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Final project report

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PROJECT FINAL REPORT

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Executive Summary

The KSERA project developed a mobile solution that brings care services to the user. The overall objective of the project is to improve daily life of older people and people affected by Chronic Obstructive Pulmonary disease (COPD) and to facilitate their daily activities within their own domestic environment. Currently, no disease management systems exist for COPD even though COPD is expected to be the third leading cause of death by 2030.
Therefore the KSERA system combines a Nao robot with a ubiquitous monitoring system that measures and detects abnormal and anomalous living patterns of older people and people affected by COPD. The robot interacts with a person in his/her own home environment, and it suggests actions to the person involved in order to improve his/her conditions.
Two prototypes were developed, implemented, tested and evaluated in realistic scenarios based on real user needs. The robotic platform proactively motivates the user to exercise and perform regular measurements. The ubiquitous monitoring system monitors the indoor and outdoor air quality and collects frequent blood oxygen level measurements to monitor the user's health. The intelligent rule engine combines the systems resulting in a proactive disease management system based on treatment plans for COPD. Enhanced video & voice communication address the need to improve social inclusion. Overall the functionalities implemented by KSERA reduce the dependence of users on caregivers, family and friends. The quality of care can be maintained or even improved with the potential of preventing sudden increases in the severity of COPD and, consequently, health care costs. The user feels safer and is more independent.

In a period of three years the KSERA project produced 42 scientific publications and was presented at no less than 38 conferences creating substantial scientific impact in the fields of socially assistive robotics and ambient assisted living. The KSERA system and its subcomponents have been demonstrated to the public at more than 13 events across Europe and Israel. This has raised interest and awareness of European robotics industry. KSERA has formed new collaborative efforts with PAL robotics and Aldebaran robotics thereby consolidating the transfer of knowledge and improving the position of the European robotics industry.

1 Summary description of project context and objectives

1.1 Overall project objectives

The overall objective of the project is to improve daily life of older people and people affected by Chronic Obstructive Pulmonary disease (COPD) and to facilitate their daily activities within their own domestic environment. Currently, no disease management systems exist for COPD even though COPD is expected to be the third leading cause of death by 2030.
The KSERA project purpose is to design a system that combines a robot (Nao) with a smart home that measures and detects normal and anomalous living patterns of older people and people affected by COPD. The robot interacts with a person in his/her own home environment, and it is connected to the smart home in order to detect possible anomalies at a very early stage. This allows the robot to suggest actions to the person involved in order to improve his/her conditions.
The project is particularly relevant for the socio-economic needs of all modern societies, especially in light of the following:

- Older people want to live independently in their own homes as long as possible, but the ratio between older people (aged 65 or more) and active working population is expected to drop from 1:5 in 2000 to 1:2 in 2050. This is why KSERA aims at a solution with a robot: a robot has the potential to act on its own behalf and, as such, it can take over tasks of care personnel that other systems cannot. By 2050 there just are not enough caregivers to maintain the same quality of care.
- Chronic Obstructive Pulmonary disease (COPD) is expected to be the 3rd leading cause of death in 2030 increasing the annual EU health care cost to €7.6 billion. The consequence is that maintaining the same quality will be too expensive by conventional means.
- Age-related diseases such as COPD are causing a decline of the patients' capabilities, including mobility limitations and self-care restrictions. This is why a mobile solution, like a robot, is needed, so that the robot can act on behalf of the patient and the caregiver.

Robots of today are used in many applications like automatic vacuum cleaning, car manufacturing, urban search and rescue, museum tour guides, automatic harvesting and so on. However, robots that take over care tasks in home environments do not exist. An important reason is that the level of sophistication of the robot's perceptual system and its cognitive skills are too poor for letting a robot operate safely in a home environment. The aim of KSERA is to boost the research that develops these skills. In addition, KSERA aims to determine the user needs and system requirements of such robotic solutions and to improve user experience and user acceptance. To this end KSERA develops two prototypes, so that people can experience these future systems today and so that the shortcomings and requirements can be made explicit.

COPD is a chronic lung disease that shows sudden irreversible increases in severity. By monitoring the air quality and by regularly assessing a patient's blood oxygen level, such sudden increases can be detected before they occur, so that preventive measures can be taken. This is the task of the ubiquitous monitoring system: a network of smart sensors collects information about the environment and monitors the patient and a rule engine interprets the information based on a medical treatment plan. Currently, no such system exists which is why the main aim of KSERA is to develop one.

The above considerations lead to the following objectives in terms of user needs, robot mobile behaviour, human robot interaction, ubiquitous monitoring system, prototype integration & validation, and communication of results.

1.2 User needs

The starting point is the iterative user-centred design approach that serves as the backbone for continuous ethical review, critical feedback from end-users on the KSERA system. Scenarios and system requirements set the scope of the KSERA system. The main objectives concerning user needs are:

- Realistic usage scenarios are developed and used to arrive at a set of requirements for system design, research activities and user tests in real-user environments.
- Develop a set of validation and evaluation metrics for Socially Assistive Robots for elderly people
- The development of an ethical, safety, privacy and trust framework for socially assistive robots.
- Identify and describe rules for detecting behavioural abnormalities and incorporating medical knowledge.

1.3 Robot Mobile Behaviour

The interface of the KSERA system with the user is a robotic platform that comes to the user. This requires integration of many hardware components:

- Design the system architecture for the mobile platform, the assistive technology and the human-robot interaction interface.
- Develop a mobile device that can navigate towards users in a domestic environment.
- Enhancement of the navigation by learning algorithms based on context awareness

1.4 Human Robot Home Interaction

For a robot to interact with a person the interaction should be simple, natural, and engaging in order to improve user experience and user acceptance. This ensures successful adoption of the system by elderly users. The main objectives are:

- Design and develop a user interface for easy and fun user-robot interaction.
- Improve the user experience by integrating social cues in the behaviour of the robot
- Promote social connectedness and awareness by static and mobile video services.

1.5 Ubiquitous Monitoring

The user's health and the air quality of the environment are monitored by the KSERA system. The monitoring functionality is integrated in the smart home environment and accessible through the traditional smart home as well as through the robot. The main objectives are:

- Select off-the-shelf devices to measure physical condition and environment sensors.
- Develop interfaces to intelligent home environments for assisted living for seamless integration
- Design, develop and test rules for monitoring functions

1.6 Prototype Integration & Validation

The integration of the KSERA system components is realised in two iterative stages. In each stage the system is evaluated using end-user tests with the implementation of the prototype:

- Proof of concept is shown by working prototypes.
- Technical and end-user verification of the integrated KSERA prototypes in real user environments at testing sites in Israel and Austria.

1.7 Communication

The results of KSERA are communicated through seminars, conferences and journals in multidisciplinary fields covered by the partners' expertise. The exploitation plan including a value chain analysis, cost-benefit analysis is developed for this novel care concept for increasing the Quality of Life of the elderly with COPD. The main objectives are:

- Communicating the benefits of the KSERA system by means of a webpage, demonstrations, conference visits and publications.

- Analysis of the value chain for the specific application and developing exploitation plans for the partners involved in the value chain. Assessment of the cost/benefit of the application with respect to different variables.
- To make optimal use of and contribute to Standards.

