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3D virtual environment system applied to aging study - Biomechanical and anthropometric approach

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Abstract

The percentage of people over 60 years increased from 8.6% in 2000 to 10.8% at Brazilian population in 2010. In 78 cities of Brazil this portion of citizens already represents 20% of the total population. In this context, fall is one of the most serious problem of aging process, and it is being recognized as an important public health issue because it is considered a major source cause of disability to older adults. This is a matter of concerning to older people because can lead to physical handicap and loss of independence. The purpose of this paper is to present a 3D digital interactive environment to work with 3D digital human models applied to aging study. The 3D interactive platform framework involved: first step - scanning older adults and caregivers at a 3D Whole Body scanner and captured caregivers motions using 17 inertial sensors from XSENS Technology; second step- 3D modeling and simulation - scans and motion data are incorporated to virtual environment; third step - study reports and e-book. The conclusion are: the simulation will assure more democratic visualization and improve available information for the stakeholders involved, as designers, architects, health personnel's in the benefit of senior population, the 1D and 3D anthropometric measurements database of the caregivers and old adults will be a tool that can help designers and health cares in the future to improve design and care services for senior people in order to improve safety and quality of life. The 3D digital interactive environment is still under development. Also this system could be used to interact with the caregivers as a game to training in order to improve the daily care services tasks.

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Keywords: Aging study; Caregivers; Biomechanics; 1D and 3D anthropometry

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1. Introduction

The elderly proportion in the Brazilian population had a general growth in the last 10 years. [4] The percentage of people over 60 years increased from 8.6% in 2000 to 10.8% in 2010. In 78 cities of Brazil this portion of citizens already represents 20% of the total population. In this context, fall is one of the most serious consequences of aging process being recognized as an important public health problem due to their incidence, to health complications and to the high assistance cost, in order words falls are a major source of disability in older people and is highly associated to postural instability and home environment. This is a matter of concern with the elderly, for it can lead to physical handicap and loss of independence. These health and social problems have increased concern of government health institutions regarding the care services and products development for this population in order to improve quality life and security.

Digital Human Model (DHM) is a digital human representation in the 3D space that can be moved and manipulated to simulate real and accurate movements of people [2] . Digital human modelling is a fast growing area that bridges computer-aided engineering, design, human factors, applied ergonomics and training [5] . Digital human modelling and simulation play an important role in product design, prototyping, manufacturing, health services and many other areas [3]

The term “serious games” describes software /video games designed specifically for training and education (in terms of learning and practice) [1,7]. A subset of educational serious gaming focuses on training, where users need to acquire a specific competence or built up a particular set of skills. Serious games are designed to solve real life problems through environment visualization and simulation [8,9]. Technological innovations have been frequently implemented in attempts to enhance the learning experience. Some technology as inertial sensors, magnetometers, GPS and wireless technologies, or a combination of such devices can improve detailed activity information, occupational biomechanics and performance measures data collected in order to enrich training and technique evaluation [5]

The purpose of this paper is to present a 3D digital interactive environment to work with 3D digital human models applied to aging study with focus on caregivers’ biomechanics analyzes and 1D and 3D anthropometry measurements’ from caregivers and older adults.

2. 3D interactive platform framework

The Ergonomics Laboratory team of the National Institute of Technology has developed "serious games" platforms and simulation environments applied to ergonomic work analysis and new ergonomic design. The goal of these simulations has been to help designers and employees to understand and implement ergonomic concepts work environment design. Based on these experiences we are developing the actual 3D interactive system.

The actual system consists of basic system and modular tools described below (see Fig.1): - Analysis: Allow to get and to record the "bone" and joint data graphs and the diagram of movement in 3D; - The E-Book – consisting of text, images of analysis of caregivers working movements, that can be readable on computers or other electronic devices; - Reports and Exports: return reports with graphs and diagram for printing or saving. Allow exporting the RAW data to XML or other exchange data format. The caregivers and old adults that invited to participate to this study are part of Center of Research and study of Elderly of Rio de Janeiro State (CEPE). The old people group will be selected by the CEPE Health care team. A formal consent is being signed by caregivers and old people that agree to participate to the study.

