Adding a Sensor to the PR2

ROS + PR2 Training Workshop

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Modifying the PR2

You may want to modify the PR2 for research
  – Add sensor or device
  – Add functionality
  – Change color

Today, we'll add a Hokuyo laser scanner to the side platform
What We're Doing Today

Add Hokuyo laser scanner on the side panel
We'll be able to scan sideways!
It's easy to demonstrate
  – Near side USB port
  – Have a ROS driver
Modification Procedure

Today's goal - show you how to modify PR2

- How to contact Willow Garage
- What to watch out for
- Simple hardware modifications
- Software configuration
- Where to go for help

We're following tutorial on wiki

http://www.ros.org/wiki/pr2_robot/Tutorials/Adding a Hokuyo to the PR2
PR2 Modifications

Safety first
- PR2 design is carefully validated at Willow Garage
- Changes to some HW or SW may be dangerous
- Can damage the PR2

Willow Garage support
- We might be able to offer tips for adding sensors
- We can't help with everything
- Some changes make it hard for us to help you
Before You Modify...

Pre-modification checklist:

- Ask your lab supervisor and safety rep
- Check Willow Garage Support
  - If specification not listed, make sure to ask us

**Note:** Under the Beta Program Agreement, permanent modifications to the PR2 must be approved by Willow Garage.
Adding Sensor Pre-check

- I'm supervising myself today
- Checked Willow Garage Support
  - Checked power requirements of the laser
  - PR2's power system is OK
- Remove and Replacement Procedures
  - Shows me how to remove covers
  - Computer configuration, AUX USB port
Software Configuration

Add new Hokuyo scanner in URDF

URDF mods: http://www.ros.org/wiki/urdf/Tutorials/AddingSensorsToPR2

Need to measure location of sensor relative to PR2 coordinate center

Software Configuration

Add driver to 
“/etc/ros/robot.launch” on PR2
  • New file “my_robot.launch” for this demo

Add diagnostic Analyzer for Hokuyo data
  • http://www.ros.org/wiki/pr2_robot/Tutorials

Test in gazebo
Before Opening PR2

PR2 is designed to operate with covers ON

When taking covers off, use extreme caution

• Power is OFF
• Wearing wrist strap for ESD
• Use proper tools (toolkit)

Inform your local safety rep

Contact Willow Garage first

Risk of damage to your PR2 and harm to yourself
Modification Procedures

Modifications like this aren't that hard...

But the downside of a mistake is huge
Opening PR2

Always shut down robot before removing covers

- `sudo pr2-shutdown`
- When red lights on server go out, safe to turn off

Remove covers using correct hex key, T-handle wrench

- Remove and replace instructions at Willow Garage Support
Mounting Sensor

We need to secure the sensor and bracket to the robot

• Sensors are expensive, mount securely

Cables must be secured to robot before we continue

Wear a wrist strap at all times
Plugging in Sensor

Plug in to AUX USB port, near head

- Port connects to c1 on PR2
- AUX USB port has USB, firewire passthroughs

Plug in 12V power cable to Hokuyo sensor
Reinstall cover
Computer/Sensor Configuration

Turn on robot, flip main breaker

Look for “/dev/ttyACM0” on “c1”


- Note that existing Hokuyo scanners are on “c2”

Make sure you have correct permissions

- sudo chmod a+rw /dev/ttyACM0

You can get check the HK firmware or other device info using tools in hokuyo_node
Getting Sensor Data

Launch robot

- `sudo robot start`

Note that sensor shows up in dashboard/diagnostics

Can view sensor in rviz, and can see laser scans
PR2 Configuration Review

In order to modify the PR2, and make it usable, I had to change:

- URDF (/etc/ros/robot.xml)
- Robot Launch File (/etc/ros/robot.launch)
- Computer Configuration/Permissions
- Physically mount cables, etc

These are the changes you will have to make for any modification to work.
PR2 Modification Summary

Safety First
Contact Willow Garage Support
Ask other PR2 users
Test your code ahead of time
Questions?