2 Main S&T results/foregrounds

2.1 Description of the main results

In the first reporting period (February 2010 – January 2011) the project's focus has been on the technological aspects of the KSERA system and the preparations required for successful field trials in later stages of the project, while in the second reporting period (February 2011 – January 2012) the focus has been on the realization and testing of the first prototype. The first prototype was successfully integrated and installed at the test sites in Austria and Israel, where it was tested with end-users in a real environment. The formative evaluation of the first prototype then guided the development and research in the second iterative design stage of the project. This has been the main focus of the third reporting period (February 2012 – January 2013). In this period, in fact, the final prototype has been realized and evaluated. In line with the foreseen schedule, the consortium has developed the following set of activities:

Assessment user needs, possible usage scenarios, use cases and personas - the specific needs of users have been analysed and resulted in a comprehensive description of the KSERA Scenarios, Use cases and Personas and the basic rules for ubiquitous monitoring. Based on three user studies five personas are described. All personas are older people with different levels of COPD. The most important user needs were found to be the need to feel safe, the need for social contacts, the need for all kinds of reminders and the need to exercise. Older people also need an easy way to call for help or alert, an easy way to communicate, help with banking, advice about their health and environment and to control different functions in the house remotely. The user needs were used to create six scenarios and a library of effective uses cases in six main categories: monitor medical parameters, monitor environmental parameters, monitor activities of daily life, Nao human-robot interaction, communication & alarm and entertainment & domotics. In addition, secondary users (friends, family members, relatives, formal and informal carers, doctors, therapists, call centre personnel) were added into the scenarios. Tertiary users (e.g. technicians for installation and maintenance, service providers, financing organisations, architects) were involved during workshops at the evaluation sites. The different types of scenarios were ranked according to their importance as follows:

1. Healthy through exercise - Motivate an older person with COPD to exercise regularly by providing a personal physical training scheme. Regular exercising enhances the person's physical condition and performance, hence slows down the COPD progress.

2. Disease self-management - Optimize the user performance by supporting disease self-management. For instance, to take the medicine as described by the doctor and receive medical advice. The patient's Quality of Life increases when a better performance and an almost stable health status are achieved.

3. A safe environment - Giving information and advice about the environmental indoor and outdoor conditions enhances the user's performance during the daily activities. As the COPD patient is aware of possible upcoming problems in- and outside the home, she can plan her daily activities in a better way and feels secure while, e.g., taking a walk outside.

4. Medical alarm - Help is given quickly when a medical emergency or abnormal situation occurs. The patient will get professional treatment in time. The older person feels secure when he is alone at home. The caregiver does not have to worry when away from home.

5. Socializing & entertainment - Using innovative IT (e.g., video link, messages and opening the door remotely) for fostering social cohesion and contacts in the community. This technology will also increase comfort and reduce stress when being alone at home and not able to move rapidly to answer the phone or the door.

6. Smart home & navigation - Support in daily living activities, e.g., opening doors and turning on a light. The user gains more autonomy and life becomes comfortable with assistive home technology.

The user needs also involve identification and definition of rules for detecting behavioural abnormalities and incorporating medical knowledge. This was done for people who have COPD as well as potential users of future versions of the KSERA system. In the KSERA prototype the indoor temperature, air humidity and CO level is measured, as well as, the outdoor conditions (such as the long lasting PM10 and PM2,5 concentrations of fine particles). The scenario, in which the robot warns the patient early about the unfavourable outdoor conditions, was successfully implemented.

To assess the KSERA system a set of validation and evaluation metrics for Socially Assistive Robots for elderly people were developed. These validation tools and metrics are used in the field trials to evaluate system performance, user background, usability, user acceptance, user experience and psychological impact. To do so a wide variety of measuring devices are adopted including questionnaires, focus groups, video analysis, interviews, heuristics, and lab studies. These measuring devices are adjusted for Socially Assistive Robots.

Design of the system architecture for the mobile platform, the assistive technology and the human-robot interaction interface - during the first year the Robot Mobile Behaviour was developed and resulted in a thorough report on the KSERA architecture and implementation details. A report on the basic robot navigation and localization capabilities (including navigation through a domestic environment and person tracking) was finalized during the second year, and used for the creation of the first prototype of robot mobile behaviour. During the third and last year, the final prototype of the robot mobile behaviour has been realized including the refinements identified by the formative evaluation of the first prototype and new and improved methods of intention reading (used to improve the navigation and localization functionalities of the mobile platform).

The overall system architecture of the second prototype is shown in Figure 1. It reveals the many different hard- and software components that were integrated for realising the first and second prototypes. The ubiquitous monitoring system contains interfaces to sensor networks, domotic actuation and an external call centre, and it houses the rule engine and knowledge base for detecting deviations from normalcy. In addition, the KSERA prototype connects the ubiquitous monitoring system to the robotic sensing and actuation systems.

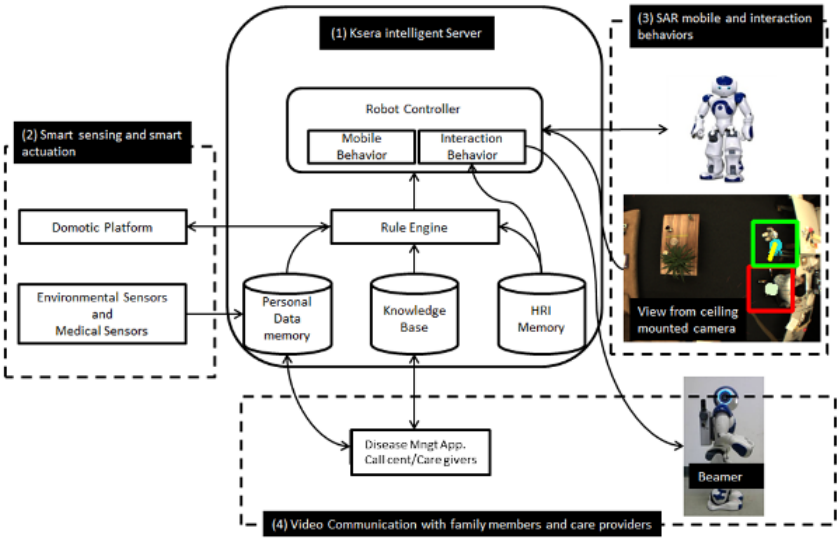

Figure 1. Overall KSERA Architecture

The humanoid robot Nao is designed as the main actuator that delivers feedback from the AAL system to the person and takes care of the connection with remote care givers. The robot and people localization and the robot navigation ability are therefore essential to achieve the task. For this purpose a real-time person tracking system was developed that only uses a ceiling camera. A behavior-based robot navigation architecture is implemented that allows the robot to safely navigate in a cluttered and dynamically changing domestic environment. The robot is aware of its context not

only because it avoids obstacles, but also because it respects the user's personal space by choosing the appropriate distance and direction of approach.

The localisation of the user has been completed, tested and integrated with navigation in the second prototype. The algorithms developed for KSERA significantly improve state of the art algorithms available today and they have led to a dozen papers in scientific journals and conference proceedings.

Human Robot Home interaction advanced algorithms have been implemented in order to build up basic social skills that enable smooth interaction with a person: when operative, the Nao robot is able to track the face of a person and estimate its head pose. This enables the robot to make eye contact, to monitor the visual attention of the user, and to time its actions. When speaking to a user, the speech is augmented with gestures and facial expression through the robots LEDs. It was shown that these features improve user experience. The robot's navigation and localisation algorithms are designed such that the robot approaches a person appropriately while avoiding obstacles. Together these features enable the robot to actively interact with a person and give instruction for his daily activities (i.e. physical activities, information about important data for the health of the person, etc.). For enabling video communication two versions of a wearable beamer for Nao were implemented successfully. The additional communication channel improves robustness and user tests show a positive effect on user acceptance.

In the KSERA project the Nao robot was chosen, because of its humanoid shape. A robot that has a functional head with eyes can look at a person and make eye contact. This is useful for monitoring the visual attention of a person. The Nao can track a face and, fairly accurately, estimate its head pose. This enables Nao to detect whether it is being looked at and what object in the environment is being attended to. Many user studies were conducted providing evidence of the positive effects of the more natural social cues. In particular a positive effect on user experience was shown of making eye contact, gesticulation and LED patterns, and an improved entertainment value was established. Other research projects explored further how to improve the entertainment value and to extend joint attention to external objects through object recognition and head pose estimation.
For enabling video communication the Nao robot was equipped with a LED projector. The LED projector module was iteratively improved (smaller, lighter, better mounting mechanism). Laboratory user tests with older persons and care experts were carried out and showed that the chosen approach is well accepted and is considered to bring advantages compared to stationary solutions (as e.g. TV sets or conventional smart home designs). Additional user studies were conducted to evaluate user experience in the context of human-robot interaction. They confirm the expected benefit of an embodied human-like system in care applications.

