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Research Article

Treadmill and a Low Cost Vision System for Human Gait Disorder Assessment

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Abstract

Human gait analysis and research has been done by several authors, mainly in the fields of biomechanics, robotics, and computer animation. It has been conducted in medicine, psychology, and biomechanics in the past five decades.

Keywords: Gait Characterization; Gait Diagnosis; Gait Pathologies

Introduction

In the field of computer vision, recognizing humans through theirs gaits has recently been investigated. Studies similar to this one are found in [1]. They analyse a human gait and compare it with medical data gotten from a marker system.

To proceed the work done in preview paper [2], using a 2D system, it is needed a 3D position acquisition system, for an accurate characterization and classification of the human gait and application of the results in the medical diagnosis. From the human gait trajectories, acquired by the 3D position acquisition system, it is possible to propose many different parameters to represent and analyse the gait trajectory.

Materials and Methods

The main objective of this research project is to develop a computerized system to characterize and automatically assess gait disorders severity. The system uses a treadmill and 2 low cost cameras connected to a personal computer (Figure 1) to provide 3D position and trajectory acquisition of the joints involved in the walking.

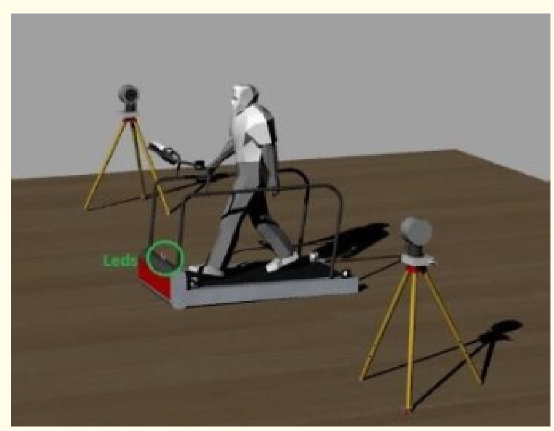

Figure 1: Layout of system.

The system calculates 17 gait joint trajectories at the sampling frequency of 30 Hz (Figure 2). This system is an important low cost new medical diagnosis tool, the limitations of the present subjective gait diagnosis tools. It will allow a much more objective understanding of the clinical evolution of patients, enabling a more effective functional rehabilitation of a patient's gait.

The system can be used in several medical areas particularly in stroke (CVA) recovery patients, mobility assessment of aged population, lower leg amputation and lower leg post-surgery.

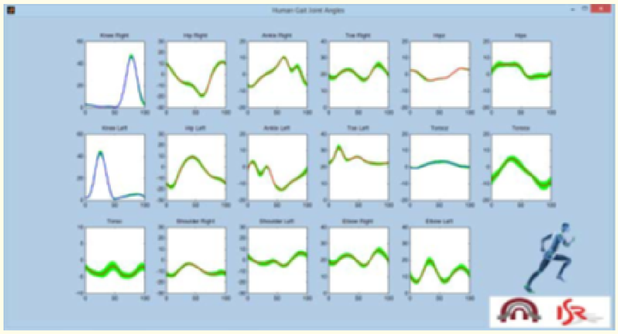

Figure 2: Average and standard deviation of 17 joint angle trajectories.

Experiments of the proposed system were performed with 4 people with similar physical characteristics, in a Physical and Rehabilitation Medicine Department of a Portuguese central and university hospital. One of the persons has no gait problems (NP), while the others have a prosthesis (a passive one, without motor) (PP) and a bionic prosthesis (BP), from the upper left leg, and the last person had a CVA 3 years ago (Figure 3), having paralyzed partially his left side (PCVA). In the person without gait problems it was induced a gait asymmetry by making he using a load of 3kg (NP1) just above the left ankle, which was considered to correspond to 20% degradation of the gait performance.

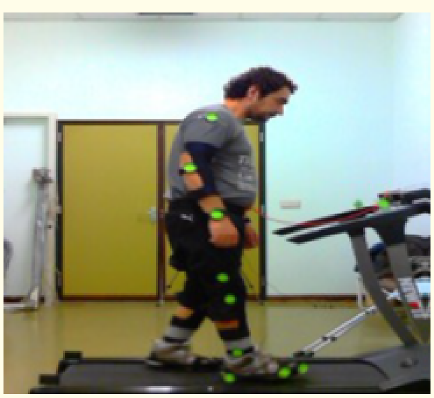

Figure 3: Person had a CVA 3 years ago, using the system.

Experiments, Results and Discussion

The experiments were performed in a treadmill at 3 different velocities (1, 2.5 and 3.5 km/h). The average of the "gait disorder severity index" value of PP, BP and PCVA for the left leg is 27%, 20% and 9% respectively, that are calculated using a software developed presented in figure 4. This means that the PP severity is greater than that of NP1 (20%) and, as expected, BP has better performance than PP. PP and BP will continue the physiotherapy and/or prosthesis adjustments. PCVA presents a good recover but needs to continue the rehabilitation.

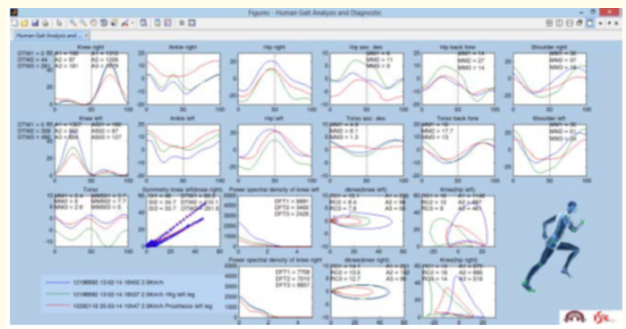

Figure 4: Layout of software developed to calculate the gait disorder severity index.

Conclusion

The developed system will be helpful in the assessment of the rehabilitation process and/or prosthesis adjustments, during a patient recovering.

Bibliography

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