Fig. 1. Flow chart

3. Data acquisition

Comprised three steps before data input in the 3D digital interactive environment: First the Caregivers and old people group from CEPE will be invited to be scanned in a *Cyberware WBX 3D* whole body scanner at Ergonomic Lab at National Institute of Technology and also to be take 1D and 3D anthropometric data. The 1D and 3D anthropometric methods that will be applied at the study follow the CAESAR research protocols [6]. (see Fig.2 a, b). After the process of acquiring scanning data, each scan will be treated using the process of retopology. In the second step the skilled caregivers was asked to select and define some working movements when manipulated elderly people that they consider the most difficulties and overloading for their bodies performance. After that, their motions were captured using a suit with 17 inertial sensors from XSENS Technology (MOCAP). (see Fig 3) Finally, the data captured from MOCAP and the 3D DHM data from scanning process will be incorporated at the virtual platform that is being developed as an interactive 3D software using Unity 3D and other game tools. The visual representation of the 3DHM at the platform is being generated based on mocap data, following position and dimension of bone segments of the virtual body. That makes the visual representation an accurate copy of the original bone position and of the specific actor's movements being captured.

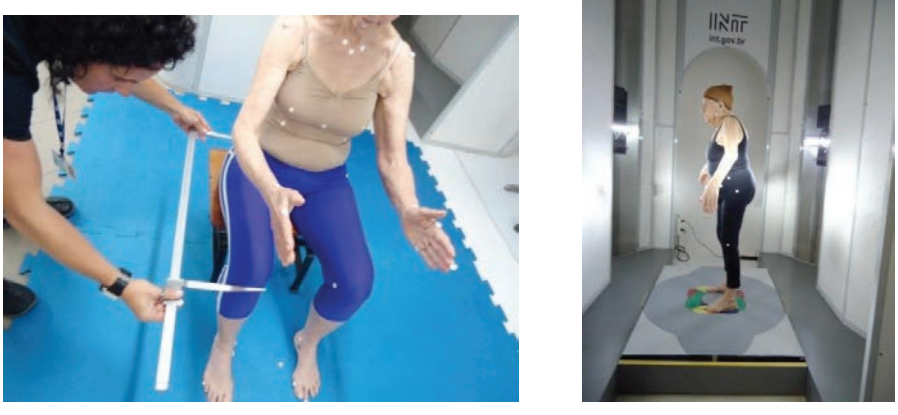

Fig. 2. (a) 1D Traditional Anthropometry applied to Elderly; (b) 3D Anthropometry applied to Elderly

