

An Instrumented Apartment to Monitor Human Behaviour During Day and Night: The NeuroTec Loft

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Introduction: The NeuroTec Loft is an instrumented apartment located at the Sitem-Inselspital in Bern. The modern 3.5 room apartment has an open kitchen-living space, a bedroom, a toilet and a storage room. The apartment is designed and equipped with sensors to unobtrusively assess and monitor human behaviour and how neurological disorders (e.g. parkinson, multiple sclerosis, stroke, epilepsy, sleep disorders) influence daily life over a prolonged time. The goal of the NeuroTec Loft is to advance the quality and to enhance the cost-efficiency of healthcare.

Method: In order not to disturb patients and healthy subjects and thus to foster natural behaviour similar to living at home, the monitoring is primarily based on contactless sensors. In the open kitchen-living space, a high-resolution patient tracking system is installed (e.g. motion tracking and lidar). In the bedroom different sensor systems to measure physiological parameters and movement during sleep are installed (e.g. radar, infrared camera, ballistocardiograph, pressure mat). In addition, there is the possibility to assess sleep disorders by mobile polysomnography. To assess activities of daily living all doors and cupboards are equipped with sensors to measure if they are open or closed, furthermore power plugs, switches and water supply, environmental parameters (e.g. temperature, humidity, brightness) are monitored.

Results: The advantages of testing patients or healthy subjects in the NeuroTec Loft are that more detailed recordings can be performed. Furthermore, the NeuroTec Loft allows to have a standardized environment and thus the comparison between patients or healthy subjects. Currently, the sensor system is validated in healthy subjects, whereas studies with patients will start in the second quarter of 2021 (e.g. the investigation how deep brain stimulation influences non-motor symptoms or the investigation of performance of activities of daily living in patients after stroke or traumatic brain injury).

Conclusion: Overall, the NeuroTec Loft has a great potential to advance science in terms of human behavioural and neurological disorders in a home-like environment and thus to address problems and increase quality of life of our aging society and patients with neurological disorders.

Key words: Instrumented Apartment, Sensors, Behavioural and neurological disorders, Activities of daily living