

Robotic support

S. HELAL (Convener). *Domotics and robotics for supporting seniors*. *Gerontechnology* 2010;9(2):105; doi:10.4017/gt.2010.09.02.012.00 **Participants:** M. MOKHTARI (SINGAPORE), S. GIROUX (CANADA), D. ZHANG (FRANCE), C. CHANG (USA) and S. MARTIN (UK). **ISSUE** Domotics and robotics in support of aging have been an active area of research for over a decade. Several research projects have focused on creating assistive environments (for instance, smart homes) and enabling health telematics, targeting aging in place, independence and well-being. Many applications involving sensing, actuation and user interactions have been prototyped and some tested in real settings. Middleware for enabling application developments has also been proposed. Yet, only a tiny subset of these applications has been commercialized as products or services. Speakers will address the challenges facing these applications especially with respect to cognitive impairments in older adults, and will discuss new research directions to overcome these challenges. **CONTENT** Experience from major deployments and findings from major funded projects will be presented. Self-assessments and comparative studies will also be presented as an analysis of research successes and failures in the past decade. Complexity of the dementia type of impairment will be particularly zoomed into and an agenda for future research directions to enable more success in this area will be outlined. The symposium is mainly technical but presentations will be prepared for a wide audience including engineers, domain experts, caregivers and the seniors' user group. **STRUCTURE** Sumi Helal will provide an overview of the state of the art in domotics and robotics and will present an analysis of the factors impeding commercialization. Mounir Mokhtari will present the CogKnow FP6 project and will discuss how any cognitive assistant must consider a multi-dimensional set of factors and holistically encompass physical, cognitive, emotional and social needs of elders. Sylvain Giroux will present SemAssist, a semantic memory assistant with dual interfaces (elders and caregivers). He will demonstrate the importance of extreme programming in ensuring that the therapist needs and concerns were fully met by the system's programmers. Daqing Zhang will present a fuzzy logic approach to robust reminding for people living with dementia. His approach provides smart alerting, interventions or assistance in the presence of interruptions and other noisy activities. Carl Chang will present a project that emphasizes holistic approaches to designing domotics. He will demonstrate such value in a monitoring system that manages elders' diet, activeness, and medicine intake, combined. Suzanne Martin will present a divide and conquer approach to dealing with the complexity of cognitive impairment. She assumes day time and night time assistance differ in needed technology and type of intervention. **CONCLUSION** The main accomplishment out of a decade in domotics and robotics research for seniors is experience that is shaping a continuation research agenda to take developed systems from the lab environments to commercially available products and services.

Keywords: domestic robots, health telematics, home care, remote monitoring

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M. MOKHTARI. *Multi-dimensional approach in designing smart living space for ageing people having physical and dementia impairments. Gerontechnology 2010;9(2):106;*

doi:10.4017/gt.2010.09.02.013.00 **Purpose** The challenges to quality of life for the older person are multi-faceted. First, the elder's physical and mental functions deteriorate with time and it is a great challenge to maximize the diminishing reserve in the older person to keep him active and independent. Second, once he becomes dependent on caregivers to any appreciable extent, that feeling of dependency presents a de-motivating influence towards independent living. Third, there is a genuine concern of safety for elderly living alone because of numerous factors that threaten his safety and well-being. In addition, there are social factors to be taken into account which, for an increasingly urbanized population, alienate the elderly from the mainstream of life and make communal or group activity difficult. There is a great need for making the transition from hospital/nursing home back to the community, as well as preserving some degree of autonomy as a means to upholding quality of life for those residing in nursing homes. Assistive technology holds much promise to help increase the autonomy and daily functioning of older persons so that they can either return to independent living in their own homes, or continue to lead good quality lives in the nursing home. The assistance given must, however, span across a multi-dimensional set of factors and the approach must be holistic to encompass physical, cognitive, emotional and social needs of older persons. **Method** During this presentation, we will focus on both the usage analysis side we have performed through COGKNOW FP6 European project and the technological system deployed in a nursing home of ageing people, through NUADU ITEA European project.

Keywords: holistic elder care, aging in place, independence, assistive technology

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P.-Y. GROUSSARD, N. BIER, S. GIROUX, H. PIGOT, J. MACOIR, J. MILHAU, C. DESCHENEAUX, P. ROY, F. ARAB, B. CHIKHAOUI, S. MEDINI, M. F. KAMMOUN, Y. PARAKH. *SemAssist: Assistance and assessment tools for semantic memory rehabilitation. Gerontechnology 2010;9(2):106-107;*

doi:10.4017/gt.2010.09.02.014.00 **Purpose** Semantic memory, which is responsible for the acquisition and maintenance of knowledge¹, plays an essential role in most cognitive functions and thus in activities of daily living (ADL). One rehabilitation approach, with patients presenting semantic memory deficits, is to help them maintain their residual knowledge or relearn lost knowledge through the execution and repetition of ADLs². During a therapy session, a caregiver supervises and assists a patient performing a predefined ADL. But this rehabilitation process is difficult to put into practice outside therapy sessions and data are lacking to assess patient progress with respect to everyday routine. SemAssist is a cognitive assistance system implemented to fill this gap. On the one hand, SemAssist guides the patient through the steps of a predefined ADL at home, providing semantic information about objects involved in this ADL. SemAssist records interactions with the patient, providing ecological data on the rehabilitation process. **Method** SemAssist software was designed and implemented thanks to extreme programming (XP)³.

