Personal Assistive Robot

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Abstract

The aging population of the United States is creating a growing need to provide assistive care for persons who are elderly or disabled. However, there are currently no commercially available modular assistive robots that can fill this increasing need. This project represents the first step in providing an alternative to current assistive living options: a Personal Assistive Robot (PARbot). PARbot's design has an emphasis on modularity, for both users and the potential for additional future functionality. This concept is implemented physically through the inclusion of mounting points and power connections, as well as in software through the use of Robot Operating System (ROS), all on a differential drive chassis. Further, large tires and high ground clearance allow for the robot to operate in a wide variety of environments.

Robot Overview

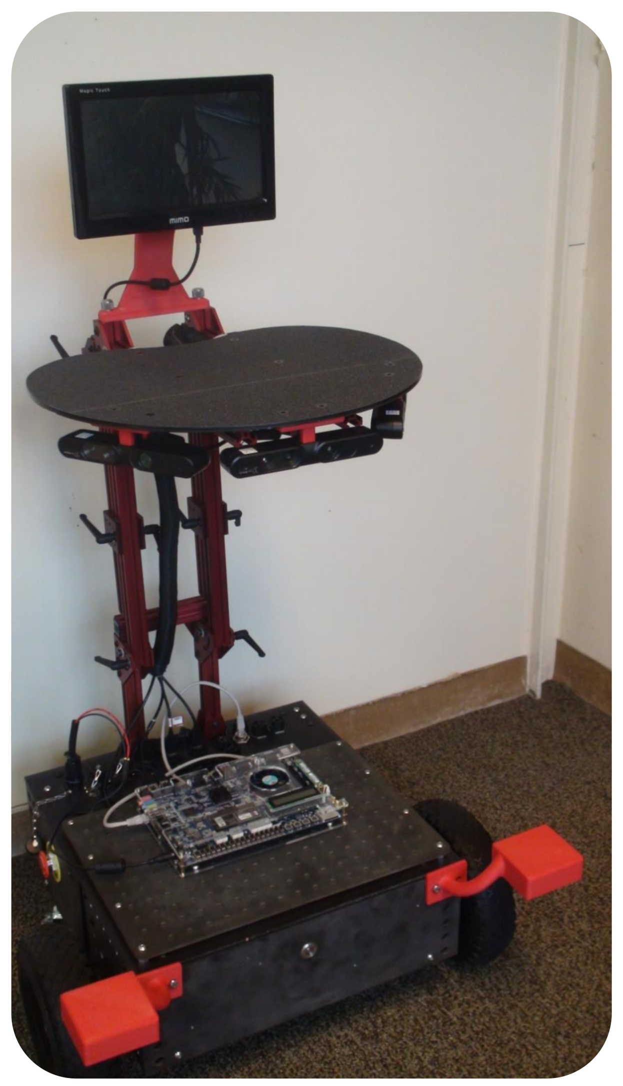

Figure 1: Fully Assembled Robot

Project Goals

- Create Modular Robot Base
- Map Surrounding Environment
- Avoid Obstacles
- Follow User
- Easy to Use
- Non Threatening
- User Centered Design

Results

- Base successfully built
- Map building
- Path/motion planning
- Color/QR tracking
- Tablet interface

Modularity Support

- Easy access waterproof power (3.3, 5, 12, 24 Volt), Ethernet, and USB connectors
- Extruded aluminum frame
- Modular software construction

