Instrument and evaluation of wheelchair propulsion for user friendly matching

H. Miura*, M. Sasaki**, G. Obinata**, T. Iwami**, K. Hase**, H. Doki**
*Department of mechanical engineering, Nagoya University; **Department of mechanical engineering, Akita University, Japan;
e-mail: miura@dynamics.mech.nagoya-u.ac.jp

The evaluation of loads on upper limbs during wheelchair propulsion is required not only for preventing secondary injuries but for matching a wheelchair to user. Many studies of analyzing loads on upper limbs during wheelchair propulsion have been carried out for finding better stroke patterns or seating positions. Most of studies are based on the analyses in sagittal plane or on 2 dimensional measurements. However, 3 dimensional measurements are necessary to evaluate quantitatively the required muscle forces and consumption energy since movements of upper limbs are essentially 3 dimensional. Therefore, we have developed a new 3 dimensional instrumental system for wheelchair propulsion. Using this system, we can measure the 3 dimensional force and moment at the contact point of the hand and handrim without giving any constraint on the wheelchair motion. The mechanical work, estimated consumption energy, and generated torques at joints of the upper limb can be calculated from the measurement values. Moreover, we can optimize the seat position or the movement of upper body based on the calculated values and the 7 links model of upper limb. A particular example is given to show the effectiveness of the optimization in which 20% reduction of mechanical work is obtained.

PAPER SESSION 'GERONTECHNOLOGY GENERAL'; CHAIR: DARIO BRACCO (ITALY)

Will Nagoya bring the breakthrough?

J.E.M.H. van Bronswijk, H. Bouma, L.G.H. Koren
Technische Universiteit Eindhoven, the Netherlands;
e-mail: j.e.m.h.v.bronswijk@gerontechjournal.net

Invention and development of Gerontechnology has been largely influenced by societal and technological developments such as greying of society, the emergence of omnipresent ICT, increased individualization of citizens, diminishing of the working population relative to the total population and an increased dependence on technological means. An additional societal tendency is to extend the duration of full citizenship by lowering the minimum age. In the Netherlands, for instance, the minimum age for marriage without parent or guardian consent, decreased within a century from 30 to 18 years of age. Gerontechnology has emerged to increase effective full citizenship also on the other end of the age scale by increasing vitality, independence, mobility, and self-esteem. However, gerontechnology has not yet rolled out massively. In this contribution we analyse the contributions to 5 international gerontechnological conferences in order to understand the process of a possible final breakthrough of the domain.

Bridging the old and the new: Empowering older citizens by ICT

B. Jaeger
Department of Social Sciences, Roskilde University, Denmark;
e-mail: birgit@ruc.dk

Senior citizens are not the first group to start utilizing Information and Communication Technology (ICT). Thus there is a danger that they will be excluded from the growing Information Society. At the same time it is obvious that ICT creates new possibilities for raising the quality of life for a lot of old people. In the last couple of years six local projects, financed by the Danish Research Agency, have been trying out the possibilities of utilizing ICT to fulfill the needs of old people. This paper will present the Danish program and the study of it. The paper will focus on the impact of utilizing ICT for the individual person. What does it mean to be a user of ICT? What kind of impact does it have to the everyday life of the old? And does it influence the role of the senior citizens when they get access to the Information Society? The paper will try to answer these questions and discuss the overall results from the program.

Technology as an aid for ageing people's life quality in Italy: Mobility in historical urban spaces

F. Astrua
Department of Building and Territorial Systems Engineering, Polytechnic of Turin, Italy; e-mail: fabrizio.astrua@polito.it

One of the main purposes that planners are today dealing with in Europe is to guarantee mobility of old and disabled persons in historical places, meant both as urban spaces and as private or public building spaces. Putting this right into practice is the successive step that involves unavoidably the following question: can technology help us and in what way?
Even in Italy that is a very topical and discussed problem for the simple reason that there is the world's greatest concentration of historical landscapes, monuments, places and works of art under conservation and protected by national and/or regional rules since 1989, when a special rule about architectural features that denies access to handicapped was published.
The Polytechnic of Turin with the teachings held in its Faculties of Engineering and Architecture and, in particular, with the Course of Specialization in Planning and Architectural feature that denies accesses to the handicapped (managed by the undersigned) since 1986 forms architects and engineers with this culture and promotes advanced studies and researches in matter. In particular, the present report explains Italian examples of structures for collective mobility (the city escalators in Perugia, the funiculars of Naples, the automatic subway of Turin).

Technology as an aid for ageing people's life quality in Italy: Domotics in historical and modern buildings

M. Picco
Department of Building and Territorial Systems Engineering, Polytechnic of Turin, Italy; e-mail: mbpicco@libero.it

In recent years a new and better attitude towards planning is giving full attention to those who, due to physical handicap, experience great difficulties in careless designed spaces.
The ageing western world is necessarily bound to take interest and to acknowledge this raising issue. Researches in domotic field have been brought forward for years and now get the opportunity to be tested in specific contests, either in new buildings or, as it mostly happens in Italy, in ancient constructions that are often difficult to restore. The study has the purpose to analyze the actual evolution of domotics, which is meant to be an opportunity for elder and low-tech people to use everyday home accessories. Starting with a remarkable leading case such as the 'Apriti Sesamo' project (Sesamo, get open!) completed in Turin by Mr. Gianni Pellis, winner of many important international prices, this paper will outline a possible way along the road pointed by this outstanding pioneer.

