A TOOL-CHAIN FOR DEPLOYING COMPONENT-BASED APPLICATIONS ON COMPLEX SERVICE ROBOTS

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Overview

- Motivation
- Concept Deployment Tool-chain
- Realisation
- Conclusion
Motivation

Intention: Update, Configure and Launch Application

(Purchase and download)

Automatic Deployment

Smartphone
With multiple different hardware components

(Non-Expert) End User
(without technical expertise)
Motivation

Intention: Update, Configure and Launch Application

(Non-Expert) End User
(without expertise in robotics and individual software components)

System Integrator/
Hardware Expert

Component Developers

Application Developer

Robot with fully developed application

update Components from Repository
And install correctly on robot
Configure and Launch Application

Configure Components
Problem Statement: Application Deployment in Robotics

- **Intensive Integration** through reuse of existing software and hardware components with **high interdependencies**

- Largely **missing interface standards** (e.g. robot manipulators) and thus difficult hardware abstraction

- Service robots often need to be deployed in open and unstructured environments
  - **high configuration and coordination efforts** (including error handling) of single software components

- Computing architecture mostly consists of a **distributed system** inteconnecting to the different hardware components, which provides **boundery conditions for application deployment**

  - For the **reuse, configuration and deployment** of existing software components often a **large expertise in robotics is required**,

  - **no separation of roles**
Contribution

What is already there?

- tool support for the development of components and component-based applications (e.g. MDE) without deployment and runtime support
- Specific tele-operation and -diagnosis tools for non-develomental components without deployment support
- PR2 remote lab (tied to middleware ROS and without deployment support)

Contribution of this work

Develop Toolchain to support *post-development* activities:

- support the deployment of service robot applications developed in distributed and heterogeneous teams
- provide assistance for runtime activities on an abstract level independent from middleware
Concept Deployment Tools: Planning and Installation

- Deployment planning based on application and domain model
- Separation of roles: application developer and system integrator
- Tools independent from middleware
Concept Runtime Tools: Configuration and Activation
Webportal Client/Server Structure

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Deployment Planning Plugin

- Application Model with requirements
- Host Model with resources

- Planner determines number of valid deployments
- Display of resource usage
Runtime Environment Plugin: Activation and Monitoring

- Components are installed according to Deployment Plan
- Abstract Configuration and Activation without direct login into the target hosts
Runtime Environment Plugin: Configuration

Component "SDH Gripper"

- Control Panel
  - Run SDH Gripper
  - Parameters for SDH Gripper
  - ShowLog

Description: SDH Gripper » SCHUNK Dextrous Hand

- Add Field

**sdhdevicetype**: PCAN

**sdhdevicestring**: /dev/pcan0

**dsddevicestring**: /dev/ttyTact

**baudrate**: 1000000

**OperationMode**: position

**frequency**: 5
The DESIRE Project
- Large joint research project with 14 partners
- One common integration platform
- Before the introduction of the webportal, integration activities took a large part of the development efforts
- Integration tests of single components mostly required a large part of the consortium

Evaluation of Webportal
- Introduction of webportal in project month 36
- Spatial and temporal decoupling of integration activities
- Integration tests could be conducted by single developers

Reference: (1) in publication list
Summary and Outlook

Summary:
- **Deployment Tool-chain**, independent from underlying middleware
- **Runtime Environment** for configuration and activation of components and applications on service robots

Results:
- **Spacial and temporal decoupling** of integration and deployment activities
- **Abstraction** and thus simplification for **service robot employment**
- **Improvement of separation of roles** through role specific tools

Outlook
- More **detailed DSL** for robotics, requiring standarized hardware interfaces
- Deeper **validation of application deployments** on robot systems (e.g. taking work space and sensor ranges into account)
- More **specific functionality** in the webportal for different **middlewares** (e.g. automated installation, configuration and activation scripts)
Relevant Publications


