENTER FOR MEDICAL PHYSICS
AND BIOMEDICAL ENGINEERING
MEDICAL UNIVERSITY OF VIENNA

Master Thesis:
TinyML for Heart Rate Estimation on Textile Edge Device

Description:
With the rapid advancement of wearable technology, there is a growing interest in integrating intelligent systems directly into textiles for real-time health monitoring. This master thesis focuses on developing a TinyML solution for heart rate estimation using textile-based edge devices. TinyML, a subset of machine learning, is designed to implement advanced models on low-power and resource-constrained devices, making it ideal for wearable applications. The primary objective of this thesis is to design and implement a deep learning model for heart rate estimation from photoplethysmography (PPG) data collected by textile-embedded sensors. This involves optimizing machine learning algorithms to run efficiently on microcontrollers and embedded systems while maintaining high accuracy and reliability. The project will leverage frameworks such as TensorFlow Lite and techniques for energy-efficient computation to ensure practical deployment in wearable textiles. In addition to model development, this thesis will explore the integration of the TinyML model with textile-based sensors, ensuring seamless data acquisition and processing. The candidate will be expected to address challenges related to sensor noise, signal variability, and real-time processing constraints. Furthermore, the project will involve rigorous testing and validation of the developed solution in various scenarios to assess its robustness and practical utility. The project will be carried out at the Center for Medical Physics and Biomedical Engineering.

Relevant knowledge/experience:
- A strong background in machine learning and artificial intelligence, particularly deep learning.
- Proficiency in programming languages such as Python and C or C++, and experience with machine learning libraries (e.g., TensorFlow, Keras, etc..).
- Experience with microcontrollers and embedded systems
- Familiarity with signal processing techniques, especially related to PPG data.
- A solid understanding of cardiovascular physiology and biomedical data analysis.
- Strong analytical and problem-solving skills, with the ability to work independently and as part of a multidisciplinary team.

How to apply:
Interested candidates are requested to send their CV, certificates and a short description of themselves to **Assoc. Prof. Francesco Moscato** (francesco.moscato@meduniwien.ac.at) and **DI Laurenz Berger** (laurenz.berger@meduniwien.ac.at)

Start date:
August 2024

Suggested literature:
Anbukarasu et al. (2022) Tiny-HR: Towards an interpretable machine learning pipeline for heart rate estimation on edge devices. IEEE Trans Consum Electron

Burrello et al. (2023) Energy-efficient Wearable-to-Mobile Offload of ML Inference for PPG-based Heart-Rate Estimation. Proc -Design, Autom Test Eur