Technology as an aid for ageing people's life quality in Italy: Mobility in historical buildings

M. Rella
Department of Building and Territorial Systems Engineering, Polytechnic of Turin, Italy; e-mail: michele.rella@fastwebnet.it

Moving inside a historical building must be thought as to let one like a disabled or old person cover easy distances, because of its inability to deal with not much accessible spaces and to make easily use, totally or partially, of services and accesses. Introducing transportation systems inside a historical building means, just like for modern buildings, to resolve any problem that makes impossible, difficult or uncomfortable for people who have motor difficulties to move themselves from a premises to the other. Furthermore, in case of ancient buildings, these systems must be perfectly adapted to the characteristics of the installation place, to the customers' necessities and must be easy usable with a constant and careful stylistic and historico-cultural safeguard of the ambient in which they are inserted and attention to the customers' requirements, safety and comfort. The present study will explain the cases applied to the panoramic lift of the Mole Antonelliana of Turin (a building built in 1863 by Alessandro Antonelli now representing the National Museum of Cinema) and to the lifts of the Residenza Palazzo Vescovile Noli, in Liguria, recent transformation of the XV century Episcopal residence of the Noli-Savona Bishop's see into a vacations-house.

Technology to serve the Italian ageing society aiming to quality of life: Gardens as healing therapy and new technology for Alzheimer patients

R. Vidale
Department of Building and Territorial Systems Engineering, Polytechnic of Turin, Italy; e-mail: robervid@tin.it

Mobility of the old or limited autonomy persons in city collective spaces must be the first worry of who is about to plan distances and accessible places, as he will have to take much care of the real users and not of the ideal ones. Making an open space accessible to more and more different users (old, disabled, children, blind) put the planner in a key-role for the research of new solutions, fantasy, simplicity and good sense, not limited to the application of sterile norms. Against an in-depth acquaintance of users' demands and problems, technology represents the means in order to overcome ageing people daily difficulties and to conquest a sure and comfortable autonomy. In Italy there are open spaces and archaeological sites accessible to everyone and in the present study the following cases will be introduced: (i) the Park of Monza (province of Milan), a unique site with great creative interactivity for persons with reduced or null ambulatory ability; (ii) the Traianian Markets, near the Imperial Forums of Rome, with a complete accessibility of the archaeological site. In the end, a plurisensory informative totem for the orientation of old people in public places will be set out.

PAPER SESSION 'GERONTECHNOLOGY AND ERGONOMICS'; CHAIR: WILLEM GOEDHARD (THE NETHERLANDS)

Analysis of factors in cognitive and physical functional changes of elderly drivers in driving

K. Hayama*, A. Motoyuki**, I. Ayuko*, D. Hideharu***, T. Juhei***
*Systemsoft Corporation; **Institute for Human Science and Biomedical Engineering, AIST; ***Japan Automobile Research Institute, Japan;
e-mail: hayama-k@systemsoft.co.jp

Since 90% or more of people below 40 years-old hold the driver's license, population of elderly drivers will dramatically increase in near future. Therefore, it is necessary to establish various measures of driving characteristics of elderly drivers for driver education and also in order to develop driving assistance systems that adapt elderly drivers. In this study, focusing on cognitive and physical functional changes of elderly drivers, the factors concerning driving tasks to be performed when driving a car were analyzed. By performing the factor analysis based on 27 items of variable in the questionnaire, it was specified the five factors concerned cognitive or psycho-motor changes and two factors concerned physical changes for driving. They were 'changes in visual functions', 'precise vehicle control in narrow road and at parking', 'resource control for driving operation', 'attention control and awareness of situation' and 'coping behaviour to keep up traffic flow', and 'sensitivity of driving workload' and 'postural control of body'. The tendency for each factor was explored by comparing with their age, frequency of driving and habitat place indexed by dependency on cars. It is expected that they can be indicators for early detection of the state change of elderly drivers.

Correlation between musculoskeletal disorders (MSD) and visual discomfort

A. Aarås, G. Horgen
Department of Optometry, Buskerud University College, Norway;
e-mail: arne.aaraas@alcatel.no

The aim of the study was to investigate if there was a correlation between visual discomfort and pain in the body. A longitudinal prospective epidemiological study, of 150 Visual Display Unit (VDU) workers showed that both lighting and optometry are important factors for reducing of visual discomfort. A correlation was found between visual discomfort and the average pain intensity in the neck and the shoulder. Visual pain 29.9 (21.7-38.9) and shoulder pain 23.0 are values given as mean with 95% confidence intervals (15.3-30.7) on Visual Analog Scale (VAS). Further details: Neck pain was related to visual problems, r=0.40; p=0.008; regression coefficient 0.37 with confidence intervals of 0.18-0.57. Neck pain was also related burning and itching of the eye (p=0.004). Shoulder pain as well as forearm and hand pain were related to induced phoria (p=0.04). Back pain was related to burning and itching of the eye (p=0.03). Headache was related to visual discomfort (r=0.34; p=0.01). For all psychosocial factors, there was no statistical intervention effect or time effect and no interactions between time and intervention. Conclusion: The study documented that visual discomfort correlate to neck and shoulder pain. Therefore, lighting and optometry must be considered in addition to workplace design in order to reduce the musculoskeletal pain for the VDU workers.

