WF Wolves @Work Team Description RoboCup 2013

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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 2013. 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 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.

3.2 Modifications

The sensor capacities of the YouBot platform are limited, to get all the necessary data to perform all tasks some additions had to be made.

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.

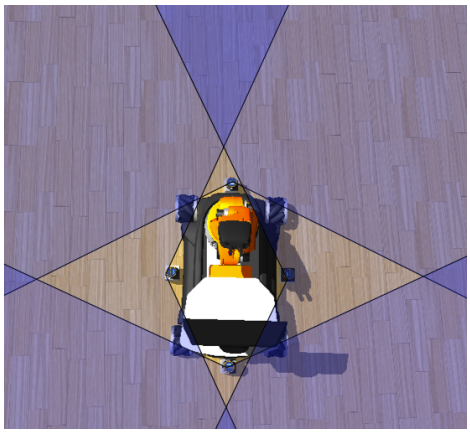

Fig. 1. Hokuyo URG-04LX

Kinect Computer Vision is the most important sensor, detecting markers, graspable objects and areas is of high importance for the robotic system. The great advantages of this system is the wide range of people currently using the Kinect and the big amount of frameworks and SDKs. The resolution of the depth-camera is 640x480px at 30fps with a 11-bit depth resolution which makes it to our preferred depth-camera. A color-camera with a resolution of 640x480px at 30fps with a 8-bit color resolution is also embedded. These characteristics fit our needs for image-processing.

Fig. 2. Kinect

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 Software

4.1 ROS

As control software the Robot Operating System by Willow Garage is used. With this powerful framework we was able to develop the whole communication between the actors and sensors within a very short amount of time. And there are even more reasons we decided us for ROS. Its blackboard architecture makes

it very easy for all parts of the robot to get informations about the whole system. Further Willow Garage is a very ambitious company which dedicates much resources to enhance the functions of ROS. The ROS community is very active and the modular architecture allows an excellent exchange of software. [1] [2]

4.2 Simulation

A major part of the development process is the simulation environment. The current approach is based on the Simulator WeBots. The simulation environment is designed to deliver as accurate results as possible without changing the control software. WeBots is the most suitable solution for our task because it is a well developed, highly customizable simulator which has also a big community. Furthermore there are several models of the YouBot and other robots in its basic configuration. So at the moment we use WeBots to get the artificial perceptions in our control software and work on that base. The Webots controller is designed as ROS Nodes, so the YouBot control software can be used without modifications.

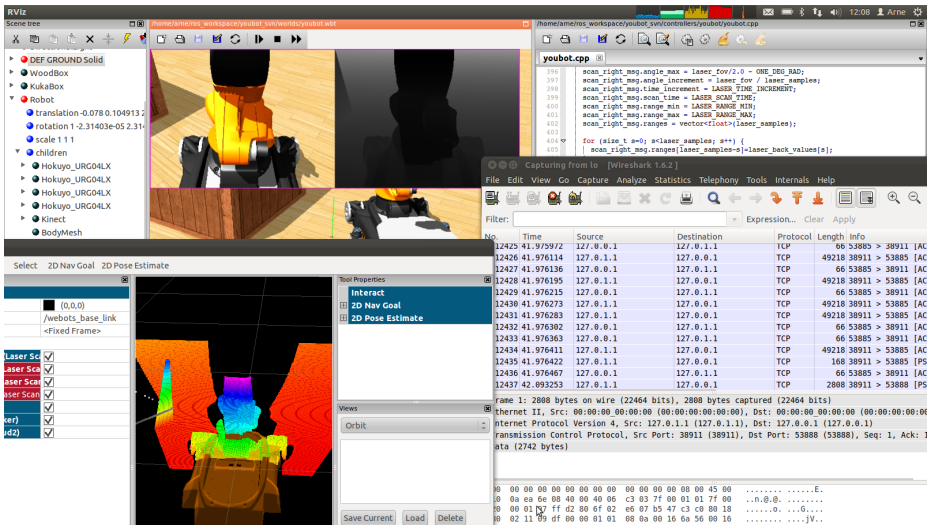

Fig. 3. WeBots Simulation Environment

4.3 SMACH

SMACH is used for modelling behaviour. With state-automatons it is much more clear how the decisions where made and changes can be done very easily. Another advantage is that through this clear decision making process it is possible

to create very complex behaviours. After using self developed state-chart frameworks and XABSL, SMACH is an improvement, it comes with out of the box visualisation and tools.

5 Conclusion

The main advances of the WF Wolves @Work team for 2013 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 very high level due a very precise world model. The team WF Wolves is looking forward to participate in the RoboCup GermanOpen 2013 in Mageburg. We will be happy to provide a team member as referee or operator.

References

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