



PoAReT

Rescue Simulation League

Politecnico di Milano

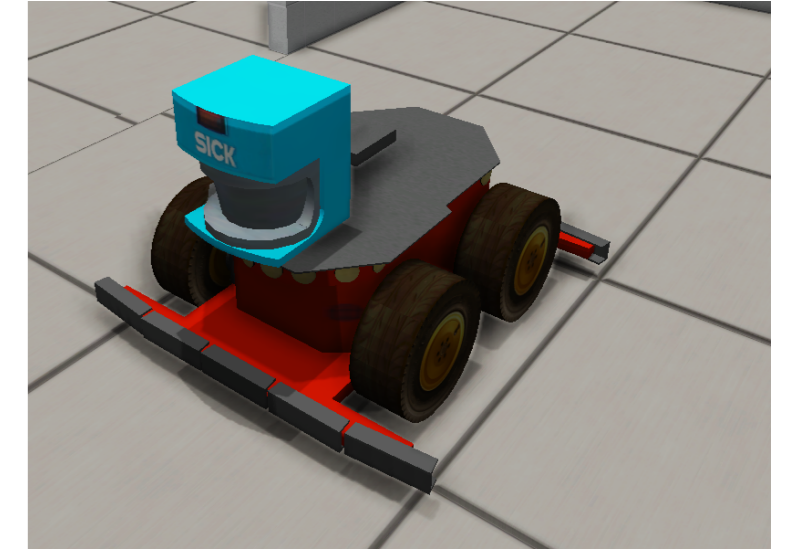
Francesco Amigoni, Alain Caltieri,
Riccardo Cipolleschi, Giovanni Conconi,

Michele Giusto, Matteo Luperto, Mladen Mazuran



Introduction

In developing PoAReT (Politecnico di Milano Autonomous Robotic Rescue Team), we tried to push along the *autonomy* axis. The PoAReT system is basically composed of P3AT mobile platforms, equipped with laser range finders, sonars, and cameras. Laser range finders are used to build a geometrical map of the environment that is represented with two sets of line segments, representing (the edges of) perceived *obstacles* and the *frontiers*, namely the boundaries between the known and unknown portions of the environment.



