ROBOTICA 2011

FESTIVAL NACIONAL DE ROBÓTICA

Competition

Rules and Technical Specifications

Robot@Factory

(January, the 7th, 2011)

Introduction

This competition aims to present a problem inspired on the deployment of autonomous mobile robots on a factory shop floor . One or more robots should be able to transport raw materials between warehouses or machines that process those materials.

The robots must collect, transport and position the materials, self localize and navigate while avoiding collisions with walls, obstacles and other robots.

All dimensions given herein, unless otherwise indicated, assume a tolerance of ±5%

The Robots

Dimensions

Each robot must, with the exception of the forks for transporting the parts, fitting into a rectangle 36 x 30 cm with a maximum of 30 cm in height. The robot must be completely autonomous and can not establish any kind of communication with an external system that is not explicitly provided by the organization.

The Shop floor

The competition area simulates a factory floor where there are warehouses and machinery. The maximum dimensions of this area are 3.5 x 2.5 m. There are eight machines available and two warehouses, one of which is used as the source of parts to be produced and the other is their final destination.

The Machines and the Warehouses

On each machine there is an area where the parts should be placed to be processed. It is the robot's responsibility the loading and unloading of the parts into the machines. After the part is placed on the machine it will be processed and during that time should not be withdrawn. An RGB LED indicates that the machine is able to accept parts (green light), the machine is processing a part (yellow light), the part inside the machine is already processed (white light) or that the machine is defective (flashing red light).

The Parts

The parts to be transported by the robots have standard dimensions, the width and length corresponding to a europallet with a scale of 1/10 (80 x 120 mm), its height will be between 30 mm and 50 mm. Each part has a RGB LED that emits a color that identifies the part type. When a part is put into a machine which is able to process it, after a time, due to the production process, the part changes color indicating that it was transformed in another part type. There will be a maximum of 3 different part types. Communication between the machines and materials will be done over an IR channel.

The Floor Markers

On the shop floor are white lines that can be used by the robots to find the way between warehouses and machinery. O course other guidance and localization schemes can be used by the teams. Four areas are set aside, near the corners of the "factory", where the teams can place their own markers to assist the robots in their localization or navigation. These areas are squares with 10 cm sides and the maximum height is 50 cm.

The Simulator

A full simulator of the competition environment is available for download from:

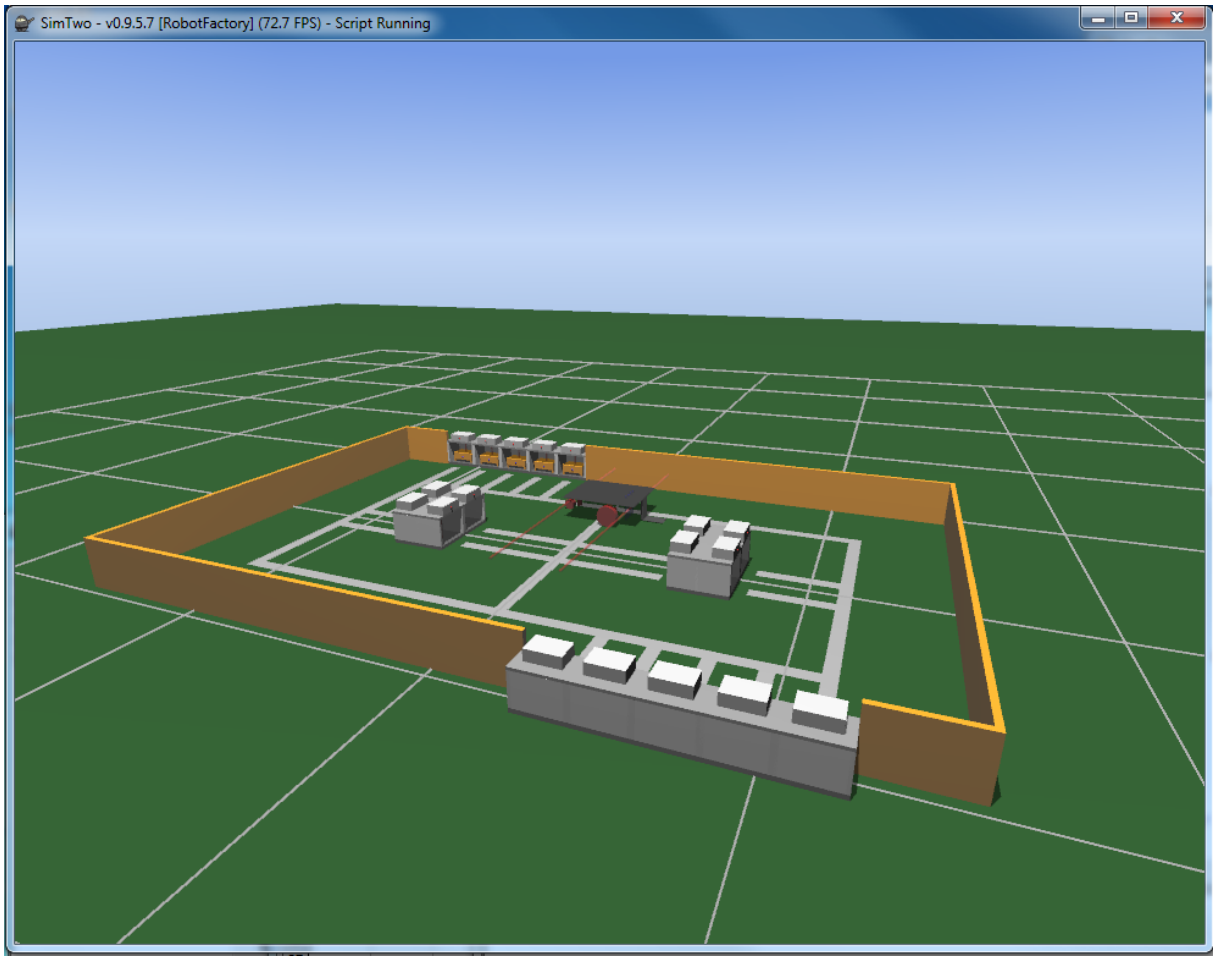
http://paginas.fe.up.pt/~paco/wiki/index.php?n=Main.SimTwo

