CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36717

Project Title

Autonomous Smartphone-Controlled Robotic Wheelchair with Beacon-Assisted Navigation

Abstract

Objectives/Goals

With the aging U.S. population, use of assistive devices by people with mobility impairments has been increasing rapidly. My objective in this project is to design and prototype a highly autonomous wheelchair robot using readily available and low-cost technologies. The wheelchair is controlled by an Android app running on the user's smartphone, which can accept voice commands and navigate autonomously to a specified destination in an indoor environment. The wheelchair makes use of Bluetooth Beacons to identify its location and download navigation data from the cloud, thus avoiding the need to store location data in the smartphone and eliminating the need to train the system in an unfamiliar environment. Such a wheelchair can significantly improve the quality of life for the elderly and the disabled by eliminating injuries from collisions, as well as enabling them to navigate through airports, shopping malls, etc. without assistance.

Methods/Materials

I have designed and built a prototype of the wheelchair robot using off-the-shelf parts. The robot is equipped with an array of sensors, including a LIDAR. An Arduino Due board controls the motors and sensors and performs steering and obstacle detection. Autonomous navigation is performed by an Android app running on a smartphone. I developed both the control software running on the Arduino, as well as the Android app. The app identifies the location of the wheelchair by monitoring Bluetooth Beacons in its vicinity, which is then used to obtain path information to the desired destination from the cloud. My software also supports a semi-autonomous mode in which the user can steer the robot using voice commands.

Results

I have tested the ability of the smartphone app to detect the beacons and navigate the robot by deploying five Bluetooth Beacons along the desired path in my school. The wheelchair controller is also able to steer around obstructions using the LIDAR and other sensors. By incorporating a remote control and monitoring capability where a second smartphone can control and monitor the wheelchair through a WiFi link, I was able to safely deploy the robot and collect real-time data from it.

Conclusions/Discussion

My results show that it is possible to design a wheelchair that can autonomously navigate in an indoor environment without training. My software can be ported to a full-size wheelchair with minimal changes.

Summary Statement

I developed a self-navigating robotic wheelchair controlled by a smartphone app and Bluetooth Beacon technology.

Help Received

None. I designed, built, and tested the robot myself.