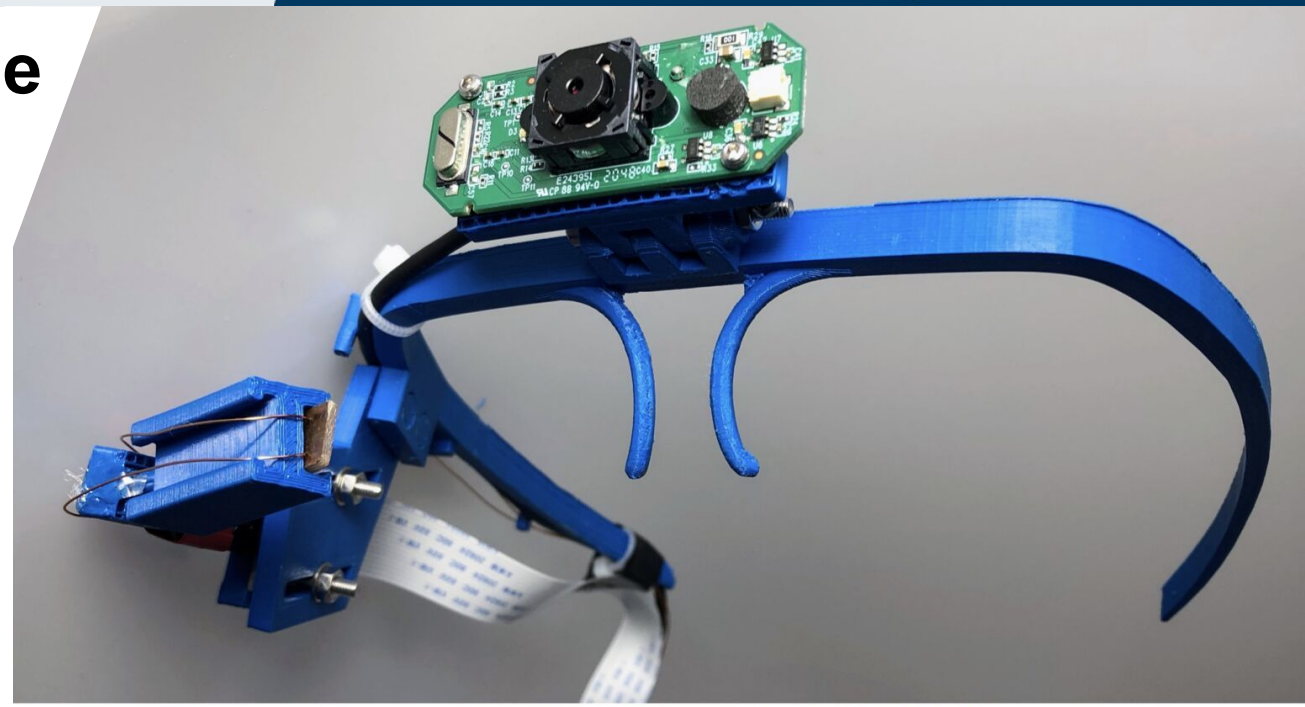
Thesis Topic

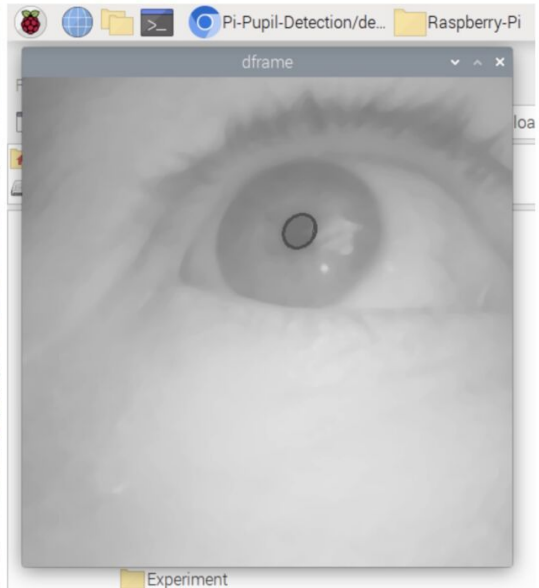
Universität Siegen

An Open-Source & Realtime Embedded Eye-Tracker

- Development of a Python and OpenCV-based wearable system on a Raspberry Pi
- Based on our existing pupil detection system
- Evaluation with two existing state- of-the-art eye tracking systems



