Blind Area Detection for Safe and Comfortable Navigation of Robotic Wheelchairs

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1. Introduction

With the increasing size of elderly population being reported in many developed countries, demand for more robotic assistive systems for people with physical disabilities is expected to increase. Assistive robotics can improve the quality of life for disabled people. One particularly useful type of robot is a wheelchair robot that can autonomously navigate through hallways. Our aim is to make a wheelchair which can autonomously move through both known and unknown environments. Blind area detection is one important issue for safe navigation of wheelchair robots.

2. Blind areas perspective of robotic wheelchairs

To be useful as a mobility assistant for a human driver, an intelligent robotic wheelchair must be able to distinguish between safe and hazardous regions in its immediate environment. Blind area detection is one of them. A blind area is a region, which is occluded from the robot's sensors (Fig.1). As a result, the robot cannot make decisions, as whether there are any hazards or not. While riding autonomously, wheelchair user may feel discomfort because of uncertainty to face blind area. Thus, it is important to detect blind areas to ensure safe and comfortable navigation for the user.

Fig 1. Example of blind area

3. Proposed methods

In our work, we propose an approach for detecting blind areas in indoor environments. In our system, we use the Hokuyo 30LX laser range sensor for sensing the environment. The distance data is projected into 2D and we apply the Hough transformation algorithm to extract the lines from the data points. Fig. 2 shows the proposed method where we apply the Hough transformation for finding the line segment through a given straight path corridor. We claculate the distribution of data points and use wheelchair position to designate the "observed area" in the environment. We set the original environmental laser map onto the detected line segment of the observed area for finding blind or non-visible area. When our system detect blind area, while moving through in an indoor corridor it will send an alert to wheelchair users by using a beep and visual indication on the user display.

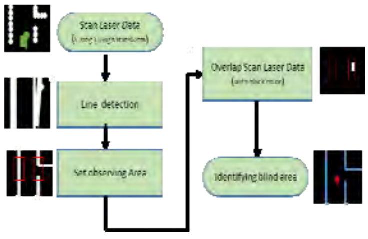

Fig 2. Flow of Our System

Fig. 3 shows the results from our system. The right upper figure shows the line of the corridor that was detected using the Hough line algorithm. The mask image in the bottom left shows the determined observed area from our analyzer. When our system detects a blind area approaching, a red circle appears on the screen and also plays beep sound to bring attention to the users.

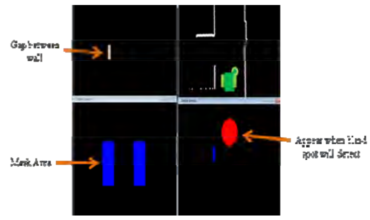
Fig 3.　Result from our Blind Area Detection System

4. Conclusion and Future work

This paper presented an approach for identifying of blind area for safe and comfortable navigation of robotic wheelchairs. Future work will consist of the implementation of a path planner and displaying critical information about blind areas that include the information and characteristic of the surrounding area. We also have aim to develop a method for measuring degree of safety and comfortability of wheelchair user.

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Reference

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