

The Development of a Semi-Autonomous Framework for Personal Assistant Robots - SRS Project

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ABSTRACT

SRS is a European research project for building robust personal assistant robots using ROS (Robotic Operating System) and Care-O-bot (COB) 3 as the demonstration platform. A semi-autonomous framework has been developed in the project. It consists of an autonomous control structure and user interfaces that support the semi-autonomous operation. The control structure is divided into two parts. First, it has an automatic task planner, which initialises actions on the symbolic level. The planner produces proactive robotic behaviours based on updated semantic knowledge. Second, it has an action executive for coordination actions at the level of sensing and actuation. The executive produces reactive behaviours in well-defined domains. The two parts are integrated by fuzzy logic based symbolic grounding. As a whole, they represent the framework for autonomous control. Based on the framework, SRS user interfaces are integrated on top of COB's existing capabilities to enable robust fetch and carry in unstructured environments.

Keywords: Automatic Task Planner; Care-O-Bot (COB) 3, Personal Assistant Robots, Robotic Operating System (ROS), Semantic Knowledge, Semi-Autonomous

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INTRODUCTION

SRS is a European research project for building robust personal assistant robots using ROS (Robotic Operating System) and Care-O-bot (COB) 3 as the initial demonstration platform. SRS is 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 caregivers. In this case, adult children or caregivers can help them remotely and physically with tasks such as fetching medication or checking around the house as if the children or caregivers were resident at home. This article is expanded from an early article published by Qiu et al. (2012) during the project development period.

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 (Graf et al., 2009). The SRS R&D has been focused on an autonomous robot control structure and human-robot interaction for more robust robot operation. 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. To support the framework, user interfaces will enable the SRS solution to be accessed by average users in real life settings (See Figure 1).

It goes beyond the architecture presented in Qiu et al. (2012) and Bohren et al. (2011) by prototyping an improved and integrated task planning and coordination system for unstructured environments. The proposed framework is validated and tested using ROS (Robotic Operating System) (Quigley et al., 2009).

For an autonomous control framework to operate in unstructured environments, there are two major challenges that must be overcome:

1. The first challenge is how to handle uncertainties in the unstructured environment. Autonomous systems require a well-defined strategy for coordination. The well-defined strategy is only available when the environment is structured. Borrowing the idea of local linearization from nonlinear systems, a possible workaround could be achieved through estimating a

Figure 1. Care-O-bot 3 testing for SRS in a home environment



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