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Mobile Robot for Object Detection Using Image Processing

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Abstract - This paper describes a robotic application that tracks a moving object by utilizing a mobile robot with sensors and image processing. The robotic platform uses a visual camera to sense the movement of the desired object and a range sensor to help the robot detect and then avoid obstacles in real time while continuing to detect and follow the desired object. In terms of real-time obstacle avoidance capacity, this paper also presents an algorithm for this robotic application specifically. Experimental results show that the robotic and intelligent system can fulfill the requirements for detecting an object and avoiding obstacles simultaneously.

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Abstract - This paper describes a robotic application that tracks a moving object by utilizing a mobile robot with sensors and image processing. The robotic platform uses a visual camera to sense the movement of the desired object and a range sensor to help the robot detect and then avoid obstacles in real time while continuing to detect and follow the desired object. In terms of real-time obstacle avoidance capacity, this paper also presents an algorithm for this robotic application specifically. Experimental results show that the robotic and intelligent system can fulfill the requirements for detecting an object and avoiding obstacles simultaneously.

I. Introduction

Video tracking, surveillance systems, and robotic platforms are fields that have been well studied in the past decade. However, in the majority of surveillance and video tracking systems, the sensors are stationary. The stationary systems require the desired object to stay within the surveillance range of the system. If the object goes beyond this range.

It no longer becomes tractable. One solution to this problem is to design the system as a mobile system that uses a infrared range sensor, and a visual-spectrum camera, to track the object and avoid obstacles . This research topic has been partially studied in several different areas. Studies made by the automotive industry in this area develop systems that assist a human driver for safety and comfort . NASA has applied this to help astronauts to carry more equipment while walking on the moon . These systems are primarily concerned with object tracking, and the obstacle avoidance problem.

The contributions of this paper are to present a mobile robotic system which can simultaneously detect an object and avoid obstacles in real-time. We first introduce the system architecture, then present strategy for object detection, obstacle detection, obstacle avoidance mechanism and robot control. Finally, the experiment and conclusion will be addressed.

II. System Architecture

In general, the overall system consists of five main phases: image input, object detection, obstacle detection, obstacle avoidance and robot mobility phase. If no obstacles are detected, then system skips the obstacle avoidance phase, and only uses four phases. The following sections explain how each phase works individually, and how the various phases work in conjunction with each other.

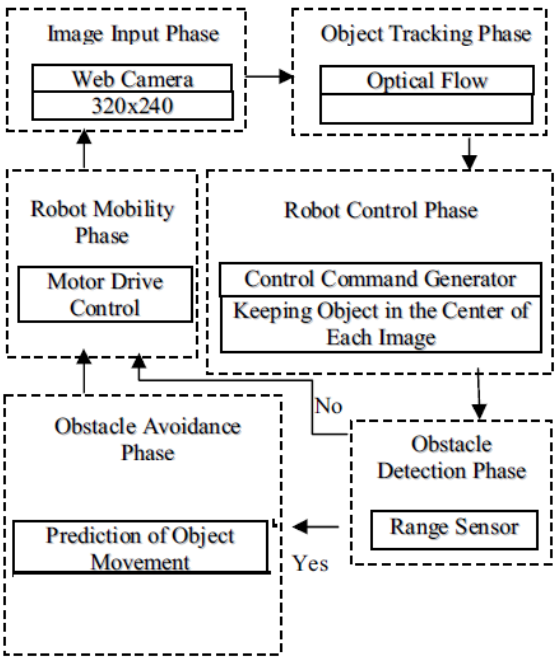

Figure 1: This block diagram shows the overall system

a) Image Input Phase

The Logitech Web Camera has a fixed view and is attached to the robotic platform. It is used to acquire color 640x420 images. The camera is tasked to capture the object image.

b) Object Detection

In this system we have one webcam which is placed on the robot platform. Webcam captures the image and stores it on hard disk. In computer system preprocessing is done on the image to convert it into gray scale image. After this we find region for an object. On the basis of this region we compare the image with previously stored image. If the image matches with the one stored on the hard disk then robot moves in forward direction towards the object. If images doesn't match robot rotates using castroy wheel and repeats the process. First convert an image to gray scale, find gradient, boost the image. Then develop histogram from gray scaled image to find the region desired region of object.

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c) Robot Control Phase

If captured image matches with the image of an object then character "V" is sent indicating that required object has found & robot moves towards the object. If there is no match between captured image and destination image then character "A" is sent indicating that required object was not found. In such case robot takes a left turn. It keeps capturing and comparing the images until the captured image matches with the destination image.

d) Obstacle Detection Phase

IR sensor is mounted on the robot for obstacle detection . Whenever an IR sensor detects an obstacle, LED on IR sensor glows. Corresponding data is sent to microcontroller due to this robot moves backwards and then takes a left turn so that it can avoid the obstacle and find a new path.

e) Obstacle Avoidance Phase

Whenever an IR sensor detects an obstacle, LED on IR sensor glows. Corresponding data is sent to microcontroller due to this robot moves backwards and then takes a left turn so that it can avoid the obstacle and find a new path.

III. Platform

Figure shows the entire system including the web camera, IR sensor and robotic platform. Robot mobility is achieved through two wheels at back and one castroy wheel at front. Motion can be controlled directly by a computer system sending motion commands to the motors via RF module signal. Web Camera IR Sensor RF Module Computer.

a) Board

PIC16F877A microcontroller is used for robot computing system. Interfacing of microcontroller and LCD is done for validation purpose. The code to control is developed using MPLAB C. This software is retargeted specifically for PIC16F877A microcontroller.

b) Wireless Transmission

Wireless transmission is done through RF module CC2500 which is interfaced with microcontroller and connected to computer system.

c) Motor Driver System

Motor driver system consists of two DC motors and L239D motor driver IC.

d) Power Supply

Rechargeble batteries are used for power supply. Batteries provide clean reliable power supply and can be recharged. 12V power supply is required for robot to work and 9V is required for RF module to work. So we are using 12V and 9V batteries.

IV. Conclusion

Thus we have implemented Robotic Application which will detect the objects and avoid the obstacles. The application we have developed is a Desktop Application in that the user gives a command to capture image .This image is stored as destination image. After that user gives command to start the robot which will capture the image. This newly captured image will be compared with the destination image.Comparison will give a conclusion wheather the captured image matches with the destination image or not. This system compares the images using regionwise comparison. The system is implemented using J2EE, Java Swing and proteus technologies.

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