

Opportunities for providing sustainability and care in existing homes through smart solution

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R.M.M. FONVILLE (Convener). **The ageing society: Health related research & education at Eindhoven University of Technology.** *Gerontechnology* 2012;11(2):223; doi:10.4017/gt.2012.11.02.640.00

Participants: M.T.T. DOMINICUS, M. MOHAMMADI, M. SINO, J. VAN HOOFF, H.S.M. KORT, D. BERA, K.M. VAN HEE, Y. KOKS, M.P.W.J. VAN OSCH, B. VAN NINHUIJS, T. MOTOASCA, D.J. VAN DER PIJL, P. VERSTEGEN, E.A. LOMONOVA (all from The Netherlands). **ISSUE** Health-related research and education at Eindhoven University of Technology. **CONTENT** In the field of healthcare, our society faces numerous challenges. These include an ageing population, a growing number of people with lifestyle-related diseases like obesity and diabetes, and other chronic diseases, as well as rapidly rising staff shortages. These challenges require new products and services in the health-care system, and technology plays a crucial role in addressing those challenges. In the Strategic Area Health@TU/e (Eindhoven University of Technology), we aim to develop people-centric technology that is self-explanatory and user-friendly. Two things are pivotal: (i) We use our high-end technical knowledge as the basis for developing suitable technological solutions for people. Often new innovations start in the complex and expensive hospital environment, but it is our strategic intent to ensure that these solutions are engineered in such a way that they can be introduced into first-line care and even self-care environments. The ultimate goal is to lower costs of the healthcare system and increase quality of life in our ageing society. (ii) The organization of care and the associated IT-systems focus on increasing patient independence. We want to make technology more accessible, also for elderly people, which in turn will make self-care easier. This goal is achieved, in part, through open innovation and sharing knowledge. We take an integrated approach to research, working together with other universities, medical centers, hospitals, care facilities, healthcare insurers, companies, and governments – both nationally and internationally. The approach to identify the Health@TU/e themes and programs can best be described as “societal driven”. The societal needs in the health domain were defined by means of a stakeholder analysis. The resulting vision has been linked with bottom-up defined research competences. Over 300 researchers from nine different departments participate in Health@TU/e and are committed to the prevention, early diagnosis, and more effective treatment of diseases, as well as to promoting healthy lifestyles and living environments. Apart from research and valorization, the TU/e focusses on healthcare-related themes in the curriculum of undergraduate and graduate students. **STRUCTURE** Roel Fonville will describe the diversity of health related research at TU/e and will motivate the chosen structure and organization of Health@TU/e. Next, four TU/e researchers will present their research projects. **CONCLUSION** With the contributions in this session we will show the great opportunities of technology for sustainable healthcare solutions in an ageing society.

Keywords: health, smart intervention, smart environment, smart diagnosis

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M.M. SINO, J. VAN HOOFF, H.S.M. KORT. **Light conditions in the nursing home.** *Gerontechnology*

2012;11(2):223-224; doi:10.4017/gt.2012.11.02.132.00 **Purpose** In the Netherlands, the prevalence of visual impairments is the highest among the subgroup of nursing home residents. Over 40 percent are estimated to have visual impairments¹. Older adults experience visual problems due to biological aging or eye disease². These problems can affect several visual functions as well as daily functions in general^{3,4}. Providing appropriate lighting of sufficient intensity and color temperature (CT), and making use of capabilities of the visual environment in the nursing home⁴ is one of the tasks for professional carers. Light conditions were measured in order to find out to what extent older adults live with the proper lighting conditions. With these data, we wanted to enhance the awareness among care professionals of how light conditions affect the daily lives of the nursing home residents. Moreover, care professionals and technical staff could make the right improvements to the nursing home environment based on the outcomes. **Method** We assessed light conditions (Konica Minolta chromameter CL-200) in seven nursing homes in the Netherlands. Light conditions were measured in places where residents spend most of their time during the day. In total, 59 living rooms and corridors were assessed in this study. Horizontal and vertical illuminances as well as CT were measured and compared to the values given in a

