14th of October 2022, 9-17hrs, PLNT, Langegracht 70, 2312 NV, Leiden

8th Wearables In Practice Symposium:
"AI for Wearables assessing population health"

09:00-10:00	*Registration*
10:00-10:15	**WIP Welcome** *Peter de Looff and Matthijs Noordzij, WIP community*
10:15-11:00	**OxWearables: Reproducible machine learning for the analysis of wearable-collected data in large-scale epidemiological health research,** *Scott Small, University of Oxford*
11:00-11:30	*Coffee break*
11:30-11:55	**5 challenges of doing health and vitality research with wearables,** *Auke Damstra, Sports Data Valley*
11:55-12:20	**Learning Trajectory Similarity with Siamese Architectures,** *Maedeh Nasri, Faculty of Social and Behavioural Sciences, Leiden University*
12:20-12:30	**Poster pitch**
12:30-14:00	*Lunch break and poster exhibition*
14:00-14:45	**Redesigning Health Care - Remote Care using The Box,** *Douwe Atsma, Leiden University Medical Center (LUMC)*
14:45-15:10	**Monitoring Parkinson's disease in real life**, *Vasileios Exadactylos, Center for Human Drug Research (CHDR)*
15:10-15:40	*Coffee break*
15:40-16:05	**Monitoring migraine attacks with wearables: the potential of EEG and tappigraphy,** *Mark van de Ruit, Leiden University Medical Center (LUMC)*
16:05-16:30	**Learning Systems in mixed methods research,** *Daniela Gawehns, Leiden Institute of Advanced Computer Science (LIACS)*

Drinks will follow

Abstracts and Speakers bios

OxWearables: Reproducible machine learning for the analysis of wearable-collected data in large-scale epidemiological health research

Scott Small, University of Oxford

The integration of wearables into health research has introduced device-measured biomarkers in both clinical and population health settings. The availability of accelerometer-measured physical activity is particularly impactful in medical research, as the foundations of early activity guidelines and research have been based on self-reported behavioural questionnaires, which are well documented to suffer from recall and social desirability biases. Our research group has focused on the creation of reproducible machine learning techniques to classify physical activity behaviours from wrist-based accelerometer data for implementation into epidemiological analysis of the UK Biobank physical activity cohort. This activity cohort consists of 100,000 participants (aged 40-79) with 7 days of accelerometer wear and longitudinal electronic health record linkage. We aim to describe the relationship between accelerometry and chronic disease, providing novel insights into disease prediction, discovery of target mechanisms, and assessing the impact of potential treatments on day-to-day activity and sleep. Current research focuses include the association of daily step count with cardiovascular mortality, implementation of accelerometry into clinical orthopaedic practice, development of reproducible machine learning and deep learning pipelines for accelerometer analysis, improvement of machine-learning sleep analysis, prediction of cardiovascular disease and Parkinson's disease, and the association between genomic profiles, physical activity, and health outcomes.

Scott is a researcher in wearable sensors at the Big Data Institute at the University of Oxford—currently funded by the Wellcome Trust to create validated wearable sensor datasets informing reproducible machine learning models for the prediction of cardiovascular disease in large-scale epidemiological studies. His recent work has additionally included the integration of wearables into clinical orthopaedic practice to monitor and improve postoperative recovery. From 2007-2016, Scott served as Engineering Director of the Joint Replacement Surgeons of Indiana Research Foundation, where he led a research team focused on improving implant design and surgical techniques for hip and knee arthroplasty. He holds a Doctorate in Musculoskeletal Sciences, completed as a Clarendon Scholar at the University of Oxford.

5 challenges of doing health and vitality research with wearables

Auke Damstra, Sports Data Valley

There is a data revolution going on in the health and vitality domain. Sport Data Valley started in (elite) sports and over the past years moved to supporting health and vitality research in relation to human movement. The possibilities of the use of wearables and AI have shifted accordingly from the happy few to the masses. Trackers that measure steps, heart rate, sleep and much more are now available for large groups of people. This gives amazing possibilities in terms of AI and research but doing research with wearables also has its challenges. This presentation will address the top 5 challenges of doing health and vitality research with wearables and shows best practices how to overcome these challenges.

Auke is managing director of Sport Data Valley, the national platform for analysis and research on sports and vitality data.

Learning Trajectory Similarity with Siamese Architectures

Maedeh Nasri, Faculty of Social and Behavioural Sciences, Leiden University

Measuring trajectory similarity is a fundamental task in trajectory pattern mining. In most previous studies, trajectory similarity algorithms have been introduced in large-scale environments and over a long period. However, exploring trajectory patterns for scenarios where movements happen in small spaces and for relatively short temporal episodes (e.g., children playing in a schoolyard) has not yet been addressed. In such scenarios, current approaches may overestimate similarities between trajectories. An additional challenge is the limitation of the location acquisition technologies in the form of noise and coarse-grained positional accuracy. Using a Siamese architecture, this research revisits the problem of measuring trajectory similarities by leveraging spatial and temporal dependencies to a maximum. This model employs a triplet loss function to learn the embedding vector of inputs, which minimises the distance between two similar movements while maximising that of non-similar pairs. The designed Siamese network inherently learns the semantic similarity of trajectories. Our experiments on datasets collected from pupils playing at school playgrounds show that our method achieves over 80% accuracy on four distance metrics, which significantly outperforms state-of-the-art baselines.

