SocRob 2013
Hardware and Software Description

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1 Hardware

The omnidirectional robotic soccer platform currently used by the SocRob team, the OmniISocRob platform, was developed jointly between ISR/IST and the Portuguese SME IdMind. The following are the most relevant details regarding the capabilities of its actuators and sensors:

Actuators:

- Each of the robot's three Swedish wheels is actuated by a MAXON DC motor (model RE35/118776), through a MAXON gear (model 203118) with a reduction of 21:1, providing the robotic platform with a maximum translational speed of approximately 3.5 m/s and maximum rotational speed of 20 rad/s;
- In order to kick the ball, a linear electromagnetic solenoid is used to drive a plunger against the ball; Four 100V/22mF capacitors are used to store the energy needed to drive the plunger.

Sensors:

- The robot's vision system is based on an AVT Marlin F-033C firewire camera, which is equipped with a fisheye lens providing a field-of-view of 185°, facing downwards. This dioptric system endows the robot with omnidirectional vision, capable of detecting relevant objects (such as the ball and other robots) at a distance of up to 5 m. This particular setup is also less sensitive to vibrations caused by the robot's motion than the previously used catadioptric system;
- Each of the robot's motors is coupled to a 500 CPR encoder for motor control and odometry; Self-Localization is assisted by a magnetometer.
- Each of these components is powered by two packs of 12V 10Ah NiMH batteries per robot, wired in parallel.
- An accelerometer and a gyroscope are used as feedback for advanced movement behaviors.

In this robotic platform, the software architecture (which accounts for most of the required computational power) runs on a Sony VAIO VPCS135FA/B laptop, equipped with a Intel Core i3-370M CPU (2.40Ghz), 4Gb of RAM, and Nvidia Geforce 310M

graphics, which is connected to the robot's sensors and actuators through plug-and-play connections (USB and FireWire). An overview of the main components of this robotic platform is shown in Figure 1.

2 Software

The SocRob project is currently using MeRMaID[2] (Multiple-Robot Middleware for Intelligent Decision-making) as its functional software architecture. MeRMaID is organized in two layers. The functional architecture layer is for higher level components, providing an organization for the most important parts of the system. The support layer is a middleware interface which is no longer being used, having been replaced by the ROS[1] middleware.

The MeRMaID functional architecture possesses a modular structure, as shown in Figure 2. The main modules are Atlas, Wisdom and Cortex, each divided in sub-modules, implemented as one or more ROS nodes. The Atlas module is where the interaction with the world occurs. All direct sensing and acting activity is performed within Atlas, perceiving and producing effects on world. This module is the only one that is dependent on the hardware, the other two can be directly ported to different hardware. The Wisdom module is where the relevant information about the world, such as robot postures, ball position or current score, is managed. This information can be obtained either by sensor information or messages received from teammates or the referee box (through the Communication module). The World Info sub-module is not implemented using ROS nodes but a specific group of ROS topics. The Cortex is where the decision process takes place, based on information retrieved from the Wisdom module.

References

1. ROS Wiki. http://www.ros.org/wiki/.
2. BARBOSA, M., RAMOS, N., AND LIMA, P. Mermaid-Multiple-robot middleware for intelligent decision-making. In *Procs. of the IAV2007-6th IFAC Symposium on Intelligent Autonomous Vehicles* (2007).

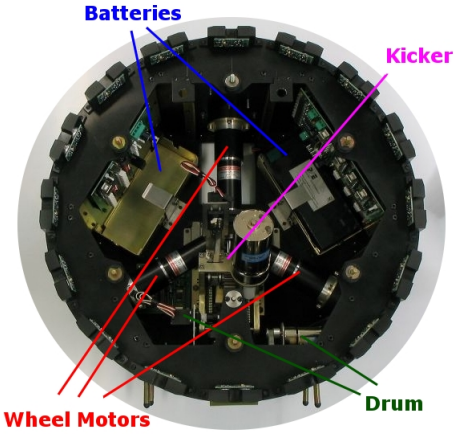

Fig. 1. Detailed view of the internal hardware of one of SocRob's robots.

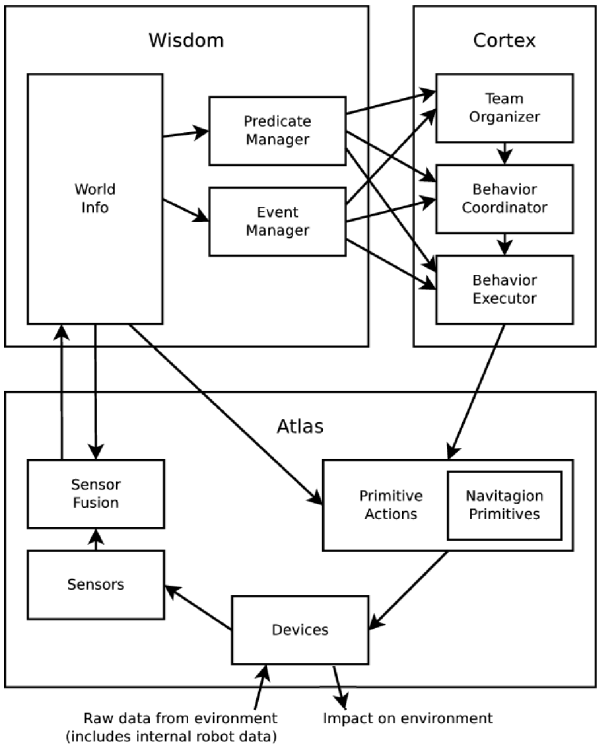

Fig. 2. Functional diagram of SocRob's middleware, MeRMaID.