Docket #: S18-010

Automated Gait Analysis using video

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 ?=0.74 with GDI computed from optical motion capture.

Figure

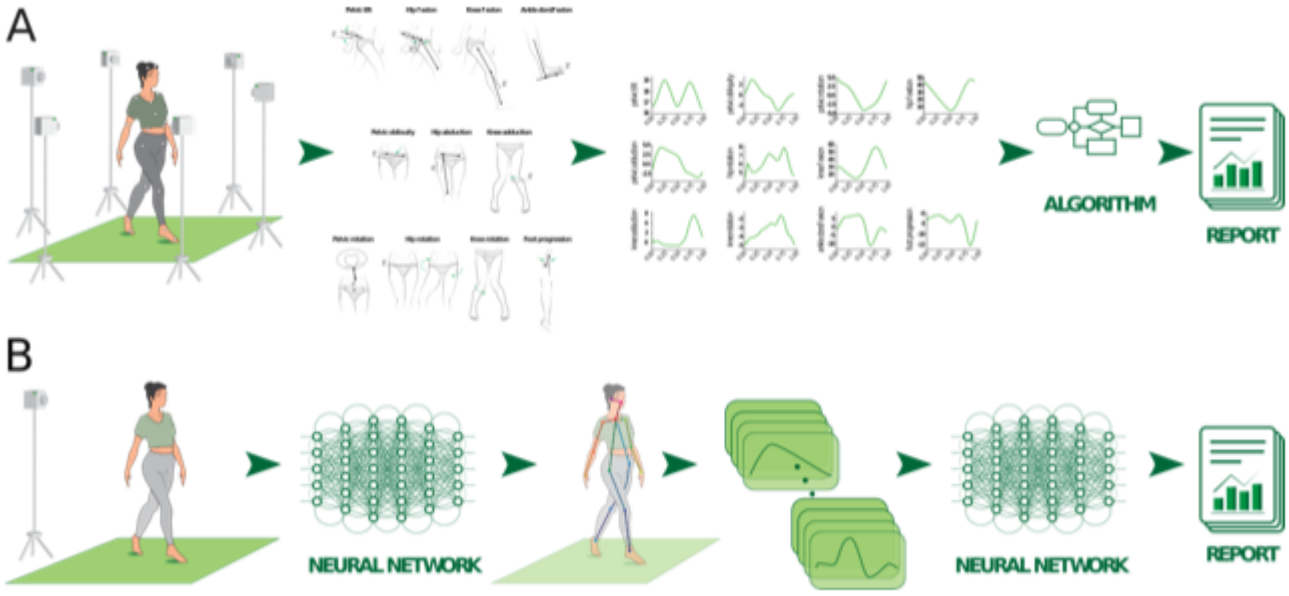


Figure description - Top panel (A): In the current clinical workflow, a physical therapist first takes a number of anthropometric measurements, and places reflective markers on the body of a subject. Then, several specialized cameras collect positions of markers, which are later reconstructed into 3D 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

Applications

- **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 robust** solution 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 implemented** at many clinics
- **Requires less space** at clinics
- **Consistent data** - No bias from misplacing markers

Patents

- Published Application: WO2020018469
- Published Application: 20210315486
- Issued: 12,635,907 (USA)

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