or

http://feupload.fe.up.pt/get/4oHauz0COtj15dN

(here with a Lazarus communication example by UDP packets, inside the directory “RobotFactory”)

The simulator communicates by UDP packets and receives the motors velocities and sends the sensors values (see Pascal code: right click -> editor or Ctrl+E). It´s possible to change the number and the positions of the sensors and the whole robot (see xml file: right click -> scene or or Ctrl+S).



Competition

The competition is divided into three rounds, held on consecutive days.

There will be two competitions simultaneously. One for the teams who only use the lines of the floors, walls or other markers to locate and another for teams that use its own localization system. Each team will have 10 minutes to the initial tests and to make up to five trials.

For each trial the final score is the time to finish plus the additional time penalization.

The ranking will use this score where lower is better.

Time penalization:

Any shock between the robot and any wall, machine or another robot, will be penalized with 5 seconds.

Parts not removed from the incoming warehouse bring a 2 minute penalty

Parts that are not correctly placed on the final outgoing warehouse bring a 5minute penalty.

First round

In the first round the objective is just to collect the five parts from the incoming warehouse and transport them to the outgoing warehouse as fast as possible. The five parts will be already placed on the incoming warehouse, ready to be moved.

Second Round

In the second round, some parts present in the incoming warehouse should be placed in a machine for processing. Only after the completion of this operation can they be carried into the outgoing warehouse. A percentage of the parts are already processed and can be taken directly to the outgoing warehouse.

Third round

In the third round, some parts in the incoming warehouse should be placed sequentially in more than one machine to be completely processed. Only after the completion of this operation should they be carried into the outgoing warehouse. Because of this there will be three types of parts in play. During this round some obstacles may block partially or totally some corridors. In this round the teams can use two robots simultaneously.

Solving problems with the robot during the race

If at any time a team considers that the robot is in a situation which does not expect to be able to recover, the team may ask to stop the trial and access to the robot. This can be done up to four times during a round. During the intervention on the robot the time does not stop.

Closed Park

An hour before the start of each round the robots must be placed in the closed park, preventing teams from having access to the robot until 10 minutes before the start of their trial. At that time, which is signaled by the referees, the team can prepare the robot to start its trial.

Final Classification

The final classification is obtained by summing the final times for the three rounds. Less time is better.

Jury, Referee and time keeping

Jury

The jury is the maximum authority in the interpretation and application of the herein defined rules or in every deliberation regarding issues that may be missing from them. Its mission is to verify the compliance of the robots with these rules during technical verifications, and support the referee, during the competition, in their audit and enforcement.

Through its authority, the jury ensures justice in the application of rules and regulations.

Decisions of the jury board are final. Appeal from jury decisions is not possible.

The Jury is appointed by the Organizing Committee.

Referee

The referee ensures the correct application of the competition rules and gives permission, if necessary, for team members to enter the track area during the initial race tests. The referee may also stop the race test whenever necessary to dialog and consult the jury.

Regarding any issues that may be missing in these rules the referee must, in all cases, consult the jury.

The referee is appointed by the Organizing Committee.

Time keeping

Timing keeping is provided by an automatic integrated control system. This system includes two independent clocks: a time totalizer, responsible for measuring the time of the race test, and a time counter responsible for measuring the time of each trial.