Machine Learning Based Gait-Parameter Extraction by Using Simple Rangefinder Technology

Background: In our aging society, gait related health issues are on the rise. There is a high interest in detecting fall risk, postural instabilities and freezing of gait in Parkinson's Disease patients. As of now, the gold standard for gait assessment are measurements in the clinic, done by a medical professional. However, the assessment in the clinic has several disadvantages like the long travel distances to the clinic, expensive assessments and no long-term assessments. To complement the clinical assessment, in the last few years wearable sensors or pressure mats have been used. Both mats and wearables are able to objectively measure gait parameters, whereas in case of the pressure mats the disadvantage is the location restrictions and for wearables the necessity to constantly wear sensors which could inhibit normal walking behavior.
However, with the commercial availability of rangefinder technology (lidar sensors), a new option for cheap contactless gait assessment has arisen. High frequency range measurements allow tracking of legs in natural environments, without the necessity to follow specific walking paths.

Aim: Therefore, the first aim of this project is the development of a gait tracking algorithm based on three lidar sensors and secondly, the development of a portable gait tracking system.

Materials and Methods: With the aim to research an instrumented apartment (SITEM, equipped with unobtrusive and home-based sensor technology) to monitor human behaviour in a natural (home-like) environment and to develop and test new sensor technologies has been opened. For indoor localization, the apartment is equipped with a variety of different sensors, including a lidar system and a camera-based motion tracking system. With the camera-based motion tracking system as a ground truth, the task is to set up an algorithm that is able to track gait based on only one lidar sensor by using machine learning techniques to identify the legs among the furniture. This project is based on a previous master thesis where a comprehensive system was developed, that allowed tracking of gait parameters using multiple lidar sensors. If time permits, a mobile sensor set is to be developed, consisting of the lidar sensor and a small computational unit to reliably extract relevant gait parameters at patients home.

Nature of the Thesis:
Conceptual work: 20%
Software and Testing: 50%
Data analysis and writing: 30%

Requirements:
Programming Skills
Mathematics (Geometry, Statistics, Analysis)
Machine learning

Figure: NeuroTec Apartment

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