More information in **H-A8110**
kvl@eti.uni-siegen.de



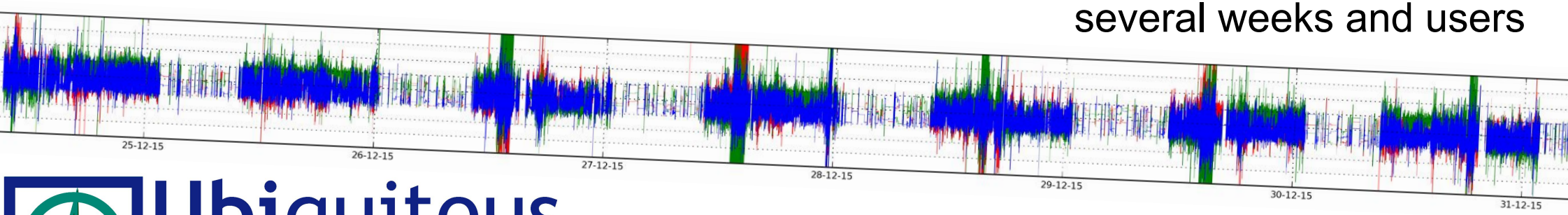
Ubiquitous Computing

Thesis Topic

Universität Siegen

A Wearable Stairs vs. Elevator Detector

- Using the internal barometric pressure and inertial sensor data from the Bangle.js.v2 watch, to detect when the wearer uses the stairs or lift
- Development of an efficient embedded algorithm in the Espruino IDE, an embedded open-source ecosystem to enable long-term operation
- Goal should be to deploy and validate the algorithms in a longitudinal deployment study of several weeks and users



Ubiquitous Computing

More information in
H-A8110 or: **kvl@eti.uni-siegen.de**

Thesis Topic

Universität Siegen

Towards A Medical-Grade Long-Term Activity Sensing Widget

- Develop an embedded Widget that fits in just a few kilobytes and operates in the Bangle open-source smartwatch ecosystem
- Design lossless compression & capture algorithms to acquire and save accurately-timed sensor data from motion and heart rate sensors
- Test your setup on a custom testbench

