Application Development with ROS

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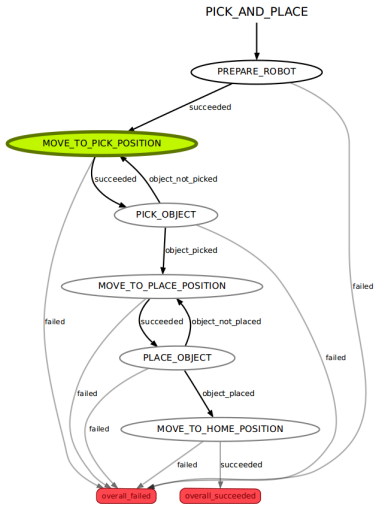
Technology Seminar – ROS in Industrial Applications



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Application Development with ROS
Goals

- Learn about how to develop an application in ROS
  - System integration
  - Application setup
  - Task specific configuration
  - Application execution monitoring
- Learn about the hardware independence in ROS
  - Hardware independent application development
  - Developing an application in simulation
  - Transfer application from simulation to real hardware
  - Running same application on different hardware setups

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Application Development with ROS
A pick and place application

- Task: Pick an object from a pre-defined source location and place it on a pre-defined target location
- For creating such an application we need:
  - An manipulator with attached gripper (real hardware or equivalent in simulation)
  - Software interfaces to move the manipulator and open and close the gripper
  - Configuration to specify source and target locations
  - Coordinator component defining task execution

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Application Development with ROS
A hardware independent pick and place application with ROS components

- ROS provides an hardware abstraction level through standardized ROS APIs (topics, services and actions)
- ROS provides a state-machine based task-level architecture for creating complex robot applications called SMACH
  - StateMachine, concurrent, sequence and iterator containers
  - Wrapper container for any ROS action
  - Configuration of states through ROS parameters
  - Runtime execution monitoring
  - Implemented in Python
- Process for using SMACH for task coordination:

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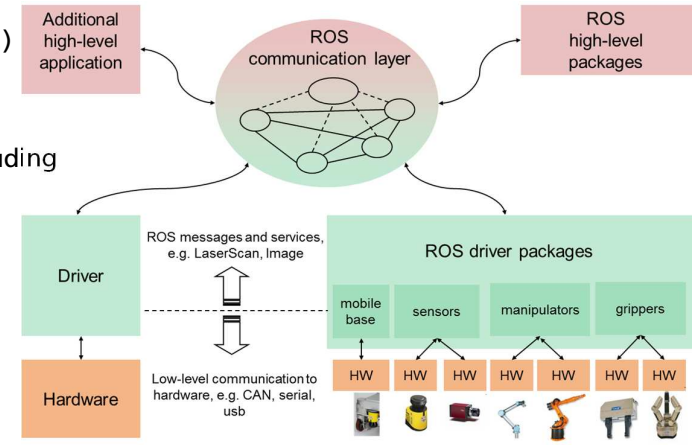
Application Development with ROS
Hardware abstraction

- Creating a system launch file including
  - All drivers (manipulator, gripper)
  - All high-level components (MoveIt!)
  - Offers standardized ROS interfaces (Topics, Services, Actions)
- Creating a application launch file including
  - Uploading parameters
  - Starting up application



Integrated hardware abstraction → Create states and state machines → Configure state machine → Run and monitor execution

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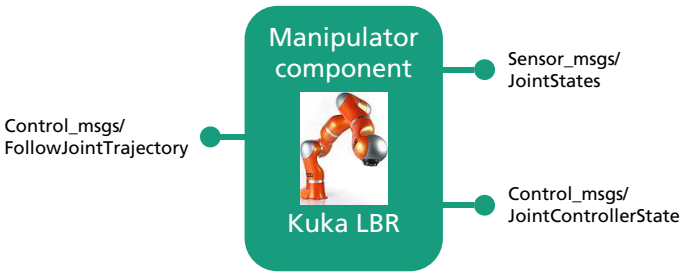
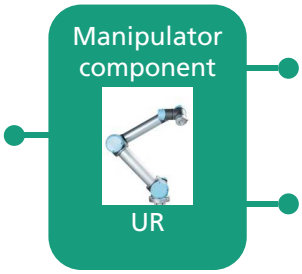
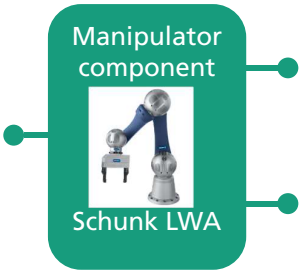
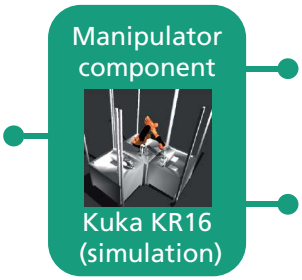
Hardware abstraction

- Standard interfaces, e.g. for manipulator component (real and simulation)









