EXPOSÉ

A Multi-Robot Platform for Mobil Robots with Multi-Agent Middleware

Sebastian Rockel

8rockel@informatik.uni-hamburg.de

December 9, 2010

Motivation

In robotics today, simple tasks still demand complex solutions.

~~In today's robotics still simple tasks require sophisticated and complex approaches to solve them~~. An important development has been ~~done~~ the use of ~~in~~ Multi-Robot-Systems (MRS) to provide high-level access to robot hardware [4, 3].

Although ~~As~~ such a platform provides transparent access to sensors and actuators ~~the difficult assignment to exercise a task~~ much difficulty still remains. ~~remains.~~ Typical tasks for a mobile robot require at least some sensors ~~like~~ such as a stereo vision camera, a robot arm or even a hand. To interconnect ~~that~~ these sensors

in software in a meaningful way is not ~~a~~ trivial~~, assignment~~ although device access itself might be simple.

To ~~conclude~~ even simple tasks ~~like~~ "grip that trash there", "open that door" ~~of~~ "find the pink one" can be assumed to be complex tasks. They can be solved ~~by one or a few~~ sophisticated and adapted robots, or multiple relative simple robots ~~which~~ coordinate ~~themselves~~. their activites.

As described in the next section, there are important advantages ~~of~~ in the latter approach. This ~~work is about providing a~~ project describes an MRS with an intelligent Multi-Agent-System (MAS) on top of it. A stable robot platform serves as base for a high-level service-oriented layer.

Goals

In the following subsections the advantages of a distributed MRS will be introduced.

I had trouble with this paragraph. Maybe what you wanted to say was: The platform shall be able to execute tasks of arbitrary complexity through the management of a dynamic and heterogeneous group of robots.

Task Flexibility

Tasks for robots can be ~~very~~ manifold. To address this, the robot platform shall be capable of accepting ~~versatile~~ tasks and ~~manage~~ of managing a dynamic~~al~~ and heterogeneous group of robots to solve them.

Do you mean homogeneous? I got the feeling that the robots would all be the same, but perhaps with differing sensors.

Scalability

~~The platform shall be enabled to be on-the-fly extendable by new robots as well as to overcome robot malfunction.~~

The platform shall be extendable "on the fly". For example it shall be able to accept additional robots or to replace malfunctioning robots.

Cost

This work assumes that a group of heterogeneous ~~and smaller~~ robots small,
is ~~mid- to long-term cheaper in maintenance~~ cheaper to maintain in the mid- to long-term than a few highly specialised ones.

Platform Flexibility

~~The later~~ Later, support for different MRS and MAS ~~shall~~ be prepared.

Scenarios

The scenarios are partly taken from the MAS Jadex [1]. They ~~shall~~ demonstrate the basic functionality of the platform and provide a template for other tasks. shall

Hunter and Prey (~~as~~ an ? extended Hide and Seek scenario)

Two or more robots look ~~out~~ for a~~n~~ hiding robot and try to catch it. The searching robots ~~shall~~ coordinate ~~to search more efficiently.~~ their search to increase efficiency.

Cleanerworld

two words?

Two or more robots ~~look out~~ ~~for~~ trash or special collect ly marked objects. ~~to be collected and put it or them to a trash can respectively a prepared place.~~ The robots ~~shall~~ coordinate ~~to~~ ~~efficiently~~ their search to cover the work area. efficiently.

~~An extension would be a second task to maintain the robot's battery life.~~ An example implementation is shown in figure 1.

As an extension, a second task could be to conserve/maintain? robot battery life.

