3D Scan of Elderly Functional Postures Applied to Interior Home Design

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ABSTRACT

The percentage of people over 60 years increased from 8.6% in 2000 to 10.8% in 2010 in last Brazilian Population Surveys (IBGE, 2010. In 78 cities of Brazil the elderly citizens already represents 20% of the total population. In this context, fall become a priority concerning and one of the most serious consequences of aging. Fall is being recognized as an important public health problem due to their incidence, health complications and high cost assistance. Research conducted in Brazil and other countries refer that falls are more frequent among institutionalized elderly people and can have multiple causes (Lojudice et al, 2010). A study conducted with elderly in Fortaleza city/Brazil pointed out that the main falling cause (57%) was related to inadequate home environment (Cavalcante, et al, 2012). Among the factors related to domestic environment, the most often cited was the existence of slippery surfaces (33%). The most common consequence of falls was fracture, indicated by 43% of the elderly; radius fracture being the most frequent one (56%). After home accidents, common consequences for elderly people may be increased physical dependency and wide range of psychological troubles due to loss of independence and self-consideration. The main purpose of this study was to scan elderly people on daily activities postures selected according to frequency, difficulty and safety at home situations, in order to create a functional postures database to be applied on interior home design. Those scans will also be used to study new interior layout proposals in order to improve safety at home and avoid hazards workload postures. In the first stage 10 women and 01 man were interviewed and then scanned simulating daily activities selected postures. In a second stage a motion capture study will be conducted. The partial results indicated the adoption of common postures; for example: getting something on the floor, where most of them performed forward trunk bending instead of knee flexion. The importance of this study is to understand how to implement new interior layout design and prevention programs in home institutions aiming to improve elderly population's quality of life and safety. This pilot study is part of two researches supported by FAPERJ – Rio de Janeiro Research Support Agency.

Keywords: Elderly, Functional posture, Elderly scan, and Home design

INTRODUCTION

The elderly proportion in the Brazilian population has had a marked growth in the last 10 years. 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, falls are one of the most serious consequences of the aging process, being recognized as an important public health problem due to their incidence, to health complications and to the high assistance cost (IBGE, 2010). In other words falls are a major source of disability in older people and are highly associated with postural instability (Lojudice, 2010, Cavalcante et al, 2012). This is a

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matter of concern with the elderly as it can lead to physical handicap and loss of independence. Research conducted in Brazil and other countries refers that falls are more frequent among institutionalized elderly people and have multiple causes. At least one-third of all falls in the
elderly involve environmental hazards in the home. The most common hazard for falls is tripping over objects on the floor. A study conducted with elderly people in Fortaleza city/Brazil pointed out that the main falling causes (57%) were related to inadequate home environments and among the factors related to domestic environment, the most often cited was the existence of slippery surfaces (33%). The most common consequence of falls was fracture, indicated by 43% of the elderly; radius fracture being the most frequent one (56%). Common consequences for elderly people after home accidents may be increased physical dependency and wide range of psychological troubles due to loss of independence and self-esteem. Aches and pains caused by chronic muscle tension and joint stiffness are also a common complaint (Maia et al 2011). Age-related vision diseases can increase the risk of falling. Cataracts and glaucoma alter older people's depth perception, visual acuity, peripheral vision and susceptibility to glare. In order to compensate for these difficulties, it is important to modify work and home environmental factors to make things easier to see. Most symptoms associated with aging that are relevant to ergonomics can either be prevented or at least successfully accommodated, so they need not to become debilitating. By being aware of common changes in the body, people can on daily tasks as cooking and cleaning elderly people face physical limitations. For that reason, to reduce tiredness in daily task performing it is important that, for instance, the kitchen be designed accordingly to their physical and physiological characteristics. Architects, designers and engineers should look into the requirements of the aging population in providing ergonomic home design (Taha et al, 2010). Old people are vulnerable to accidents, since the senses of direction, vision, touch, hearing and smell decrease with age. Physical abilities become limited, making the execution of common tasks more difficult. Through the use of ergonomic analysis it was possible to observe many problems concerning the activities performed in the kitchen (Taha et al, 2010). As stated by official Brazilian population demographic surveys, the Brazilian population is witnessing an irreversible population aging. The resulting physical and mental change and limitations, bring about a new population profile, which generates changes and challenges in its demands. The main research approach is in the occupation and use of the domestic space with safety and comfort. The main purpose of this study was to scan elderly people in daily activities postures selected according to frequency, difficulty and safety in home situations, in order to create a functional postures database to be applied with interior home design.

