

PR2 HEAD AND HAND MANIPULATION THROUGH TELE-OPERATION

Using an Attitude and Heading Reference System

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A Brief Introduction of Teleoperation in Robots

➤ What is Teleoperation?

The control of a machine or device over a given distance.



A Brief Introduction of Teleoperation in Robots

➤ What are the Applications of Teleoperation?

Military



Search and Rescue



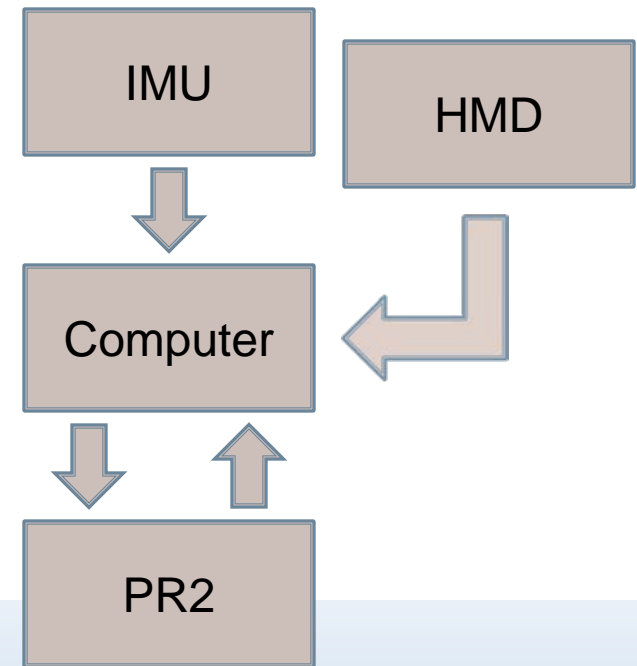
Space



How is the GRASP Lab using Teleoperation?

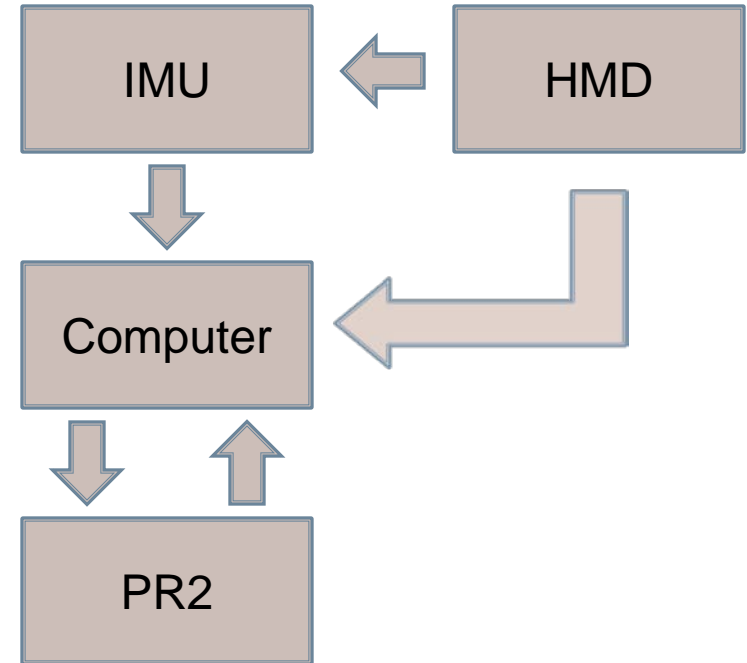
➤ How Teleoperation is used for this Research?

1. Inertia Measurement Unit (IMU) is attached to a Head Mounted Display (HMD), worn by the Operator.
2. Data from the IMU is feed to a computer, through serial interface, running ROS.
3. Computer sends IMU data to the PR2 connected through a wireless network.
4. PR2, also running ROS, translates IMU data into physical movement.



