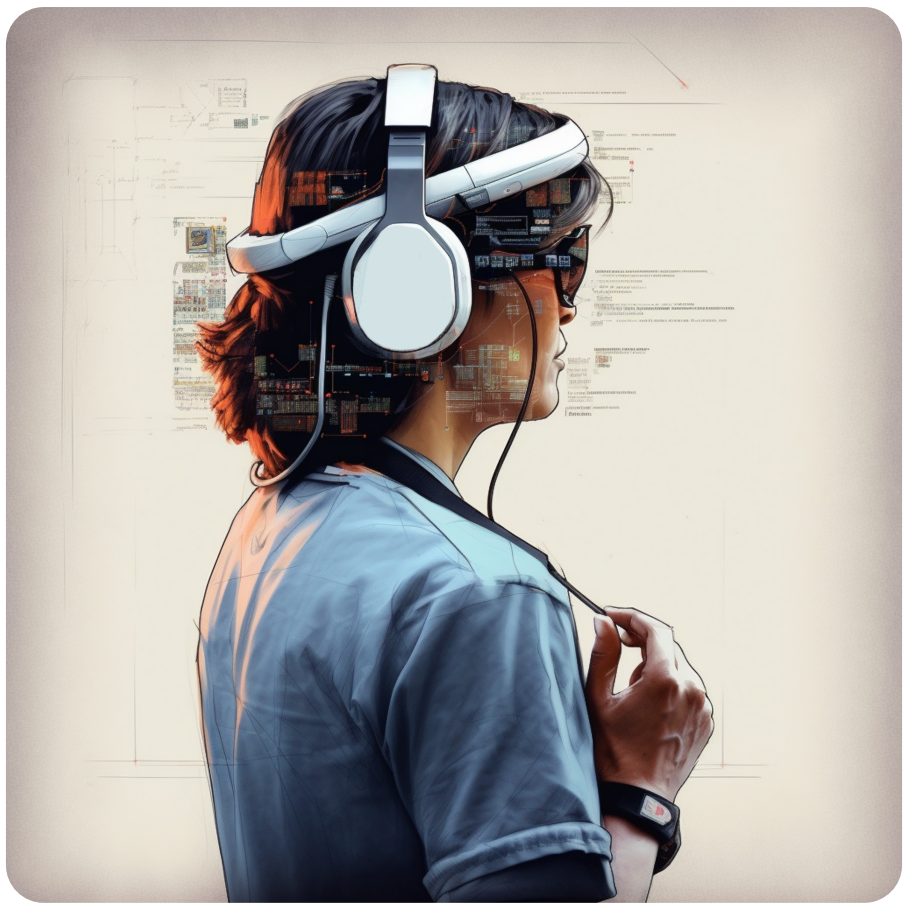
Code Understanding Under the Microscope: An Extensive Evaluation of Wearables in Assessing Developers' Cognitive Load

Master's Thesis Offer

Have you ever considered owning or currently own a smartwatch? Nowadays, wearables have become ubiquitous. They offer valuable insights into our health and physical state and are worn in various situations and environments, including the workplace. For software engineering research, this raises an intriguing question: can we leverage them to gain novel insights into software development? One way to approach this question is by tracking the cognitive load developers experience.

Developing software involves various tasks that require a lot of mental effort. Wearable technology can help us identify signs of high cognitive load. For instance, we can use head-worn devices to measure brainwaves, wrist-worn devices to measure heart rate and perspiration, and eye trackers to measure pupil dilation. Instead of relying on just one of these measurements that can indicate cognitive load, by combining data from different sensors, we can get more accurate assessments. It is crucial, however, that we obtain well-organized, synchronized, and reliable data from all the sensors to achieve this.



A software developer wearing body sensors. Generated with Midjourney, modified.

As you work on your master's thesis, your focus will be on evaluating wearables such as Emotiv Epoc X (EEG), Shimmer3 GSR+ (heart rate, perspiration), and Tobii Nano Pro (gaze, pupil dilation) and their compatibility with open source tools like *lab streaming layer* (LSL). This includes calibrating the wearables, recording data from several body sensors simultaneously, and ensuring synchronization and harmonized data formats. Only if these steps are guaranteed, high-quality insights into cognitive load and developer behavior can be gathered. Thus, with your master's thesis you will be able to provide valuable insights into the use of wearables for cognitive load assessment in software development settings to the research community.

As you embark on your journey toward completing your master's thesis, you will acquire a wealth of knowledge in the use of diverse wearables, data calibration, synchronization, and quality control. Additionally, you will gain valuable general experience in evaluating the validity of time series data, which will be beneficial in your future academic and professional pursuits. Ultimately, this experience will provide you with a comprehensive understanding of data collection and analysis, applicable to any career path you choose.

Fabian Stolp, Prof. Dr. Bert Arnrich
Digital Health – Connected Healthcare

You want to know more? Please scan:

Objectives

The key objectives for this master's thesis are:

- To compare different wearables for their applicability for measuring cognitive load in software development settings.
- To ensure optimal data collection by considering calibration and further requirements of body sensors.
- To run experiments to evaluate the reliability and data quality of certain wearables and their compatibility with open-source tools such as LSL.

Methodology

- Device comparison: You will research and discuss information about wearables including manufacturers' claims, previous use in research studies, and compatibility with open-source tools such as LSL.
- Validation experiments: You will design and execute experiments to assess the quality of sensor data gathered simultaneously from multiple wearables using open-source tools such as LSL.
- Data analysis: You will analyze potential issues that are present in the collected data.

Requirements and Expectations

Some of the following points should apply to you. You have:

- Some experience with data analysis in Python or R.
- An interest in body sensors with a focus on wearable EEG and eye-tracking devices.
- An interest in publishing your work for the research community to build upon it.

Contact

If you are interested or would like to get more information please contact:

Fabian Stolp
Fabian.Stolp@hpi.de
+49 (0) 331 5509-3453
G-2.1.11, Campus 3

Bert Arnrich
Bert.Arnrich@hpi.de
+49 (0) 331 5509-4851
G-2.1.14, Campus 3

You want to know more? Please scan: