Ultra-Low-Cost, Integrated Sensor, Markerless, Comprehensive 3D Measurement of Spatiotemporal Gait Parameters

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Musculoskeletal and neurological conditions are the biggest drivers of disability & illness. Currently, physicians diagnose them by triangulating possible biomarkers and multiple abnormalities, such as deviations in patients' walking gait patterns in clinical settings, long after onset. Accelerated intervention forestalls progression and could reduce the incidence of falls, injuries, disabilities, and ensuing loss of independence, resulting in a poor quality of life. A markerless, unobtrusive solution that aspires to constant monitoring of gait is proposed. Aberrations and similarities to known patterns could facilitate detection of early symptoms of degeneration. This system measures multiple components of the patient's ambulation. In the stance phase, pressure distribution on different points on the soles is measured using a 16-point pressure sensor matrix of Force-Sensitive Resistance (FSRs). In the swing phase, features to compute cadence, stride length, and movement form are measured using a 9-axis Inertial Measurement Unit. By analyzing time series readings, comprehensive 3D spatiotemporal relationships and postural information—gait parameters—are captured. In proposed future work, using cloud-based computation, resemblances to the gait patterns of patients with diagnosed conditions could be identified. Further, using longitudinal data, the system could detect deviations from users' baselines and provide alerts to undiagnosed individuals. The design of the wearable facilitates wide data collection from activities of daily living rather than being limited to controlled settings. This approach could enable earlier detection and intervention and better disease outcomes despite difficult access to in-person clinicians.

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