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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 track and follow the desired object. In terms of real-time obstacle avoidance capacity, this paper also presents a algorithm for this robotic application specifically. Experimental results show that the robotic and intelligent system can fulfill the requirements of tracking an object and avoiding obstacles simultaneously.***

Keywords: Mobility, Obstacles, Robot, Detection, Sensor, Tracking.

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 an 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 or 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 track an object and avoid obstacles in real-time. We first introduce the system architecture, then present the object tracking strategy, obstacle detection and avoidance mechanism, and robot control. Finally, the experiment and conclusion will be addressed.

II. SYSTEM ARCHITECTURE

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

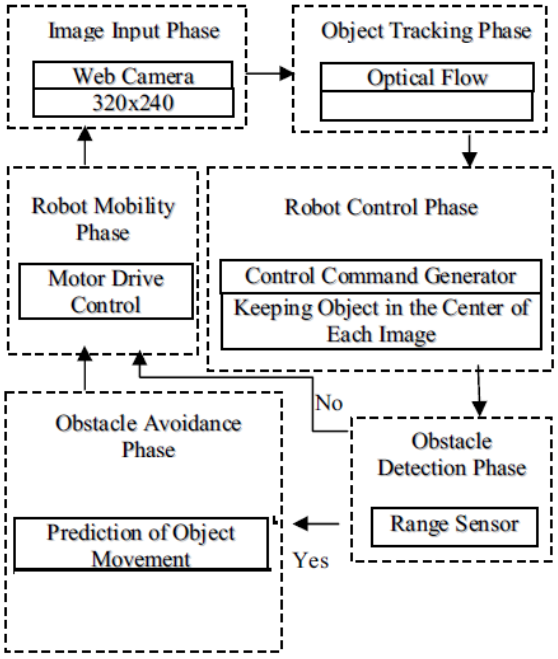


Figure 1. This block diagram shows the overall system.

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 store image on hard disk. In computer system we pre-process the image and convert it into gray scale. After this we find region for an object. After that on the basis of region we compare the image with previously stored image. If the image matches with the one stored on the hard disk then move the robot in forward direction towards the object. If image doesn't match rotate the robot and capture image and repeat the process. First convert an image to gray scale. Then find gradient, after that boost the image, then histogram from gray scaled image. Then we have to find the region.

C. *Robot Control Phase*

If object image is matched with captured image then character "V" is sent indicating that required object has found & robot moves towards the object. If object image is not matched with captured image then character "A" is sent indicating that required object was not found & robot takes a left turn & continues to find objects.

D. *Obstacle Detection Phase*

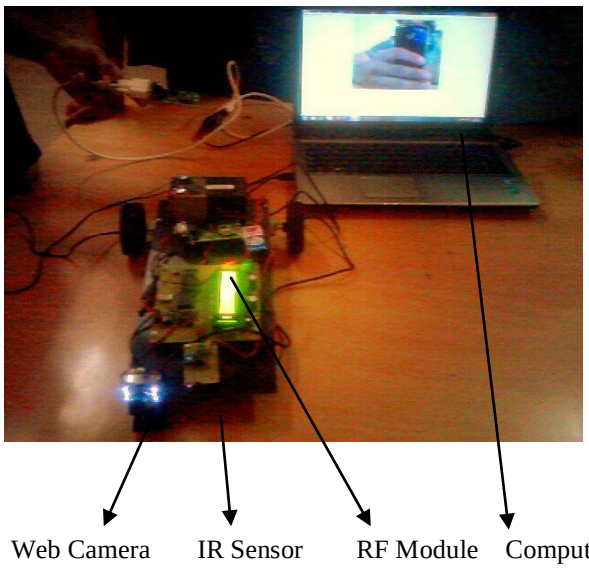
IR sensor is mounted on the robot and whenever any obstacle is detected LED on IR sensor glows and corresponding data is sent to the microcontroller and the robot moves back word and then takes a left turn.

E. *Obstacle Avoidance Phase*

Whenever obstacle is detected LED on IR sensor glows and it sends 1 to microcontroller and robot moves backward and takes left turn.

III. PLATFORM

The figure shows the entire system, including the web camera, IR sensor, and robotic platform. Robotic mobility is accomplished through two wheels at back and one castroy wheel at front. Motion can be controlled directly by a computer sending motion commands into the motors via RF module signal.



A. Board

PIC16F877A microcontroller is used for the robot computing system. Interfacing of the 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 the computer system.

C. Motor Driver System

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

D. Power Supply

Rechargeable batteries for power supply. Batteries provide clean, reliable power and allow reuse of batteries when discharged.

12V batteries are required for robots to work and 9V batteries are required for RF module to work.

IV. CONCLUSION

Thus we have implemented Robotic Application which will track the objects and avoid the obstacle.

The application we have developed is a Desktop Application in that the user gives the command to capture images .After that user gives command start robot which will capture the image that image will compared with the user image. On that result we conclude the object match or not. Our System compares the images of the object with previously stored image by the region wise matching. The system is implemented using J2EE, Java Swing and proteus technologies.

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