Figure 2: Easy Access Waterproof Connectors

Software Architecture

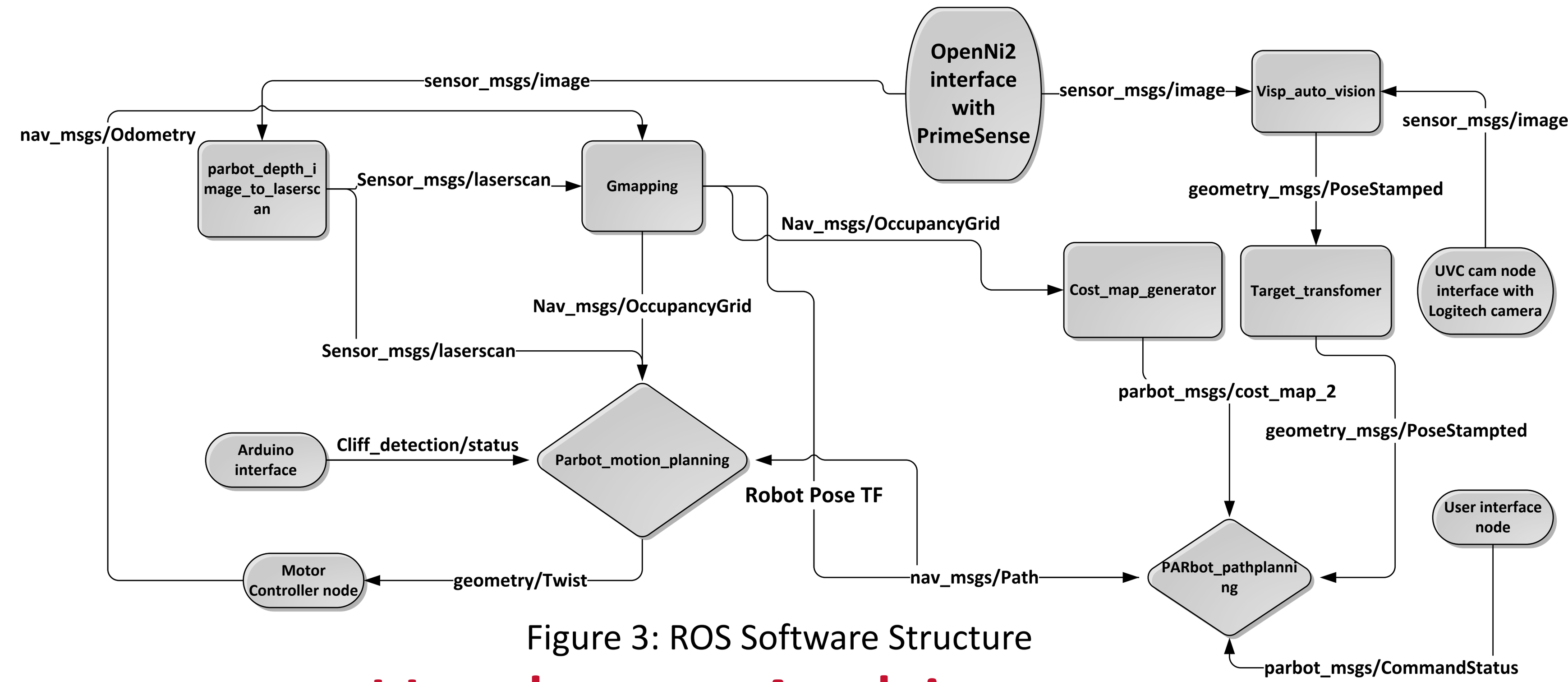

Figure 3: ROS Software Structure

Hardware Architecture

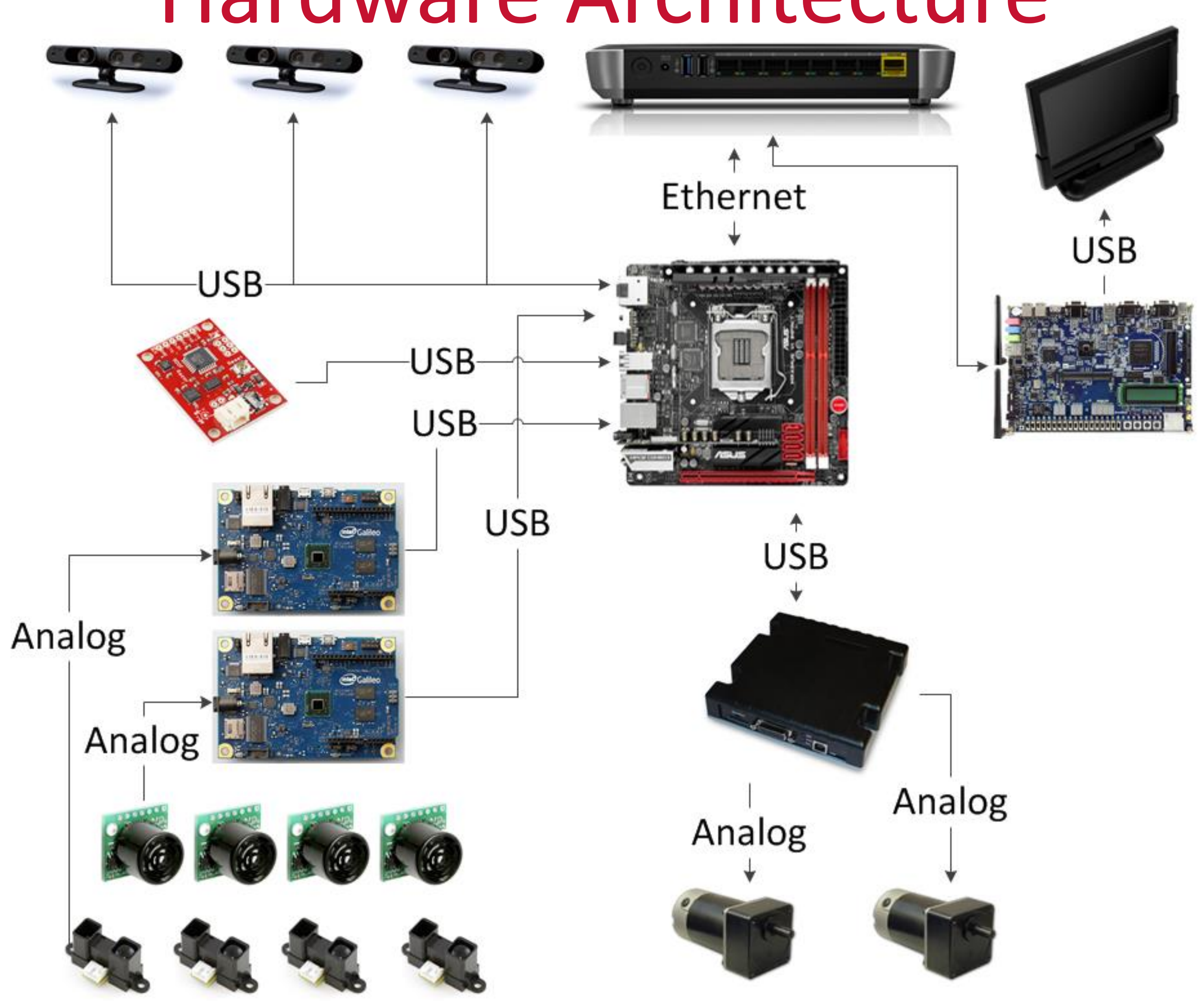

Figure 4: Robot Data Flow

User Interface

Figure 5: User Interface Standard Button State

- Touch screen controls
- Control robot functions
- 3D printed neck
- Intuitive
- Good viewing angle