In the third year of the project the Human Robot Interaction for prototype 2 was completed. Among others a dialogue management system was designed that incorporates gestures and eye LED patterns allowing the robot to gesticulate and express emotions. The various HRI communication channels were designed and validated based on lab studies with potential end users. This way user acceptance and entertainment value are optimised. In a similar way the video communication was evaluated by comparing it to stationary solutions and integrated into PT2. The main features are:

- Integrated Face tracking and head pose estimation algorithm enabling eye contact as a form of joint attention and context awareness
- Gesticulation and emotional LED patterns were added to dialogues.
- Developed a dialogue management system that allows easy changes to dialogue scripts, gestures and LED patterns
- A wearable video communication device providing an additional interface to the care organization and family/friends

Overview of sensors, sensors network and monitoring functions for ubiquitous data monitoring - during the first year the focus was on the selection of off-the-shelf devices to measure the physical conditions and environmental sensors, that were analysed and resulted in a report that enumerates the classes and the devices that were used to create the first prototype of the KSERA Ubiquitous Monitoring System, finalized during the second year. The report also explains how the data will be used to achieve the goals stated in the Use Cases and Monitoring Rules. Finally, during the third year, a second and final prototype has been realized including all the designed and developed learning and decision making algorithms for monitoring functions, and also the refinements based on the formative evaluation of the first prototype. The software modules have been designed, developed and tested in close collaboration with medical experts and elderly end users: depending on the input from the physiological and environmental sensors, and based on medical knowledge and practice, they enable the system to advise the COPD user. Costs and benefits have been taken into consideration during the whole project so as to keep the system as cheap and flexible as possible: tools such as using web services for weather forecast were used in order to reduce the costs of the implementation of the project (Nao can give instructions to the person, for instance, in relation with the specific outdoor environment).

The most significant results of the Ubiquitous Monitoring System of prototype 2 are:

- A number of device drivers were implemented for easily interfacing medical and other devices permitting to collect a wide range of parameters useful to set up the triggered reactions of the intelligent remote care application.

- The functionalities were tested in laboratory environment and deployed for the real life evaluation. There were no new bugs discovered during the field evaluation. Therefore the UMS sub-system is stable and this asset could be exploited.

- To meet the commercial intentions (to exploit the system as whole, the sub-systems, and services), a stand-alone variant of the UMS sub-system was created and embedded in the Demo installation. The sub-system was correctly working.

The intelligent components of the KSERA system have the possibility to acquire the direct awareness about the intention of COPD patient to venture outdoor (by asking and by analysing the spoken reply) and to correlate this situation with the pollution conditions. The KSERA prototype 2 is able to proactively warn COPD patients about the long lasting high levels of pollution in the neighbourhood.

Development of a trial plan in real user environments including ethics and safety issues – the user involvement in the planning of the system design and the field trials led to the constitution of a framework and the guideline for the pre-trial, testing and post-trial phase, so that a smoothly running evaluation is guaranteed. The described workflows for studies in real user environments together with Socially Assistive Robots (SAR) and vulnerable target groups can be used as basis for on-going research activities in the research area of Assistive robots and Human-Robot-Interaction.

KSERA developed an ethical, safety, privacy and trust framework for socially assistive robots. It lays out the KSERA domain of ethics, focuses on safe and appropriate user involvement in light of national legislation and national and international guidance documents, and provides in conclusion a short risk identification and summary of ethical guidance chapter.

An Ethical Advisory Board (EAB) was installed for providing external advice on ethical issues concerning the KSERA system and field trials. Two face-to-face meetings were organised in which the EAB evaluated the first and second prototype of the KSERA system and the first and second iteration of the field trials. Overall, the EAB was satisfied with the way the ethical issues have been addressed in the KSERA context:

"In general it is impressive how seriously ethical issues are taken into account by the KSERA project. The EAB is well satisfied. Further ethical issues are expected to be raised in the long run by the release of such a new technology."

First prototype integration, installation, testing and formative evaluation - one of the objectives of the project is the creation of two prototype releases, and the first was finalized during the second year. This first prototype includes the integration of the basic components (Robot Mobile Behaviour, Human Robot Interaction, and Ubiquitous Monitoring System) and was integrated, installed and tested at two sites in Austria and Israel, under the advice and guide of the ethical advisory board. The formative evaluation was held with real users in real environments, and the results (that have been reported in a dedicated deliverable) have been used to guide the development and research needed for the design of the second prototype, during the third year of the project.

Final prototype integration, installation, testing and end evaluation - during the third and last year, the second cycle of the iterative prototype design was performed, integrating the revised version of the SAR, the navigation based on context awareness and intention reading, an intuitive and easy to use human robot interface that enables joint attention and monitoring functions to detect abnormalities (in practice were integrated all the sub-components mentioned above). Also the final prototype has been tested at the same two sites of the first one: Austria and Israel, again under the advice and guide of the ethical advisory board. The final prototype has been tested with real end-users in real environments, and the test setup and results (including user experience and satisfaction) have been reported. The effectiveness of the program has been evaluated through questionnaires, data monitoring and changes in functional status and subjective feelings of well-being (using the evaluation metric identified during the project).

Exploitation and standardization activities - an analysis of the value chain has been made that underlies the KSERA application, during the second and the third year of the project. The analysis includes the market possibilities, the legal constraints, and a potential roadmap to market not only for the project as a whole but also considering the sub-components. In market perspective, the main envisioned *KSERA tool* is an automated Ambient Assistive Living solution (tele-care *product*) with humanoid robot for remote care of COPD patients. As such, the prototyped solution has been presented to standardization bodies in the last months of the project to check the achievable interoperability with other market products and standardization related issues.

Communication activities – in KSERA many demonstrations to raise public awareness including a website of the project (http://www.ksera-project.eu), and a project leaflet were done. A workshop was organised in Hamburg on December 2012 involving two major European robotics companies (PAL Robotics and Aldebaran Robotics). The press was approached in all countries concerned by the project and this resulted in a number of references to the project on the web and in local newspapers. The project was also presented at local TV stations in Germany, Austria, Israel and the Netherlands, as well as on Dutch national radio. A press conference was organized in Turin in December 2010 and at the Parliament of Israel in January 2011.

For scientific dissemination a symposium was organised at the ISG*ISARC 2012 conference on gerontology highlighting KSERA's main results. Many scientific publications have been submitted and were accepted in conference proceedings and journals. These papers describe the many different results: context-aware robot navigation in domestic environments, human-robot interaction like non-verbal communication and eye-contact, the impact of user needs on the design of social robots, user acceptance and user experience of implementations of the KSERA system.
KSERA is part of education programmes at universities in Vienna, Hamburg and Eindhoven through research projects and specific lectures.

2.2 Key enablers

KSERA offers a mobile solution that brings care services to the user. This is particularly useful for people whose mobility is impaired, not just COPD patients. The KSERA system helps to provide lifestyle as well as health promotion and prevention services to healthy population. This enables the system to provide service and motivate the user at any time. Such technology was unavailable. The key enablers of KSERA are as follows:

User needs

- realistic scenarios and based on real user needs

Robotic platform

- person localisation and tracking in domestic environments
- robust map-free robot navigation for domestic environments
- person aware approach of the user
- more natural, socially acceptable Human-Robot interaction

Ubiquitous Monitoring system

- improved air quality sensors, measured parameters, and integration of telemedicine components
- intelligent rule engine enabling trend analysis and automated health monitoring

Health care applications

- proactive disease management based on treatment plans
- improved protocols for COPD treatment and educational materials for health care organizations
- intelligent rule engine incorporating COPD treatment plans

AAL applications

- enhanced video & voice communication improving social inclusion
- robot and ICT-based physical training for COPD-patients and generally for the elderly
- concept of robot battery recharging station and vision-guided docking procedure for long-duration usage of a home robot

Evaluation

- user centred iterative prototype design
- metrics for evaluation SARs
- ethical guidelines for developing SARs

3 Potential impact

3.1 Socio-economic impact

3.1.1 Disease management system for COPD

There are no disease management systems available for COPD. In Healthcare, there are many products proposing remote disease management. However, the commonly used approach is reactive by using tele-consultation and emergency services at time of need. The KSERA system offers the following functionalities:

- Proactive disease management platform.