guideline by the Dutch Society for Illumination⁵. The study was performed between October 2009 and the end of March 2010 at daytime between 10:00 and 15:00 hours. By measuring in autumn, winter and early spring, the contribution of daylight to the indoor illuminance levels was kept at a minimum. **Results & Discussion** In general lighting conditions encountered in the nursing homes were poor. Four-fifths of the measured illuminances in the common rooms were below the 1,000 lx threshold. Illuminances in the corridors fell below the 200 lx threshold in at least three quarters of the measurements. This means that nursing home residents may have difficulty carrying out tasks and could fall during transfers. The CT of light to which nursing home residents were exposed, fell below the reference value for daylight of 5,000 K with median scores of 3,400 to 4,500 K. High CT of light, in combination with higher illuminances, may positively affect the biological clock, resulting in better sleep quantity and quality. Nursing home staff should be aware of these data in order to arrange better light conditions. Technical staff should be aware that lighting guidelines are not specifically developed for older adults. Special attention should be paid to the fact that older adults need more light than younger persons to perform Activities of Daily Living (ADL).

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Keywords: illuminance, nursing home, light, lighting, colour temperature, older adults

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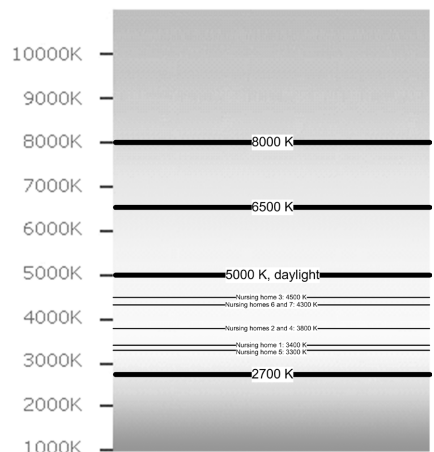


Figure 1. Medians of measured colour temperature in seven nursing homes⁶

M.M.T. DOMINICUS, M. MOHAMMADI. **Opportunities for providing sustainability and care in existing homes through smart solutions.** *Gerontechnology* 2012;11(2):224-225; doi:10.4017/gt.2012.11.02.516.00

Purpose In the coming decade, a huge increase in demand is expected for public housings for older adults in the Netherlands. However, public housing corporations are not planning to build new homes in the near future. Current housing stocks do not fulfill to the requirements for care¹ and energy saving². One solution to this problem is to transform existing homes into integrated and smart environments that corresponds to requirements and leads to healthier and independent living in combination with sustainable goals. At the moment, some housing corporations have pilots⁴ ongoing on smart and sustainable homes that are also suitable for providing care and supporting aging-in-place³. The purpose of this study is therefore to define the opportunities, challenges and criteria for developing sustainable care home concepts and solutions in the existing housing stocks in the light of these pilots. **Method** Relevant information will be gathered by performing interviews and visiting sites on (i) the per-

spective of the housing corporation, (ii) the specific approach of the project and underlying principles, (iii) the level of integration of the technology, (iv) financial aspects and exploitation possibilities, (v) long-term maintenance, (vi) processes, and (vii) the satisfaction level of the residents. **Results & Discussion** Application of these smart solutions in existing homes calls for an approach which integrates sustainability and care at home. This study aids the housing corporation in creating an inclusive renovation plan for care homes and forms a recommendation for the development of a policy scheme for upgrading existing homes.

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Keywords: housing, sustainability, renovation, existing homes, public housing, care

