

Project “Rescue Robot Systems”

Winter Semester 2012/13

- Topics -

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 - **Teleoperation / Hardware (Dirk Fischer)**
 - 3D Representations and Mapping (Tobias Kotthäuser)
 - Vision Module (Zaheer Aziz)

Teleoperation

- Visualization

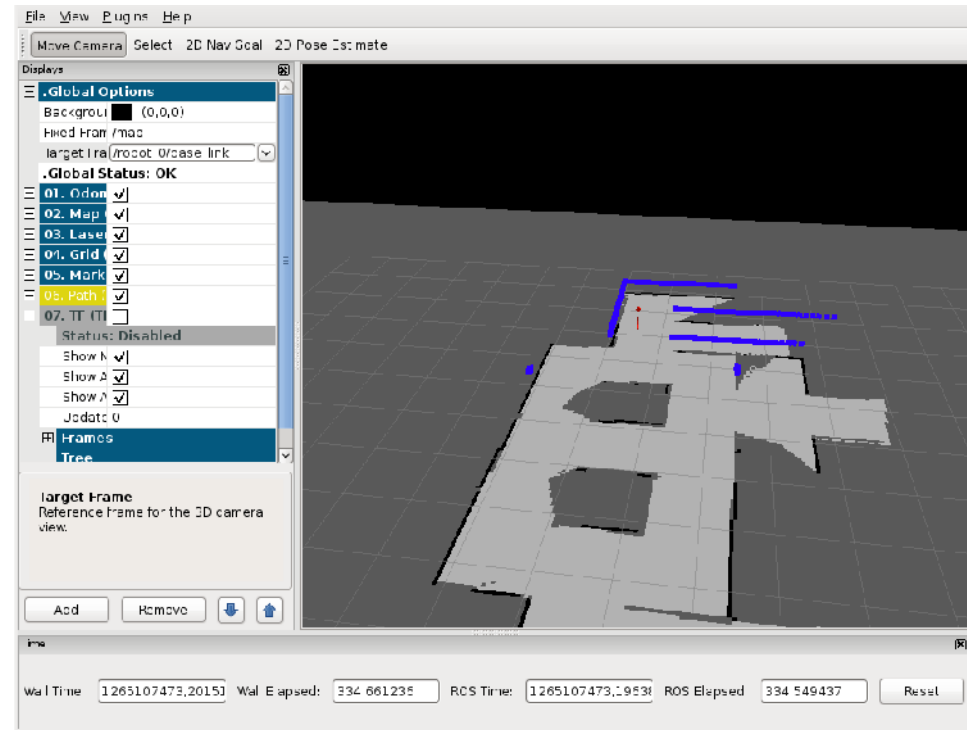
- Sensor data
- Maps
- Exploration progress
- Victim positions and marker

- Tasks

- Visualization of 3D data
- Placing of QR code locations in the constructed map
- Remote control of two and more robots including pan-tilt-units and user interaction (autonomous robots)
- Semi autonomous behavior: navigation points, danger points, etc.

- Tools

- C++ / ROS / QT



Navigation

- Navigation algorithm using 360° FOV
 - Drive backwards to get out of dead ends (instead of 360° turns)
 - Check clearance at all sides before taking a turn (e.g. robot touches a wall at its rear after slipping)
- Solution to recognize tunnels as obstacles depending on clearance height
- Navigation based upon terrain analysis
 - Find the best way to go over the ramps, e.g. minimize chances of slipping
 - Adjust speed settings depending upon the complexity (drivability) of the ground



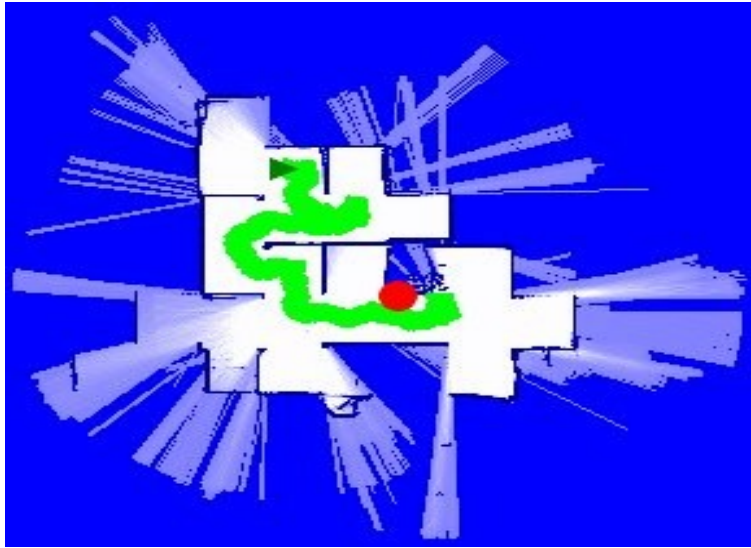
Hardware

- Reduce weight of robot
- Reduce size
 - All possible gadgets inside the main body
- Victim indication using omni vision mirror with thermal camera
- New sensors
 - Thermopile for heat detection
 - CO2 sensor
 - Microphones and speakers used for communication and victim localization
- Design of simple robot arm



