Evaluate the use of a Roomba robot as a mobile node in a wireless sensor platform

Thursday 13 September 2012
Plan

I. Internship Environment
II. Subject and requirements
III. Devices and softwares
IV. Solutions and Results
  - Setting up the robot
  - Charging batteries
  - Using odometry
  - Using navigation
V. Conclusion
I. Internship environment

• INRIA

• SED (Service of Experimentation and Development)
II. Subject and requirements

- Senslab project

- Mobile node: robot equipped with a sensor and moving inside the platform

- Requirements:
  1) run and recharge autonomously
  2) move the robot from a given point A to point B
  3) receive information about the robot (localisation, sensor information, ...)

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III. Devices and software

• Willow Garage

• Turtlebot:
  > Not sold in France → inspired by it
  > Equipped with:
    - Microsoft Kinect
    - iRobot Roomba 531
    - Portable computer
  Low cost: ~1000€
III. Devices and software

- ROS (Robot operating system):
  - Powerful structure: nodes, parameters, topics, services
  - No graphical interface with user
  - Many available device drivers
  - Standardised
  - Visualizers, diverse applications such as navigation

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IV.1 Setting up the robot

- Kinect powered by batteries of Roomba
- Serial communication between PC & robot
- Communication to PC using SSH protocol

First tries:

- Starting up ROS and the turtlebot node
- Creating small programs
IV.2 Recharging the batteries

Solution:

- Creation of a service to call the « dock » function
- Adapting the source code to enable charging

Results: function works under certain conditions
- no interference
- robot has to be facing the dock

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IV.3 Using odometry to localize the robot

Odometry: estimate change of position from moving sensors

Results:
- Not precise enough
- Low quality sensors
- Wheels slip

Not precise enough

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IV.4 Using the Navigation

Required information:
- grey scale map
- 2D laserscan

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IV.4 Using the Navigation application

- Creation of a ROS application with the following scenario:

1) start at dock
2) back up
3) go to point A then point B (as many times or as long as wanted)
   During this time:
   - if bumpers are hit, the robot stops
   - if batteries are low, it goes to recharge
4) go in front of dock
5) call the dock service
6) recharge
IV.4 Using the Navigation Application

Results:
- localization possible and precise
- can receive and send information (position in map)
- total distance covered: 2.8 km
- recharge batteries

Adaptations made:
- adjusting projection laserscan (minimum height)
- changing position of the Kinect
- changing navigation parameters (goal tolerance)

Remaining problems:
- Wi-fi disconnection
- unknown behaviours
- limitations of the Kinect: range: 0.8 to 6 meters, angular view: 57° horizontally, 43° vertically
V. Conclusion
Questions