METHODS

This research is a pilot study. The elderly sample was selected with CEPE (Rio de Janeiro State Elderly Research Center) and some that were invited to take part of this pilot stage**.** First were selected 10 healthy elderly people. They were invited to go to the Ergonomics Laboratory. Interviews were conducted in order to understand their limitations and difficulties in their daily living activities at home. After the interview analysis, the selection of functional postures was conducted based on the answer of the interviews. A letter of consent was present and signed by the elderly people that agree to take part of the research.
The postures selected were: simulation of getting objects from below knee height and above shoulder height, using a walking stick and sweeping the floor. The scanning stage took place at the Ergonomics Laboratory and the scanning equipment was a WBX Laser Scan from Cyberware Enterprise. Only one elderly person was scanned while using a walking cane.

Scanning Session

The scanning session was divided into two parts - First: traditional and 3D anthropometric have being collected based on Caesar 3D Scanning Project Protocol methodology (Figure 1 and 2). At second part, each elderly person has being invited to enter into the WBX scanner and assume one of the functional posture selected (Figuere 3). After the process o acquiring scanning data, each scan was treated using the process of retopology. Afterwards they were superimposed to compare the differences in posture between them, and to compute the occupied space in the three planes of motion (Guimarães et al, 2013).

Figure 1 - Traditional Anthropometry

Figure 2 - 3D Anthropometry

Figure 3 - Functional postural scanning

RESULTS

It is important to state that this research is a pilot study and the researchers are still testing the methodology to be applied in two main projects associated with CEPE - Rio de Janeiro Study and Research Elderly Center and sponsors by FAPERJ.

A - Posture 1 - simulation of getting objects above shoulder height

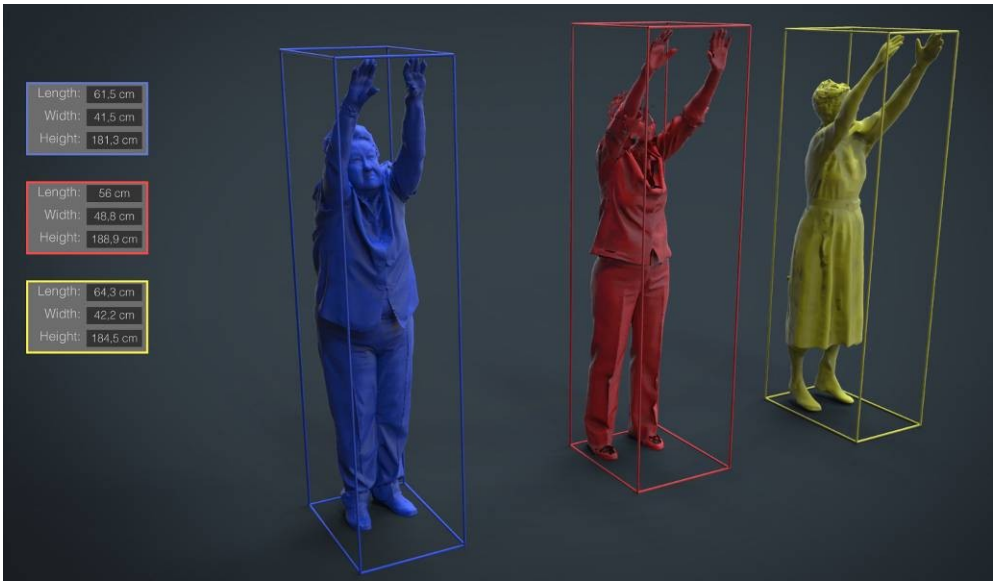

Figure 4 - Posture simulation of getting objects above shoulder height

Figures 4 show that they **try not to lean forward in order not to lose balance**. They stretched their arms, but **most of them presented difficulties to sustain that movement**.

