



Autonomous Robots

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Autonomy and Humans

Autonomy: ability to act without human direct control and guidance

Sometimes *autonomy* is considered not appropriate for robots in human society

Our thesis: autonomy is needed for introducing robots in everyday life



Case Studies / Argumentations

- Search and rescue in emergency scenarios
- Domestic environment
- Multiple robots



SIED Laboratory



SIED Mission:
Intelligent
Systems for
Emergency and
Civil Defense

Istituto Superiore Antincendi
School of
Italian Firemen Commands
ROMA



SIED Activities



Search & Rescue Robots



Agent-based simulation of emergency scenarios



Requirements for rescue robot

- 1) Return to initial position
- 2) Possible lack of communication
- 3) ...

Tasks

- Mapping
- Exploration
- Surveillance

Capabilities

- Explicit knowledge of map
- Autonomous navigation
- Victim detection




Focus: Mapping



Map unknown
SLAM
Cluttered env.

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Focus: Victim Detection



DOF of human body
Partly occluded
Ambiguous Appearance
Req: Position in the env
Aid: Sensor fusion

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Focus: Autonomous Exploration



Environment:
•Unknown
•Unstructured
•Risk for human

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Robotic Platform

Pioneer 3 ATX robot

- Frontal and rear sonar rings
- SICK and Hokuyo laser range finders
- Stereo cameras
- Non-touch thermo sensor
- Voice transmission system

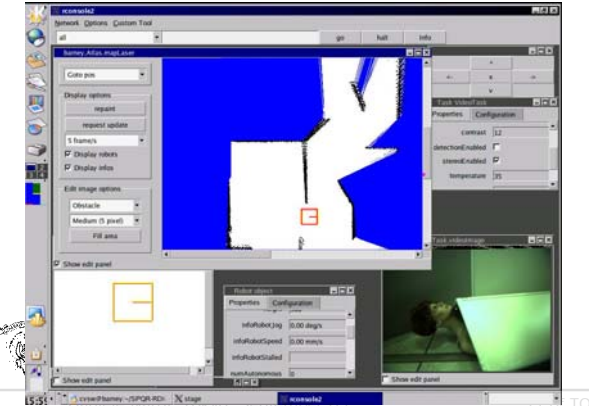
Controlled by 2 laptops

- Remote communication with operator's graphical interface
- Modular sw architecture, (C++ on GNU/Linux OS) used both with real robots and simulators (e.g. Stage).



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Graphical Interface



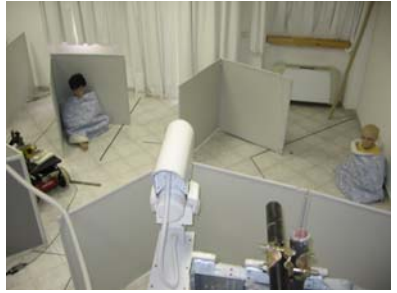
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RoboCup Rescue

Experimental set-up for search & rescue robots

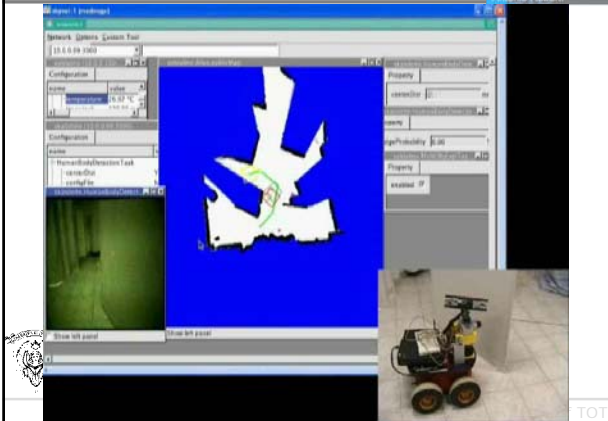
Yellow Arena
Autonomous (wheeled robots)
Focus on *autonomy*

Red Arena
Teleoperated robots
Focus on *mobility*



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Autonomous Search of Victims



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RoboCare: Robotics for the elderly



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A distributed system

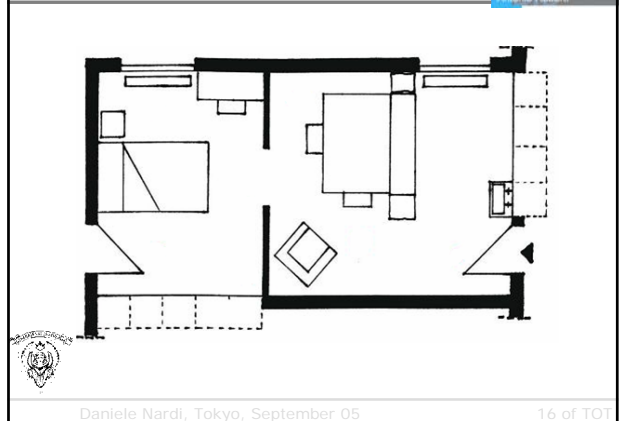
- Software Agents
- Robotic Agents
- Human Agents

All cooperate to provide services for human assistance

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Domestic Environment (ISTC-CNR)



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Some RoboCare Goals

- **Reminder** (“It’s the time for the suppository”)
- **Entertainment** (“Let’s have a chess game”)
- **Transport** (“Get me a coffee from the coffee machine”)
- **Check** (“Check the stove”)
- **Search** (“Look for Mr.Smith”)
- **Escort** (“Go for a walk with Mrs.Brown”)

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Simple action: Fetch



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AIBO following RoboCare robot

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Robot Soccer

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NO-MULTI-ROBOT games: WHY?

Cooperative Multi Robot Systems require
autonomy

In RoboCup a *team* of robots must cooperate in
playing soccer



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Cooperation in Robot Soccer

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Cooperation in task accomplishment

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Summary

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We have argued that *autonomy* is needed when
robots are required to interact with humans

Autonomous intelligent behaviour is still an
open challenge in several application domains



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Projects

"Sistemi di simulazione e robotici per l'intervento in scenari di emergenza", MIUR-PRIN, 2003-2005.

"Emergenze post terremoto: metodi, tecniche e strumenti di supporto", Scientific Cooperation Italy-Japan, MAE 2003-2006.

"A Multi-Agent System with Intelligent Fixed and Mobile Robotic Components", MIUR 2003-2006.



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RoboCup Camp 2005

Venue

Istituto Superiore Antincendi - Via del Commercio, 13 -
ROMA - Italy.

Dates

October 29th - November 2nd, 2005

Aims and Goals

The goal of the camp is to provide a methodological and
practical basis for the design and implementation of robotic
solutions for search and rescue (or their components) and
test their effectiveness in RoboCup rescue competition
scenarios.