More information in
H-A8110 or: **kvl@eti.uni-siegen.de**

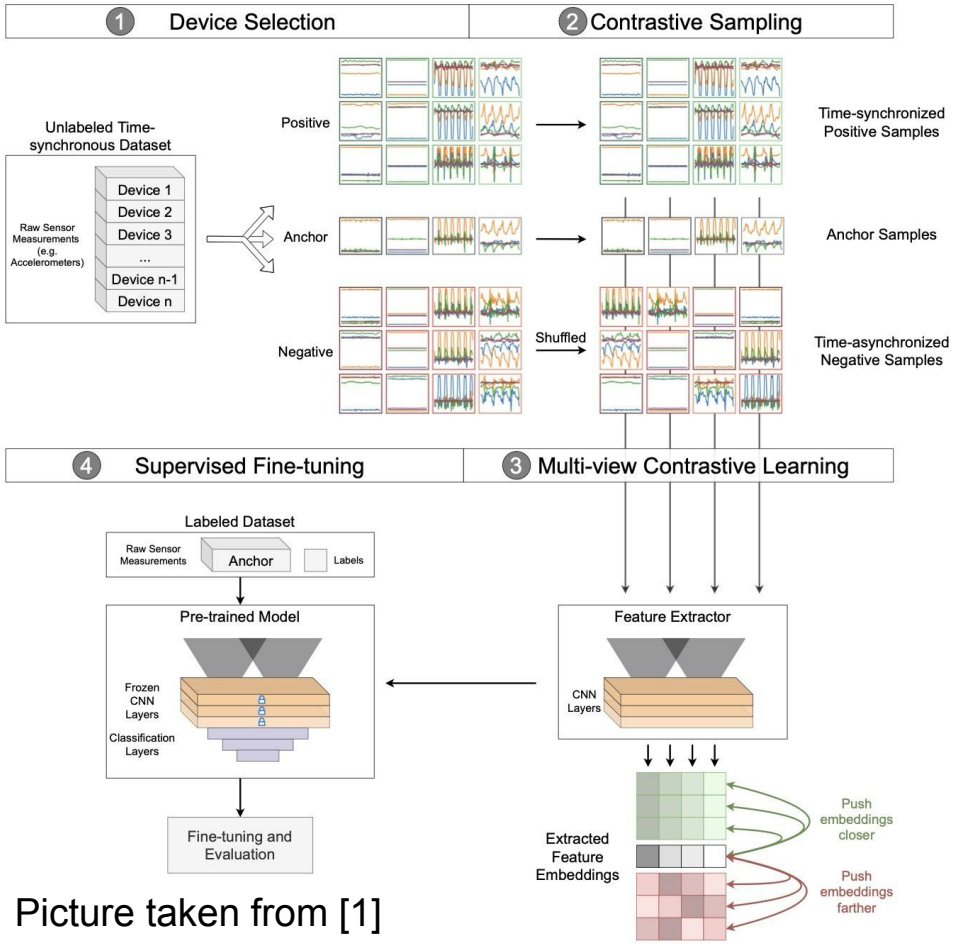
Ubiquitous Computing

Thesis Topic

Universität Siegen

Morphology-based Collaborative Self-Supervised Learning for Multi-Sensor Wearable Activity Recognition

- Collaborative capabilities of sensors in self-supervised wearable activity recognition have been shown [1]
- **Goal of Thesis**: extend existing framework in [1] using statistical and deep learning based similarity metrics to determine collaborating sensors



Picture taken from [1]

[1] https://doi.org/10.1145/3517246

Ubiquitous Computing

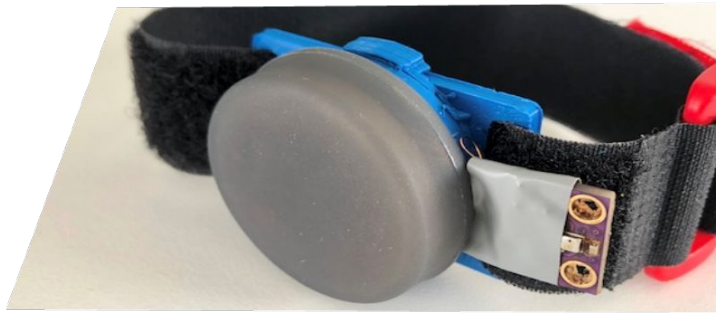
Contact: **marius.bock@uni-siegen.de**

Thesis Topic*

Universität Siegen

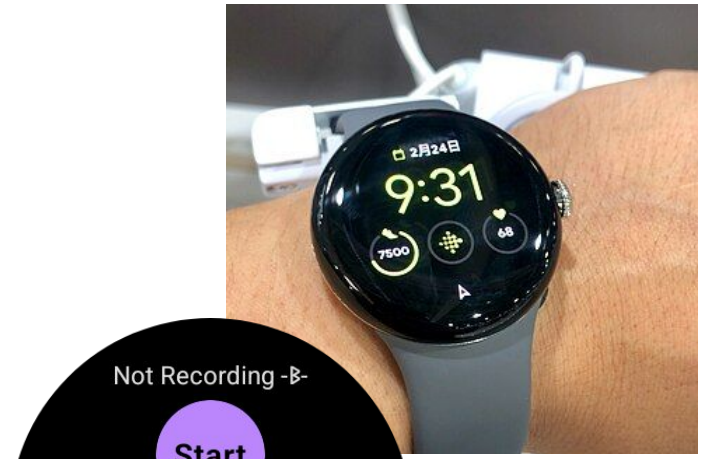
Audio-Augmented Activity Recognition (recording and processing a dataset)

