DESIGN AND DEVELOPMENT OF AN OBSTACLE AVOIDING ROBO-CAR

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Abstract

A real-time obstacle avoidance ROBO-CAR has been designed using microcontroller. A dynamic algorithm is designed that directs the robot to navigate smoothly in any flat environments, avoiding obstacles. The obstacle detection scheme is based on an ultrasonic sensor. The microcontroller takes input from the sensor and then compares the input with predefined reference. Then it gives input to the two h-bridges that in turn direct the motors to control the movement of the robo- car. Here, the car moves continuously forward and avoid obstacles by stopping and steering away immediately.

***Keywords*— microcontroller, autonomous robo-car,self-navigation, real time performance, obstacle detection**

Introduction

In robotics, autonomous wheeled robot is known as robo-car. One of the basic functions of a robo-car is to detect and avoid obstacles. Ultrasonic sensing system is a commonly used technique to detect and measure distance from obstacles. The aim of this project is to design & develop obstacle avoiding robo-car.

A. Objectives

The main objective is to detect obstacles and avoid it. For this purpose an efficient algorithm is designed & developed. Then the robo-car is tested in any flat environment at real time.

B. Robot Criteria

To be a robot a hardware should have some kind of mechanical construction. It must be designed to achieve a particular task. It must be have some electrical components containing computer programming code. [8]

Methods

In this project three-control mechanisms are used to work together in the whole system.

a. obstacle detection & avoidance control using ultrasonic sensor
b. controlling wheels movement by motor driver board
c. rotating the sensor using servo motor

As a whole ARDUINO UNO controls this three mechanism. The power is given for the system by two 3.7-volt Li-ion batteries using in series.

A. obstacle detection and avoiding system

Ultrasonic sensor based Obstacle Avoidance system is divided into two parts. They are obstacle detection and avoidance system. Sensor radiates a pulse signal, **ST** (transmitted signal) to the object and then receives a reflection signal, **SR** (reflected signal) back to sensor. The distance is measured by calculating the reflection time interval between the target and sensor as shown in Figure 1.

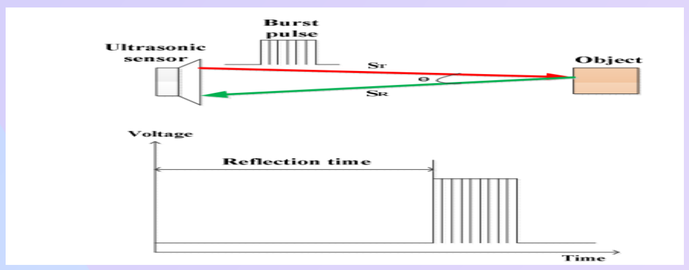


Figure 1: Distance measurement process using ultrasonic sensor [5][6]

B. Motor Driver Board (L293D IC)

Motor driver board is used to control a set of two DC motors simultaneously in any direction. It works on the concept of H-bridge. A H-bridge consists of four transistors which acts as switch. In Figure2 it is seen that the circuit has four switches S1, S2, S3 and S4 . According to turn these switches ON and OFF dc motors are driven in different ways.[3][4]

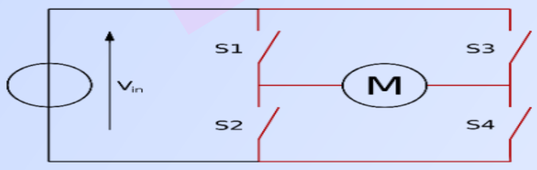


Figure 2: H-bridge operation

Table 1
Movement of Motor with H-bridge

Switch ON	Switch OFF	Motor State
S1,S4	S2,S3	Clockwise
S3,S2	S1,S4	Anticlockwise
S1,S3	S2,S4	Stop
	S1,S2,S3,S4	Free Wheel Drive
S1,S2 OR S3,S4		Short Circuit

C. Controlling Servo Motor

Servos are controlled by PWM pulse .The length of the pulse determines in which angle, the motor turns. A 1.5ms pulse make the motor turn to the 90-degree 1.5ms moves it to 0 degrees and any longer than 1.5ms turn the servo to 180 degrees. [1]

Procedures

The project is done under integration of software & hardware.

A. Software & Hardware Components

For implementing the robo-car the following components in Figure 3 are used

Figure3: Main Components [2]

ARDUINO software is used to code the program and upload it to the ARDUINO UNO.

B.Interfacing with Hardware & Software

Three different circuits are assembled to develop the project. The first one is the interaction between microcontroller and L293D motor driver IC. It receives signal from microcontroller and then send it to the motor driver circuit to move the wheels. The microcontroller, motor driver circuit and sensor based combined circuit is the second circuit. It will receive input signal from sensor and send it to the brain.

The third circuit is to produce PWM (Pulse Width Modulation) signal to control the servo motor to rotate the sensor.