Experimental analysis of age dependence on eye movements for walking: Use of visual fields for walking control

N. Itoh, T. Fukuda
National Institute of Advanced Industrial Science and Technology (AIST), Japan;
e-mail: nana-itoh@aist.go.jp

The purpose of this study is to reveal the relationship of walking conditions and the eye movements. In this study, we focused on the role of two visions, central and peripheral vision, particularly while subjects were attempting to control for consistency of walking. The experiment was carried out in space, which was composed of a straight walkway and corner. The young used their peripheral vision effectively to confirm their own movements with controlling direction and the positions. In contrast, the elderly depend on their central vision, and some of them tried to definite their walking by watching around the edge of the floor. From the results of the experiment, we found that usage of each vision was the important factor to clarify the stable walking. In addition, the difference of the receptivity of the information for walking between the young and the elderly was made clear by periodicity analysis of the eye movements and walking movements of the body. The period of the eye movements of the young is consistent with their walking cadence, while some elderly subjects seem not to have such a strategy and their eye movements do not show any consistency. The results of this study provide basic data of the visual information which assist stable and safe walking for elderly.

Comparison of perceptual error characteristics when judging position of index line between young and older adults

M. Sorai*, A. Murata**, C. Hashiba**, M. Moriwaka**
*Department of Industrial Engineering, Nippon Bunri University; **Department of Computer and Media Technologies, Hiroshima City University, Japan;
e-mail: sorai@ie.nbu.ac.jp

The perceptual error characteristics when judging the position of index line presented horizontally or vertically were compared between young and older adults in order to provide basis for designing displays that took perceptual error characteristics into account. In the vertical judgment, the index line was presented horizontally. The index line was presented vertically in the horizontal judgment. The index line appeared randomly on a position between scales 0 and 10. The experimental factors were direction of judgment (horizontal and vertical) and age (young and older adults). The task was to judge the position using an integer from 0 to 10. For both young and older adults, even if the length of scale was equally sized, the perceptual error characteristics differed between vertical and horizontal presentations. The error rate of young adults was lower than that of older adults. As a whole, the percentage correct did not differ between the vertical and horizontal directions. For the physical positions 2, 3, 8, and 7, both young and older adults showed a similar error pattern. As for other positions, the error characteristics were different between young and older adults. Some implications for designing the analogue display system on CRT were provided.

Proposal of human interfaces for central control devices of home network appliances based on elderly users' cognitive process

T. Sato*, M. Shimizu**, T. Daimon***, H. Kawashima***
*National Institute of Advanced Industrial Science and Technology (AIST);
**School of Science for Open and Environmental Systems, Keio University;
***Faculty of Science and Technology, Keio University, Japan;
e-mail: toshihisa-sato@aist.go.jp

This paper describes a human interface for a central control device of home network appliances from the viewpoint of users' cognitive process modeling. The central control device of home network appliances can access to various home electric devices and provide a common interface for the function which is common in each home appliance. In the experiment, twelve young subjects and twelve elderly subjects were required to entry a timer of an air-conditioner and entry a timer of a VCR for recording a TV program. Based on the investigation on young and elderly users' operating behaviour and their cognitive process when using the real devices (remote controllers of both devices), an interface prototype for the central control device was developed which guided the users through a sequence of interaction steps and showed a flowchart of the whole steps. The results of the usability test suggested that this interface was not adapted for the elderly users and the cognitive process models differed between the young users and the elderly users. Based on the differences in the cognitive process models, a new interface which was easy to use for the elderly was proposed and evaluated in terms of operational behaviours and subjective measurement.

Access for all by cognitive engineering

H.H. Nap, H.P. de Greef, D.G. Bouwhuis
Group of Human Technology Interaction, Technische Universiteit Eindhoven, The Netherlands; e-mail: H.H.nap@tm.tue.nl

Today it is widely believed that technology is the key to successfully retrieving digitally stored information. Without a usable interface, access to the information will likely be hard and interaction might be very dissatisfying. This paper presents empirical evidence for the effect of a cognitively engineered retrieval system on user-system performance for young and older adults. Paper prototyping was used to elicitate behaviour from representative users in tasks intended to provide valid information. In these tasks user interface simplicity was consistently maintained. In a comparison with 2 esteemed art web sites, the resulting prototype significantly enhanced performance for young adults, however not for the older adults. The experimental treatments caused much stress in older adults, most tasks failed and the experiment had to be called off. A more sensitive approach was needed to ensure accessibility for all. Following a thorough error analysis, three different low-cost redesigns were compared and resulted in a large performance improvement and stress reduction for the older adults. In addition, a category based design was more satisfying than a single box design. Variations in errors made between the young and older adults are discussed and will be examined in future research.