RoboCup2004
Rescue Robot League Competition
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RoboCupRescue - Robot League Team SPQR, Italy

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Abstract. In this qualification material we describe the Hardware/Software characteristics of SPQR-Real Rescue team requested for the Lisbon 2004 Real Rescue competition.

Introduction

Our team comprises of two wheeled robots: Pioneer AT and Pioneer III of Active Media. Our objective for this competition is to perform the rescue mission by controlling the robots by using high level commands. In particular our robots will be able to autonomously localize and find the way inside the arena and signal the position of the victims. By using the high level commands one operator can to control both robots using a graphical interface. For this competition we intend to participate only in the Yellow and Orange arenas focusing on the robot semi-autonomy in the mission executions.

Team Members and Their Contributions

Sharham Bahadori	Human body detection
Giorgio Grisetti	Human Interface Development/Localization and Mapping
Alessandro Farinelli	Robots Coordination/Path Planning
Daniele Calisi	Path Planning
Censi Andrea	Localization and Mapping
Luca Iocchi	Team Coordinator
Daniele Nardi	Adviser

Operator Station Set-up and Break-Down (10 minutes)

The robots we will use for the rescue mission are two middle size wheeled robots (50, 60,20 cm for 10 kg) that are easily transported by operators or normal trolley.
For robots Control the operator will use a laptop with a wireless card (therefore easily transported).

Communications

We are currently using 802.11b wireless connection between robots and with the laptop of the operator. We are currently planning to acquire 802.11a wireless cards and

verify the compatibility of such devices with our OS (Linux RedHat 9.0) and we will probably use this new configuration for Lisbon.

Control Method and Human-Robot Interface

As human interface we will use a remote graphical console that is able to represent data coming from robots via a low band-width wireless connection.
The console will be able to send both high level commands to the robot (such as go to a specified position) through a graphical interface and to graphically represent the robot state and sensor readings. A compressed video streaming will be exported from the robot and visualized on the graphical console.

As for control strategies we are working in implementation a localization method that will allow the robots to navigate in the environment to the desired positions given by the operator automatically avoiding obstacles and finding their way through the arena.

We are studying the possibility of controlling only one robot at time while the other robot have to be able to use the information of the tele-operated robot to navigate semi-autonomously in the arena.

Map generation/printing

The map building process is fully passive and autonomous, while the victim locations in the map are added by sensory human body detection system, and the final metric map is provided in an electronic form.

Our approach for map building uses the output provided by the laser range finder, ultrasonic sensors, and integrates them by using dead reckoning.

The sonar input is used to discard the wrong laser readings (like the ones produced by mirrors or glasses) by validating a perception region around the robot.

The overall mapping algorithm works by collecting the last laser readings, and aligning them, through a scan match procedure, in order to improve the dead reckoning estimate. From such an estimate some statistical parameters are extracted and are used by a rao-blackwellized particle filter for tracking both the robot pose and the map estimates. Each particle in the filter represents a candidate robot pose and the resulting metric map is obtained by accumulating the laser readings in an occupancy grid. Each particle is then re-sampled according to the evidence provided the laser readings and the knowledge contained in the related maps, only the most feasible map hypotheses are shown to the operator.

Sensors for Navigation and Localization

We use the following sensors:

1. Stereo Cameras, located in front of the robot, that provide a visual feedback to the operator;
2. Laser/Infrared Range Finder and Ultrasonic, Sensors that provides the shape of the free space in front of the robot, and are used by the mapping process.
3. Dead Reckoning (encoder based), for locally tracking the robot pose.

Sensors for Victim Identification

For victim identification relay mainly on sensor the stereo vision system, this system is based on a shape based human body detection, the other sensors that we use for additional information about the victims are, thermal IR sensors, gas sensors, and acoustic.

Robot Locomotion
Both the robots we use have a wheeled locomotion, with a unicycle like cinematic model. Our plan is to enter the yellow and part of the orange arena, exploiting semi autonomous behaviors for the robots.

Team Training for Operation (Human Factors)
Our interface comprises only a remote GUI that is able to visualize information coming from robots and send command back.

Possibility for Practical Application to Real Disaster Site
We collaborate with ISA (Instituto Superiore Anti-incendio) of Rome to examine the possibility of using robotic agents in real rescue scenarios, to do so we prepared Rescue Arenas in the main site of ISA

System Cost
We use two mobile bases 10 K Euros and 8 K Euros for sensors and computational units.

RoboCup
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TRAVEL SUPPORT FORM

LEAGUE NAME:	RESCUE ROBOT LEAGUE
TEAM NAME:	SPQR
ORGANIZATION:	DIPARTIMENTO DI INFORMATICA E SISTEMISTICA UNIVERSITY LA SAPIENZA ROME
COUNTRY:	ITALY
CONTACT PERSON:	SHAHRAM BAHADORI
EMAIL:	BAHADORI@DIS.UNIROMA1.IT
TELEPHONE:	+39 06/49918477
NUMBER OF FACULTY:	1
NUMBER OF STUDENTS:	4
ESTIMATE YOUR TRAVEL ACCOMMODATION COSTS:	EUROS 3250.00
ESTIMATE YOUR TRAVEL SHIPPING COSTS:	EUROS 1000.00
HOW MUCH DOES YOUR TEAM REQUEST:	EUROS 2400.00

What is your justification for travel support?:

We request support for three students since we do not have specific funds covering their travel and registration expenses. 750 (team registration) + 150*3 (accodomadation) + 400*3 (travel) = 2400 euros

Have you ever participated in previous competitions? If so, note the year/event/league/result:

1998 RoboCup MSL Parigi quarter-finals
1999 RoboCup MSL Stockolm second place
2000 RoboCup European Amsterdam MSL second place
2000 Melbourne Round Robin
2001 Seattle Round Robin
2002 German Open quarter finals
2003 Rescue 7th place ?

In addition the competition referring to SPQR legged league is reported in the four legged league.

Do you have paper(s) submitted to the associated Symposium? If so, please note the title(s) and author(s):

Alessandro Farinelli, Giorgio Grisetti, Luca Iocchi
SPQR-RDK: a modular framework for programming mobile robots

Detail any sponsorship you have for participating in this event (either institutional grants or company support):

University of Rome La Sapienza

Add any other information concerning your team/research group that you consider relevant:

The team SPQR will participate also in the Four Legged League in Lisbon.
In addition our research group is very active in RoboCup since 1998 both in the preparation of teams in different leagues and in the organization of scientific events.