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Design and Implementation of Track Following & Obstacles Avoiding Robotics System Based on Programmable Technique

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Abstract

Line following robot detects a visual line on a smooth surface area embedded on the floor and follows it. The path line is predefined and visible with a black line on the white surface area or the opposite. A line follower robot is designed, developed and implemented on a path of black on white or white on black using IR sensor and ultrasonic for object detector. The Arduino coding is developed on using C programming and tested and verified. The proposed system can be implemented on any commercial, industrial, medical and also in educational labs.

Keywords: Line follower, Obstacle detection, IR sensor and Ultrasonic sensor.

1 Introduction

The line following robot is the self-operating intelligent machine that follows a drawn line on a floor area and the path line can be visible as black on a white surface area; or a white line on the black surface area. It is an autonomous robot which identify and tracks either on a black line in white surface area or a white line in black surface area. Line following robot must be able to detect a specified line and maintain track on it and do the assign jobs. For performing job, the given path line must be followed by the designed and developed robot for special situations. The developed system composed of input, process and output parts. First read the black/white or white/black path on considered floor and take input signal for transmission into microcontroller (Arduino UNO) in a process that can be asked and made the decisions. Microcontroller decided based on the received inputs that can change (if needed) to be made directions or speeds of the robot. It converts the result to any directions which can be sent to the line follower speed. The system sends the first or previous adjusted control signals to speed and directions of line follower robot.

To design a line follower an ultrasonic sensor is needed, which is a device that can measure distance to an object by using sound waves. It computes the distance between the object and the line follower by sending a sound wave at a specific frequency and listening for that sound wave to bounce back. It is important to understand that some objects might not be detect by ultrasonic sensor. This can be applied for military purposes, delivery services, transportation systems, blind assistive applications. Finally, there are many annual line follower robot's competitions organized by universities or industries around the world.

2 LINE FOLLOWING PRINCIPLE

Here in this line follower robot we are using two IR sensor modules left sensor and right sensor. When both left and right sensor senses white then robot move forward (Fig. 1.1). If left sensor comes on black line, then the robot turns left side in the black line. (Fig. 1.2). If right sensor sense black line, then the robot turn right side until both sensors at white surface. When white surface comes robot starts moving on forward again (Fig. 1.3). If both sensors come on black line, robot stops (Fig. 1.4).

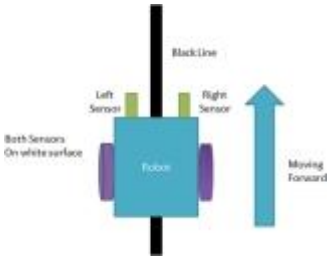

Fig 1.1: Move Forward

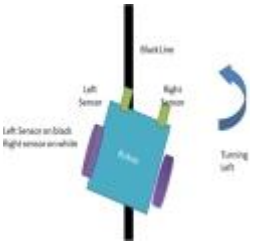

Fig 1.2: Turn Left Side

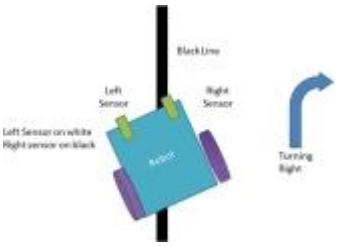

Fig 1.3: Turn Right Side

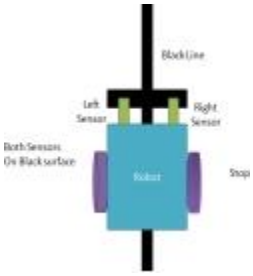

Fig 1.4: Stop

Fig. 1: Principle of Line Follower

3 PATHS OF LINE FOLLOWER

Line follower robot follows path drawn on the floor. The line will be mainly black on a white surface. If it occurs any line break on its way, the robot will go forward. If it finds a cross line, the robot will stop. Lines and robot movements can be changed by using programming code easily. Some lines are that the robot can follow:

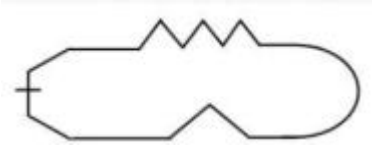

Fig. 2: Sample Path

The robot will follow a bad angle of 45° and cycle or bad curves. It will stop when it finds a cross black line.

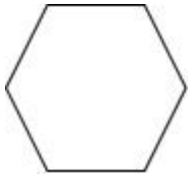

Fig. 3: Polygon Shape Path

On any kind of polygon, it can follow the line and maintain a particular speed.

Fig. 4: Cycle and Hard Curve

The line may have cycles and unwanted curves that it has to follow on narrow space or moving one room to another.

4 EXPERIMENTAL EQUIPMENT

The proposed robot is made of several components and they are: Arduino Uno R3, Arduino IDE, Ultrasonic Sensor (HC-SR04), Sonar Sensor Base, Digital IR sensor array, Motor Driver (L298N), Battery (900mAh), Two DC motors with Chassis Board, Mini Bread Board and Jumper Wires and are presented in Fig. 5.

