LINDERA

Digital Health Center
by Hasso-Plattner-Institut

Master's Thesis Offering

Connected Health Group, Digital Health Center

Unsupervised Human 3D Pose Estimation for Clinical Use Cases

Start Date: from now, flexible

Human motion analysis is an important instrument for assessing gait in neurological diseases or for exercise recognition as used for smart mirrors. Established gold standard solutions for Human Motion Analysis such as OptoGait[1] or the Vicon[2] camera system are very expensive (e.g. Vicon > 100.000€). Furthermore, optical systems in particular require a more elaborate preparation of the patients, i.e. the application of optical markers. These disadvantages increase the need for inexpensive, unobtrusive (markerless) methods for capturing human movements.

An established and cost-effective alternative motion capture system is the Microsoft Kinect camera, which is able to track users as a skeleton. However, they require wire connections to a computer, and is therefore not suitable for out-of-the-lab scenarios. Due to the recent success of Deep Learning, it has become possible to estimate the human skeleton based on 2D images only. This leads to the idea of using a regular smartphone or surveillance camera to record human motion data. The advantage of such a system is the possibility to work outside the laboratory environment, where the gait pattern is different from within controlled environments. Training a neural network in a supervised manner requires a large number of labeled data, which can be hard to obtain. A few studies have demonstrated that it is possible to use unsupervised learning for skeleton extraction from 2D images[3,4].

The aim of this Master's Thesis is to implement an unsupervised human motion analysis system capable of detecting 3D skeletons only from 2D images. The here developed system could be evaluated versus a gold standard system at the motion analysis lab of one of our cooperation partners. Afterwards, its performance could be evaluated on one of the following use cases:

- Early Detection of Neurological Diseases (such as Parkinson's disease) with Gait
- Quantifying Progress during Rehabilitation
- Comparing User's Exercise Movements with Professionals based on Video

If you are interested in working in this computer vision, machine learning and health related topic together with our team and our industrial partner (Lindera, based in Berlin[5]) in order to generate real clinical impact, please don't hesitate to send an email to justin.albert@hpi.de for further information and / or a personal discussion.

[1] www.optogait.com
[2] www.vicon.com
[3] www.arxiv.org/pdf/1712.01337.pdf
[4] www.arxiv.org/pdf/1803.08244.pdf
[5] www.lindera.de/