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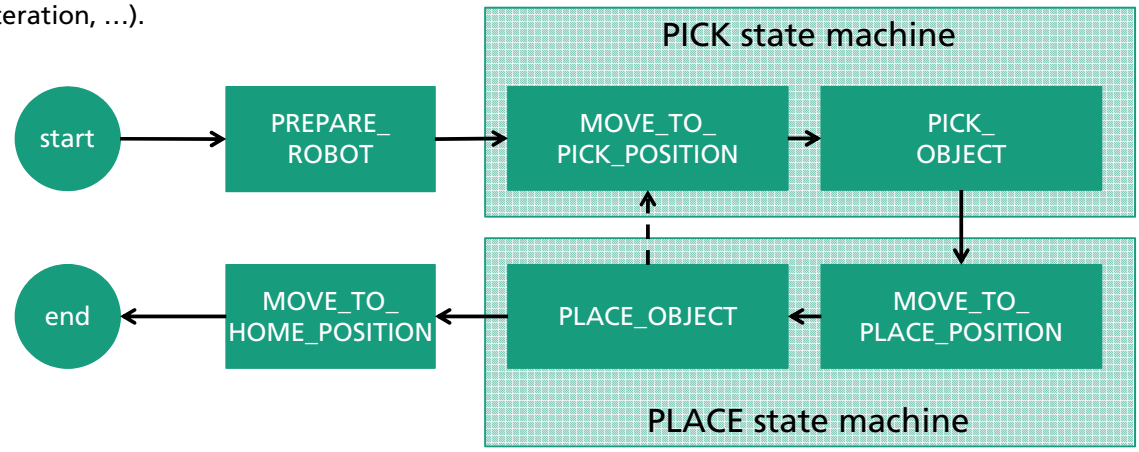
Application Development with ROS
Creating states and state machines

- Each state has transitions to link to following states .
- States are executed in containers. Containers define the execution behavior (e.g. concurrency, iteration, …).



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Application Development with ROS
Configuration

- Configuration needed for
  - Source location (Pose6D)
  - Target location (Pose6D)
- Configuration can be done through ROS parameter server
  - Uploading parameters in launch file
  - Uploading parameters through yaml file

Integrated hardware abstraction | Create states and state machines | Configure state machine | Run and monitor execution

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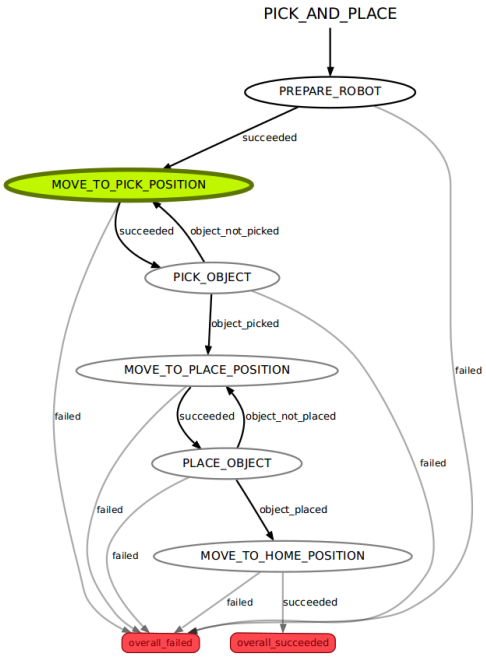
Application Development with ROS
Execution monitoring

- Running the application by starting the Python script for the state machine
- SMACH offers a graphical tool for
  - Visualizing states and transitions
  - Monitor current state of execution



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Application Development with ROS
Summary

- ROS includes state-machine based task-level programming
  - SMACH: http://wiki.ros.org/smach
  - SMACH_viewer: http://wiki.ros.org/smach_viewer
- Separation of hardware driver layer, capability layer and application layer with hardware abstraction through standardized ROS interfaces
- More detailed documentation about standard interfaces can be found at
  - Sensor_msgs: http://wiki.ros.org/sensor_msgs
  - Geometry_msgs: http://wiki.ros.org/geometry_msgs
  - Trajectory_msgs: http://wiki.ros.org/trajectory_msgs
  - Control_msgs: http://wiki.ros.org/control_msgs

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Application Development with ROS
Your ROS application expert

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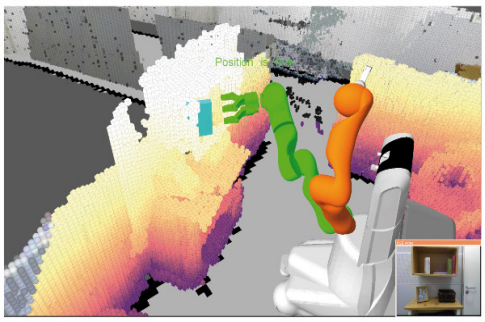
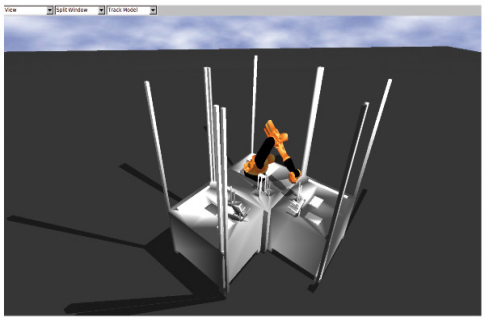
ROS IN DER INDUSTRIELLEN ANWENDUNG



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