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M.P.W.J. VAN OSCH, D. BERA, Y. KOKS, K.M. VAN HEE. **Tele-operated service robots for household and care.** *Gerontechnology* 2012;11(2):225-226; doi:10.4017/gt.2012.11.02.194.00 **Purpose** Service robots are a relatively new branch of robotics after the successful industry robots and the experimental humanoids. Service robots are supposed to perform tasks that normally are done by humans in particular daily life activities. However they do not have to do it in the same way as humans and neither do they not have to look like a human. Service robots have to operate in environments meant for humans so they have to navigate in environments with unforeseen moving objects and subjects, to mention only one of the challenges. This paper is based on our experience with a tele-operated service robot, named Rose. Tele-operated means that Rose is not completely autonomous but that it is remotely controlled by a human operator. The human operator has the option to control the robot manually or provide indications to carry out complex coordinated procedures (eg. move and grab object). Tele-operated service robots have a wide range of applications, such as in the building industry to carry and place heavy objects, or in the security business. We focused on daily life household tasks. Experiments with Rose were performed in a field lab setting, for the care of elderly people. They need attention several times a day, but in total not more than two hours. This means that one operator can service several homes. This results in a five-fold productivity improvement of care takers. After an introduction on tele-operated service robots, we concisely present the system design of Rose. Then we sketch the field lab experiments and we consider the lessons learned. Based on this information we present some scenarios for the future of tele-operated service robots for caretaking and household tasks. Both the technical and the application aspects will be covered. **Method** First, a number of general purpose use cases¹ covering daily household activities such as warming a meal, picking and placing objects, turning on the light etc. were defined. From these use cases, the system architecture of Rose was derived using a construction technique called correctness by construction². This construction technique guarantees deadlock freedom and livelock freedom. The software development was carried out using the popular Robot Operating System (ROS) framework³. Four rounds of tests covering all use cases were carried out by nurses from a care organization called Zuid Zorg in Waalre, the Netherlands. In the first three sessions the cockpit was located in a room next to the robot. In the fourth session, the cockpit was located in Veldhoven, another nearby town, while the robot remained in Waalre. Results from each test round were used to improve the software of Rose. **Results & Discussion** From the results of all test sessions we were

servicing multiple homes (Table 1). Furthermore, consistency in performance can be achieved by exploiting the robot's autonomy.

Table 1. Time trials (in Minutes)

Activity	Operator: Ceclile		
	Manual	Shared Autonomy	Shared Autonomy
Driving to the Fridge	2.25	2.18	2.28
Picking up Object	5.15	0.57	0.26
Driving to the Table	2.40	2.15	2.16
Putting down object	2.47	0.58	0.57
End Time	12.27	5.48	5.27

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Keywords: service robots, home-care, correctness by construction

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B. VAN NINHUIJS, T.E. MOTOASCA, D.J. VAN DER PIJL, P. VERSTEGEN, E.A. LOMONOVA. **Development of a smart arm support for daily-life activities and entertainment.** *Gerontechnology* 2012;11(2):226-227; doi:10.4017/gt.2012.11.02.255.00 **Purpose** Today's society is becoming aware of the long-term effects of the strong increase in ageing population while the numbers of caregivers decreases. It will become a difficult and expensive task to provide all the elderly people with the care they require. Many older adults are mentally healthy enough to take care of themselves, but their body, especially their muscle functionalities, deteriorate due to aging. This means that the more the muscles deteriorate, the more they will be dependent on caregivers. To provide some level of independence, while the impairments are not very severe, assistive devices can help with their daily activities¹. For most basic daily activities, like eating, drinking, washing etc., arm functionalities are essential. To provide assistance and enhancement of these functionalities, arm support systems can be used that provide support for all user movements. These movements can also be used to trigger games if the arm support is developed as a smart system with multiple functionalities. This way not only support is offered, but it is also possible to play games where the impaired user will be entertained and, at the same time, the arm muscles will be trained to improve arm functionality. **Method** The already commercially available arm supports can be categorized in four groups: simple arm supports with only horizontal support², arm supports with only gravitation compensation using mechanical springs³, arm supports where the spring tension for the gravitation compensation is adjusted using an electrical machine⁴ and, arm supports that are completely electrically actuated in all directions⁵. However, the fully actuated arm supports are designed for rehabilitation purposes and are too big to be used at home. Therefore there is a need for an ambulatory actuated arm support which assists the elderly with their daily living activities. This arm support can have added entertainment and training value if equipped with a serious gaming functionality. To verify the entertainment value of such arm supports a prototype was developed (Figure 1). **Results & Discussion** Tests on the prototype (Figure 1) have been performed with elderly people who suffer from deteriorated muscles due to ageing. Playing games using the arm support as a joystick was experienced as a fun activity; muscle training as a by-product of gaming movements was also experienced as enjoyable. However, the tests were conducted with a mechanical arm support that only allows some arm movements. To provide the user with an optimal and interactive arm support for any motion direction, actuators need to be implemented in the arm support, resulting in a small, light-weight and flexible novel ambulatory smart arm support. This novel arm support can be used both for assisting the daily activities as

for rehabilitation purposes. [The research leading to these results has received funding from the Dutch “Pieken in de Delta” program, project McArm no. PID102055.]

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Keywords: robotics, actuators, smart arm support, exoskeletons

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Figure 1. Playing a game using the supported human arm as a joystick