

System for Automated Gait Analysis Using an RGB-D Camera

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Nowadays it is still common in clinical practice to assess the gait (or way of walking) of a person using a subjective approach (visual observation and/or use of rating scales). However, there are currently sensors, including RGB-D cameras (e.g., Microsoft Kinect), that can be used to obtain quantitative information that allows performing gait analysis more objectively. The results of quantitative gait analysis can be very useful for example to support the clinical assessment of patients with diseases that can affect gait, such as Parkinson's disease.

In this context, we developed a portable system for automated quantitative gait analysis in a quick, inexpensive and minimally invasive way, using a single RGB-D camera (Kinect v1 or v2). The system relies on 3-D body data to automatically select data corresponding to walking, detect the performed gait cycles and extract several gait parameters. Moreover, the gait parameters are used together with anthropometric measures to automatically identify the subject being assessed.

The gait data selection relies on machine learning techniques to recognize three different activities (walking, standing, and marching), as well as two different positions of the subject in relation to the camera (facing the camera and facing away from it). For gait cycle detection, we developed an algorithm that estimates the instants corresponding to specific gait events. Subject identification based on gait is enabled by a solution also implemented relying on machine learning.

Our system was found to be a viable alternative to gold standard systems for obtaining several spatiotemporal and some kinematic gait parameters. Furthermore, the system is suitable for both clinical and ambulatory scenarios, since it relies on a single markerless RGB-D camera that is less expensive, more portable, less intrusive and easier to set up, when compared with the gold standard systems (multiple cameras and several markers attached to the subject's body).

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FIGURE 1

System for automated gait analysis using an RGB-D Camera, including the acquisition of 3-D body data provided by the camera from a given subject, computation of different types of measures, selection of gait data relying on activity recognition, gait analysis and identification of the subject based on their gait.