Sonar Sensor Base

Digital IR sensor array

Motor Driver (L2 98N)

Battery (900mAh)

Two DC motors with Chassis Board

Mini Bread Board and Jumper Wires

Fig. 5: Necessary Equipment

5. CIRCUIT DIAGRAM AND CODE

A. Circuit Diagram

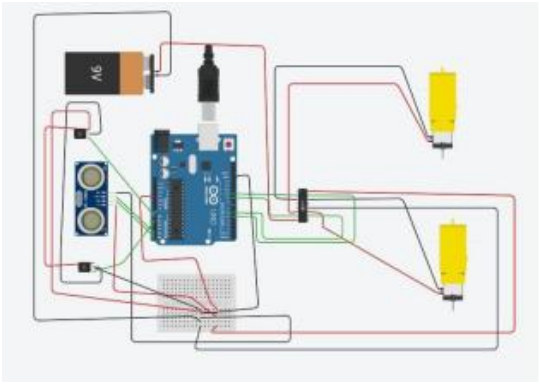

Fig.5:Diagram

A. PinConnection

Table1:Connectionbetween MotorDriverandArduino

Motor Driver	Arduino UNO
IN1	10
IN2	9
IN3	6
IN4VCC/	5
12VGND	Vin/5v
5V	GND5 V

Table1

Table 2: Connection between IRSensorandArduino

IRSensor	ArduinoUNO
Sensor 1:VCCG	VCC
NDOUT	GND
Sensor 2:VCCG	A0
NDOUT	VCC
	GND
	A1

Table2

Table 3: Connection between Ultrasonic Sensorand Arduino

Ultrasonic Sensor	ArduinoUNO
GND	GND
ECHO	A3
TRIG	A5V
VCC	CC

Table3

B. SourceCode

The complete code of the of the proposed system ispresented below
.

```
#define trigpin A5#defineechopinA4intmotor_l1=6;intmotor_l2=5;int motor_r1 =
10;int motor_r2 = 9;intspeed=115;
intfrontdist;long duration;intsetdist = 10;int L_S = A0;int R_S = A1;void
setup(){
pinMode(motor_l1,OUTPUT);pinMode(motor_l2,OUTPUT);pinMode(motor_r1,OUTPUT);pin
Mode(motor_r2,OUTPUT);pinMode(trigpin,OUTPUT);pinMode(echopin,OUTPUT);pinMode(
L_S,INPUT);pinMode(R_S,INPUT);Serial.begin(9600);delay(1000);
}
void loop(){frontdist=data();
Serial.println(frontdist);if(frontdist>setdist){
if((digitalRead(L_S) == 0) && (digitalRead(R_S) ==0){forword();}
if((digitalRead(L_S) == 0) && (digitalRead(R_S) ==1){turnRight();}
if((digitalRead(L_S) == 1) && (digitalRead(R_S) ==1){turnLeft();}
}else{turnLeft();delay(350);forword();delay(1000);turnRight();delay(200)
;forword();delay(500);
}
}
long data(){Longdata(){
digitalWrite(trigpin,LOW);delayMicroseconds(2);digitalWrite(trigpin,HIGH);delayMicrosecon
ds(10);duration=pulseIn(echopin,HIGH);returnduaration/ 29/2
}
Void stop(){analogWrite(motor_11,0);
analogWrite(motor_l2,0);
analogWrite(motor_r1,0);
analogWrite(motor_r2,0);
}
Void forward(){analogWrite(motor_11, speed);analogWrite(motor_l2,0);
analogWrite(motor_r1, 0);analogWrite(motor_r2,speed);
}
Void backword(){analogWrite(motor_11, 0);analogWrite(motor_l2,
speed);analogWrite(motor_r1,speed);analogWrite(motor_r2,0);
}
Void turnRight(){analogWrite(motor_11, 0);analogWrite(motor_l2,
speed;analogWrite(motor_r1, 0);analogWrite(motor_r2,speed);
}
Void turnLeft(){analogWrite(motor_11, speed);analogWrite(motor_l2,
0);analogWrite(motor_r1, speed);analogWrite(motor_r2,0);
}
```

6.APPLICATIONS

There are some identified application of the designed line follower robot and they are presented below:

(a)It can be used to deliver mail within an office building, industrial floor, medical ward and any robotics lab for education.

(b)It can be any mass transit system either bus stations of any airports.

(c)Line follower robots can be applied in military spy kids moving activities.

7.CONCLUSION

A line following robot is designed, developed and implemented that does not need any remote controller, Bluetooth, Wi-Fi, GSM, etc. This will run automatically with following a given line using Arduino microcontroller. This line follower robot is low cost but very effective for various purposes.

This approach can be applied in different sectors like an office building, industrial floor, medical ward and any robotics lab for education purposes.

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