DEVELOPMENT OF MULTI-MODAL CONTROL INTERFACES FOR A SEMI-AUTONOMOUS WHEELCHAIR

ABSTRACT
The purpose of the project is to assist different levels of disabilities to apply multiple control technologies to the semi-autonomous wheelchair to. A semi-autonomous wheelchair developed by Robotics and Intelligent Vehicles Research Laboratory (WPI River Lab) is able to perform assistive control to avoid obstacles and walls and to follow walls. With a joystick control adapter, the basic joystick of the wheelchair can take commands directly from computers. In addition to joystick mechanical adapter control, human-machine interaction and control methods such as voice and electromyography (EMG) are deployed, with the aim of enabling people with different levels and types of disabilities to control the wheelchair. These non-physical motion based user control interfaces allow people with limited mobility to control the wheelchair with a desired accuracy.

Joystick Control Interface
• Able to control the position of the Joystick
• Allows for control of the wheelchair without modifying any components, non invasive technology allows for greater modularity
• Uses ROS Serial package and Arduino ROS Library to integrate with the ROS environment

EMG Control Interface
• The EPOC Emotiv headset communicates with the wheelchair through the computer as shown in Figure 5.
• Emotiv API processes the EMG signal and sends the motion commands to motor driver and the voice feedback of the wheelchair.
• Experiment of expression control reaches 70% accuracy, providing a reliable control interface

Multiple Interfaces Architecture
• Robot Operating System (ROS) architecture.
• Multiple user interface nodes can publish to command topics.
• Motor node, voice feedback and joystick adapter subscribe to the topics for new messages from the control interfaces.
• The open software architecture makes it easy to add other user control interfaces into the system.

Sensor system
• Figure 7 shows IR and Ultrasonic range sensors’ coverage and their layout. Such placement minimizes the possible interferences.
• Figure 8 demonstrates the ability to generate an alternative laser scan.
• The sensor system provides a standard data structure interface for other ROS package.

Results
• Sensors system is able to generate an alternative laser scan as a standard ROS data type interface.
• Voice control interface allows user to drive, as well as to interact with the wheelchair through voice commands.
• EMG control interfaces is implemented and tested with 70% accuracy.
• Joystick adapter is ready and requires further testing on the reliability of the ROS serial package
• Casings are ready and some have been deployed on the wheelchair
• Back Rack is functional, stable, and components have been mounted to it

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