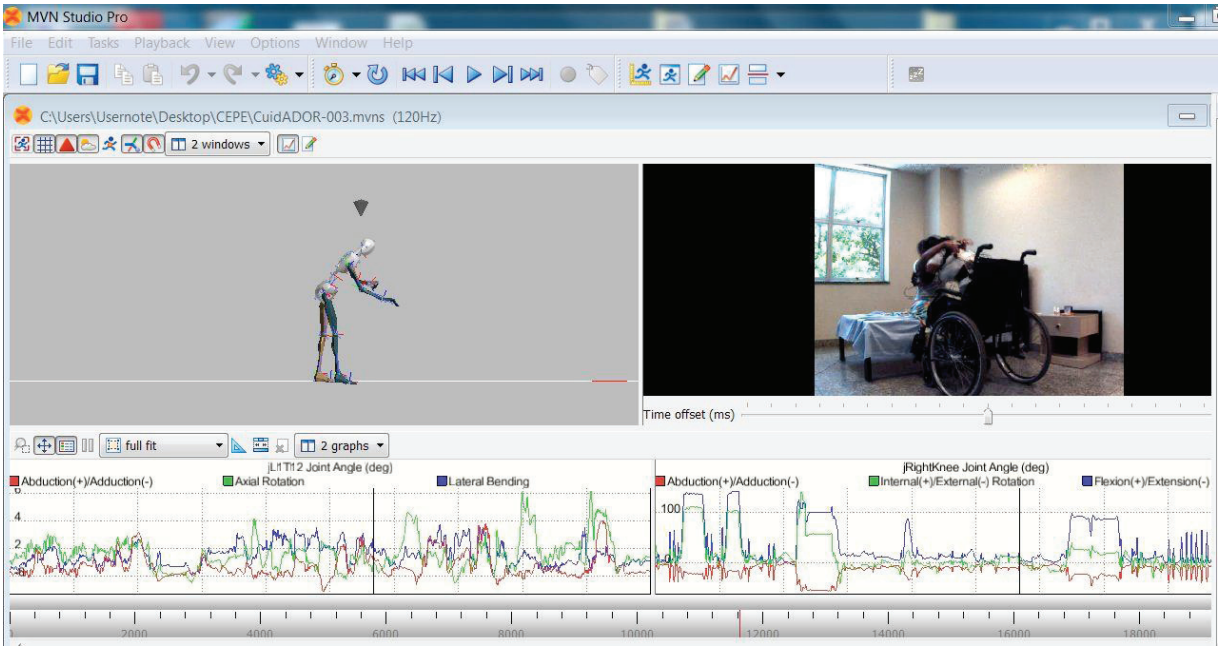

Fig. 3. Caregiver task motion captured using inertial sensors MOCAP

4. Data analysis

That platform is being developed considering the need to analyze data from different caregivers movements being repeated in different moments (kinematics analysis) and also with different skills (see Fig. 4 and Fig.5). These analysis is been done at Visual 3D software and will be incorporate at the 3D platform. The 1D and 3D anthropometric measurements data from caregivers and old people will be analyze with Matlab statistic's software and Cloud Compare software and the database with these measures' will be incorporate at the platform. The data analysis allows the kinematic data to be visualized by means of graphics. This kind of visualization makes it easy to analyze the data and the application to training. (see Fig. 4).

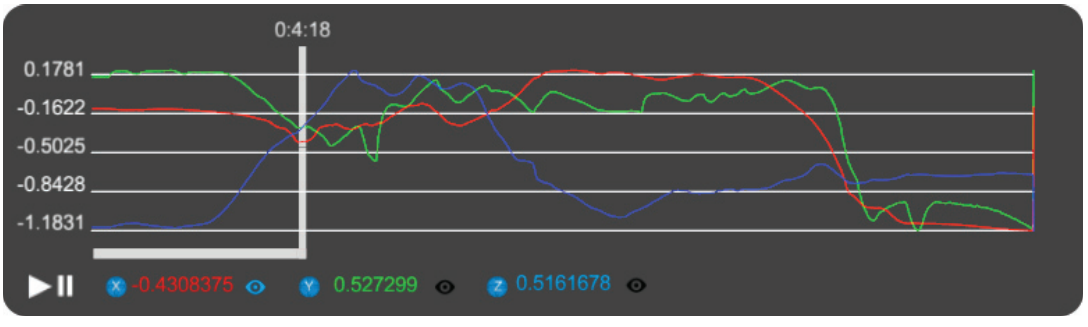

Fig. 4. Kinematic data graphic interface.

5. E-Book and reports

Those modulus complete the interactive platform - The book features an entry corresponding to the movement currently under analysis and shows anthropometric data while the Report Module exports the Analysis as results to an exchangeable and readable data format. The overall organization of the modules of the plataform can be seen in the spreadsheet. (see Fig.5)

