Automated Gait Analysis using video

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Technology description

Neurological disorders such as Parkinsons disease, Cerebral Palsy or strokes, often result in the motor impairments causing great inconvenience to the patients. Treatments targeting the neurological of these diseases are still in their infancy and in practice clinitians perform orthopedic surgeries and/or advise physicaltherapy. To take appropriate decisions regarding parameters of the surgery, they take quantitative measurements using expensive marker-based motion capture systems. In this invention, we develop a methodology for extracting clinically relevant variables from videos of patients walking. This system enables:

* data collection in clinics not equipped with motion capture systems,
* performing gait checks-ups at home, using a camera or a mobile device,
* detecting early signs of neurological disorders,
* data collection at scale.

Stanford researchers have developed a new machine learning method for extracting gait parameters, such as cadence, step length, peak knee flexion, and Gait Deviation Index (GDI), from a single video. Measuring GDI can help identify conditions such as osteoarthritis, Parkinson’ s, Alzheimer’ s, Cerebral Palsy, Multiple Sclerosis and general decline in the elderly. This method is inexpensive, faster and more robust compared to current methods which require manual measurements taken by clinicians. In addition, this simple, portable set-up only requires a video camera, computer and mobile phone to implement. The team demonstrated the feasibility of this method using 2212 annotated videos, algorithms, and trained convolution neural network (CNN). Predictions using this CNN model achieved correlation ρ=0.74 with GDI computed from optical motion capture.

Top panel (A): In the current clinical workflow, a physical therapist first takes a number of anthropometric measurements, and places reflective markers on the body of a subject. Then, several specialized cameras collect positions of markers, which are later reconstructed into 3D position time series. These signals are converted to joint angles in time and are subsequently processed with algorithms and tools unique to each clinic or laboratory, usually implemented in the clinic.

Bottom panel (B): In the proposed work-flow, data is collected using a single commodity camera. Next, the posture in each frame is extracted using neural networks. These signals are then fed into another neural network which extracts characteristics relevant for clinical decisions. Note that this workflow does not require operators or specialized hardware, allowing monitoring at home

Application area

Clinical:
Identifying severity of conditions such as osteoarthritis, Parkinson’ s, Alzheimer’ s, Cerebral Palsy, dementia, multiple sclerosis, muscular dystrophy and general decline in elderly Monitoring progress after surgery or other treatment Monitoring decline with chronic conditions
Sports Medicine:
Analyzing sports performance such as parameters of running gait Determining new gait metrics, including symmetry, and stride-to-stride variability
Large Scale Research and other studies in Biomechanics

Advantages

Cheaper, more efficient and more robustsolution for clinics compared to optical motion capture
Faster:
Clinics can see more patients Requires less engineering time Automated method to predict gait parameters
Simple set-up– requires only mobile phone and a computer to process data
Portable– results can be viewed on a mobile phone
Can be widely implementedat many clinics
Requires less spaceat clinics
Consistent data- No bias from misplacing markers

Institution

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