The KSERA system is proactive and includes treatment plan, continuous supervision and personalized treatment adapted to patient's needs and wishes on a daily basis.

- Tele-health methodology and Clinical protocols for COPD treatment.

The Disease management application along with the newly created methodologies for remote treatment for chronic disease and homebound people is a unique product and includes methodologies for remote care using robotic platform and clinical protocols with embedded guidelines for COPD treatment.

- Intelligent rule engine incorporating COPD treatment plans.

Knowledge and intelligence embedded in the KSERA rule engine developed by Maccabi's healthcare professionals and ISMB regarding decision making and integration of environmental and clinical parameters does not exist on the market and will be further developed and commercialized for COPD patients, other lung diseases vulnerable (children, elderly, other diseases) and healthy populations

3.1.2 New technologies for addressing user needs of the ageing society

The KSERA project designed a socially assistive robot that helps elderly people with COPD. In particular, the KSERA system actively engages users, monitors their health and the physical environment, motivates people to exercise and is able to detect abnormal situations. This provides a set of new tools for addressing user needs, especially when combined with a remote care centre. KSERA has an important potential towards increasing the efficiency of such remote care, because it takes over tasks that would require regular nurse visits. This has the potential of reducing care costs while maintaining the same quality of care.

A growing need for home care exists in Europe and other industrialised countries. It is caused by an ageing population, increase in self-determination of elderly people, changing family structures and increases in chronic illnesses such as COPD. KSERA offers a novel care approach to relief the strain between care demand and care supply. The scientific and technological advances in the KSERA project offer personalized and adaptable services to respond to this care demand. The mobile system Nao with integrated monitoring functionalities and social communication delivers the needed care and / or social contact with family members.

3.1.3 Improved Quality of Life and Independence

The KSERA system addresses the need to prevent social isolation. The robot delivers mobile video communication services, which can be used alongside conventional solutions. It allows the user to get into touch with remote caregivers and family/friends much more easily. As such, it improves the feeling of security and the experienced quality of life.

The KSERA system continuously monitors air quality in the indoor and outdoor environment and proactively advices the user to stay indoors and close the windows if the outdoor quality is bad and vice versa. This increases the feeling of security and off-loads secondary users like family, friends and professional caregivers. The user is more confident when venturing outdoors and may even do so more frequently when feeling safe.

The Nao robot also helps users with their daily schedule to do frequent blood oxygen measurements and it motivates users to exercise. The system detects sudden changes and monitors trends, so that preventive measures can be taken in an early stage. The blood oxygen levels and air quality data are made available to the remote caregiver making it easier to assess the patient's health remotely.

Together these functionalities reduce the dependence on caregivers, family and friends as simple regular assessments are automated. The quality of care can be maintained or even improved with the potential of preventing sudden increases in the severity of COPD. The user feels safer and is more independent.

3.1.4 Advancement of European industries

The KSERA project is unique in the world, because the scientific and technological developments are geared to increase the user acceptance and, thus, the uptake of the tele-homecare technology to eventually results in care efficiency and reduced healthcare expenditure. The proactive robot mobile behaviour will increase the perceived usefulness by the elderly people as well as by the formal and informal caregivers. The seamless integration of the Nao robot in the intelligent home environment promotes the service robot research & development and opens new markets for service robots. In particular, KSERA strengthens the European industry in service robotics for ageing well and industries in the domain of Ambient Assisted Living.

KSERA has developed new Human Robot Interaction Algorithms for person localisation, person-aware navigation, dialog management enhanced with gestures and artificial emotional expressions and implemented it on Aldebaran's Nao robot. These results are made available to Aldebaran robotics and PAL robotics. This has formed the basis of new collaborative efforts between the partners in the KSERA project and Aldebaran Robotics and PAL robotics in order to acquire new funding for continuing the research and development of KSERA in future projects.

In the domain of Ambient Assisted Living KSERA has opened a new field of services at home. This enhances development of additional applications, development of domotic products that complement the KSERA system, medical devices. In particular, KSERA:

- enhanced video & voice communication improving social inclusion – using a mobile beamer to be carried by the Nao robot.
- developed robot and ICT-based physical training for COPD-patients and generally for the elderly. Movements from a health exercise instruction video were implemented on the robot enabling embodied health exercises.
- created a concept of robot battery recharging station and vision-guided docking procedure for long-duration usage of a home robot addressing the need for recharge the robot in an automated way.

3.2 Scientific dissemination activities

KSERA has produced many scientific dissemination activities. More than 40 publications have been produced in peer-reviewed scientific journals and conference proceedings and still more are in the pipeline. KSERA has been presented in no less than 38 conferences presentations, 3 workshops were organised and in many cases the KSERA system was demonstrated to the audience. During the final year of the project additional effort was spent on dissemination of the KSERA system as a whole. This led to a number of joint papers on results of the KSERA project as a whole.

KSERA's research activities have progressed well beyond current state of the art. Already KSERA is creating impact: two of KSERA's conference papers were selected by peer-reviewers for publication in the International Journal of Social Robotics, and a book chapter on Robotic Vision that appeared in 2012 is already cited 6 times. The interest of the scientific community in KSERA results is huge as is evident from two special issues in the Journal of Human Robot Interaction on topics that KSERA is addressing: complex HRI system architectures and perspectives on HRI. In fact, the

whole field of socially assistive robotics is booming as is evident from the growing impact factors (see Figure 2). The route map estimates - as laid down by the European Commission's Joint Research Centre (Forge & Blackman, 2010) - shows that of 'Medical and healthcare robotics' and 'Domestic service for Elderly care support' are still in their infancy, but are expected to reach marketable products in about 10 years (Figure 3). Figure 3 shows that KSERA provides a huge boost to precisely those areas that are still in their infancy and that are expected to bring value to the market in the near future.

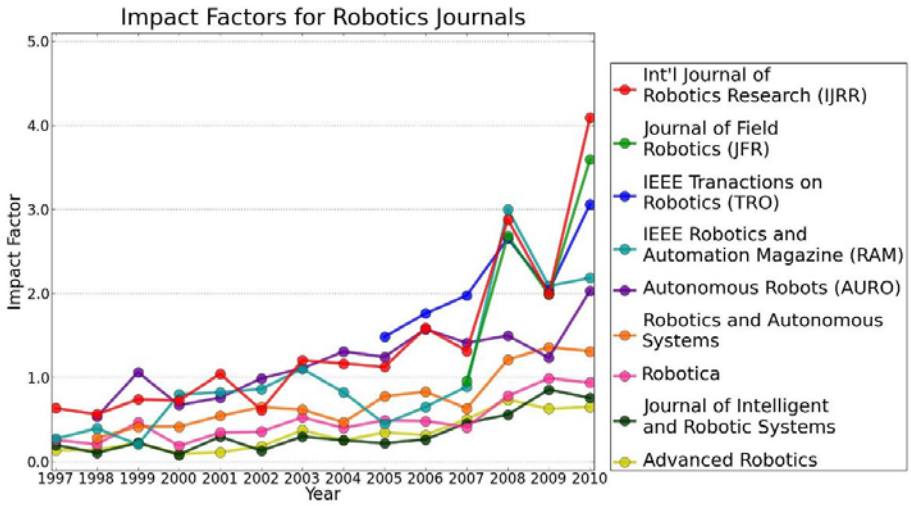

Figure 2 ISI impact factors for robotics journals reproduced from Deyle (2011)

