Problem: Autonomous Multi-Floor Navigation

Goal:
• Travel between two labs autonomously, via the elevator.

Applications:
• Mail or package delivery.
• Automatic response to user requests, with self-navigation capabilities.

Overview:

General Task Flow:
1. Generate floor maps using pr2_2dnav_slam package.
2. Navigate between lab and elevator using pr2_2dnav package.
3. Change floor map after taking elevator using map_server package.

Challenges:

Elevator Button Detection:
1. Detect pixel locations using template matching.
2. Solve for wall plane using textured light-enhanced stereo vision.
3. Project button pixels into a line in 3D space.
4. Solve line-plane intersection to obtain 3D button location.

Elevator Button Pressing:
1. Solve arm IK to place gripper in front of button.
2. Determine straight line trajectory perpendicular to wall.
3. Retract the arms to prevent collisions.

System Integration:
• Integration with the SMACH library.
• Builds hierarchical state machines with user-defined states and transitions.
• Each state performs an action(s) and returns an outcome.

Software:

Robot Operating System (ROS):
• Software framework by Willow Garage.
• Provides many libraries (called “stacks” and “packages”) for low-level and high-level control.
• Open-source, promotes code sharing.

Our code is available at:
http://sourceforge.net > ubc-ros-pkg > pr2_elevator

Hardware – PR2 Robot:

Textured Light Projector, Stereoscopic Cameras
Tilting Laser Sensor
7 DoF Arm Plus Gripper
Base Laser Sensor

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