Driving Miss Daisy
EEL 5666 IMDL
Formal Report 1

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Abstract

Driving Miss Daisy (DMD) will be an autonomous wheelchair designed to assist with day-to-day transportation, including mobility inside a house or apartment. DMD is targeted for the elderly or disabled who have limited coordination and have difficulty manipulating a joystick but can be used by any wheelchair user for safety and convenience. DMD will use several sonar sensors for obstacle avoidance, a series of CdS cells and a compass for mapping, a wireless interface to a laptop for navigation tracking and control and a joystick for user interaction.

Introduction

DMD will primarily function in one of two modes – user driven and destination driven. In both modes, DMD and the user work together to steer the platform through either a known space (the house) or an unknown space. In the house, certain locations such as the kitchen or front door are known but the locations of obstacles are not known.

In user mode, the user drives wherever they want and DMD only takes over if necessary to prevent collisions. If DMD has to take over the steering it will try to preserve the original intent or direction that the user was trying to achieve.

In destination mode, DMD tries to navigate around obstacles to reach a specific destination that the user requested (within the house). The user may modify the route at any time by manipulating the joystick but once control is given back to DMD, the original destination will be targeted.

Integrated System

Position Tracking

DMD will be designed to assist with navigation in any "tiled" house or apartment using the "grout" lines to track position. The current position of the DMD will be calculated using a line of 4-6 CdS cells and a compass. As DMD travels over the grid the CdS cells will sense whenever a grid line has been crossed. The current compass reading along with the order in which the CdS cells cross will allow DMD to determine its current position relative to the grid squares.

Wireless Control

A wireless interface such as XBee, ANT or Bluetooth with be used to update a corresponding grid map on a laptop with DMD's current position. The user will be able to click on other grid squares on the laptop to move to other positions such as the kitchen, front door or bathroom. Clicking on a grid square will tell the DMD to switch to the destination mode. Clicking again on the current square will effectively cancel the destination mode.

Navigation

User Mode

In user mode DMD allows the user to pick a desired direction on the fly (along with speed) using the joystick. If a potential collision is detected, DMD will slow down and help the user turn around the object.

For example, if the user is about to run into a table with the joystick in the forward position, DMD will understand that the user wants to go forward and will attempt to go in that direction by going around the table. If the user keeps the joystick in the forward position, the DMD will go entirely around the table and then start going in the proper direction. If the user doesn't keep the joystick in that position the DMD will surrender control as long as the user doesn't collide with the obstacle.

Destination Mode

If DMD is navigating the user may use the joystick to help with obstacle avoidance or control speed. The joystick input in this mode is possible but not necessary.

Support for Off-Grid Mobility

If the user directs DMD to drive off the grid, the user will have to navigate to a known grid square before using automatic navigational features again. DMD will detect that the grid is missing by estimating when a grid line should have been passed using a motor encoder. As soon as the grid is missing, DMD will notify the laptop that it is lost and the laptop will wait for a location update from the user before allowing automatic navigation.

Mobile Platform

The mobile platform will be mostly donated. A friend of mine, Andy Thon, used to work for the school board leading the robot teams so I should be able to get one of two mobile platforms from him. The platforms are complete with motors and motor drivers so either way most of the platform work should be done.

Sensors

My current plan includes the following sensors:

- Bump sensor
- Sonar (4 to 6)
- CdS cells (4 to 6)
- Compass
- Wireless interface with laptop (XBee, ANT, or Bluetooth)
- Joystick
- Motor encoder (optional?)