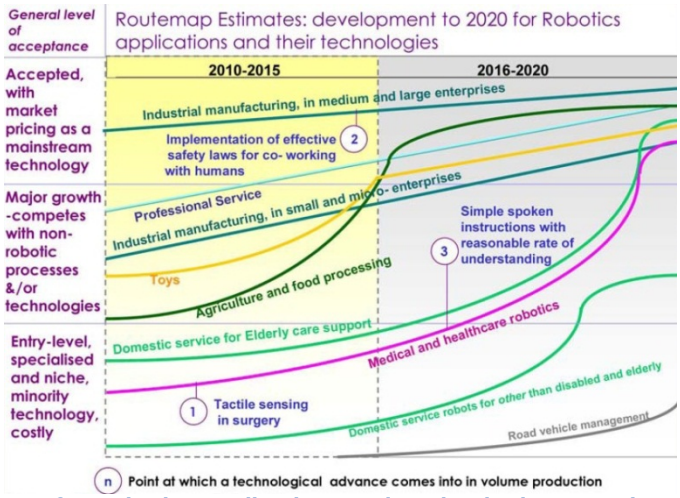

Figure 3 Routemap Estimates for Robotics applications and Technologies reproduced from Forge & Blackman (2010). The graph shows the expected increase in market value of 'Medical and healthcare robotics' and 'Domestic service for Elderly care support' in the next 5-10 years.

At the AAL Forum 2012 KSERA took part in a workshop organised by Smart Homes and FP7 Companionable, and established contacts with other projects like AAL-JP ALIAS. Current commercial robots do not have a functional head and arms for supporting natural human-robot interaction. Instead they exploit features of tablets and touch screens to interact with people (see Figure 4). Needless to say that KSERA is of great interest for future developments of such systems, which presumably will have these functionalities.

Figure 4: Robotic platforms for supporting elderly at home as exhibited at the AAL Forum 2012 (left) and the KSERA system in action (right).

At the ISG*ISARC conference KSERA organized a symposium entitled A socially assistive robot for persons with COPD. The ISG*ISARC conference is a biennial World Conference on technologies and technology use to serve the aging society (Gerontechnology), in combination with the yearly ISARC conference dedicated to Robotics and Automation in Construction. At this event KSERA presented the Ubiquitous Monitoring System, Robotic navigation for assisted living and Human Robot Interactions in care applications. Philips Research joined the symposium with a presentation from the Florence EU FP7 project on the industrial viewpoint.

3.3 Other dissemination activities

3.3.1 Creating Awareness of the general public

The KSERA project has appeared in several occasions on local TV stations in the Netherlands, Austria, Germany and Israel. KSERA also appeared twice on Dutch national radio, where it was interviewed on the future of robots in healthcare.

The KSERA website (http://www.ksera-project.eu) is frequently updated with publications and videos of the KSERA system, and KSERA has its own YouTube channel (http://www.youtube.com/user/kseraproject). TUW produced (with support of partner Raltec) a demonstration video which shows the procedure of a mobile video communication call in PT2 using the LED projector (http://www.aat.tuwien.ac.at/ksera/).

The KSERA system and its subcomponents have been demonstrated to the public at more than 13 events across Europe and Israel. The audiences varied from general public (local fairs, Wiener Forschungsfest, TU/experience event and UH/experience event), to high-school students (TU/e Open lab day, UH/Open Lab day, UH/Girls Day, TUW "Tag der offenen Tür" i.e. open house presentation), and professionals in the field of robotic home automation (ISG*ISARC conference, Super TU/esday "House of Robots").

3.3.2 Involving primary/secondary users

The user centred design approach of the KSERA project ensured the involvement of primary and secondary users from the start. Further involvement of users took place in the form of focus groups with elderly end users, professional caregivers, and medical professionals. In addition, domain experts in the fields of socially assistive robotics, COPD, ambient assisted living and care at home were interviewed.

3.3.3 Health care organizations, Governments and municipalities

Maccabi has been involved in various ways with dissemination of the KSERA project. This took the form of discussions with industry leaders in scientific meetings on health care and technology, as well as a special symposium organized by the OECD on health care in Israel with participation of OECD representatives from a number of countries.

CEIT Raltec is a research institute that closely collaborates with the municipality of Schwechat and the Senior Citizen Club Schwechat in Austria. This resulted, among others, in a TV broadcast about the KSERA project (http://www.tv-web.at/show_gemeinde.php?idbeitrag=8317&idgemeinde=9). Raltec also gave an oral presentation and demonstration of NAO and KSERA in a Workshop on future scenarios at the Senior Citizen Club Schwechat, Schwechat, Austria.

Another major event to get into touch with health care organizations, policy makers and (local) governments is the AAL Forum 2012. KSERA was present in the form of an invited talk in the workshop on companion robots. There was much interest in the wearable LED projector for the Nao robot.

3.3.4 Education

KSERA's research activities are used for several ongoing teaching activities:

- Many student research projects are carried out in the context of KSERA. TU/e, UH and TUW all supervised bachelor and master students training them the areas of socially assistive robots and ambient assisted living.
- All universities (TUW, TU/e and UH) developed courses in which the research paradigms and technologies involved in the KSERA project are taught.
- A direct spin-off from the KSERA project in teaching is the development of Socially Assistive Robotics theme in the new bachelor programme Psychology & Technology at the Eindhoven University of Technology.

3.3.5 Open source software

KSERA contributes software to the TU/e ROS stack. In particular the software for head pose estimation, person-aware navigation and the Dialog state machine is made available to the general public under GNU public license. This ensures software availability well beyond project end. A crucial part for successful transfer of knowledge is proper documentation of the software. A comprehensive document for internal use was constructed. Large parts are publicly available in various public deliverables.

3.4 Exploitation results

3.4.1 The robotic platform

KSERA adopted a humanoid robotic agent based on the claim for coaching or behaviour change, sociable robots offer advantages over on-screen agents or embedded technology (Kidd and Breazeal, 2005). This shows the huge gap in knowledge concerning the social skills required for humanoid robots that need to interact with humans. Indeed Aldebaran's Nao robot is sold as an academic research platform. Despite its potential the robot is an empty shell with no functional services. Everything has to be built from scratch. KSERA provides some of the very basic functionalities needed in care applications:

- Person localization and tracking in domestic environments –a non-obtrusive system that tracks a person's location and orientation in a room enabling the person aware approach of the user.
- Robust map-free robot navigation for domestic environments –allows robots to move in unknown cluttered environments. It does not require expensive sensors.
- Person aware approach of the user –a model for personal space and integrated it with the map-independent navigation. This enables a socially acceptable way of approaching the user
- More natural and socially acceptable Human-Robot interaction – gestures, eye led patterns and a dialog state machine that enables more natural and fluid interaction and that improves the user's experience. The newly developed head pose estimation algorithm that, in combination with face detection software, enables eye contact, tracking of the user's attention and joint attention.

3.4.2 Ubiquitous Monitoring System

- Improved air quality sensors, measured parameters and integration of telemedicine components.

The ubiquitous monitoring system is made of several commercial components, already available on the market (gas sensors, air quality, telemedicine devices). The added value relies in the integration of a set of heterogeneous sensors in only one platform that is able to gather both medical and environmental data, from both fixed home sensor and virtual sensors. Similar solutions are available at a research or a pilot project level, but still not available on the market.

- Intelligent rule engine enabling trend analysis and automated health monitoring.

The KSERA intelligent server includes the rule engine for the data processing and the decision making. The rule engine can be considered as a first step to address a limitation of all the systems currently exists on the market that is preventing them to strongly penetrate the market.

3.5 Additional information

The project website (http://www.ksera-project.eu) provides detailed information on the project, including KSERA-related events, collaborations, public reports and contact information.