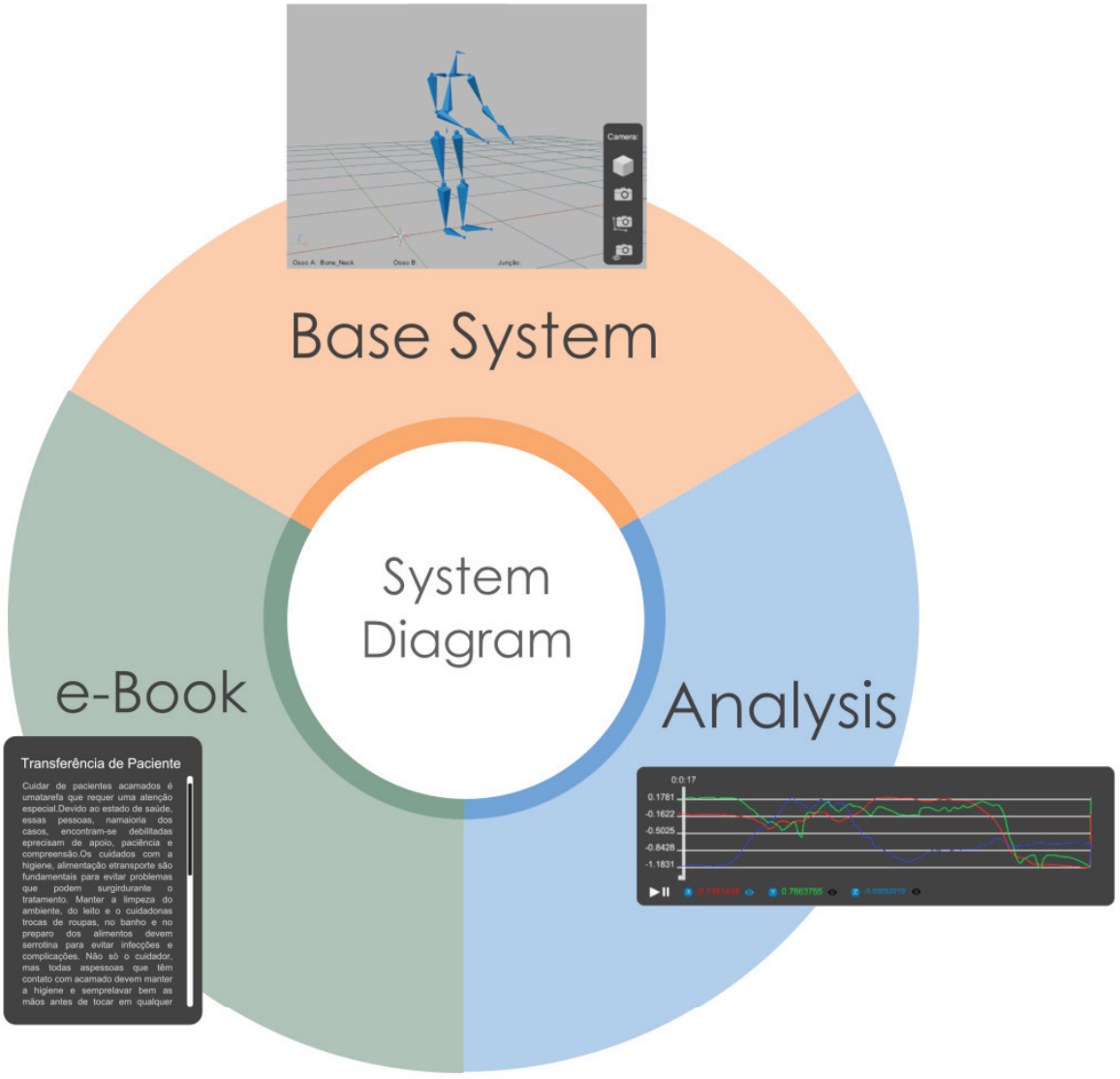

Fig. 5. 3D Interactive Platform Structure.

6. Conclusions

The 3D digital interactive environment is still under development. Its analysis will allow to study and to improve caregivers performance through training and to prevent work related musculoskeletal problems. The simulation will assure more democratic visualization and improve available information for the stakeholders involved, as designers, architects, health personnel in the benefit of senior population. The 1D and 3D anthropometric database from caregivers and old people will be an information tool that can help designers and health care stakeholders in the future to improve health care services, safety and quality of life for elderly population.

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