DEVELOPING A COMPUTER AIDED DESIGN TOOL FOR INCLUSIVE DESIGN

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INTRODUCTION

Globally the proportion of older adults in the population is increasing, the fastest growing subgroup being those aged over 80 years. In Europe, it is estimated that 24% of the population will be aged over 65 by 2030 [1]. The majority of these people will remain living in their own home.

The aging process leads to changes in strength, flexibility and balance, which in older adults can combine to limit the use of products or services (transport, buildings etc.)[2]. Inclusive design aims to overcome this by designing products that can be used by all. However, for designers to achieve products that can be used by all it is important to provide them with relevant information on the performance capacity of the older population.

The purpose of this study was to investigate age-related changes in the performance of a range of movement tasks for integration into a computer aided design (CAD) tool for use in inclusive design.

METHODS

Eighty four healthy older adults (age 60 –88 years) underwent full body 3-D biomechanical assessment of five activities of daily living using a VICON 8-camera motion analysis system (120Hz) with 3 Kistler forceplates. Activities consisted of gait, sit-stand-sit, door opening and closing, stair ascent and descent and lifting a small object to different heights (Figure 1). Vicon BodyBuilder was used to analyze the data and export limb segment positions as a series of rotations and translations from the position of the pelvis segment. Maximum isometric joint moments at the hip and knee over a range of angles were also assessed. Maximum upper limb moments for older adults were determined from the literature.

Custom written software was developed in Visual C++ utilizing the OpenGL 3d library. This software imported the processed data and produced an animated model of a subject performing an activity. This model can be manipulated by the designer by changing the position of the limbs. Limits were placed on joint movement to represent loss of motion in the older adult. The resulting change in joint angles and moments were calculated using inverse kinematics. A plug-in was written for the engineering CAD software package SolidWorks using C++. This enabled a potential product developed using CAD to be imported and attached to the hand of the model (Figure 2). The effects on upper limb joint moments as a result of this potential product were determined.

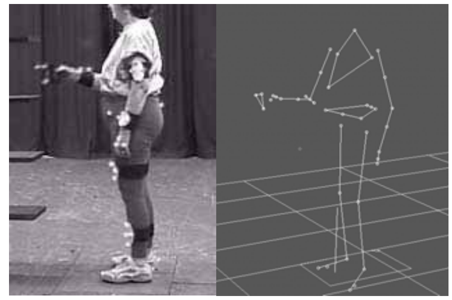

Figure 1: Data collected and processed in VICON.

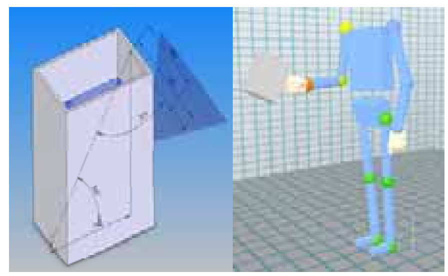

Figure 2: CAD model imported from SolidWorks and attached to model.

RESULTS AND DISCUSSION

Joint moments are presented in both numerical form and graphically on the model. Joint moments are visualized using a colour scale and expressed as the percentage of the expected age related maximum joint moment at that point in time. This allows designers to quickly visualize when a task may prove too difficult for an older adult to accomplish. Changes can then be made to the virtual design in SolidWorks and the usability of the re-engineered product reassessed.

CONCLUSIONS

The study demonstrated that biomechanical data can be interfaced with standard CAD software to aid inclusive design. The prototype CAD tool is currently being tested by designers and work is ongoing to develop it further.

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