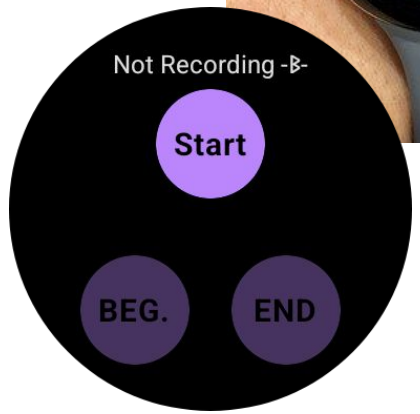
Human Activity Recognition with additional Sensors (Microphone, Atmospheric Sens.)



Additional sensors can be needed to classify ambiguous or difficult activities!

- First step: recording a dataset. Includes recruiting participants and closely following a given experiment protocol, Recording 20 participants, for 4 hours each. (Recording hardware and software is already available)
- Afterward, the recorded dataset must be annotated (annotations will be created during the recording, but must be cleaned) and analyzed.
- Run Machine Learning / Deep Learning Experiments with the data, testing the influence of the addition of the audio recordings or lack thereof.





Required background:

- Strong skills in Python, Basic knowledge in the area of machine learning
- Ability to tightly stick to a given experiment protocol, in order to collect high-quality data
- Willingness to recruit and record participants

* Can also be a project work!

Ubiquitous Computing

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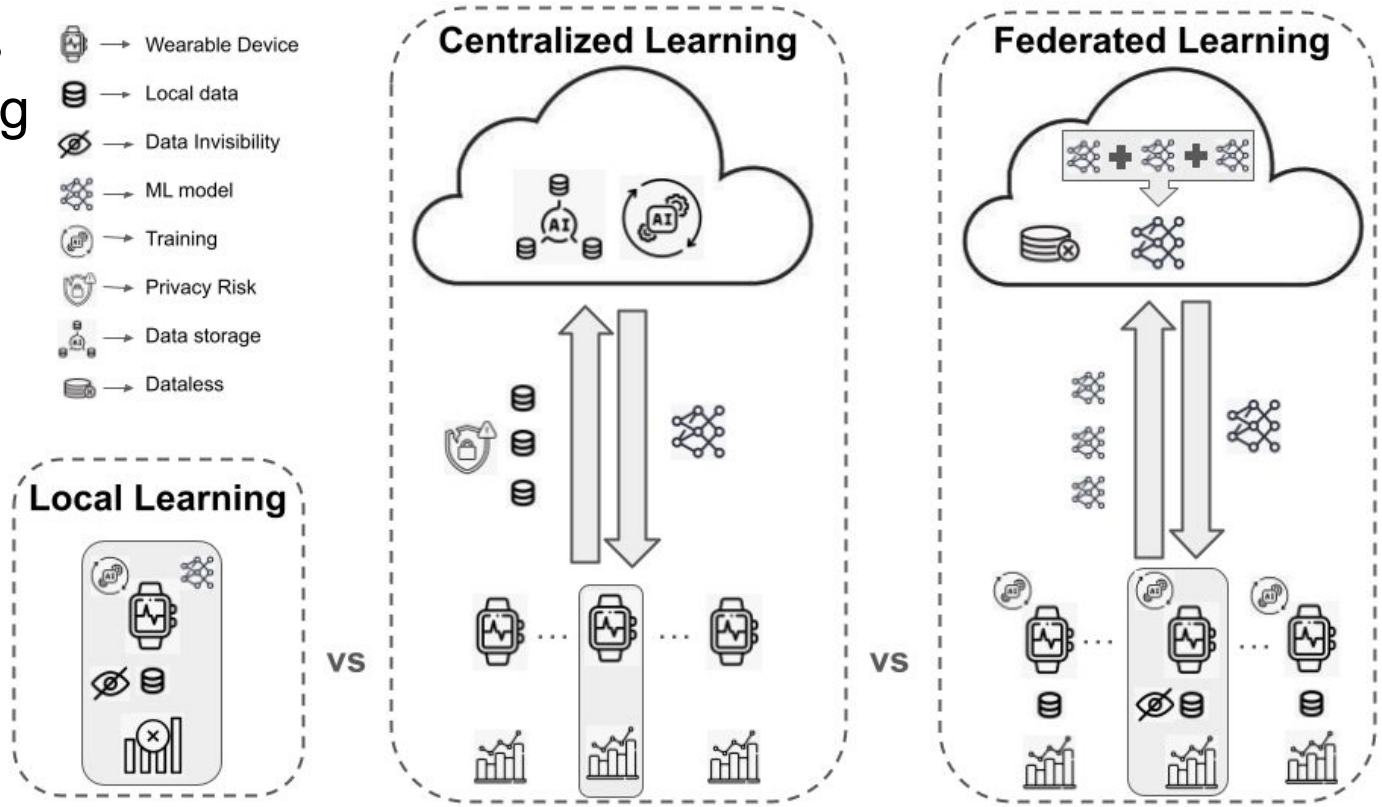
Thesis Topic

