Section 1: Publishable Summary

1.1 Summary of project objectives

The overall objective of the project is to improve daily life of elderly people and people affected by Chronic Obstructive Pulmonary disease (COPD) and to facilitate their daily activities within their domestic environment.

The specific objective of the project is to integrate a robot machine (called Nao) in a smart home environment for measuring and detecting normal and anomalous living patterns of elderly people and people affected by COPD. A machine navigation will follow a target person in its domestic environment, will transmit data that permit to detect possible anomalies at a very early stage and will suggest actions to the target person itself to improve her/his conditions.

The project is particularly relevant for the socio-economic needs of all modern societies, especially in light of the following:

- Elderly people want to live independently in their own homes as long as possible, and the ratio between elderly people (aged 65 or more) and active working population is expected to drop from 1:5 in 2000 to 1:2 in 2050.
- 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
- Age-related diseases such as COPD cause a decline of the patients' capabilities, including mobility limitations and self-care restrictions.

1.2 Description of the work performed since the beginning of the project and main results achieved so far

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, in fact, has been integrated and installed at the test sites in Austria and Israel, where it has been tested with real end-users in a real environment. The formative evaluation of the first prototype will guide the development and research in the second iterative design stage of the project that will be executed in the third and last year.

In line with the foreseen schedule, the consortium has developed the following set of activities:

1. **Needs assessment of possible usage scenario**: the specific needs of users have been analyzed and resulted in a comprehensive description of the KSERA Scenarios, Use cases and Personas and the basic rules for ubiquitous monitoring. The different types of scenarios were ranked according to their importance, so as to be included in the first prototype, to be produced. An updated version of different scenarios integrating the recommendations received during the interim mid-term and the first year reviews was drafted.

Members for the Ethical Advisory Board (EAB) were nominated. Needs for ethical clearance in Austria, Israel, and the Netherlands were clarified and ethical clearance was obtained for the field trials in Austria and Israel. Different programming documents for the implementation of the trial were produced, according to the recommendations provided during the interim mid –term and the first year reviews.

The KSERA project (http://www.ksera-project.eu) has received funding from the European Commission under the 7th Framework Programme (FP7) for Research and Technological Development under grant agreement n°2010-248085.

2. **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. This report was updated according to the recommendations of the interim mid–term review. A report on the basic robot navigation and localization capabilities (including navigation through a domestic environment and person tracking) has been finalized during the second year, and used for the creation of the first prototype of robot mobile behaviour.

A person interacting with Nao

3. **Analysis of the Human Robot Home interaction:** advanced algorithms have been implemented in order to build up basic functionalities needed to put Nao in contact with the target person: when operative, Nao will be able to track the face of the person and to estimate its head pose. In addition speech is augmented with gestures and facial expression through Nao's LEDs. These features enable the robot to actively interact with the person and give instruction for his daily activities (i.e. physical activities, information about important data for the health of the person, etc.), Two versions of a wearable beamer for Nao were created, the second being smaller and lighter, and implemented successfully for enabling video communication and for improving robustness by providing an additional communication channel. User acceptance issues were explored for the LED projector approach comparing it also with other stationary approaches. Promising results were found which support the assumed usefulness. Additional user studies were conducted to evaluate user experience and human-robot interaction. They confirm the expected benefit of an embodied human-like system in care applications.

4. **Overview of sensors and sensors network 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 analyzed and resulted in a report that enumerates the classes and the devices that have been 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. Several integration meetings involving all partners have been organized in the course of both 2010 and 2011. Costs and benefits have been taken into consideration during this phase 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).

5. **Development of a trial plan in real user environments including ethics and safety issues**: this involved, during the first year, planning of the study design, user involvement processes, environment, trial documents and organizational issues. The results lead 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 ongoing research activities in the research area of Assistive robots and Human-Robot-Interaction.

6. 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 has been finalized during the second year. This first prototype includes the integration of the basic components (Robot Mobile Behaviour, Human Robot Interaction, Ubiquitous Monitoring System) and has been integrated, installed and tested at two sites in Austria and Israel, under the advice and guide of the ethical advisory board. The formative evaluation has been held with real users in real environments, and the results (that have been reported in a dedicated deliverable) will be used to guide the

development and research needed for the design of the second prototype, during the third year of the project.

7. Communication activities: a website of the project (http://www.ksera-project.eu) was designed and is currently operative. A project leaflet has been produced and distributed during several events. 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 the Eindhoven local TV station and on the Dutch national radio. A press conference was organized in Turin in December 2010 and at the Parliament of Israel in January 2011. The press uptake continues to be good as is evident from a news report on user tests with Nao on Israel's Channel 2 TV, and several interviews and invited lectures.

Many scientific publications were submitted and 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.

KSERA also collaborates with several other projects such as ROBOEARTH, Robo M.D. and FLORENCE mostly exchanging scientific knowledge, robot software and organizing dissemination events.

A document on standardization has been produced: this describes the relevant standards determining the inter-operability of the KSERA system with the external applications, which might be envisaged for the future exploitation of the KSERA results.

8. **Development of a risk management plan**: the main results are the assessment of the project risks and the construction of a risk plan. Further outputs are the interim progress report for the first period and the first annual progress report. The project is running smoothly, regular conference calls and progress meetings took place in 2010 and the planned milestones have been achieved.

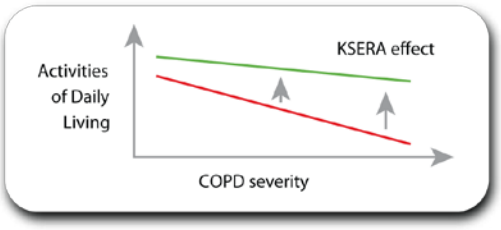
1.3 Expected final results and potential impact and use

The **applications** include:

- A mobile assistant to support and interact with an elderly person.
- Delivering useful communication (video, internet) to an elderly person.
- Advising an elderly person or caregivers about anomalous or dangerous situations on the basis of health and behavioural monitoring.

The **expected impact** is:

- Increasing the acceptance and adoption of service robots in domestic environments.
- Increasing independence and improving the quality of life (QoL) for elderly people, in particular those affected by COPD.
- Decreasing burdens on families and caregivers.
- Decreasing healthcare costs.



1.4 Additional information: http://www.ksera-project.eu

The project website provides more 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)

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