The KSERA project is developed and implemented by a consortium of the following partners:

- Technische Universiteit Eindhoven (TU/e)
- Istituto Superiore Mario Boella (ISMB)
- Maccabi Healthcare Services (Maccabi)
- Technische Universität Wien (TUW)
- CEIT RALTEC gemeinnützige GmbH (RALTEC)
- Consoft Sistemi S.P.A. (Consoft)
- Universität Hamburg (UH)

To contact the project coordinator send an e-mail to coordinator_ksera@tue.nl

4 Use and dissemination of foreground

4.1 Section A (public)

template A1: list of scientific (peer reviewed) publications, starting with the most important ones										
NO.	Title	Main author	Title of the periodical or the series	Volume	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[1]	Is/Will open access
1	Attitudes towards socially assistive robots in intelligent homes: results from laboratory studies and field trials	Torta, E.	Journal of Human-Robot Interaction	1(2)			2012	76-99	DOI: 10.5898/JHRI.1.2.Torta	no
2	Learning Robot Vision for Assisted Living	Yan, W.	Robotic Vision: Technologies for Machine Learning and Vision Applications		IGI Global		2013	257-280	IGI Global. DOI: 10.4018/978-1-4666-2672-0.ch015	no
3	Modelling and testing proxemic behaviour for humanoid robots.	Torta, E.	International Journal of Humanoid Robotics	09(4)			2012	1250028-1--24	DOI: 10.1142/S0219843612500284	no
4	Socially Assistive Robots: A comprehensive approach to extending independent living	Johnson, D.O.	International Journal of Social Robotics				submitted			no
5	Mobile Video Phone Communication Carried by a NAO Robot	Panek, P.	Ambient Assisted Living, Advanced Technologies and Societal Changes		Springer	Berlin	in press			no
6	A hybrid probabilistic model for person tracking based on a ceiling-mounted camera	Yan, W.	Journal of Ambient Intelligence and Smart Environments	3(3)			2011	237-252	doi:10.3233/AIS-2011-0111	no
7	Real-world reinforcement learning for autonomous humanoid robot docking	Navarro, N.	Robotics and Autonomous Systems	60(11)			2012	1400-1407		no
8	Design of a parametric model of personal space for robotic social navigation	Torta, E.	International Journal of Social Robotics				submitted			no
9	Prototyping a LED Projector Module Carried by a Humanoid Nao Robot to Assist Human Robot Communication by an Additional Visual Output Channel	Edelmayer, G.	Proceedings of the IASTED International Conference Assistive Technologies (AT 2012)				2012	809-816	ISBN: 978-0-88986-909-7, DOI: 10.2316/P.2012.766-006	no
10	Object Learning with Natural Language in a Distributed Intelligent System - A Case Study of Human-Robot Interaction	Heinrich, S.	Proceedings of the IEEE First International Conference on Cognitive Systems and Information Processing (CSIP 2012)		Springer	Berlin	in press			no
11	Adaboost and Hopfield Neural Networks on Different Image Representations for Robust Face Detection	Meins, N.	Proceedings of the 12th International Conference on Hybrid Intelligent Systems (HIS 2012)				2012	531-536		no

12	Hybrid Ensembles Using Hopfield Neural Networks	Meins, N.	Proceedings of the 22nd International Conference on Artificial Neural Networks (ICANN 2012)		Springer	Berlin	2012	403-410		no
13	How Can a Robot Attract the Attention of Its Human Partner? A Comparative Study over Different Modalities for Attracting Attention	Torta, E.	Social Robotics		Springer	Berlin	2012	pp. 288–297	DOI: 10.1007/978-3-642-34103-8_29	no
14	A Neural Approach for Robot Navigation based on Cognitive Map Learning	Yan, W.	Proceedings of the International Joint Conference on Neural Networks (IJCNN 2012)				2012	1146-1153		no
15	Head pose estimation for a domestic robot	Pol, David van der	Proceedings of the 6th international conference on Human-robot interaction (HRI '11)		ACM	New York	2011	277-278	DOI: 10.1145/1957656.1957769	no
16	A model of the user's proximity for Bayesian inference	Torta, E.	Proceedings of the 6th international conference on Human-robot interaction (HRI '11)		ACM	New York	2011	273-274	DOI: 10.1145/1957656.1957767	no
17	Object Affordances in the Context of Sensory Motor Contingencies	Kleesiek J.	Frontiers in Computational Neuroscience	5			2011	5	DOI: 10.3389/conf.fncom.2010.51.00071	no
18	Person Tracking Based on a Hybrid Neural Probabilistic Model	Yan, W.	Artificial Neural Networks and Machine Learning – ICANN 2011		Springer	Berlin	2011	365-372	DOI: 10.1007/978-3-642-21738-8_43	no
19	Robot Trajectory Prediction and Recognition based on a Computational Mirror Neurons Model	Zhong, J.	Proc. International Conference on Artificial Neural Networks (ICANN)				2011	333-340	Doi: 10.1007/978-3-642-21738-8_43	no
20	Attitude towards Robots Depends on Interaction But Not on Anticipatory Behaviour	Cuijpers, R. H.	Social Robotics		Springer	Berlin	2011	163-172	DOI: 10.1007/978-3-642-25504-5_17	no
21	Making Robots Persuasive: The Influence of Combining Persuasive Strategies (Gazing and Gestures) by a Storytelling Robot on Its Persuasive Power	Ham, J.	Social Robotics		Springer	Berlin	2011	71-83	DOI: 10.1007/978-3-642-25504-5_8	no
22	Design of Robust Robotic Proxemic Behaviour	Torta, E.	Social Robotics		Springer	Berlin	2011	21-30	DOI: 10.1007/978-3-642-25504-5_3	no
23	Dynamic neural field as framework for behaviour coordination in mobile robots	Torta, E.	World Automation Congress (WAC)				2012	1-6		no
24	Human robot interactions in care applications	Cuijpers, R.H.	Gerontechnology	11(2)			2012	353-354	Doi: http://dx.doi.org/10.4017/gt.2012.11.02.186.00	no
25	Incorporating new technologies in health-care systems	Lemberger, J.	Gerontechnology	11(2)			2012	131	doi:10.4017/gt.2012.11.02.133.00	no
26	Barriers and success factors in implementing advanced technologies to benefit the elderly: A perspective from Israel	Lemberger, J.	Gerontechnology	11(2)			2012	131-132	doi:10.4017/gt.2012.11.02.297.00	no

27	A socially assistive robot for persons with COPD	Simonov, M.	Gerontechnology	11(2)			2012	353	doi:10.4017/gt.2012.11.02.150.00	no
28	Capturing and triggering relevant events and trends by Ubiquitous Monitoring	Simonov, M.	Gerontechnology	11(2)			2012	355-356	doi:10.4017/gt.2012.11.02.203.00	no
29	Real-life evaluation of a socially assistive robot	Werner F.	Gerontechnology	11(2)			2012	382	Doi: http://dx.doi.org/10.4017/gt.2012.11.02.352.00	no
30	Robot navigation for assisted living	Yan, W.	Gerontechnology	11(2)			2012	356	Doi: http://dx.doi.org/10.4017/gt.2012.11.02.190.00	no
31	Technology And Aging For Maccabi's Elders	Lemberger, J.	Aging And Technology International Conference				2013			no
32	Digital Healthcare And Innovation In Maccabi Healthcare Services	Lewy, H.	Advances In Digital Healthcare Through Telehealth And Three Million Lives				2012			no
33	Examples of multimodal user interfaces for socially assistive robots in Ambient Assisted Living environments	Mayer, P.	Cognitive Infocommunications (CogInfoCom)				2012	401-406		no
34	KSERA: Making video communication mobile by using a small humanoid social assistive robot	Panek, P.	Proceedings of AAL Forum 2012				2012		http://www.researchgate.net/publication/233416865__KSERA_Making_video_communication_mobile_by_using_a_small_humanoid_social_assistive_robot	no
35	Ein LED Projektor zur mobilen Video-Kommunikation getragen von einem sozial unterstützenden Roboter	Panek, P.	Lebensqualität im Wandel von Demografie und Technik		VDE Verlag	Berlin	2013	22-23	http://www.vde-verlag.de/proceedings-en/453484085.html	no
36	Continuously Linking Patients Caregivers And All Healthcare Actors By A Multidisciplinary Telecenter For Chronically Ill Patients	Kaye, R.	Symposium: Facts Not Fiction-The Future Is Already Here of the European Economic And Social Committee				2012			no
37	Ubiquitous Monitoring & Service Robot for Care	Simonov, M.	Proc. of KI-2012 conference,		Springer	Berlin	2012	93-97		no
38	Using humanoid robot in ambient-assisted living	Simonov, M.	Global Telemedicine and eHealth Updates: Knowledge Resources	5			2012	438-442	ISSN: 1818-9334	no
39	Evaluation of the acceptance of a socially assistive robot by older users within the project KSERA	Werner F.	Lebensqualität im Wandel von Demografie und Technik		VDE Verlag	Berlin	2013	22-23	http://www.vde-verlag.de/proceedings-en/453484078.html	no
40	Evaluation of human robot interaction factors of a	Werner, K.	Complex, Intelligent and Software				2012	455 - 460	http://ieeexplore.ieee.	no

