Chapter 1

Introduction

1.1 Introduction

In the past two decades, many great improvements have been introduced in the field of robotics and many competitions all over the world have been made such as the international RoboCup competition [1] that was founded in 1993, and the DARPA Grand Challenge competition for autonomous cars [2] sponsored by the Defense Advanced Research Projects Agency (DARPA) in the U.S. These competitions have inspired many academic institutions to move into the field of autonomous robotics. There are many problems and challenges that are still open for researcher to solve and to enhance.

1.2 Research Motivation

Mobile Robots are now expected to be the next generation for assisting elderly and disabled persons as they present huge contributions in many industrial areas such as production lines at factories, surveillance systems, AGVs (autonomous guided vehicles), and indoor cleaning machines. One of the most researched areas in assistive technology is the development of intelligent wheelchairs.

Intelligent wheelchairs are constructed by integrating artificial intelligence methods into a robotic wheelchair which has the ability to safely transport users to their desired destination. This work was originally inspired by the need for robotic assistance to contribute in developing an intelligent system to assist users with disabilities in core day-to-day activities.

There are many ways that the intelligent wheelchairs could help elderly and disabled persons like transporting them from place to place, following someone to his destination, detecting and opening doors and avoiding any obstacles in the way to the desired destination.

1.3 Related Work

Vision-based robot navigation systems allow a robot to explore and to navigate in its environment in a way that facilitates path planning and goal-oriented tasks. The vision sensor will be mainly used for obstacle detection and avoidance, object detection and tracking, and interaction with users. Usually these systems do not depend solely on vision sensors but use other sensors like sonar and laser range finder.

Many vision-based robot navigation systems have been developed in the last years which allow the robot to move in its environment and to deal with the required tasks.

Yuki Ono, Walter D. Potter [3] used a robot equipped with a minimal set of sensors such as a camera and infrared sensors, their multi-agent based control system is built to tackle various problems encountered during corridor navigation.

Takeshi Saitoh, Naoya Tada, and Ryosuke Konishi [4] proposed the appearance based method for detecting two boundary lines between the wall and corridor and detecting the obstacles between them using the image processing based on monocular vision. Moreover, the proposed method was implemented in a wheelchair based indoor mobile robot.

D. Santosh, Supreeth Achar, and C.V. Jawahar [5] presented a novel image-based exploration algorithm. The algorithm facilitates a mobile robot equipped only with a monocular pan-tilt camera to autonomously explore an indoor environment. The algorithm inferred frontier information directly from the images and displaces the robot towards regions that are informative for navigation. The frontiers were detected using a geometric context-based segmentation scheme that exploits the natural scene structure in indoor environments. In the due process, a topological graph of the workspace is built in terms of images which can be subsequently utilized for the tasks of localization, path planning and navigation.

Eric Stephen Olson [6] presented a software interface which allows several open- and closed-loop control methods to be easily implemented. He used a hanged vision system to guide the robot in

the environment from its position to a destination point using PD control algorithm. The software is implemented in LabVIEW.

James Bruce, Ucker Balch, and Anuela Veloso [7] presented a new system for real-time segmentation of color images. It could classify each pixel in a full resolution captured color image, find and merge regions of up to 32 colors, and report their centroid, bounding box and area at 30 Hz. The primary contribution of this system was that it was a software-only approach implemented on general purpose, inexpensive, hardware (350MHz or 700MHz x86 compatible systems with $200 image digitizers). Among full frame processing systems, this provided a significant advantage over more expensive hardware-only solutions, or other slower software approaches.

Mohamed H.Saad [8] presented a system for the precise object tracking under deformation such as scaling, rotation, noise, blurring and change of illumination. This research is a trail to solve these serious problems in visual object tracking by which the quality of the overall system will be improved. The presented research work is applied to real video stream and achieved high precession results.

Juan Fasola, Paul E. Rybski [9] introduced an algorithm for navigating to a goal while avoiding obstacles for an autonomous robot, in particular the Sony AIBO robot. The algorithm makes use of the robot’s single monocular camera for both localization and obstacle detection. The algorithm is built upon a method for representing free-space around the robot that was previously

developed for use on the AIBO robot. The algorithm alternates between two different navigation modes. When the area in front of the robot is unobstructed, the robot navigates straight towards the goal. When the path is obstructed, the robot follows the contours of the obstacles until the way is clear. They showed how the algorithm operates in several different experimental environments and provide an analysis of its performance.

Zsolt MikloÂs, KovaÂ cs-Vajna [10] proposed approaches for RGB to YCbCr conversion because they discovered that processing an image in the RGB color space, with a set of RGB values for each pixel is not the most efficient method. They used YCbCr to speed up some processing steps for broadcasting, video and imaging standards.

Pantelis Elinas, Jesse Hoey, Darrell Lahey, Jefferson D. Montgomery, Don Murray, Stephen Se, and James J. Little [11] presented a visually guided autonomous serving robot “Jos'e”. Mapping, localization and navigation issues which have been the focus of recent research in their laboratory were discussed. Human-robot interaction and serving issues were also covered. Their results showed that Jose was capable waiter, combining effective robotic techniques with panache and wit, and the delicate savoir-faire of an elite waiter.

Rafael García-Campos, Joan Batlle, and Rainer Bischoff [12] presented a robust specialized architecture for real time tracking,