Collision Avoidance System for a Powered Wheelchair

MTE 482 — Group #2

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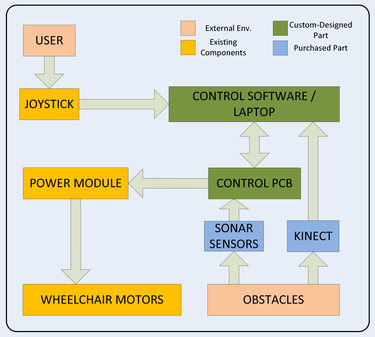
The System



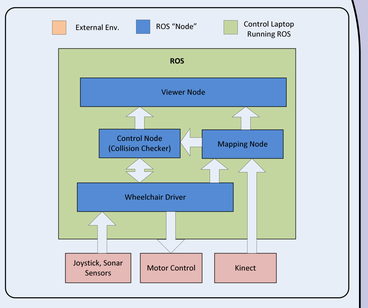
An existing wheelchair is modified to allow for collision avoidance.

The sensors, a Primesense -based Kinect and 4 sonar sensors are purchased.

A control PCB is custom designed to interface between the wheelchair and the laptop, as well as provide power to the various sensors.

Control software is written for a laptop computer that sits on-board the wheelchair. This software makes decisions based on sensor input about where the user is allowed to navigate.

Software



A visualization of the wheelchair moving down a hallway. Obstacles are represented by white tiles. Requested path in green/red, where the green portion is collision-free and will be allowed by the software.

The software takes the Kinect and sonar input about obstacles in the environment and user commands entered via the joystick. Combined with a model of the wheelchair the path of the chair is predicted and collision checking performed. Movement of the chair is limited based on these collision checks.

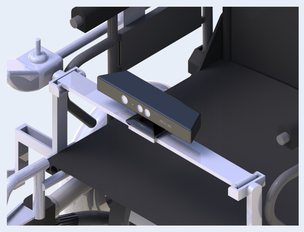
The Need

Powered wheelchairs can greatly improve the mobility and independence of the disabled, but many potential users in care homes are denied access due to safety concerns. Collision avoidance systems are needed for powered chairs to increase safety and allow many more people access to the enhanced quality of life they can provide.

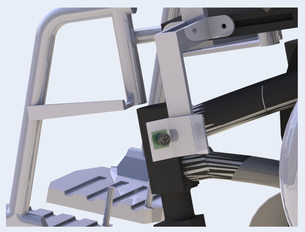
Our Objectives

- Provide a low-cost system to the end-user — Cost is sensitive to many potential users and powered chairs are expensive enough as it is
- Effective collision avoidance — Must be a very dependable system for care homes to consider allowing patients access
- Integrates with an existing wheelchair model — No need to redesign from scratch

Mechanical



The Kinect is mounted via a quick-release mechanism on a custom-designed tray in front of the user. The tray flips up to allow the user to enter or exit the chair.



The sonar sensor mounts place the sensors in the optimal location and orientation to detect nearby obstacles around the sides of the chair.

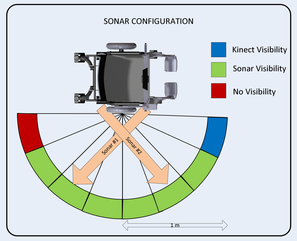
The Sensors

Kinect

(http://www.primesense.com/images/technology/PrimeSensor-Depth_Diagram.gif)

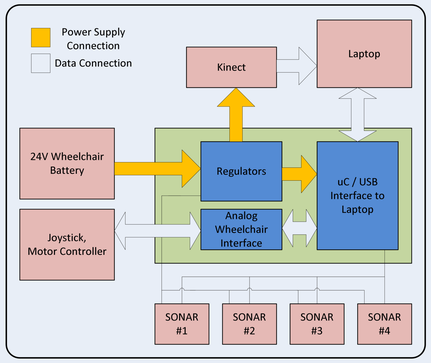
The Kinect depth sensor provides precision obstacle detection for the area in the front of the user. This is the main sensor used for obstacle detection.

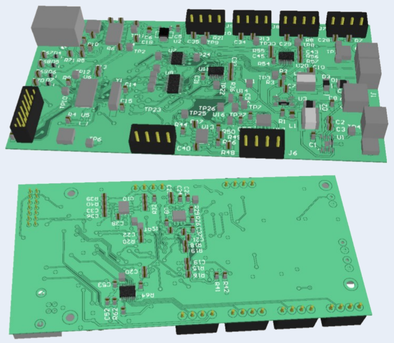
SONAR



Sonar sensors are cheap and provide coarse obstacle detection around the sides of the chair. They provide basic information about whether it is safe to turn.

Electronics





A custom PCB allows the chair, laptop, and sensors to be interconnected. The PCB is responsible for the following tasks:

- Providing 12V/5V power for the Kinect and sonar sensors from the wheelchair's lead-acid battery pack
- Aggregating sonar sensor data and joystick input from user into a single USB stream for laptop
- Sending movement commands to the wheelchair's motor controller

Acknowledgements

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