Regular discussion and feedback sessions occurred all along the development process between the developers and the user, an occupational therapist. So XP ensured that the therapist's needs were really met.



Figure 1. SemAssist cognitive assistant user interface. Left: all steps, all ingredients, and all utensils. Top: the current step of the selected recipe; Center: instructions, ingredients, and utensils for the current step; Bottom: go to previous/next step and go back to the menu screen

The therapist sketched a series of simple scenarios to identify required features and set priorities over the development process. A person suffering from severe semantic memory deficits tested SemAssist at her home. The selected category of ADL addressed for this test was cooking. Her use of SemAssist was recorded during two months. **Results & Discussion** SemAssist is made of two modules: a cognitive assistant for patients and an assessment tool for therapists. The cognitive assistant helps a patient to perform a predefined activity and keeps a record of the patient actions. The assistant runs on a standard PC connected to a touch screen. A patient first selects a recipe among all recipes available and then the assistant guides her step by step until recipe completion. At each step, the required ingredients and utensils are displayed. By touching the screen, the patient gets detailed information on the semantic category and the functional usage of an ingredient or a utensil (*Figure 1*). The occupational therapist then uses the assessment tool to analyse ecological data and draw curves and diagrams on the use of the assistant by the patient. The therapist can see how many times a patient has used the cognitive assistant at home, what pages she was looking at, time spent on each page, and so forth. The experimentation showed that the patient had less difficulty in food preparation when using the cognitive assistant. SemAssist seems promising for semantic memory therapy as it helps patients to perform their ADLs and therapists to monitor and assess progress of patients.

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D. ZHANG, K. DU, L. SUN. A fuzzy logic based context-aware reminder for elders with mild dementia. Gerontechnology 2010;9(2):107-108; doi:10.4017/gt.2010.09.02.015.00 **Purpose** Dementia is a progressive, disabling, chronic disease affecting 5% of all persons above 65 years old and over 40% of people above 90. In Europe, about 1.9 million people experience mild dementia¹. The term dementia refers to a combination of symptoms involving impairments of memory, thought, speech, perception and reasoning. Early impairments in performing complex tasks lead to an inability to perform even the most basic functional activities such as washing and eating. The objective of this paper is to apply pervasive technologies to support elders with mild dementia to live independently. Specifically, the paper intends to develop novel solutions for providing appropriate alerting, interventions or assistance to the elders in the right time. **Method** The common way to design reminding systems is to pre-define necessary ADLs into a plan and then prompt the elders according to the plan. The plan expresses the temporal constraints of various daily activities. If the subjects forget to execute those activities in the plan, the reminding system will prompt them accordingly. However, the dynamic nature of people's daily activities poses many challenges in building the reminding systems. Problems arise when the planned activities are interrupted by 'disruptive' activities, as those disruptive activities that cannot be predicted in advance, thus the system has to evaluate, between the planned and disruptive activity, which has higher priority in real-time environment and then decide to either deliver, or delay, or even cancel the reminder for the planned activities. In our previous work, we proposed a general framework for designing context-aware reminders² and analyzed the possible conflict among different activities³. **Results & Discussion** In this paper, by quantifying the interruption degree of the 'disruptive' activity and the urgency of the planned activity via fuzzy logic, we formulate the context-aware reminder problem as a fuzzy decision making one. Then, through fuzzy logic reasoning, the system generates an appropriate strategy to resolve the activity conflict and infer a proper prompting time.

