

Static and Dynamic Body Analysis in Physiotherapy and Rehabilitation

ABSTRACT

World Health Organization estimates that 80% of the world population is affected of back pain during his life. In this work, we propose a novel tool for posture and range of movement estimation based on the analysis of 3D information from depth maps. The system purpose is the posture reeducation to prevent musculoskeletal disorders, such as back pain, as well as tracking the patients evolution in rehabilitation treatments.

1. Requiriments

Motivation



- World Health Organization has categorized musculoskeletal disorders as the main cause for absence from occupational work, leading to considerable costs for public health systems.
- Posture abnormalities represent a risk factor for musculoskeletal disorders.
- It is necessary a set of tools to obtain an accurate body posture analysis, reliable, and cheap.

2. Framework

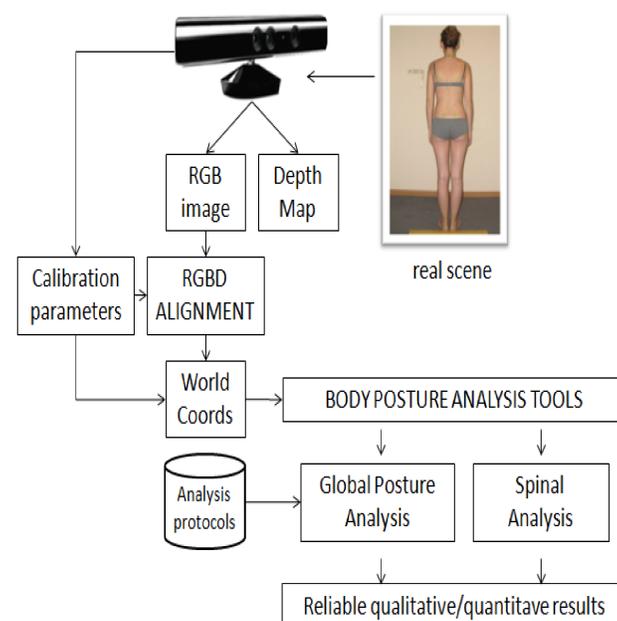
Technique

- It is presented a novel semi-automatic system that uses RGB-Depth information for clinical postural analysis.
- Given a set of keypoints defined by the user, and accurate measurements are computed.
- The output obtained allows us to monitor the evolution of the patient.

Principal Strengths

- **Accurate** and **reliable** results.
- **Non-invasive**.
- **Easy installation** on a wide variety of scenarios and settings.
- **Customizable** to the needs of the therapist.
- Allows **automatic** complex analysis **quickly**.
- **3D** visualization environment.
- Efficient control of **evolution**.
- **Low cost** system.