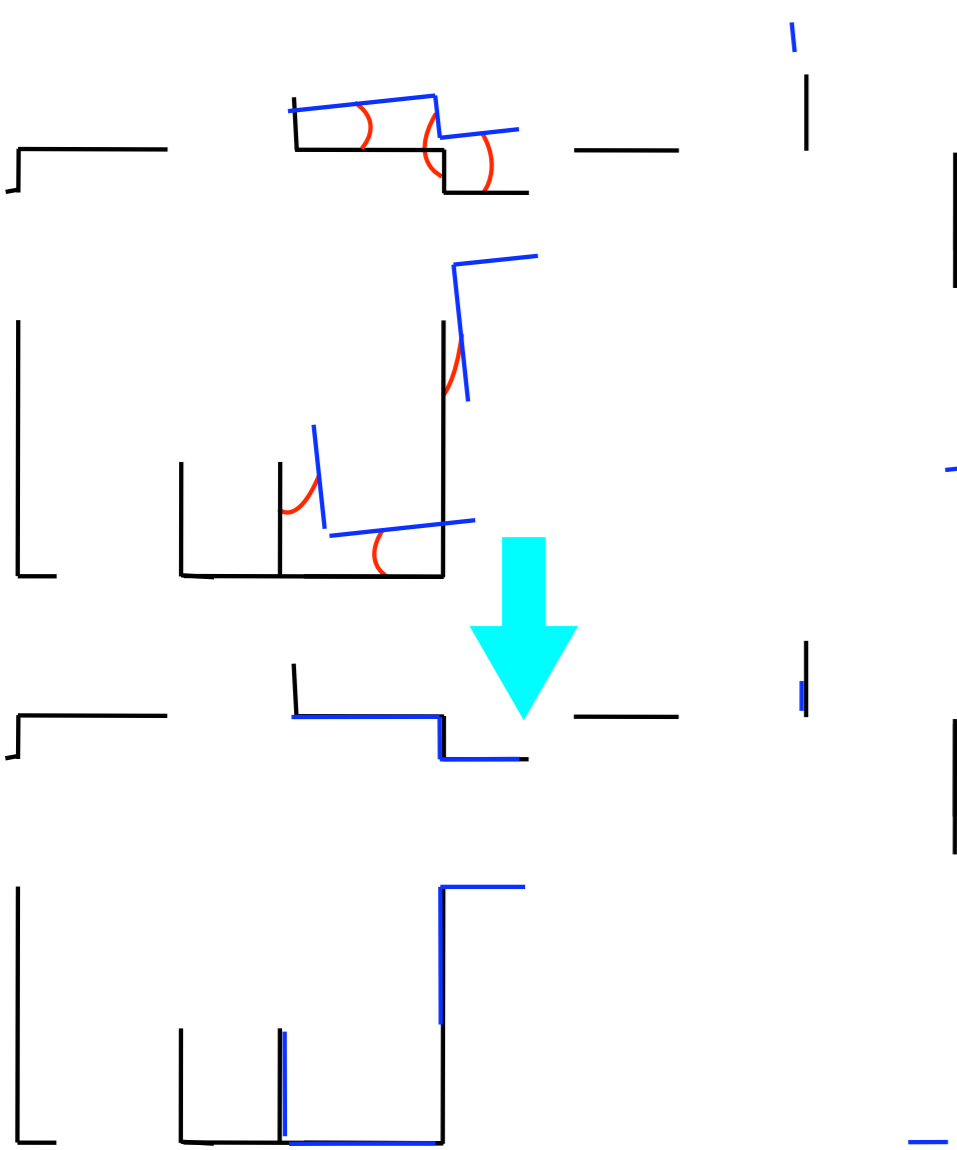
Overview

The main activities of the PoAReT system are: (a) building a geometrical map of the environment (SLAM), (b) selecting the most convenient frontiers to reach (exploration), (c) coordinating the allocation of robots to the frontiers, (d) maintaining a semantic map of the environment, (e) performing the detection of victims, and (f) managing the interaction with the human operator.

Exploration

- Frontiers are evaluated using the MCDM theoretical framework.
- Evaluation is based on several criteria, including information gain, distance of the frontier from the robot, battery consumption, and user suggestions.

SLAM



- Iterative closest line (ICL) scan matching.
- Singular geometries like corridors yield gross uncertainty along the tangential axis, but can be detected through singular value decomposition and handled with a probabilistic framework like a particle filter.

Coordination

- Market-based approach: auctions with minimum increment threshold to improve stability of assignments.

	Owned frontier	Minimum evaluation for interesting frontier	Frontier1	Frontier2	Frontier3	Frontier4	Frontier5
Robot1	31	34,1	21	23	63	11	55
Robot2	41	45,1	57	14	67	31	44
Robot3	15	16,5	88	27	54	22	7