Universität Siegen

Enabling Trustworthy Collaborative Learning Systems for Human Activity Recognition

- Development of ML systems for the HAR domain by taking GDPR measures.
- Enhancing Federated Learning considering the characteristic of the target application.
- Evaluating metrics of designed system with existing learning systems using wearable device data.



Ubiquitous Computing

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Thesis Topic

Universität Siegen

Updating the process to record entry's of the WEAR Dataset

- Implementing Bluetooth synchronisation
- Implementing approximation saving
- Creating a more user-friendly way to convert data
- Compare recording between old and new method

More information in **H-A 8115** or **michael.brilka@uni-siegen.de**

Ubiquitous Computing

Thesis Topic

Universität Siegen

ML-Optimized Dynamic Resource Allocation for LoRaWAN in Indoor IoT Networks

Description:

- Develop an ML-driven LoRaWAN resource management system that dynamically allocates resources such as bandwidth based on environmental conditions, human occupancy, and interference levels.
- The main aim is to improve network efficiency and reduce packet loss in dense IoT deployments.

Key Tasks:

- Using **an already available dataset**, design LoRaWAN network models (mainly ML) considering multi-wall penetration and environmental parameters.
- Validate performance of the models via simulations and/or streaming data.
- On device implementation of the optimal ML-based algorithm for dynamic channel selection & power adjustment.

Image source

Skills: Python data analysis and willingness to research and learn new methods.

Ubiquitous Computing

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Thesis Topic

Universität Siegen

Multi-Protocol IoT Network for Indoor Localization Using BLE, Thread, and LoRaWAN

Description:

- Develop a hybrid **BLE/Thread - LoRaWAN** network for **precise indoor localization** in smart buildings.
- **Application Examples:** asset tracking, personnel monitoring, and indoor navigation.
- The system will leverage **BLE's fine-grained positioning** with **LoRaWAN's long-range efficiency** to provide **real-time tracking** while optimizing power consumption.

Image taken from *here*

Key Tasks:

- Develop a BLE/Thread-LoRaWAN hybrid localization system using the existing LoRaWAN setup.
- Implement and optimize ML-based RSSI fingerprinting with sensor fusion for improved accuracy.
- Design an adaptive transmission strategy to balance localization precision and power efficiency.

Image taken from *here*

Skills: Understanding of BLE/Thread/LoRaWAN, basics in ML for HAR and localization, and proficiency in Python/C++ for IoT firmware development; Willingness to carry out research.

Ubiquitous Computing

Contact: **nahshon.obiri@student.uni-siegen.de**