The block diagram is shown in Figure 4

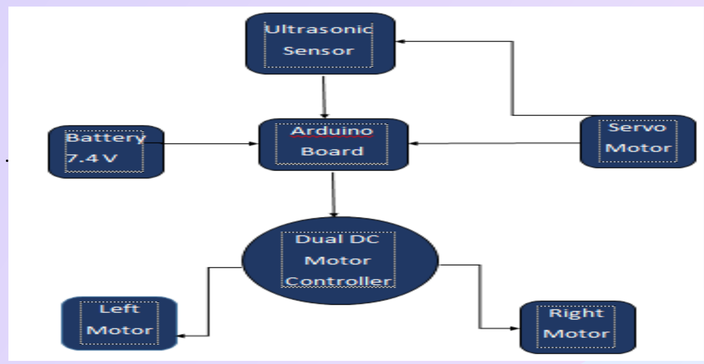
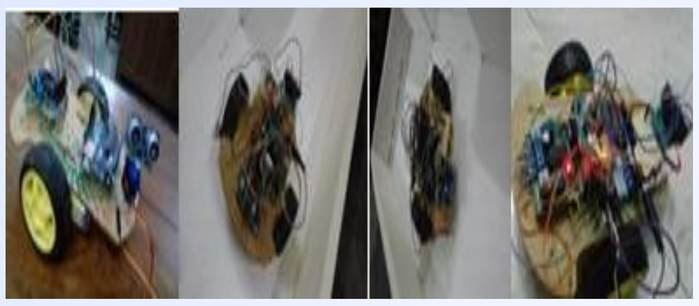


Figure4: Block Diagram of the robo-car

In Figure4 the whole system is explained . By calculating as in Figure6 sensor give input to the microcontroller. The servo motor is used to rotate the sensor in angles as in Figure7. According to the mechanism of Figure1, sensor passes signal to the ARDUINO UNO. Then after analysing the value , it sends signal to the motor controller board which controls left & right dc motors . The motors are controlled internally as Figure 2 & Table1. Wheels shown in Figure3 are attached to the dc motors. So controlling motors in turn controls wheels . According to this process the robo-car moves as the algorithm as shown in Figure5.

Results

The wheels of the robot car are tested first. There were no error. They move nicely. The initial stage & final moving stage is shown in Figure 5



Figur5:Obstacle Avoiding Robo-Car

Results (Continued)

The sensor is tested using serial monitor. It calculates the distance correctly. It shows no fault.It is shown in Figure6.

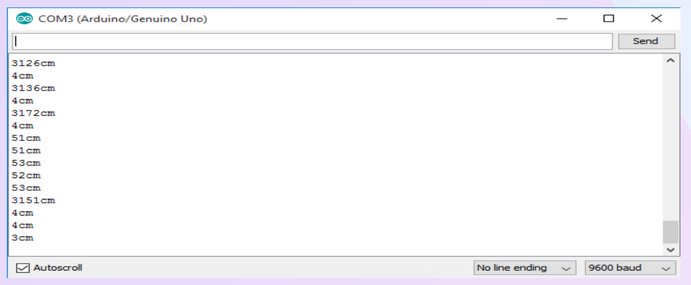


Figure 6: testing serial monitor

The servo motor is tested in real time operation. When it get 1.5ms pulse, it is turned to the 90-degree position. Shorter than 1.5ms moves it to 0 degrees and any longer than 1.5ms turn the servo to 180 degrees. So it functions well. It is explained in Figure 7.

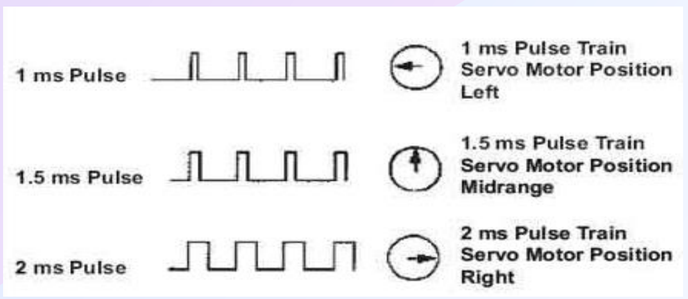


Figure 7: controlling servo motor [7]

Conclusion

The robo-car can detect obstacles and avoid them which is tested in a flat platform using ultrasonic sensing system .There are not seen any major problems. But the developed system is not suitable for rough platform. Here ARDUINO UNO is used as brain which can be changed to Raspberry Pi or other. It can be upgraded with computer vision or artificial intelligence to exhibit more intelligent behaviour. It can be upgraded to navigate any rough or complicated environment. Power source of the car can be upgraded with solar panel. As a whole the project can be further improved both as equipped with hardware components and theoretical approaches.

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