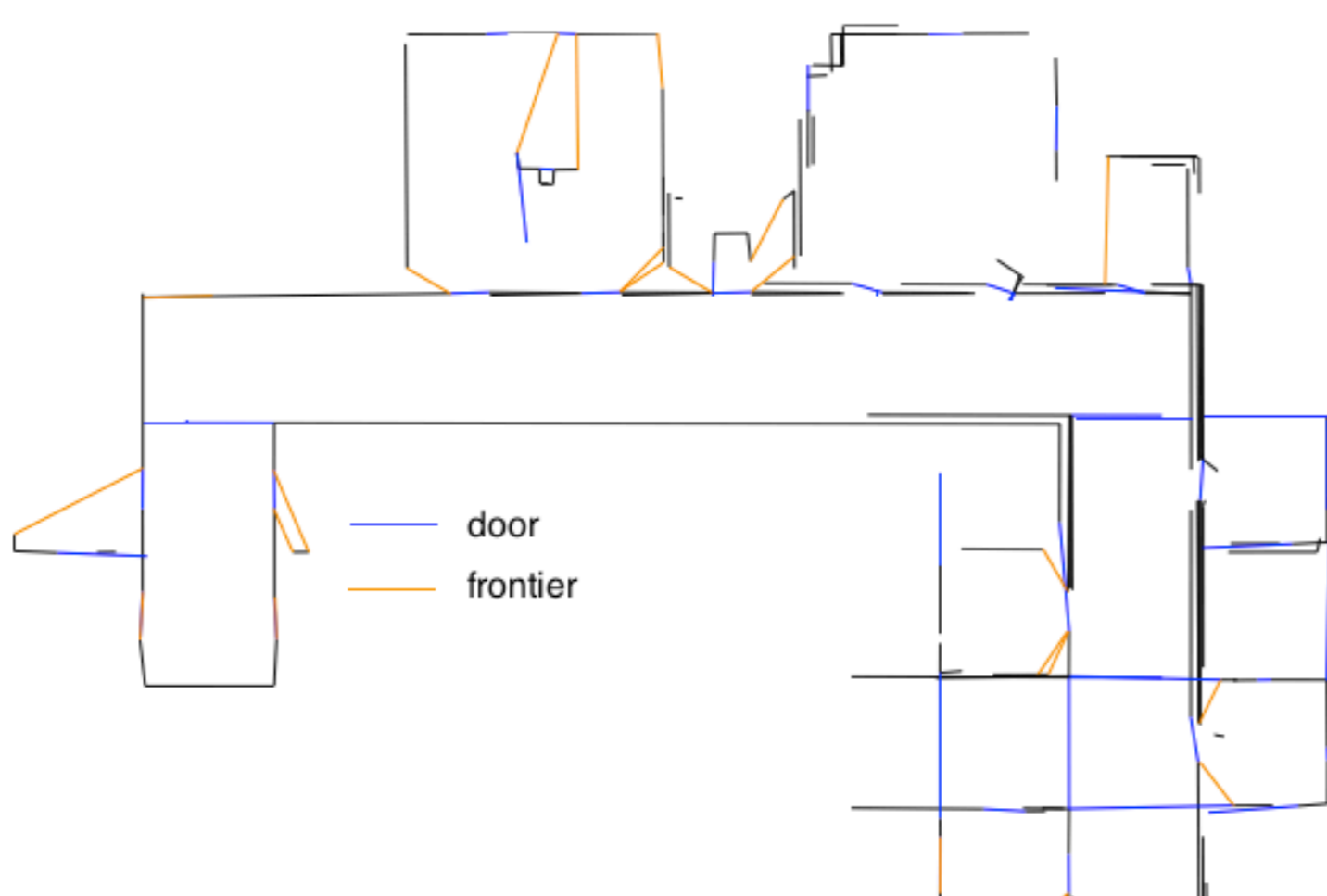
Victim Detection

- Victim detection with a cascade classifier.
- HSV skin detection and subsequent skin blobs classification based on their shape and size.



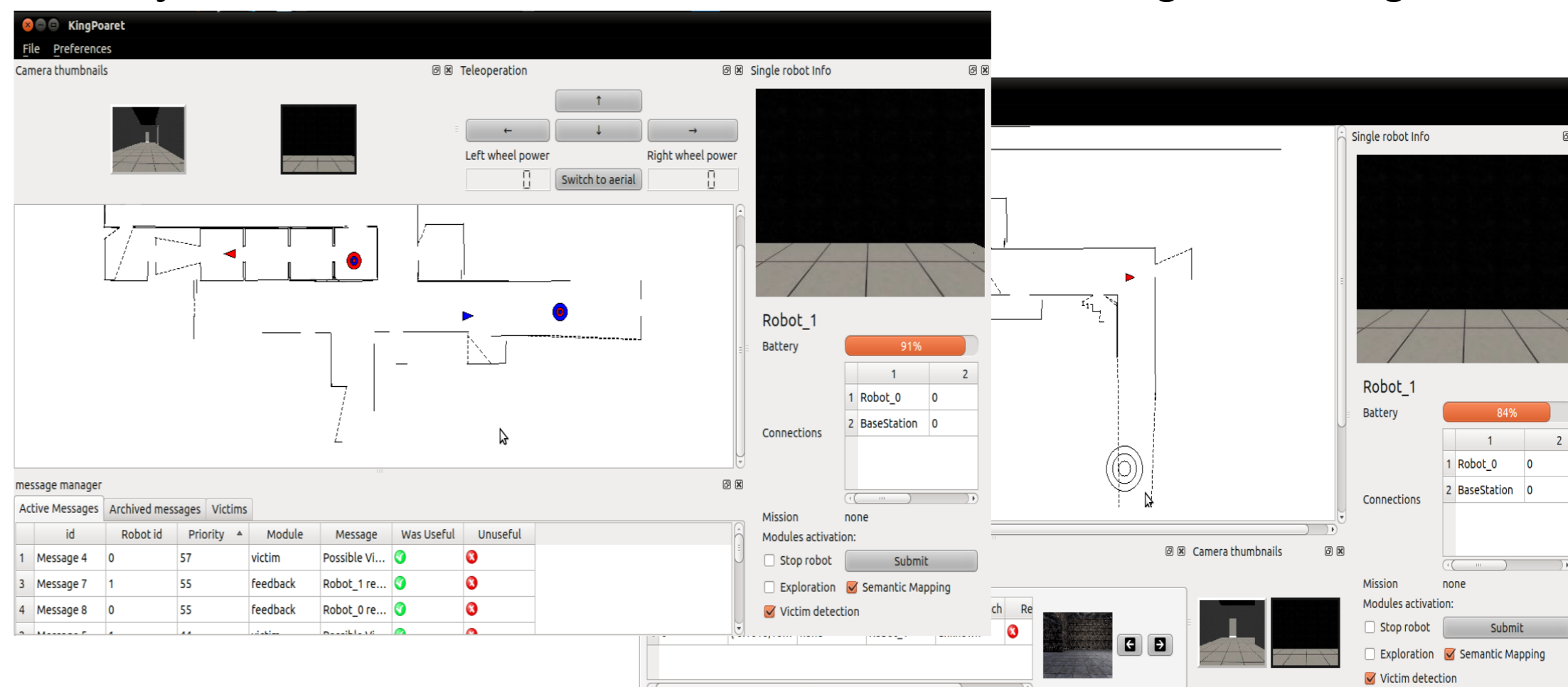
Semantic Mapping

- Identification of doors (and rooms) using geometrical features.
- Support to path planning.
- Introduction of new frontiers.



User Interface

- Three levels of interaction: high-level commands, waypoint commands, and teleoperation.
- Fully customizable modular GUI with message filtering.



18-24 June 2012

WORLD TRADE CENTER
MEXICO CITY