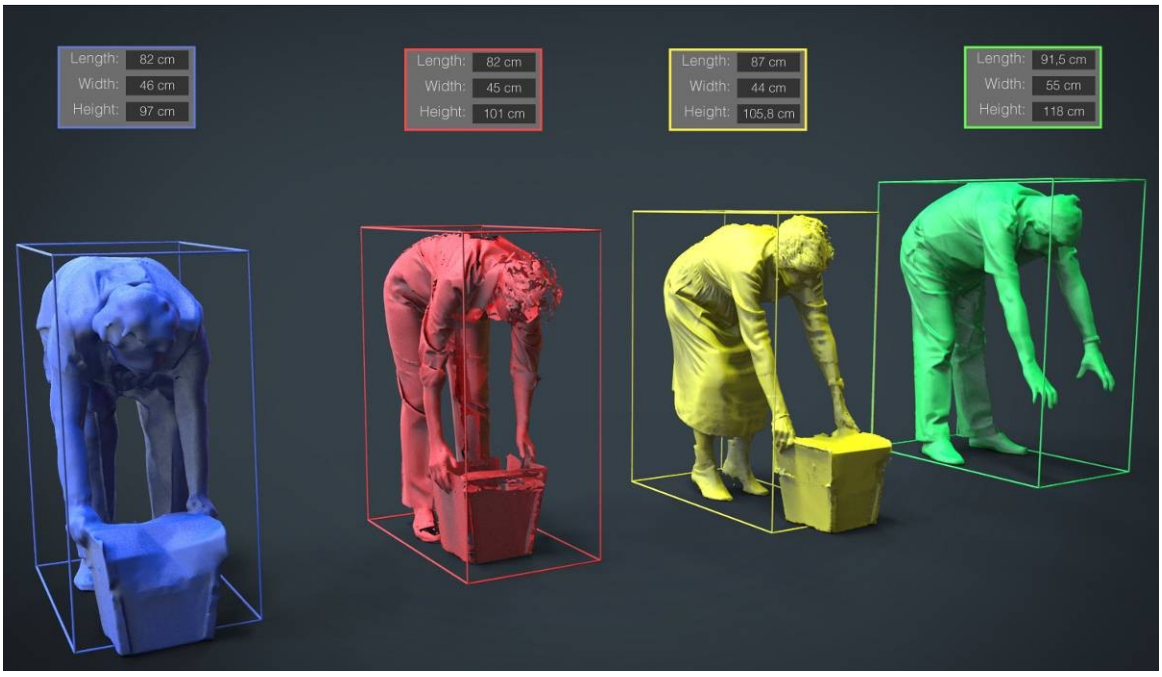

Figure 5 - Simulation of getting objects below knee height

Figures 5 show that **they try not to flex the knees** in order to get something near the floor. Most of the **movement were made by the trunk** and they complain a lot of these because some of them felt **back pain** and others complained that they where like "**feeling dizzy**". Most of them present difficulties to sustain this movement.