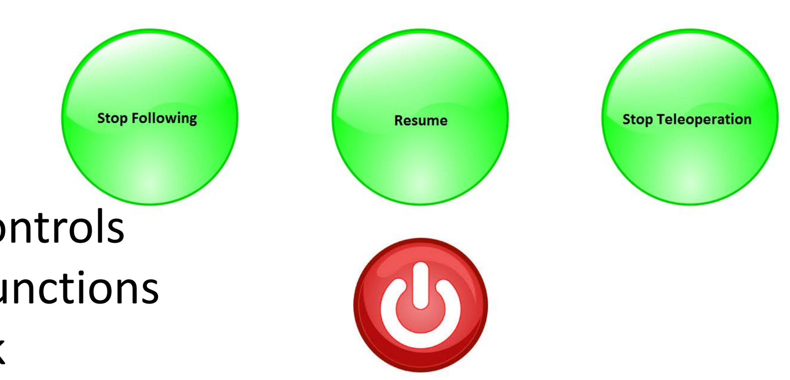

Figure 6: User Interface Alternate Button State

Mapping

Figure 7: Map of Second Floor, Atwater Kent Laboratories

- Data condensed into laser scan
- Gmapping used for mapping
- Cost map is built
- A* Algorithm for path planning

Motion Planning

- Tentacle Style Planning
- Includes many possibilities
- Adapts locally to environmental changes

