WF Wolves @Work Team Description RoboCup 2014

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Abstract. This paper details the current state of the hardware and software design of the WF Wolves robot, used for the @Work demonstration in 2014. The development for this competition started in 2011. The platform used is a youBot. The Robot was equipped with additional sensors for enhanced sensoric capability. The current state of the robot, research topics and current projects will be presented in this paper.

1 Introduction

Industrial working with robots imposes a series of challenges. It involves developing solutions for navigating through various environments. Creating a sensor system which is capable to precisely detect a wide rage of objects of different sizes and simulating environments to assure the robot will work proper in various environments. Most of our work is simulation based, because our time spent working on an actual robot was limited. The "WF Wolves" RoboCup Team has been participating in international RoboCup since the year 2007 and in a number of national and international robotic events. In 2008 and 2010 the WF Wolves won the world championship in the Mixed Reality League. Developing a sensor system which enable numerous industrial applications is the challenge presented, the approaches used by the WF Wolves will be explained in the following sections.

2 Research Overview

This section describes the main research and development objectives. The current Research focusses on Simulation. Simulation is an important part in the development of many robotic systems. Machine learning is a powerful tool in improving robotic performance. Because of this it is important to have a simulation environment which simulates the robot as realistic as possible. Improving the accuracy of the simulation is one of the major goals.

3 Hardware

3.1 KUKA youBot

As a hardware platform the WF Wolves use the youBot platform from KuKa. The major benefits over other robots which would be suitable are the omnidirectional platform which allows a high agility and gives the advantage manoeuvring in small space or approaching a target. The EtherCat based communication allows for a very flexible system which is easily extended to fit more difficult tasks. The manipulator it self uses proven technology and therefore is very likely to full fill all manipulation tasks specified in the rules of 2012 or following years.

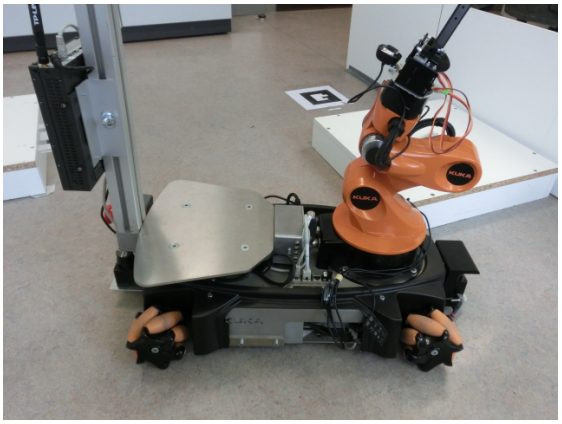

Fig. 1. Current State of our youBot platform

3.2 Modifications

The sensor and computation capabilities of the youBot platform are very limited, to get all the necessary data to perform the demanded tasks some additions had to be made.

Additional Computer Due to the limited computation power of the integrated industrial computer inside of the youBot's chassis we had to extend this capabilities by changing the existing computer to a more powerful one, like other teams did this already. Or we take advantage of the network based infrastructure of the ROS-Framework. Allowing for possible cooling problems of bigger computer inside of the youBot's chassis we decided to add an additional computer to the back of the youBot. At this position we can guarantee a sufficient cooling even for the biggest Intel CPUs available in this form factor. While combining these two systems we are able to increase the map size and it's resolution for the navigation algorithms used for by our navigation stack.

Laser Scanners Laser scanners are highly reliable for localisation and navigation. The provide accurate data of possible obstacles and therefore improve the capability of the robot to move without collision in an unknown area. The Model "Hokuyo URG-04LX" is used in the Robot, because of its overall performance. Its measuring area reaches from 0.06m to 4.095m with an angle of 240. It also does scans on a 10Hz resolution what will give us up-to-data data about our environment. The scanners are positioned at the front and at the end of the robot to have a good coverage of the surrounding area. Allowing the Robot to move in any direction without the risk of collision.

Arm Cameras The robot is also equipped with two arm cameras. These cameras are used to inspect objects dynamically. This is needed due the high noise of the kinect deepth-sensor. Because of the limited payload of the arm the camera which fits our needs the best is a Microsoft Live HD 3000. With a resolution of 1280x720, a framerate of 30fps and a weight of 89.9 grams is this camera capable to provide the quality of images we need for image-processing without picking up to much of the available payload. The Live HD 3000 is also full video4linux compatible which enables us to adjust the camera parameters during the runtime without the need of proprietary drivers.

4 Mentionable software besides the ROS-Framework

4.1 Vision and object grasping

Our approach of detecting objects in it's service areas is based on processing different channels of the obtained images. With this method we are able to distinguish between the service area itself and the objects with a very high success rate. After detecting the objects, their properties are identified and based on this information we can determine the kind of the object with a bayes network used for the decision making. The state machine which is used to grasp the objects based on the object detection of our vision uses a closed loop approach. The relative position of the object is tracked after every move of the arm to ensure a collision free and precise grasping.

5 Conclusion

The main advances of the WF Wolves @Work team for 2014 are the improved abilities using ROS and SMACH for a modular architecture of our robot control software. With our elaborated sensor model we will be able to pass the contests on a high level due a very precise world model and object recognition. The team WF Wolves is looking forward to participate in the RoboCup 2014 in Brazil. We will be happy to provide a team member as referee or operator.