Age Simulation Suits for Training, Research and Development

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Abstract—Simulation of old age can be a strong tool in providing information to researchers and developers for products that address to elderly people, and also for the disabled. Medical personal that is working with people that need care could also be users for an age simulator, with the purpose of understanding the needs of the ones they take care of. The benefits would be to provide better services and give empathy. In this paper technical solutions are proposed for development of age simulation suits, in order to identify different ways of integrating the physical functions.

Keywords—ageing suit, age simulator, elderly.

I. INTRODUCTION

The importance of an age simulation suit is relevant thru the information that it provides to the users of this systems. So far we have identified a few areas of interest for this type of simulators: research and development; studies regarding elderly; development of assistive systems for elderly or the disabled; development of biomechanisms like exoskeletons; development of households for the elderly; development of vehicles; the use for life insurance companies; training of medical specialists.

There are different models of simulators that cover limitation for the limbs, back, neck and head, and also different sensorial losses like hearing and vision. The materials used for construction start from simple products like an elastic strap and can go up to virtual reality glasses to simulate vision deficiencies.

II. AGEING SUITS PREVIOUSLY DEVELOPED

A. AGNES

The Age Gain Now Empathy System also known as AGNES Fig. 1 is a suit developed by the MIT AgeLab researchers and it has been designed to simulate the motor, visual, flexibility, dexterity and strength of a person around 75 years old [1]. The main components of the suit are: a helmet- used to anchor the elastic straps attached to the belt; glasses to simulate eye related degradation; ear plugs to reduce hearing; a cervical collar to limit mobility at the cervical level; orthosis for the wrists to reduce mobility; gloves used to alter the tactile sense and reduce the hand mobility; a belt used as an anchor for the elastic straps; elastic straps connected between the belt and the helmet, belt and ankles, belt and wrists - they create a tension that creates difficulty in movement; orthosis for knees and elbows to reduce movement and induce fatigue; shoes made from foam to embrace the user.

B. Genworth R70i

The R70i suit, Fig. 2, produced by Applied Minds LLC for Genworth is considered to be the most evolved ageing simulator at this moment [2]. Latest technologies are combined to create a realistic feeling of old age.

The suit is made of an exoskeleton, controlled by a computer located in the back, and a virtual reality helmet. The helmet integrates a set of headphones, that simulate hearing disorders, and cameras combined with an augmented reality vision systems, that simulate age related vision disorders.

The exoskeleton is able to add force to the joints, in this way making movement difficult. This experience is highlighted to other participants by the LED-s installed and change color accordingly.

The augmented system simulate hearing impediments like hearing loss, tinnitus, aphasia, and vision deficiencies like glaucoma, cataracts, macular degeneration, and floaters.
These technical elements have the role to disorient and weaken the user, in order to simulate the feelings of an elderly person. Due to the multitude of the stimulus it is not uncommon that the user would fall during utilization.

GERT is a system that integrates different components into a suit to limit movement and sensorial capacities in order to create similar effects to the ones experienced by elderly people [3]. The different components are divided in modules. The head age simulation includes special goggles, hearing protection and a cervical collar. The torso age simulator includes a weight vest. The arms age simulation includes elbow wraps, weight cuffs and special gloves. The legs age simulation includes knee wraps, weight cuffs and special overshoes for unsteady walking.

Some special modules can be available to simulate: tremor, hearing loss and tinnitus, different eye diseases, hemiparesis simulator and a back pain simulator.

III. DEVELOPMENT OF AGE SIMULATION SUITS

A. Major components of an ageing suit

An ageing suit should integrate different devices or technological elements into a system that covers as much as possible all biological systems of the body, in order to simulate natural sensations of ageing. Of course all effects of the suit have to be reversible.

There have been identified 4 modules, as described in Fig. 4, which need to be integrated to obtain the ageing experience: the head module; torso module; arms module and legs module. Each module has to interact with the other ones so the simulation effect would as realistic as possible.

In the research and development step both sensorial and locomotion functions have to be taken into consideration. The loss of some sensorial functions, like taste for example, cannot be simulated in an immediate reversible way. Regarding motion related functions, we consider that most can be simulated.