1 Publishable summary

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Figure 1. SRS Project Logo

Partners: Cardiff University, UK; Central Laboratory of Mechatronics and Instrumentation - Bulgarian Academy of Sciences, Bulgaria; Fondazione Don Carlo Gnocchi Onlus, Italy; Fraunhofer-Gesellschaft Zur Foerderung Der Angewandten Forschung E.V, Germany; Stuttgart Media University (Hochschule der Medien), Germany; Hewlett-Packard Italiana srl, Italy; Fundacion Instituto Gerontologico Matia – INGEMA, Spain; Profactor GMBH, Austria; Robotnik Automation SLL, Spain; University of Bedfordshire, UK

Duration: 1 February 2010 – 31 January 2013.

URL: http://www.srs-project.eu

Description: The project focuses on the development and prototyping of multi-purpose remotely-controlled, semi-autonomous robotic solutions in domestic environments to support elderly people. In particular, the SRS project will demonstrate an innovative, practical and efficient system called "SRS robot" for personalised home care.

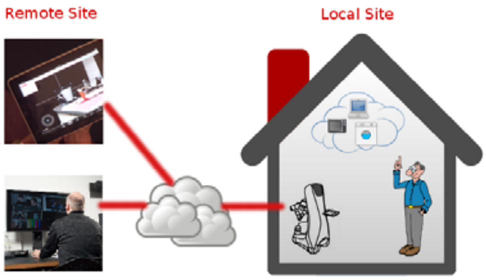

Figure 2. SRS concept

Most elderly people want to live in the familiar environment of their own residence for as long as possible. However, not many can live with their adult children and therefore, at some stage, often late in life, people have to live alone. Studies show that some form of home care is usually required as they advance in years.

Figure 3. SRS Prototype from Fraunhofer IPA

SRS solutions are designed to enable a robot to act as a shadow of its controller and to perform multiple functions. For example, elderly parents can have a robot as a shadow of their children or carers. In this case, adult children or carers can help them remotely and physically with tasks such as getting drinks or checking around the house as if the children or carers were resident in the house.

Many application scenarios have been proposed. The following two expandable scenarios are considered first:

- **Fetch and Carry:** Through this scenario SRS's semi-autonomous navigation and object manipulation will be demonstrated. In a wider sense, this scenario can be regarded as semi-autonomous manipulation in general.
- **Video Communication:** This scenario includes face-to-face communication through an interactive device as well as through the robot's own cameras. Video communication can be

used for checking the health status of the elderly person remotely by family members, friends or remote doctor visits.

Once these base scenarios are implemented, the following scenarios can be easily realised as new situations for the robot:

- **Emergency Assistance:** The elderly person places an emergency call (for example, after a fall), using a device carried on the body and a teleoperator uses video calling and robot navigation, e.g. to assess the health status and the type of injury.
- **Prepare Food:** This scenario represents a sequence of fetching tasks that remain similar for different occasions. It is necessary to implement this scenario in order to demonstrate SRS's ability to learn fetch-carry procedures autonomously.
- **Fetch and Carry Difficult-to-Reach or Heavy Objects:** For elderly people, objects that are on the ground or placed high (e.g. on a shelf) are often difficult to reach. Furthermore, heavy objects can also be problematic (more than 3 kg). Although the prototype hardware has limitations regarding maximum payload and reach, this scenario can be seen as a key benefit of an in-house manipulator.

The SRS hardware platform is based on the Care-O-bot 3 from Fraunhofer IPA. Care-O-bot 3 is a mobile assistant robot able to move safely among humans, to detect and grasp typical household objects, and to safely exchange them with humans. However, the user interface and the intelligence of Care-O-bot 3 cannot satisfy the usability and acceptance requirements of SRS users. Therefore, the project R&D will focus on the gaps in the current version of Care-O-bot and use it as a remotely controlled home carer. The research can be summarised in the following two aspects:

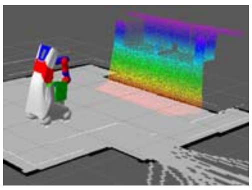

Figure 4. SRS environment perception

Cognitive Capabilities of Remotely-Controlled Service Robots: Research on cognitive capabilities is to explore methodologies and techniques to facilitate perception and decision making capabilities for remotely controlled semi-autonomous robotic systems. For tasks that cannot be performed by robots autonomously but can be executed remotely, a robot can try and support the remote operator as much as possible.

The above cognitive capability will be realised in the following SRS software modules:

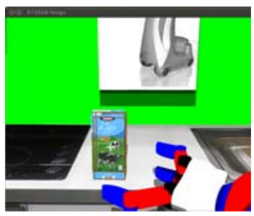

Figure 5. SRS assisted object detection and grasp

- **High level action representation, translation and learning module**:
  allows human operators to issue high-level control commands such as "go to kitchen" or "serve me a drink" and translates them into low-level control messages automatically. Based on the skill level, the task planning and execution can be switched between different autonomous modes. SRS will learn new objects, environments and action sequences from the operation to expand its skills.
- **Assisted object detection module**: enables interactive object detection in a mixed-reality environment. This kind of perception guidance is important for unexpected and complicated situations. With user assistance such as highlighting the region of interest or specifying object

category, the software translates complicated scenes to identified target, obstacles and the supporting surfaces.

- **Assisted grasp module**: enables interactive object fetch and bring for known objects and simple shaped unknown objects. With user-assisted grasp posture and grasp configuration selection, the module will expand the grasp capability of the robot.

Figure 6. SRS local UI on IPod touch

Human-Robot Interaction of Remotely-Controlled Service Robots: Research in user interaction is to explore the ***usability*** and ***safety requirement*** of remotely-controlled service robotic systems in a domestic environment. This work is critical for the *overall acceptance* of the system. The following user interfaces will enable the SRS solution to be accessed by average users in real life settings.

Figure 7. SRS UI for private remote operators such as family members

- **UI for Local User** focuses on usability by elderly users, privacy and safety assurance. It is designed to be used in the post-deployment stage to control the robot. The local UI includes a smartphone based mobile user interface which is always easily reachable; it also enables human motion sensing which issues simple commands based on local user gestures.
- **UI for Private Remote Operator** is a multi-touch tablet based mobile user interface which is always available. Interaction between a private care giver and SRS takes place through this interface only. Targeted to private care givers such as family members, the focus of the UI is on issuing high level control commands to control the behaviour of the robot.
- **UI for Professional Remote Operator** focuses on functionality and high-fidelity input/output systems; it is to be used in the deployment and post-deployment stage for the teaching and learning of a new environment. It provides full implementation of the SRS remote control for professional users.

Figure 8. 3D visualisation as a base of UI for professional remote operators such as 24 hours teleoperators

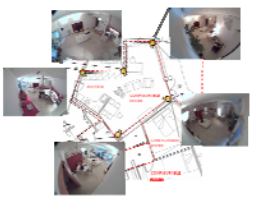

Figure 9. SRS testing site in Milan

The SRS solution will be tested and validated in real-life contexts in terms of significance for the target audience, technical functioning, and effectiveness in meeting the user needs, usability, cost-effectiveness and ethical implications. Real user tests will be arranged in a rented flat in Stuttgart, at the “S.Maria Nascente” Centre in Milano and at the IZA Care Center in San Sebastián.

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