	socially assistive robot together with older people		Intensive Systems (CISIS) 2012						org/xpls/abs_all.jsp?arnumber=6245642&tag=1	
41	Evaluierung eines mobilen LED Projektors als Benutzerschnittstelle eines sozial unterstützenden Roboters	Panek, P.	Proceedings of the 5th German AAL Congress 2012		VDE Verlag	Berlin	2012		http://www.vde-verlag.de/proceedings-en/453400042.html	no
42	User Acceptance of a Mobile LED Projector on a Socially Assistive Robot	Panek, P.	Ambient Assisted Living, 5th AAL-Kongress 2012				2012	77-91	Doi 10.1007/978-3-642-27491-6	No

template A2: list of dissemination activities							
NO.	Type of activities[1]	Main leader	Title	Date/Period	Place	Type of audience[2]	Size of audience
1	Conference	Maccabi	Conference for Maccabi Geritatric Assessment Teams	01 April, 2011	Tel Aviv, Israel	Research, Industry	>100
2	Conference	TUW	IASTED conference	01 February, 2012	Innsbruck, Austria	Research	>100
3	Conference	Maccabi	ISG*ISARC conference	27 June, 2012	Eindhoven, The Netherlands	Research	>100
4	Conference	Raltec	ISG*ISARC conference	27 June, 2012	Eindhoven, The Netherlands	Research	>100
5	Conference	ISMB	ISG*ISARC conference	29 June, 2012	Eindhoven, The Netherlands	Research	>100
6	Conference	TU/e	ISG*ISARC conference	29 June, 2012	Eindhoven, The Netherlands	Research	>100
7	Conference	UH	ISG*ISARC conference	29 June, 2012	Eindhoven, The Netherlands	Research	>100
8	Conference	UH	International Joint Conference on Neural Networks 2012 (IJCNN 2012)	10-15 June 2012	Brisbane, Australia	Research	>100
9	Conference	UH	International Conference on Artificial Neural Networks 2012 (ICANN 2012)	11-14 September 2012	Lausanne, Switzerland	Research	>100
10	Conference	ISMB	MED-E-TEL Conference	16-20 April 2012	Luxembourg	Research	>100
11	Conference	Raltec	6th German AAL congress	21-23 January 2013	Berlin, Germany	Research, Industry	>100
12	Conference	TUW	6th German AAL congress	21-23 January 2013	Berlin, Germany	Research, Industry	>100
13	Conference	Raltec	project Active Ageing	23-25 January 2013	Tampere, Finland	Research	>100
14	Conference	TUW	AAL Forum 2012	24-27 September 2012	Eindhoven, The Netherlands	Research, Industry	>100
15	Conference	Raltec	AAL Forum 2012	24-27 September 2013	Eindhoven, The Netherlands	Research, Industry	>100
16	Conference	ISMB	KI-2012 International Conference	24-27 September, 2012	Saarbrücken, Germany	Research	>100
17	Conference	Elena Torta	IEEE World Automation Congress 2012 (WAC2012)	24-28 June 2012	Puerto Vallarta, Mexico	Research	>100
18	Conference	TU/e	Int. Conference on Social Robotics (ICSR 2012)	28 October - 3 November 2012	Chengdu, China	Research	>100
19	Conference	UH	Hybrid Intelligent Systems 2012 (HIS 2012)	4-7 December 2012	Pune, India	Research	>100
20	Conference	TU/e	7-th ACM/IEEE Conference on Human-Robot Interaction (HRI12)	5-8 March 2012	Boston, USA	Research	>100
21	Conference	TU/e	the European Conference on Cognitive Ergonomics (ECCE 2010)	Aug 25-27, 2010	Delft, The Netherlands	Research	50
22	Conference	ISMB	Convegno su Ergonomia,	December 2nd, 2011	Torino, Italy	Research	>100
23	Conference	Maccabi	Conference for Medical Home Care Teams of Maccabi	December, 2009	Tel Aviv, Israel	Care professionals	175

24	Conference	TUW	5th German AAL Congress	January 24th, 2012	Berlin, Germany	Research, Industry	>100
25	Conference	UH	International Conference on Artificial Neural Networks	June 14-17th, 2011	Espoo, Finland	Research	>100
26	Conference	Maccabi	Conference on technology and aging	June 14th, 2011	Haifa, Israel	Research	>100
27	Conference	TU/e	Human Robot Interaction (HRI 2011), Lausanne, Switzerland	March 5-9th, 2011	Lausanne, Switzerland	Research	>100
28	Conference	Consoft	Euromedtech Conference	May 16-17th, 2011	Turin, Italy	Research	>100
29	Conference	TU/e	the 7th World Conference on Gerontechnology	May 23-27, 2010	Vancouver, Canada	Research	>100
30	Conference	TUW	eHealth 2011	May 26-27th, 2011	Vienna, Austria	Research	>100
31	Conference	ISMB	Information Day on Challenge 2	November 15th, 2011	Brussels, Belgium	Research	
32	Conference	Consoft	TOSM (Torino software and System Meeting),	November 16-17th, 2011; May 19, 2010	Turin, Italy	Industry	>100
33	Conference	Consoft	Medica world forum 2011	November 18-19th, 2011	Dusseldorf, Germany	Research	>100
34	Conference	TU/e	International Conference on Social Robotics 2011	November 24-25th, 2011	Amsterdam, The Netherlands	Research	>100
35	Conference	TUW	Chamber of Commerce Innovation Day	November 28th, 2011	Vienna, Austria	Industry	>100
36	Conference	TUW	2nd AAL Forum	Sep 15-17, 2010	Odense, Denmark	Research, Industry	>100
37	Conference	TU/e	Ambient Assisted Living Forum 2011	September 26-28th, 2011	Lecce, Italy	Research, Industry	>100
38	Conference	Maccabi	European Respiratory Society	September, 2011	Amsterdam, The Netherlands	Research, Industry	>100
39	Workshop	UH	Workshop on ICT and Robotics for Care and Service	11 December, 2012	Hamburg, Germany	Research, Industry	>100
40	Workshop	TU/e	3TU springschool had as theme “Robots in health care” with workshops and lectures	April 11 - 15th, 2011	Rotterdam, The Netherlands	Research, Higher Education	20
41	Workshop	TU/e	TU/e hosted the Aldebaran Robotics European Tour	October 26th, 2011	Eindhoven, The Netherlands	Research, Higher Education	20
42	Demonstration	TU/e	TU/e Super TU/esday	26 June, 2012	Eindhoven, The Netherlands	Research, Industry	>100
43	Demonstration	ISMB	ISG*ISARC demo floor	27 June, 2012	Eindhoven, The Netherlands	Research, Industry	>100
44	Demonstration	UH	UH/Lab open day	10 October, 2012	Hamburg, Germany	Higher Education	>100
45	Demonstration	Raltec	Workshop on future scenarios - Senior citizen club Schwechat	04 December, 2012	Schwechat Austria	Research, Industry	50
46	Demonstration	UH	UH/Experience	April 14, 2012 and 2011	Hamburg, DE	Higher Education	>100
47	Demonstration	TU/e	The Beta Girls day is a university wide event to stimulate last year high school girls to choose engineering education.	December 13th, 2011	Eindhoven, The Netherlands	Higher Education	>100
48	Demonstration	UH	UH/Experience	December 14 – 16th 2011	Hamburg, Germany	General Public	>100