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Keywords: elderly care, context-aware reminder, fuzzy logic

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C.K. CHANG, H-I. YANG, R. BABBITT, J.M. REYES ALAMO, F. ZHOU, J. WONG. *A holistic approach to seniors' health monitoring and management using domotics. Gerontechnology* 2010;9(2): 108-109; doi:10.4017/gt.2010.09.02.016.00 **Purpose** The advent of wireless networks, miniature sensors and embedded systems has resulted in rapid advances in domotics to make aging in place more feasible than ever. However, existing research has yet to generate comprehensive, easily usable and widely adopted systems. Many projects aim at establishing extensive and complex frameworks^{1,2}, while others focus narrowly on replacement or enhancement of a single application. The majority of them focus on addressing the system perspective in the design and development, hence they fail to connect with how users actually use and can benefit from the system. Domotics has the potential to monitor, manage and improve users' health in a non-intrusive fashion. For older adults, whose health conditions can be extremely volatile and more easily affected by their diets, medicine intakes and the strenuousness of daily activities, utilizing domotics to monitor and manage their health allows them to age in place, gives them and their families a sense of security and control and can collect valuable real-time and long-term data critical for their care. We take a holistic approach to monitor and manage three of users' most frequent health-related aspects^{3,4}, which include diet^{5,6}, exercise⁷ and medicine intake⁸. These activities are not independent of each other, but are bound by both static conditions, such as medical history, chronic conditions and allergies, as well as dynamic conditions, such as medications taken after meals or a period of time or to avoid strenuous exercise after taking certain medicines. **Method** We integrate several existing health monitoring services in the smart home to facilitate interactions between these activities and address cross-cutting concerns. Built on the service-oriented architecture (SOA) with web services and OSGi bundles, the resulting health management system is integrated at the data, service and knowledge levels. With an innovative mobile interface to present a summary panel and with non-intrusive user interfaces aiming at user behavioral modifications, the system monitors users' activities in all three aspects, and makes suggestions for prevention and intervenes when necessary. **Results & Discussion** Our system follows the SOA which allows incremental expansion and easy modification, and can resiliently accommodate partial system failures. A combination of wearable and environment sensors eliminates the burden on end users to manually input the diet, medicine intake and exercise information. The number of sensors employed is reasonable, and include an RFID reader, biometric monitors and smart shelf, and can be deployed incrementally. We plan to deploy the system in the lab and in homes of the recruited subjects to evaluate its effectiveness in health-related behavioral modification in the future.

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Keywords: domotics, nutrition, exercise, medication, health monitoring and management

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J.C. AUGUSTO, S. MARTIN, M.D. MULVENNA, W. CARSWELL, H. ZHENG. *Holistic night-time care. Gerontechnology* 2010;9(2):109-110; doi:10.4017/gt.2010.09.02.017.00 **Purpose** Assisted living systems for healthcare are being developed as part of the fundamental shift from hospital-centred to home-centred models of care within health services. These systems are supported by Smart Environments, physical environments enriched with sensing and actuating devices, for instance, smart homes. Most of the contributions reported in the technical literature focus on the most active period of the day (daylight time). Our project NOCTURNAL (Night Optimised Care Technology for UseRs Needing Assisted Lifestyles) assumes that the night period and daylight periods of the day are different enough to require separate analysis¹. At night time, people with dementia can experience fearfulness and anxiety which can lead to restlessness, physically threatening behaviour, ‘wandering’, and disruption of normal behaviour (feeding, sleeping and hygiene). **Method** A number of different approaches have been tried by other researchers. A literature study² shows that technology can play a pivotal role providing assistance to people with dementia during night time (*Table 1*). However, these studies focused on monitoring a specific aspect of the night time activity or applying a single technology to aid people with dementia during the night. Our work builds upon the current setup commercial telecare offerings and provides additional features. Several of these additional features focus around providing greater guidance. Smart sensing and guidance algorithms will help control the lights and support navigational guidance at night time. A primary goal of the work is to encourage good sleeping habits through a combination of movement sensors (bed and infra-red based) that detect movement in sleep augmented by a combination of changing light levels and music³. An important, multi-functional feature for each dwelling will include a bedside audio visual unit. This unit will form a type of Avatar with extra input received from the array of sensors located throughout the house. The audio visual unit will be

Table 1. Technology for night time care

Activity	Possible assistive technology	Time of the day
Music therapy	-Digital TV -Personalised music library	-Planned times during the day
Reminiscing therapy	-Digital TV -Personalised photo and music library	-Planned sessions during the day
Simulated presence & verbal instruction	-Digital TV -Avatar -PIRs -RFIDs	-Non specific -Some planned -Some reactive to PwD
Active therapy	-Keyboards -Touchpad's -Activity planner	-Planned sessions during the day
Vocalisation and restlessness during the night	-Digital TV -PIRs -Pressure sensors -Lighting and music	-Reactive to PwD

able to collect the in-house sensor information and form a Decision Support Structure (DSS) choosing the appropriate response. The unit can also display pictures and play music for reminiscence therapy, which has also been proven to alleviate anger, confusion and tension⁴.

Results & Discussion At night, a person with dementia will be more likely to be confused and disorientated as they awake from sleep. Therefore, it can be argued that for them, a need for assistive technology may be more acute. The opportunities for research for nocturnal care of people with dementia using holistic assistive technologies are far more specialised algorithms; specially designed interventions that provide therapeutic support to people to reduce anxiety; and sophisticated guidance, through the use of lightning.

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