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Automatic Digital Biometry Analysis System

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 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.

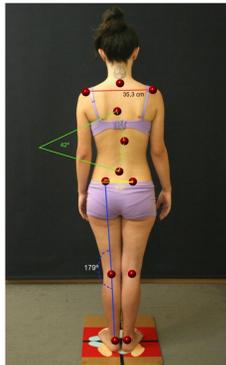
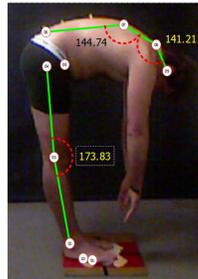
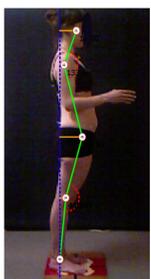
1. Motivation

- **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**.
- In the field of **physical rehabilitation and fitness conditioning**, exists the need to develop systems able to **evaluate the body posture**.



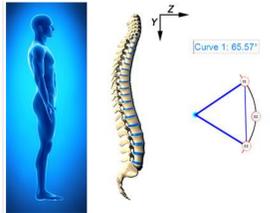
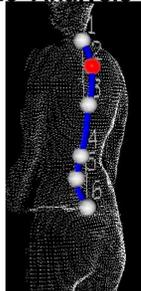
3. Software and Results

- **ADiBAS Posture platform** allows measuring distances and angles in 3D using as input the data of Kinect™ device.
- It allows quantifying the posture imbalances and muscular flexibility



Back Spine Analysis

- It evaluates sagittal spine curvatures by non-invasive graphic estimations in kyphosis and lordosis patients.
- Easy to obtain Cobb angle.



Measurement errors:
 VALIDITY = bias (systematic error)
 FIABILITY = SEM or estándar measure error (random error).
 Significance level $\alpha = 0,05$
 Confidence level 95%

	LENGTH	bias $\leq -3,3$ mm	mean 0,2 mm	range [3,3 a 3,3]
Viability	ANGLE	bias $\leq 1,8^\circ$	mean 0,1°	range [-1,7 a 1,8]
Fiability	LENGTH	SEM ≤ 3 mm	mean 1,9 mm	CCI>0.9
	ANGLE	SEM $\leq 2,9^\circ$	mean 1,0°	CCI>0.9

The system shows precise estimations

2. Framework

- **ADiBAS Posture** has been developed by a multi-disciplinary team, including engineers, computer vision and machine learning doctors and physiotherapists, with the objective of filling this need.
- Using **Kinect™ as an input sensor device**, it has been developed a platform able to estimate postural parameters with high precision, giving support to a **reliable clinical diagnosis**.
- Its **easiness of usage, robustness and reduced cost** respect to actual mechanisms make from this product a **promising alternative**.

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 Composition



- The platform analyzes depth and color maps using the data acquired from Microsoft **Kinect™** device.
- The data provided by the implemented system determine the real distances and angles given a set of corporal keypoints manually defined by the user.
- The system provides to the **health and fitness conditioning professionals** the required information to perform **precise clinical diagnostics that support efficient treatments**.

4. Who should use ADiBAS Posture?

Identified **potential sectors of interest for ADiBAS system:**

- **Clinical sector:** primary attention centers, work insurance, hospitals and rehabilitation centers, private centers (orthopedics, rheumatology, dentistry, etc.), functional recovery centers, private centers physiotherapy, podiatry, osteopathy, etc.
- **Early diagnosis sector:** school services and occupational health (e.g. early detection of scoliosis)
- **Fitness conditioning sector:** high performance centers, gyms and sport clubs.
- **Educational sector:** physiotherapy universities, medicine, fitness conditioning, educational centers of posturology and osteopathy.
- **Research:** as a measure tool in research studies

BEFORE AFTER



References

- Miguel Reyes, Albert Clapés, José Ramírez, Juan R. Revilla, Sergio Escalera, Automatic Digital Biometry Analysis based on Depth Maps, Computers in Industry, DOI 10.1016/j.compind.2013.04.009, 2013.
- Registered software number B3342-11, ADiBAS Posture: Automatic Digital Biometry Analysis System, Miguel Reyes, Sergio Escalera, José Ramírez, Juan Ramón Revilla, and Petia Radeva, 2011.