The LUH-Bots RoboCup@Work 2013 Team Description Paper

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1 Introduction

The LUH-Bots team has been founded in 2012 consisting of Diploma, Bachelor and Master Students of the faculty of mechanical engineering at the Leibniz Universität Hannover. Some of the team members have participated in the research inspired practical lecture RobotChallenge. Others started working on the robot in the context of various research projects. RoboCup@work is an opportunity for us to combine and extend the knowledge we gained from the work each one of us put into the lecture or his or her individual research topic.

Over the last year we accomplished tasks such as:

- remote control of the robot utilizing a space navigator with smart collision detection, based on the laser sensor
- basic object recognition by means of color, shape and features
- simple localization in a rectangular, known area, which is established by image processing of laser sensor data
- manipulation of simple objects (e.g. balls, cubes) and more complex objects such as bottles
- localization and mapping on the basis of particle filters
- motion planning considering static and dynamic obstacles
- autonomous object manipulation in known areas

A demonstrative example of the accomplishments is the application of the last challenge of the above mentioned lecture. The task was to map an arena containing two ball storages and a ball pool with a SLAM algorithm. Both robots were subsequently placed into the same arena having the task of collecting as much balls as possible form the pool and place them in the respective storage. It was also allowed to withdraw balls from the opposing ball storage. Therefore, the robots had to navigate autonomously in the same area without colliding with the static walls and unanticipated obstacles e.g. the second robot. They needed to localize themselves, detect balls and perform the required movement of the mobile platform and manipulator in order to accomplish the task.

2. The Robot Platform

Our two robots, Max and Moritz, are based on the mobile robot KUKA youBot. Each robot consists of a platform with four omnidirectional wheels and five degrees of freedom (DoF) manipulator with an attached one DoF Gripper. They are equipped with a commercial laser range finder (hokuyo urg-04lx-ug01) at the platform's front and a webcam mounted to the wrist of each manipulator (fig. 2.1). We

plan to use a time of flight camera for 3D object recognition for the RoboCup. In addition, the robot is equipped with an emergency stop system, allowing for keeping the platform and the manipulator in the actual pose when activated by remote or onboard button.

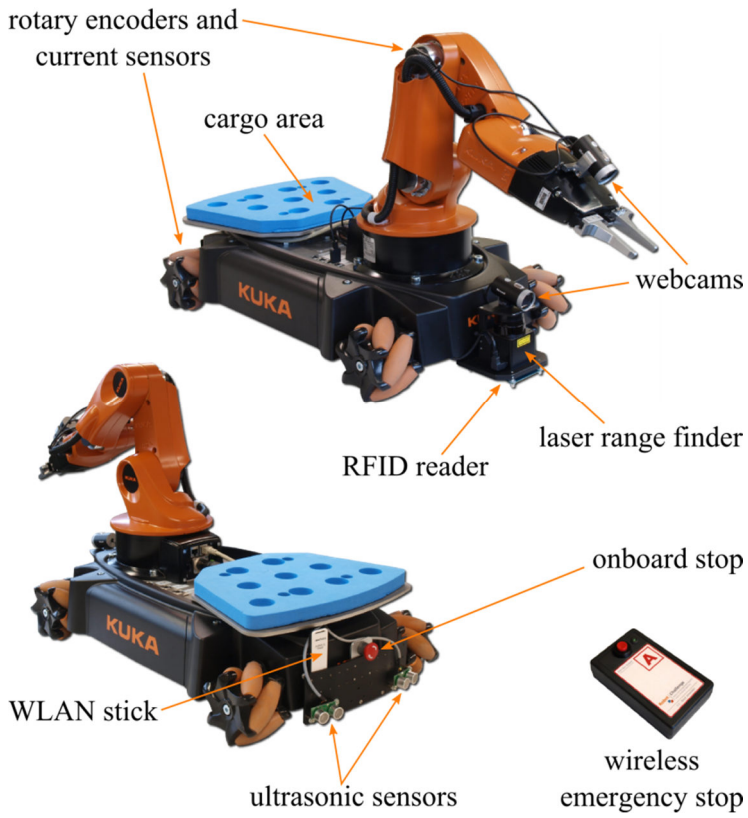

Fig. 2.1: Modified KUKA youBot equipped with additional sensors; the rotary encoders and current sensors are only shown exemplarily for two actuators

3. Software

ROS in combination with the Linux distribution Ubuntu is used as software platform. Image processing is accomplished utilizing OpenCV.

4. Targets and Goals

The current research focuses on the following topics:

- mobile manipulation, handling of complex objects based on 2D and 3D sensors
- interaction and cooperation between robotic systems
- intelligent logistics systems
- iterative learning during object manipulation
- human-machine-interaction, especially intuitive control of the manipulator by the user based on a 3D sensor

5. Videos

http://www.imes.uni-hannover.de/172.html?&L=1