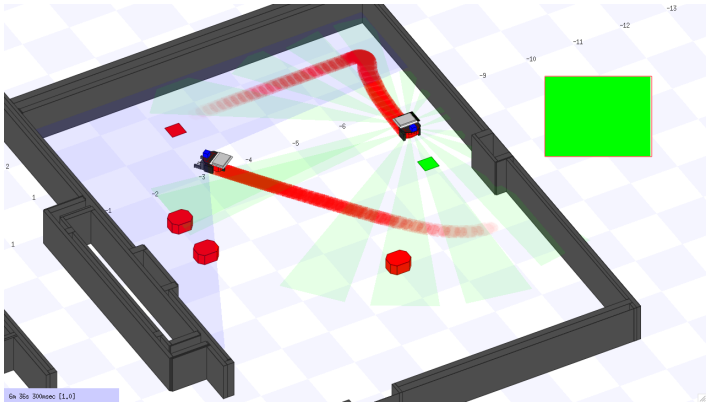

Fig. 1: Two mobile robots and another scenario. The ~~right one~~ is equipped with a camera to look ~~out~~ for certain colors and ~~the left one~~ has a gripper ~~attached~~ to collect ~~detected~~ objects. ~~Both working together to collect these objects.~~ Here in the simulator Stage [3].

robot on the right

robot on the left

detected.

?

Exploration

collaborate to

In this scenarios two or more robots ~~shall~~ explore unknown territory and to build a map ~~collaboratively.~~

Preliminary Work

In an earlier project

?

In the context of the student's project [2] the author ~~had the chance to~~ used the robot platform Player/Stage [3]. ~~As hardware served a Pioneer 2DX robot~~ (as can be seen at Fig. 2) with Sonar, Laser and an omni-directional camera on board.

A Pioneer 2DX robot with on-board sonar, laser, and omni-directional camera served as the hardware, ...

wall-following

sonar, laser and camera

With a wall follow exploration algorithm and the ~~fusion of the mentioned sensor~~ data its goal was to look ~~out~~ for a small pink ball in its ~~near~~ environment. Once detected ~~by the vision device~~ the robot heads towards the ball ~~position~~ while continuous ly tracking it.

Fig. 2: Pioneer robot used in practical student project. The mounted Laptop runs the control program and communicates via wireless. The (dismounted) laser ~~at the front top~~ can be seen on top of the robot and the fixed sonar sensors are visible too (where?).

The project provided practical ~~knowledge~~ experience with a robot platform and mobile robot hardware. ~~This will be exhaustively used~~ with that will be relied upon by this work.

Restrictions

This work will ~~deal with the combination of~~ combine a high level multi-agent ? with ~~and~~ a robot platform. Current technologies in MAS and Mobile Robotics will be used to achieve ~~high-level~~ a high degree of task flexibility.

~~There might be implemented specialized algorithms~~ Some specialized algorithms might be implemented, e.g. for robot control, but mostly out-of-the box drivers and interfaces ~~shall~~ will be used.

~~Especially~~ the MAS ~~shall be used and~~ is assumed to provide following features:

- Task description and definition

division and distribution

- Task ~~dividing and sharing~~ between agents
- Communication via (W)LAN between agents

The robot platform shall provide at least:

- Path planning
- Localization
- Collision avoidance
- Sensor and effector drivers (Laser, Gripper etc.)

Table of Contents

1 Introduction

2 State of the Art

2.1 Robot Platform

2.2 Multi-agent Platform

2.3 Middleware

3 Study and discussion

3.1 Prototype Implementation

3.2 Test Results

3.3 Future Enhancements

3.4 Outlook

References

[1] Jadex bdi agent system [online]. 2010. Available from: `http://sourceforge.net/projects/jadex/` [cited Wednesday, December 8, 2010].

[2] Master project 2009 at hamburg university [online]. 2010. Available from: `https://github.com/buzzer/Pioneer-Project-2009` [cited Wednesday, December 8, 2010].

[3] Player project [online]. 11 2010. Available from: http://playerstage.sourceforge.net/ [cited Wednesday, December 8, 2010].

[4] Ros - robot operating system [online]. 9 2010. Available from: http://www.ros.org/wiki/ [cited Wednesday, December 8, 2010].