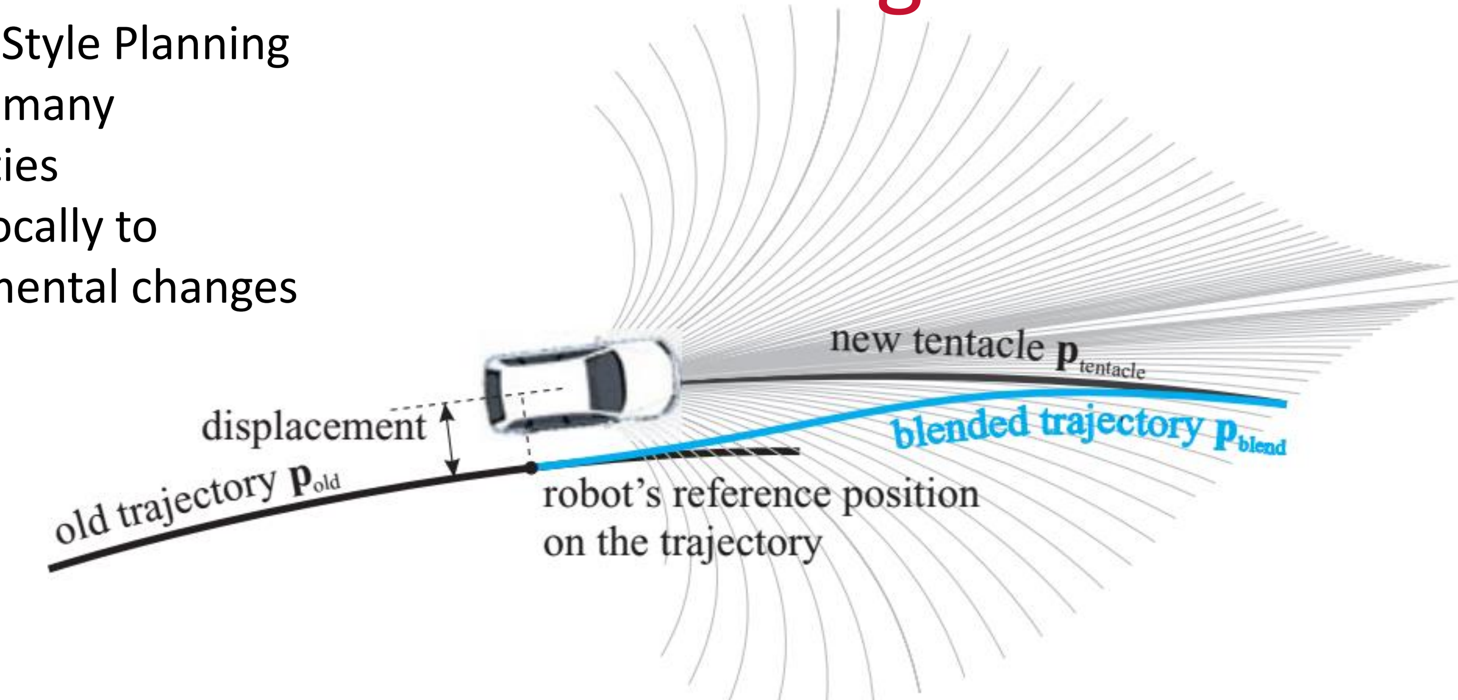

Figure 8: Motion Planning Method

Testing

- Tracks QR Code
- Uses known size QR code and geometry
- Provides position relative to robot
- Detecting Obstacles
- Avoiding obstacles
- Carrying user's Tray

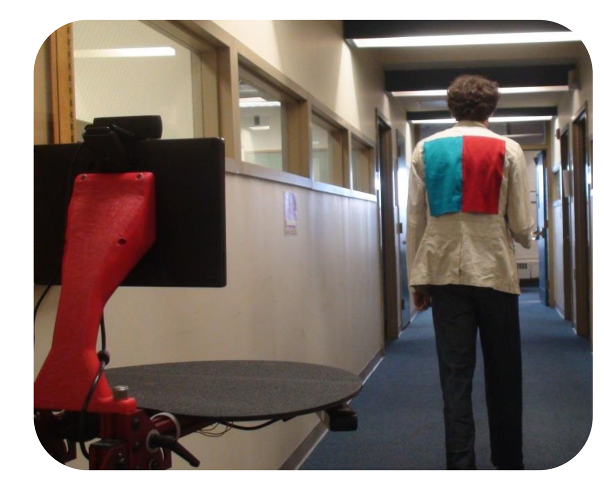

Figure 9: Color Tracking

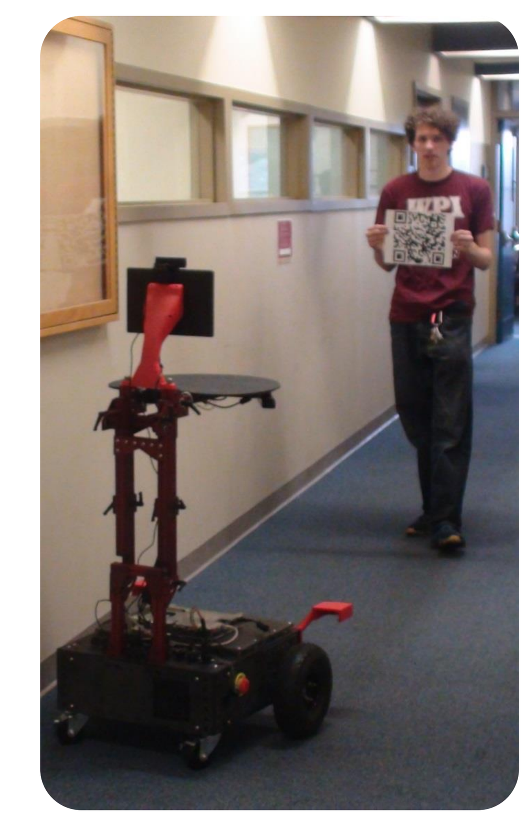

Figure 10: QR Tracking

Acknowledgments

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References

Von Hundelshausen, Felix, Michael Himmelsbach, Falk Hecker, Andre Mueller, and Hans-Joachim Wuensche. "Driving with Tentacles: Integral Structures for Sensing and Motion." *Journal Of Field Robotics* (2008): n. pag. Web. 10 Mar. 2014. <www.interscience.wiley.com>.

Sponsors

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