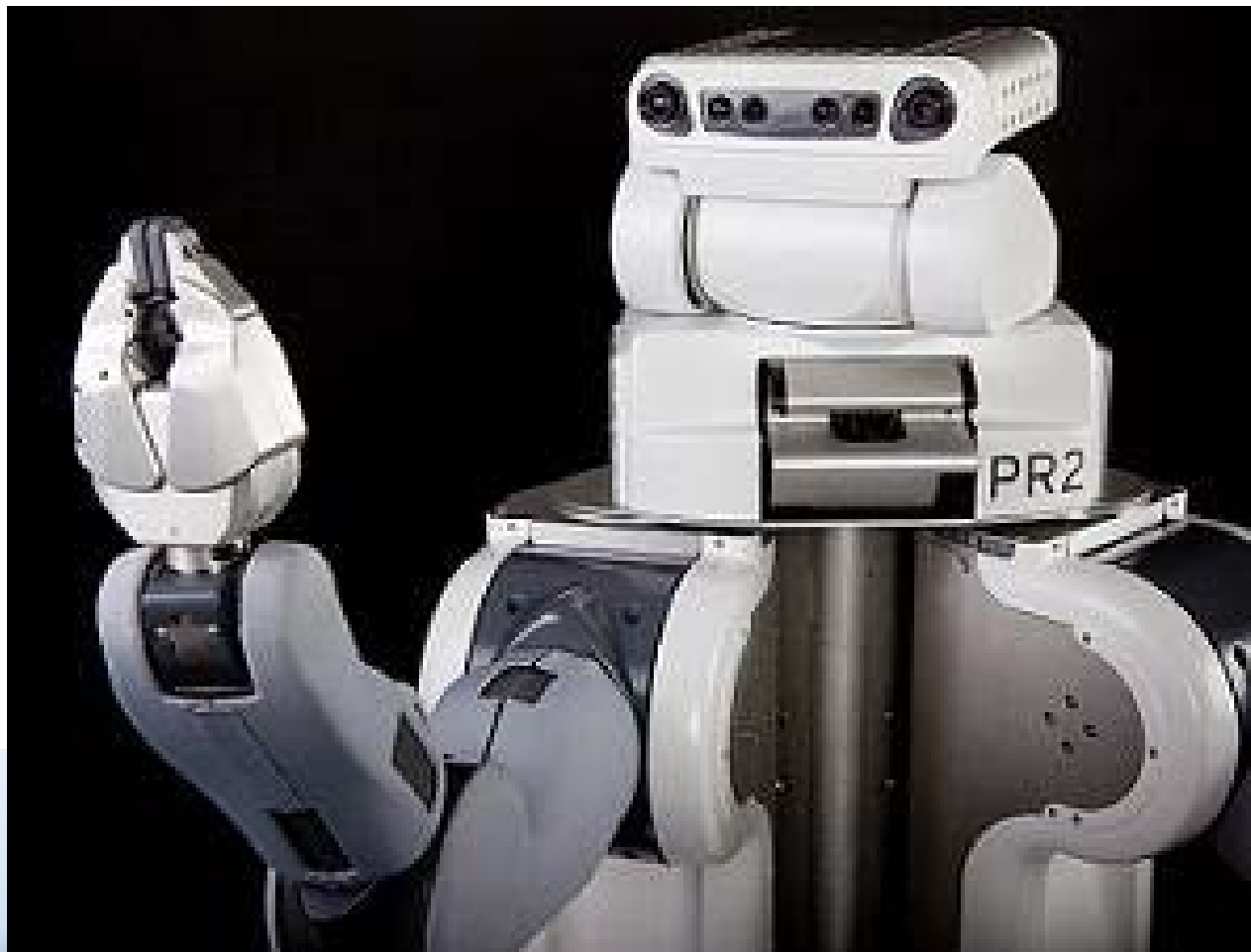
How does this Compare to Previous Work in the GRASP Lab.

- Teleoperation done with Vicon motion capture system.
- Vicon system uses IR cameras attached to special rigging.
- Markers attached to HMD are tracked by Vicon system.
- Data fed to Computer then fed to PR2.



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LET'S SEE AN EXAMPLE!

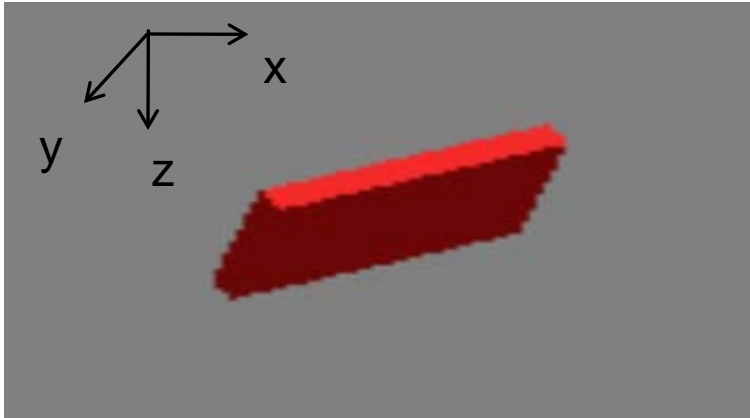


The Robot: PR2

- An Open Source Humanoid Robot Developed by Willow Garage.
- Sensor Array of Cameras, Lasers, Haptics, Actuators.
- Can be controlled with a Joystick.
- Omnidirectional movement for navigation through any indoor environment.
- Grippers able to grab anything from pens to brooms and eggs to tea cups.



The IMU: CHR-6dm



```
header:
  seq: 8497
  stamp:
    secs: 1312133795
    nsecs: 720052003
  frame id: imu_link
orientation:
  x: -0.0726721557838
  y: -0.210921824174
  z: 0.949531703011
  w: 0.0
orientation_covariance: [0.009999999776482582, 0.0, 0.0, 0.0, 0.0099999997764825
82, 0.0, 0.0, 0.0, 0.009999999776482582]
angular_velocity:
  x: 0.369593232912
  y: -0.807256814817
  z: 0.184317247801
angular_velocity_covariance: [9.999999747378752e-06, 0.0, 0.0, 0.0, 9.9999997473
78752e-06, 0.0, 0.0, 0.0, 9.999999747378752e-06]
linear_acceleration:
  x: 0.186449286164
  y: 0.180164478766
  z: 6.63885154893
linear_acceleration_covariance: [0.09617038422250002, 0.0, 0.0, 0.0, 0.096170384
22250002, 0.0, 0.0, 0.0, 0.09617038422250002]
---
```

CHR-6dm Attitude and Heading Reference System.

- Generates Estimated Yaw, Pitch, and Roll Angles using Extended Kalman Filter (EKF).
- Transmission rate of 20 Hz to 300 Hz.
- Size of a Quarter, Inexpensive, and Adaptable to a wide range of systems.

The Software: ROS

- Robot Operating Software (ROS) developed by Willow Garage, the PR2 Robot's primary Operating System.
- Diamondback is current distribution and supported only through Ubuntu, a Linux based OS.
- Uses C++ and Python programming languages
- Utilizes Stacks to share code between Nodes, which allows communication between devices and the machine.

Further Applications

PR2 Gripper Manipulation

- IMU will track operator's hand pose
- Actuator to control opening and closing of PR2 gripper.
- Actuator will also provide tactile feedback from PR2.



Acknowledgements

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- William McMahan and Keith Wallace



SUNFEST

The SUNFEST logo consists of the word "SUNFEST" in a bold, dark red, sans-serif font, centered between two horizontal dark red bars.

References

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