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MECH 493 project: Detecting and Predicting Wheelchair Trajectory for Mobile Robot Navigation

Background and research goal

Human-robot interactions are becoming increasingly commonplace as autonomous robots are being introduced to public settings. Such mobile robots must be accustomed to navigating human-populated areas like pedestrian sidewalks. Successful algorithms for identifying and tracking pedestrian groups already exist; however, one special challenge that presents in this scenario is the identification and tracking of non-walking pedestrians, such as wheelchair users, who may exhibit discrepant behaviors. The project will be focused on applying computer/3D vision techniques to identify wheelchair users on the sidewalk using sensors equipped on a PowerBot robot (2D laser sensor, stereo cameras, and Kinect sensor). A further step is to predict the trajectory of wheelchair candidates using an existing model of wheelchair behaviors.

Tasks to be performed by the student

- Perform literature review of existing vision methods of wheelchair detection and behavior modelling
- Apply/modify existing sensor fusion algorithms to stereo camera and 2D laser data stream to enable wheelchair detection
- Leverage existing wheelchair behaviour models (if any) to predict the trajectory of a wheelchair candidate object

Facilities and team:

The Collaborative Advanced Robotics and Intelligent Systems (CARIS) Lab focuses on human-robot interaction in both rehabilitative and industrial applications. The lab equipment includes 5 complete arm-type robots, one PR2 2-armed mobile robot, and 2 PowerBot mobile robots designed for indoor and fair-weather outside use. One PowerBot has been outfitted with a NUC processor for real-time computation, wireless router and a suite of vision, LIDAR and proximity sensing devices to support navigation and obstacle detection and avoidance. The PowerBot is programmed in ROS and communicates with lab-based computers for software development and trajectory control. The lab also has a project supervised by PhD candidate Mahsa Khalili in the enhanced control of manual wheelchairs with powered mobility add-ons. These resources will be useful to te proposed project.

The CARIS faculty includes the director, MECH Assoc. Prof. Mike Van der Loos, MECH Assistant Prof. Lyndia Wu, and several active collaborators, notably former director Elizabeth Croft and former post-doc Wesley Chan, who perform remote co-supervision and tele-consulting activities with current lab researchers. The lab currently has 4 PhD students and 3 MASc students, plus several undergraduate interns.