The DESIRE Service Robotics Initiative

Paul G. Plöger, Kai Pervölz, Christoph Mies,
Patrick Eyerich, Michael Brenner, Bernhard Nebel

We present some advanced hardware units and an appropriate component based SW architecture for DESIRE. As an example we describe the integration of an enhanced AI task planner which allows for higher flexibility and dependability during complex task execution.

1 Introduction

In 2006 a consortium of twelve German partners -including some leading providers of industrial robotic technology components (RTCs)- teamed up with some research institutes and universities to work on a joint publicly funded four year project called DESIRE. It is focused on service robots, which shall offer their services under unconstrained conditions in immediate proximity of users in everyday situations. The dedicated goal was to address the extraordinary high demands on functional competence ("capability"), reliability ("dependability") and an acceptable price ("affordability").

In this article we focus on the open issues of defining a suitable software architectural framework on one hand in combination to the use of an advanced planer to cope with the high complexity demands of service robotics on the other. We report on the current status of the DESIRE work, especially the architecture and the planer component.

For the architecture side it is a widely accepted fact that in the large a major revision of the methods and technologies currently used for the implementation of robotic software is called for. Like in many other areas the construction of robot control software should focus more on the deployment of common off-the-shelf software and components in combination with a conceptually clean integration of them. This topic has drawn major attention of a large number of researchers [1], conference sessions and workshops and also some major organizations initiated and funded respective activities [7]. The issues are much under debate and far from being settled.

The integration of a task planner into an autonomous robot increases the robot's level of intelligence and flexibility by altering the way the robot is controlled, moving away from predefined sequences of detailed user instructions to a more sophisticated target oriented approach. It is not longer required to provide the robot with a fully worked out description of its task (e.g., "Go to the big table, take the plate, come back to me an give the plate to me!") but rather to state some declarative targets (e.g., "Give me the plate!") and leave it to the robot to find a suitable way to achieve them on its own. Accordingly, planning can be understood as reasoning on a human level of abstraction.

Task planning itself is a thoroughly investigated subfield in artificial intelligence [3]. However, in a robotics context, one has to deal with aspects complicating the application of task planning, some of which are: Imperfect knowledge of the surroundings, non deterministic changes, and user interaction. One of the main goals of this project, as far as the planning part is concerned, is to make task planning more suitable for everyday use in a robotics context.

The remainder of this article is structured as follows. The section 2, which gives some general aspects of the overall project, is followed by two sections dealing with deduction of architectural requirements from the given hardware components and how we define the architecture of so called *Autonomous Robotic Components (ARC)* to address the special needs induced by this approach. This is followed by section 4 which describes the use of an advanced planner which is aggressively used and thus builds an important improvement in the technology demonstrator. We close with some remarks on lessons learned in the penultimate section 5.

2 DESIRE Overview

DESIRE is an acronym for "Deutsche Servicerobotik Initiative". As such it is a collaborative research project funded by the German Federal Ministry of Education and Research (BMBF). The main objective is to deliver those key functions and components in hardware and software which will achieve a technological leap towards the use of service robots in everyday scenarios. Project activities have been grouped into three action-lines namely the creation of a reference architecture for mobile manipulation, the promotion the convergence of technologies through integration into one common technology platform and finally pre-competition research for new products to enable technology transfer into start-up enterprises in the field of service robotics.

The consortium is composed of 14 partners, four of which are research institutes, three universities and three larger and four small and medium sized enterprises. Some partners take a lead in respective work packages, see Table 1, where ALU abbreviates "Albert Ludwigs University" and FHG "Fraunhofer e.V.". For all detailed names and contact informations please refer to the project website [4]. Since the overall project scope is very wide and the number of partners is large we can only give a more detailed account on the architectural and the task planning aspects in sections 3 and 4. Other areas of research are briefly sketched in the following three subsections.