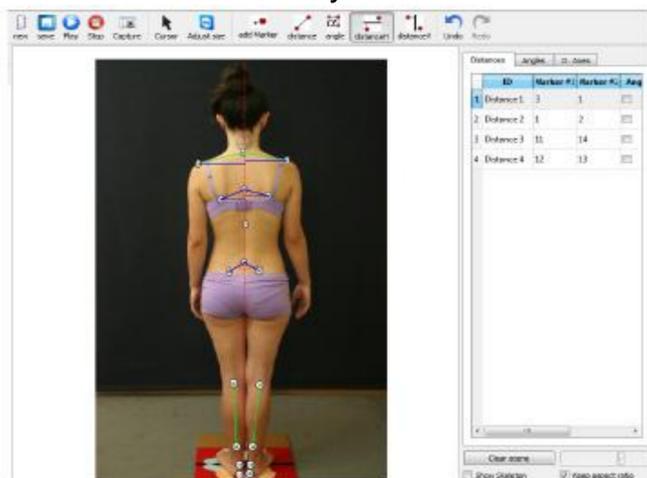
System Overview



3. Software and Results

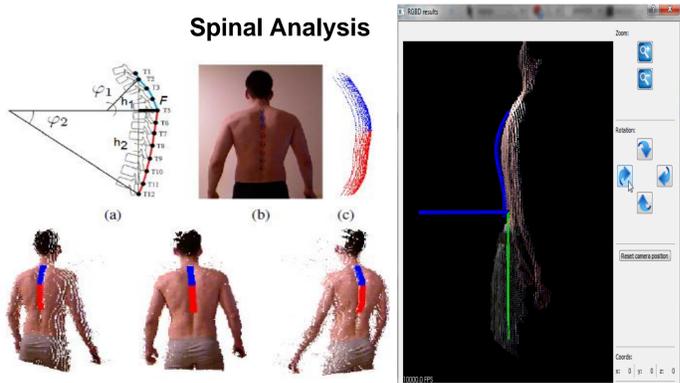
Global Posture Analysis

- This module computes and associates a set of three-dimensional angles and distances to keypoints defined by the customizable protocol designed by the user.



Spinal Analysis

- It evaluates sagittal spine curvatures by non-invasive graphic estimations in kyphosis and lordosis patients [1].



Quantitative results

Distance subject-device (m)	1,3	1,9	2,2
AAV (mm)	3,2	4,8	6,2
AAV (o angles)	1,98	1,42	2,1
AAV (%)	0,46	0,77	1,3
Standard Error (%)	1,01	1,18	1,71

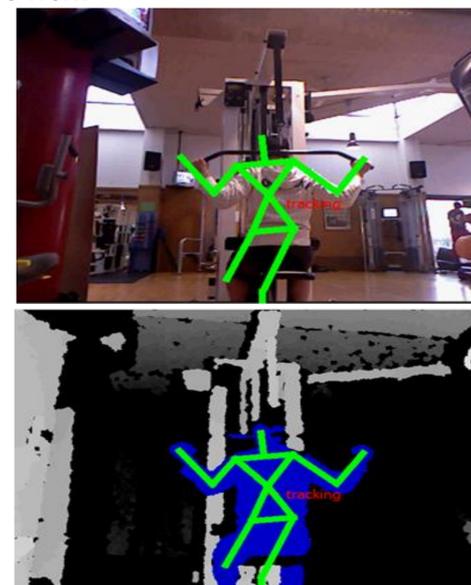
- A battery of 500 simple tests has been labeled by three different observers,
- 99% intra class correlation coefficient up to for all planes (X,Y,Z).

4. Next step: Dynamic Analysis

Future Work

- Within the field of physiotherapy and rehabilitation therapy there is a need to develop a reliable and accurate assessment of dynamic body posture.
- Our idea is focused on developing a reliable and accurate system to validate the achievement of a rehabilitation or fitness exercise, providing the necessary biofeedback to assess postural correction, rehabilitation, and fitness condition.

- Applications: **autonomous** and **automatic examination and evolution analysis in rehabilitation, ehealth, telecare, and fitness condition**.



References

[1] M. A. Leroux and K. Zabjek. A non-invasive anthropometric technique for measuring kyphosis and lordosis: application for scoliosis, volume 25, pages 1689-94, 2000.
 [2] M. Reyes, J. Ramirez, J.R. Revilla, Petia Radeva, and Sergio Escalera, Non-Invasive Multisensor System for Automatic Data Acquisition target body, robust and reliable. Iberdiscap 2011: Ibero-American Congress of Technologies disability support, Majorca. June, 2011.
 [3] M. Reyes, G. Dominguez and Sergio Escalera. Feature Weighting in Dynamic Time Warping for Gesture Recognition in Depth Data, IEEE Workshop on Consumer Depth Cameras for Computer Vision, International Conference in Computer Vision, Barcelona. October, 2011.
 [4] J. Shotton, A. Fitzgibbon, M. Cook, T. Sharp, M. Finocchio, R. Moore, A. Kipman, and A. Blake. Real-time human pose recognition in parts from single depth images. CVPR, 2011.