

Gesture Controls for the Raven Robot

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Goal

- Develop software to control the Raven II Surgical Robot using hand gestures
- Integrate the 3Gear Gesture Control System, CISST libraries, the open-source Robot Operating System, and the Raven II robot controller

Significance

- Integration of the open-source CISST and ROS libraries allows researchers to more easily develop and software for surgical robot systems
- By enabling the 3Gear device to communicate using the CISST library, we open the doors for this more natural form of input to be used in other surgical robot systems

Background

3Gear

- Uses 3D cameras (2 Microsoft Kinects) and proprietary software to track hand position and poses, accurate to millimeters



3Gear system with 2 Kinects (source Engadget)

CISST/SAW

- Open-source libraries designed to be used in computer-assisted intervention systems
- SAW, the Surgical Assistant Workstation, is used to enhance a surgeon's capabilities. This package contains interfaces for devices used for computer-integrated surgery.

ROS

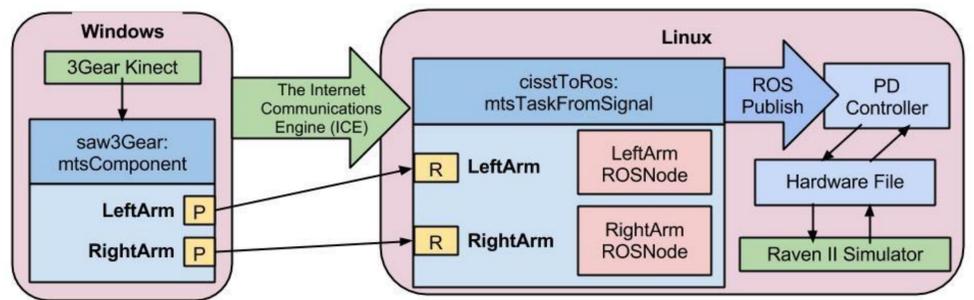
- The Robot Operating System is an open-source operating system for robots.
- Provides hardware abstraction, low-level device control, implementation of commonly-used functionality, message-passing between processes, and package management.

Raven II Surgical Robot

- A robotic surgery research system that uses open-source software based on ROS.
- Developed by BioRobotics Laboratory in the University of Washington in Seattle and sent to multiple research laboratories to enable further research in tele-operative and minimally invasive surgery.



Raven II Surgical Robot (source University of Washington)



System-Block Diagram

Technical Approach

- On a Windows system, we use 3Gear's C++ API and CISST to create a SAW wrapper for the 3Gear System, which parses the hand tracking data into CISST Cartesian position data structures
- The SAW wrapper also sends the data over the Internet Communications Engine (ICE) to a Linux system, which receives it in our cisstToRos program.
- Our cisstToRos program converts the CISST cartesian positions into ROS transforms, and then publishes them.
- A PD controller subscribes to the positions published by cisstToRos and uses them, along with the robot's current joint positions, to calculate the robot's desired joint positions and velocities. It then publishes the calculated joint velocities.
- The hardware file subscribes to the joint velocities and controls the robot (or robot simulator). It also publishes current joint states back to the PD controller.

Results

- Demonstration of Raven Robot Simulator controlled using hand gestures
- Completed software and documentation for further development of a CISST-ROS interface

Future Work

- Alan would like to continue working on a more robust cisstToRos interface.
- Our tutorials and documentation should allow for further development using the 3Gear system, the Raven Robot Simulator, and the cisstToRos interface.

Lessons Learned

- Compiling of cross-platform software can be very difficult to get working properly.
- Learned to work with cisstMultiTask, 3Gear API, and ROS.
- Learned about PID controllers for robots.

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