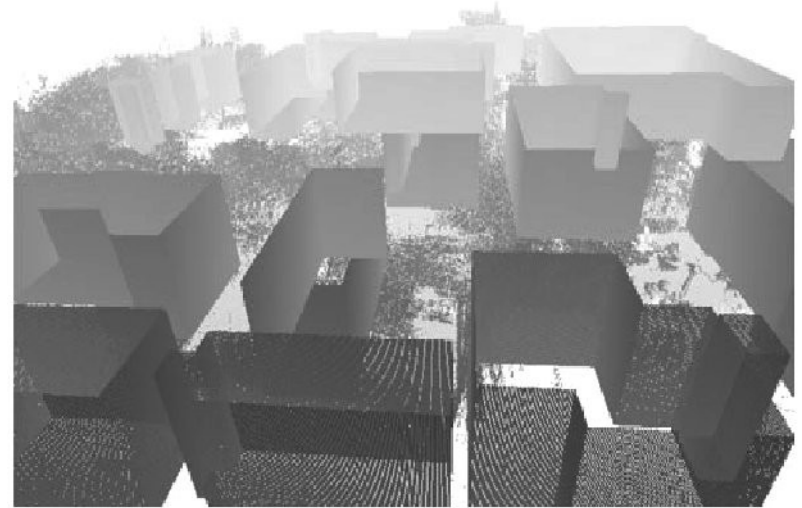
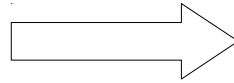
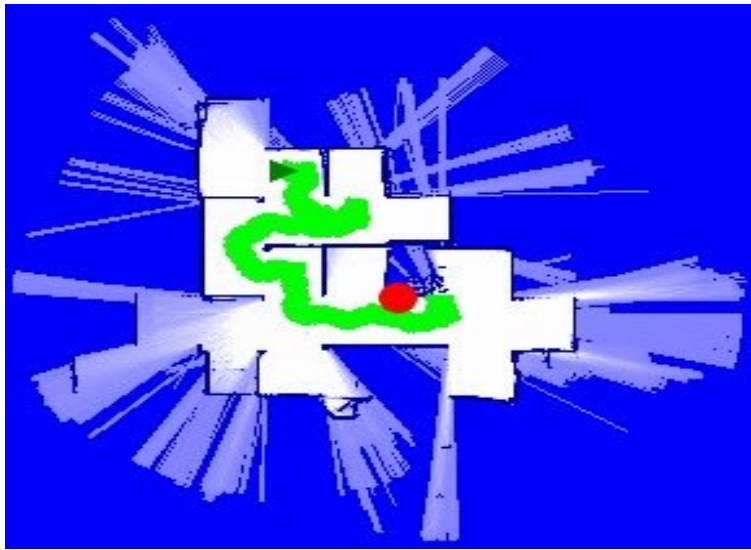
- **Tasks**
 - Teleoperation / Hardware (Dirk Fischer)
 - **3D Representations and Mapping (Tobias Kotthäuser)**
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3D Representations and Mapping



- 1998 – 2011: 2D maps
- Sufficient for simple environments
- No height modeled
 - Identification of victims and obstacles difficult.

3D Representations and Mapping



- 1998 – 2011: 2D maps
- Sufficient for simple environments
- No height modeled
 - Identification of victims and obstacles difficult.

- Starting 2012: Additional 3D maps
- Model height and more complex environments
- Integrate semantic knowledge into the map

3D Representations and Mapping

VIDEO

3D Representations and Mapping

Topics

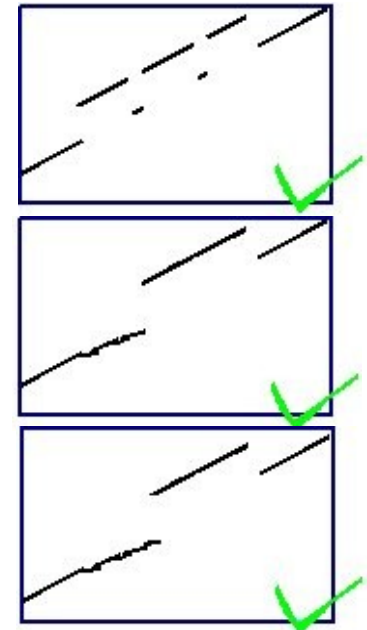
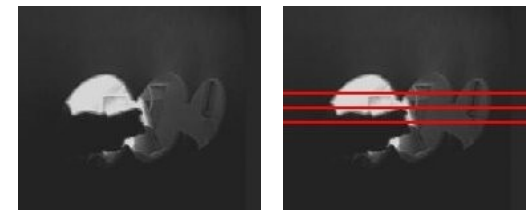
- 3D Mapping: Incorporating more registration algorithms
- Merging features (e.g. planar patches) acquired from different locations
- Recognizing obstacles and other Robocup elements in the 3d map (e.g. determine tunnels)
- Tools
 - C++ / Point Cloud Library (PCL)

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Victim Reconfirmation Using Laser Range Data

Heat sources other than human body may also have a similar temperature. One way to confirm if the warm body is a human victim is to analyze its 3D shape. This task includes:

- Calibration of thermal camera center and the laser scan angles.
- Looking for a pattern wall-cavity-wall in the laser data after focusing by sensor head on the potential victim.
- Minor vertical head rotation and getting at least two more depth readings for error reduction.
- Decision about existence of cavity around the thermal signal.



Victim Detection Using Omni Vision Mirror

- Stopping and scanning around takes a lot of time and decreases possibility of scoring.
- Omni vision mirror can solve this problem

This task includes:

- Experimenting with heat signals reflected from a semi-spherical mirror.
- Estimation of target direction in 3D.
- Focusing with camera head towards the target.
- Creating an interface with the existing target homing procedure.