49	Demonstration	TU/e	TU/Open day	January 20th, 2012	Eindhoven, The Netherlands	Higher Education	112
50	Demonstration	Raltec	KSERA was presented at the summer event of the “senior’s centre Schwechat”	June 11th, 2011	Schwechat, Austria	End users, Politicians, General Public	
51	Demonstration	Raltec	KSERA was presented at local fair “Leben und Freizeit in Schwechat” at RALTEC’s booth	March, 2011	Schwechat, Austria	General Public	>100
52	Demonstration	TUW	„Innovation Day“ of Viennese chamber of commerce („Wiener Wirtschaftskammer“)	November 28th, 2011	Vienna, Austria	General Public	400
53	Demonstration	ISMB	Researcher's Night event in Torino, 23/09/2011	September 23rd, 2011	Torino, Italy	General Public	>100
54	Demonstration	Raltec	RALTEC presented KSERA at “senior’s advisory council of the municipality of Schwechat” within the AAL Living Lab Schwechat	September, 2011	Schwechat, Austria	Policy makers	
55	Education	UH	Project: Learning and Helping Robots/Lernende und Helfende Roboter	03 July, 1905	Hamburg, Germany	Higher Education	02-05
56	Education	Raltec	lectures concerning AAL at Carinthia University of Applied Sciences	04 July, 1905	Klagenfurt, Austria	Higher Education	25
57	Education	TU/e	master’s degree lecture on “Human Factors Engineering for the Elderly”	04 July, 1905	Eindhoven, The Netherlands	Higher Education	20
58	Education	UH	Project: Human-Robot Interaction/Mensch-Roboter Interaktion	04 July, 1905	Hamburg, Germany	Higher Education	02-05
59	Education	TU/e	Jim Juola (TU/e) gave an introductory lecture on Robots in Healthcare at the 3TU Springschool	11 April, 2011	Rotterdam, The Netherlands	Higher Education	20
60	Education	TU/e	Raymond Cuijpers (TU/e) gave a lecture entitled “KSERA project: smart robots, smart homes and care for older persons” at the 3TU Springschool	12 April, 2011	Rotterdam, The Netherlands	Higher Education	20
61	Education	TU/e	Raymond Cuijpers (TU/e) gave an invited talk about Robots in health care and the KSERA project organised by the studying association COGNAC	18 May, 2011	Nijmegen, The Netherlands	Higher Education	50
62	Education	TU/e	seminar Telecare & Telehealth	22 November, 2011	Nankai, Taiwan	Higher Education	60
63	Education	TU/e	Student research projects are carried out in the context of KSERA.	2010-2012	Eindhoven, The Netherlands	Higher Education	25
64	Education	UH	practical training with the robots at Knowledge Technology	Jan-Feb 2012	Hamburg, Germany	Higher Education	2
65	Flyer	All	KSERA Leaflet distribution	2010-present	European wide	Various	1000
66	Presentation	Raltec	"EUROPA FORSCHT - FP7 im Endspurt"	13 December, 2012	Vienna, Austria	Research, Industry, Policy Makers	50
67	Presentation	TU/e	KSERA aims were included in a presentation for the LivingLab Eindhoven project	August 16, 2010	Eindhoven, The Netherlands	Industry	50
68	Presentation	Maccabi	Maccabi has presented KSERA to the heads of medical departments.	August 22, 2010	Tel Aviv, Israel	Industry	
69	Presentation	Maccabi	Maccabi Healthcare Service as well as the Maccabi Research Institute.	August 3, 2010	Tel Aviv, Israel	Research, Industry	50
70	Presentation	UH	CINACS Colloquium	February 4-6th, 2011	Wenningstedt, Sylt, Germany	Research	50
71	Presentation	UH	University Colloquium	Jul 12, 2010		Research, Higher	20

						Education	
72	Presentation	ISMB	ISMB made presentations about KSERA to clinical doctors from medical departments in Molinette Hospital, local SMEs and R&D centres.	June - August, 2010	Turin, Italy	Research, Industry	50
73	Presentation	TUW	Invited lecture	June 25-26, 2010	Salzburg, AT	Research	50
74	Presentation	TU/e	Invited lecture	May 19, 2010	Munchen, Germany	Research	20
75	Presentation	TUW	Wiener Forschungsfest (Viennese Research Festival)	September 18-20, 2010	Vienna, Austria	General Public	>100
76	Press release	UH	The Hamburger Abendblatt newspaper published a report "Robots that care about seniors"	March 3, 2012	Hamburg, Germany	General Public	
77	Press release	UH	The Hamburger Abendblatt newspaper reports about "Robots which impress elderly people"	March 31, 2012	Hamburg, Germany	General Public	
78	Publication	Maccabi	DOROT-Israeli magazine for professionals in Gerontology	01 September, 2010		Research, Industry	
79	Publication	TU/e	Cuijpers R.H. (2011). Interview: Robots come of Age. Research EU Results Magazine, Issue 6 (October 2011), pp. 7-9.	01 October, 2011	European wide	Research, Industry, Policy Makers	100-1000
80	Publication	TUW	ERCIM News (http://ercim-news.ercim.eu/en92/ri/a-projector-as-mobile-visualization-device-on-an-assistive-robot)	01 January, 2013	European wide	Research, Industry, Policy Makers	>1000
81	Publication	TU/e	Interview J.F. Juola: Researcher customizes robot to serve the elderly in their own homes	Fall 2011	Kansas, USA	Higher Education	>100
82	Publication	TU/e	KSERA: healthy ageing with smart robots. Public Service Review: Health and Social Care 32, 60.		UK and Europe	Research, Industry, Policy Makers	>1000
83	Radio interview	TU/e	'Robots: friendly/horrible' about the future of robots in care applications. (http://www.ikonrtv.nl/daw/uitzending.asp?lIntItem=2&lIntEntityId=382).	Jan. 2013	The Netherlands	General Public	
84	TV report	UH	RTL-Nord, a German TV broadcaster, reported about Nao's reception by elderly persons in a senior residence, medical functionalities of KSERA, the technology, implications for care services. (http://www.rtlregional.de/player.php?id=19254)	April 4, 2012	Germany	General Public	
85	TV report	Raltec	TV-report about the KSERA-field trial at the Senior's Centre Schwechat was broadcasted on a regional TV-station (http://www.tv-web.at/show_gemeinde.php?idbeitrag=8317&idgemeinde=9)	Dec. 2012	Austria	General Public	
86	TV report	Maccabi	Israel's Channel 2 news ran a report on KSERA NAO user tests taking place at Maccabi. ISMB provided commentary in both English and Russian languages.	December, 2011	Tel Aviv, Israel	General Public	>100
87	Videos	All	Various videos of the KSERA system are available on YouTube and the KSERA project website.	2010-Present	Worldwide	General Public	>1000
88	Web	TU/e	The KSERA project web-site	2010-present	Worldwide	General Public	>1000
89	Web	Maccabi	KSERA was featured in video reportage on the Israeli internet magazine the Marker, Israel's leading economic news magazine	June 14th, 2011	Haifa, Israel	End users, Politicians, General Public	