Maedeh Nasri is a PhD candidate at the Department of Developmental and Educational Psychology (Institute of Psychology) at Leiden University. Her PhD project is embedded in a larger research project called "Data-driven, urban policymaking for social inclusion of young, vulnerable people" within the Centre for BOLD Cities. In this larger project, Maedeh focuses on integrating different sources of information, measuring complex social phenomena through modern sensing technologies, and designing algorithms that analyse the social behaviour of pupils, their use of space and activities during recess time.

Abstracts and Speakers bios

Redesigning Health Care - Remote Care using The Box

Douwe Atsma, Leiden University Medical Center (LUMC)

I will discuss the role of eHealth and remote care in transforming the health care system, which is needed to address the challenge of more complex patients with multimorbidity, aging, rising health care costs and a decreasing health care work force. We develop regional health care systems over the traditional 1st , 2nd and 3rd health care lines, and support this transmural care with eHealth technology (The Box) supported by Artificial Intelligence. The Box started in 2013 and has become the standard of remote care at the Leiden University Medical Center. I will explain our method to analyze the clinical problem and to implement The Box from the medical, organizational and technical perspective.

Douwe E. Atsma is interventional cardiologist and Professor of Cardiology at the Department of Cardiology, Leiden University Medical Center. He is board member of the National eHealth Living Lab and of the Physician and Lifestyle Society (Vereniging Arts en Leefstijl). In addition to cardiac cell therapy research, his research focuses on developing novel treatment strategies for cardiac patients. Specifically, patients at risk within primary and secondary prevention programs are subjected to novel eHealth-based interventions to improve lifestyle and provide early detection of adverse psychological and/or physical parameters. The efficacy of home-measurements using mHealth devices ('The Box') in combination with blended care via remote video-consultation and physical visits are studied. Also, the effects of eHealth on the ability to change detrimental lifestyles in the general population using eHealth-medicated personal coaching are assessed. Big data/AI is used to define optimal monitoring and therapeutic algorithms.

Monitoring Parkinson's disease in real life

Vasileios Exadactylos, Center for Human Drug Research (CHDR)

Parkinson's Disease (PD) is becoming increasingly prevalent in older populations. This work will focus on the motor component of PD. Disease follow-up is very valuable for the patient, as it leads to adaptations of medication that can impact quality of life, and is currently performed during visits to the doctor. Numerous approaches have been presented in the scientific literature that have developed methods to monitor the disease in a palliative setting using technology. In this work, an approach is presented that aims to bring together earlier research and identify practical ways of using technology to monitor PD severity at home. More specifically, we aim to develop a balance model for PD at home and look at the optimal sensor location for monitoring the most well-known motor-related phenotype of PD (tremor, dyskinesia and bradykinesia). Although our approach has been developed with drug development in mind, it is argued that it can be adapted for healthcare applications.

Vasileios Exadaktylos has been working since 2007 in the field of analysis of bioresponses using technology. He has held both academic and industrial positions leading to an output of more than 40 peer reviewed journal publications and 5 patents. Since 2019, he is the Product Manager Trial@Home at CHDR working on the creation of a platform that allows validated and reliable collection and interpretation of data using digital technologies to complement clinical trials with real-world information.

Monitoring migraine attacks with wearables: the potential of EEG and tappigraphy

Mark van de Ruit, Leiden University Medical Center (LUMC)

Migraine is a complex episodic brain disorder characterized by disabling attacks with headache and neurological features. Migraine hits 1 in 7 people at least twice a month, each attack lasting 1 to 3 days. Notably, migraine is most incapacitating when patients are in their productive years and is difficult to manage due to its unpredictability.
The major hurdle towards successful migraine management is the lack of markers for upcoming attacks. Conventional short-term in-hospital observations fail to identify such predictive markers, as they do not capture day-to-day fluctuations in brain function nor the trigger factors patients experience in daily life. We hypothesize that the onset of attacks is the result of interactions between a lowered attack threshold and fluctuating trigger factors affecting the brain in combination.
In this talk I will show work done within the Brain@Home project at LUMC where we leverage the power of wearables to record brain activity (encephalography – EEG) and smartphone touchscreen interactions (tappigraphy) in the home environment of a migraine patient. We aim to enable capturing day-to-day fluctuations in brain function and behaviour and the use of artificial neural networks to develop a predictive model for migraine attack susceptibility.

Mark van de Ruit is an assistant professor at the Department of Biomechanical Engineering of TU Delft and guest researcher at the Department of Neurology of Leiden University Medical. Mark aims to develop and employ cutting-edge methodologies such as encephalography (EEG) and robotics to aid understanding and diagnostics of neurological diseases. His current work involves developing new (diagnostic) tools for the assessment of spasticity following e.g. stroke and evaluation of day-to-day fluctuations in brain function and behaviour at home for the prediction of migraine attacks.

Abstracts and Speakers bios

Learning Systems in mixed methods research

Daniela Gawehns, Leiden Institute of Advanced Computer Science (LIACS)

Research on standards of care at doctor's offices, nursing homes or hospitals is often conducted by combining qualitative and quantitative research methods in so called mixed methods research designs. With more data being collecting in routine care, data scientists might be invited to take part in such research projects.
The aim of the project "Dementia back in the heart of society" was to describe the effect of a change of care management on the physical activity of residents in a dementia care ward. The collected data included interviews, management reports, observations and measurements with wearable and fixed sensors.
Using this project as an example, we show where machine learning can support knowledge generation in mixed methods designs. We will also discuss how data collection tools are central to ensuring machine learning researchers as well as health scientists get the data they need to work on their own research questions.

Daniela is a PhD student in computer science at Leiden University. Her research focuses on the integration of quantitative and qualitative data sources for data science applications in the Health Sciences. She is a clinical neuropsychologist and statistician by training and interested in open and reproducible research practices for machine learning research.