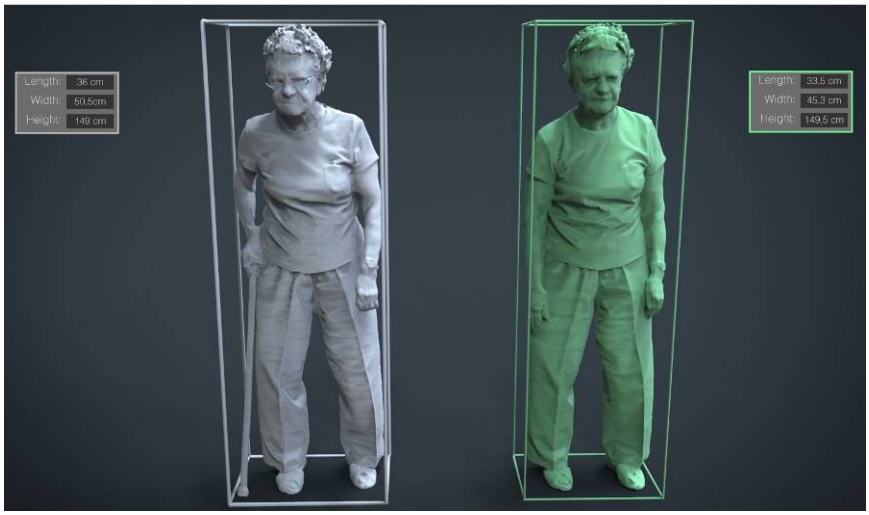

Figure 6 - Elderly person using a walking cane

Comparison made by a person with or without using a walking cane found out that the elderly (Figure 6) **change the posture assuming a lean forward posture**. Because of the cane size the **trunk adopted a lateral inclination**.

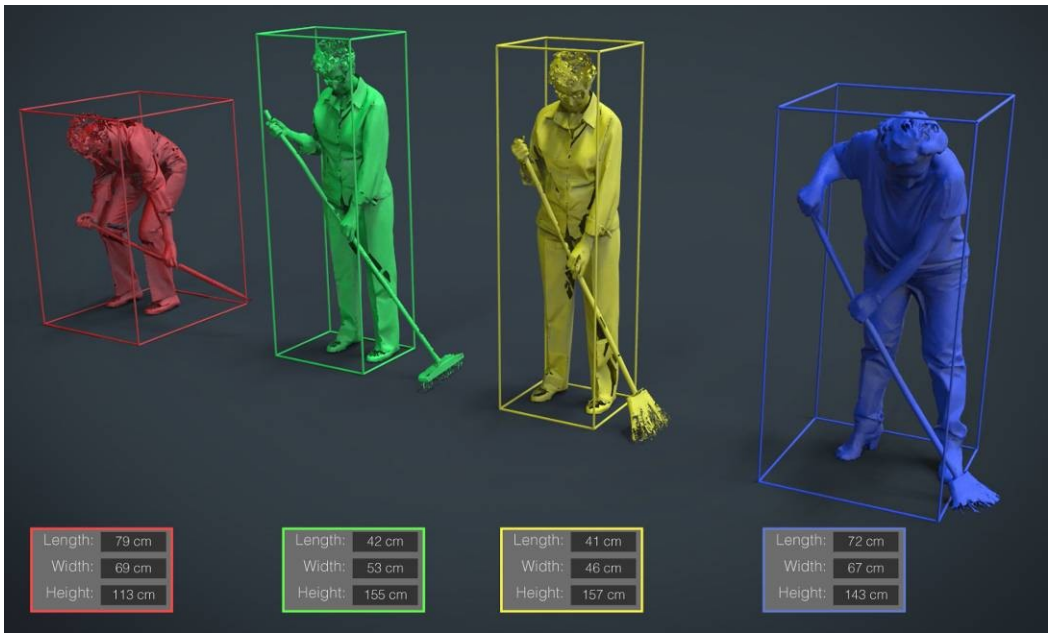

Figure 7 - Simulation of sweeping the floor using a broom

The analysis of Figure 7 shown that the occupied space and the adopted posture is depending on the daily living work activities' and broom's size.

CONCLUSION

This pilot study is part of a major project conducted by the Ergonomic Laboratory/ INT and Rio de Janeiro Study and Research Elderly Center (CEPE). The analysis of these functional postures showed some important design parameters that could help designers to understand and design better equipments for home adjustments to elderly person conditions. In the future, the goal is to develop a functional posture database as a tool to help designer to design interior layout of elderly home. Our researcher group has applied the same methods to study a interior trains

occupancy (Santos, et al, 2012). The traditional and 3D anthropometric data will be used in other project that is in development at Ergonomic Laboratory and are still in testing.

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