EXPOSÉ

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

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December 9, 2010

Motivation

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

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

As described in the next section there are important advantages of the latter approach. This work is about providing a 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.

Task Flexibility

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

Scalability

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

Cost

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

Platform Flexibility

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

Scenarios

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

Hunter and Prey (as extended Hide and Seek scenario)

Two or more robots look out for an hiding robot and try to catch it. The searching robots shall coordinate to search more efficiently.

Cleanerworld

Two or more robots look out for trash or special marked objects to be collected and put it or them to a trash can respectively a prepared place. The robots shall coordinate to efficiently cover the work area. An extension would be a second task to maintain the robot's battery life. An example implementation is shown in figure 1.

Exploration

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

Preliminary Work

In the context of the student's project [2] the author had the chance to use 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.

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 tracking it.

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

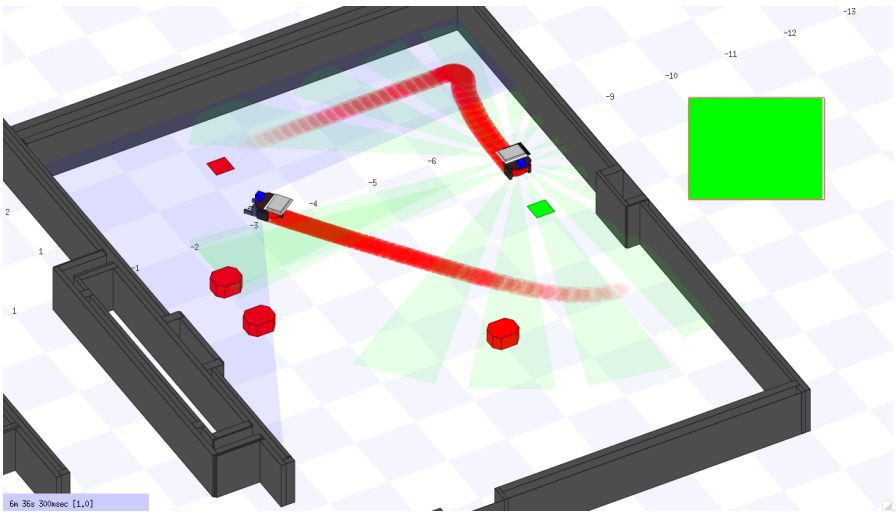

Fig. 1: Two mobile robots and another scenario. The right one is equipped with a camera to look out for certain colors and the left one has a gripper attached to collect detected objects. Both working together to collect these objects. Here in the simulator Stage [3].

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 and the fixed sonar sensors are visible too.

Restrictions

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

There might be implemented specialized algorithms, e.g. for robot control, but mostly out-of-the box drivers and interfaces shall be used. Especially the MAS shall be used and is assumed to provide following features:

- Task description and definition
- 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.)

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References

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