# Obstacle Avoidance Robot using Ultrasonic Sensor

**Abstract:** The project is designed by using ultrasonic sensors to build an obstacle avoidance robotic vehicle. A microcontroller (ATmega328) is used to achieve the desired operation. A robot is a machine that can perform operations automatically or according to guidance. The project proposes a robotic vehicle that has intelligence built in it such that it changes its direction by itself whenever an obstacle comes in its way. Every moment by the robot is automatic. An ultrasonic sensor is used to detect any obstacle ahead in the way and sends a command to the micro-controller. Depending on the input signal received, the micro-controller redirects the robot to move in an alternate direction by actuating the motors which are interfaced to it through a motor driver.

## INTRODUCTION

The Obstacle avoidance Robot is designed in order to navigate the robot in unknown environment by avoiding collisions. The robot avoids the obstacles senses in the path and resumes its running. There are some very popular methods for robot navigation like wall-following, edge detection, line following and many more. A disadvantage with obstacle avoidance based on edge detecting is the need of the robot to stop in front of an obstacle in order to provide a more accurate measurement. All mobile robots feature some kind of collision avoidance, ranging from primitive algorithms that detect an obstacle and stop the robot in order to avoid a collision, using some sophisticated algorithms that enable the robot to detour obstacles. The latter algorithms are more complex, since they involve detection of an obstacle as well as some kind of quantitative measurements concerning the obstacle's dimensions.
Once these have been determined, the obstacle avoidance algorithm needs to steer the robot around the obstacle and resume motion toward the original target. The steering algorithm ensures that the robot does not have to stop in front of an obstacle during its navigation. An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the micro-controller Hence the robots may overcome some of the problems during navigation, which are discussed above and it can navigate smoothly during its operation avoiding the collisions.

If we were use the IR sensor Infrared sensors detect the object's distance with infrared radiation. When the beam detects an object, the light beam returns to the receiver with an angle after reflection there is a limitation in sensor those limitations are Performance of IR sensors has been limited by their poor tolerance to light reflections such as ambient light or bright object colours. No object recognition at the dead zone area, for example Sharp GP2D12 IR distance sensor dead zone between 0 to 4 cm. IR sensors also gives inaccurate detection result with transparent or bright colour materials. Detection results also depend on the weather conditions and the sensing reliability of IR sensors decreases with moisture and humidity. Furthermore, IR sensors can sense IR radiation

from the sunlight, which can cause correctable or non-correctable errors at output. Besides that, if analogue IR sensor is used, signal losses will occur at the amplifier circuit. Meanwhile, PIR motion sensor needs a long calibration time and is sensitive to thermal radiation. Besides that, PIR sensor is insensitive to very slow motions or to objects in standing mode.

**METHODLOGY**

The basic block diagram for the implementation of the project is as shown in figure1

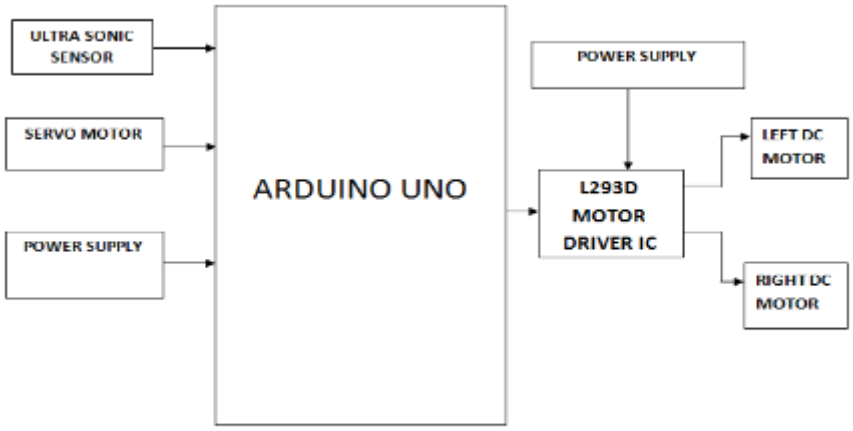



Fig. 1. Block Diagram of the system

The sonar system is used in HC-SR04 ultrasonic sensor to determine distance to an object like bats do. It offers excellent non-contact range detection from about 2 cm to 400 cm or 1feet to 13 feet. Its operation is not affected by sunlight or black material. The ultrasonic sensor emits the short and high frequency signal. If they detect any object, then they reflect back echo signal which is taken as input to the sensor through Echo pin. Firstly, user initialize Trigger and Echo pin as low and push the robot in forward direction. When obstacle is detected Echo pin will give input as high to microcontroller. Pulse In function is used for calculating the time of distance from the obstacle. Every time the function waits for pin to go high and starts timing, then timing will be stopped when pin go to low. It returns the pulse length in microseconds or when complete pulse was not received within the timeout it returns. The timing has been determined means it gives length of the pulse and will show errors in shorter pulses. Pulses from 10microseconds to 3 minutes in length are taken into consideration.

After determining the time, it converts into a distance. If the distance of object is moderate then speed of robot get reduced and will take left turn, If obstacle is present in left side then it will take right turn.

If the distance of object is short then speed of robot get reduced and will turn in backward direction and then can go in left or right direction. This robot was built with an Arduino development board on which microcontroller is placed.

TABLE I. INPUT PINS FOR MOVEMENT

| Movement | Pin10 | Pin11 | Pin 12 | Pin 13 |
|---|---|---|---|---|
| Forward | 1 | 0 | 0 | 1 |
| Backward | 0 | 1 | 1 | 0 |
| Left | 1 | 0 | 1 | 0 |
| Right | 0 | 1 | 0 | 1 |

Arduino board is connected with DC Motor through Motor driver board (pin10, pin11, pin12, pin13) which provides power to the actuators. Actuators are used to move robot in Forward, Backward, Left and Right directions. The brief description of inputs pins for movement of robot is given in below in table. The movement of robot will be stop whenever there is an obstacle is present on its path which can be detected by ultrasonic sensors. Ultrasonic sensors give time in length to the microcontroller as an input for further actions.

## Sensors For Obstacle Avoidance

Varieties of sensors are available which can be used for the detection of obstacles some of the very popular sensors are: Infrared sensors (IR), Ultrasonic sensors, Cameras, which can be used as a part of Computer Vision, Sonar. It can measure the distance in its field of view of about thousands to hundreds points In the design of robot, we are using ultrasonic sensors for obstacle detection and avoidance The ultrasonic sensors continuously emits the frequency signals, when obstacle is detected this signals are reflected back which then considered as input to the sensor.

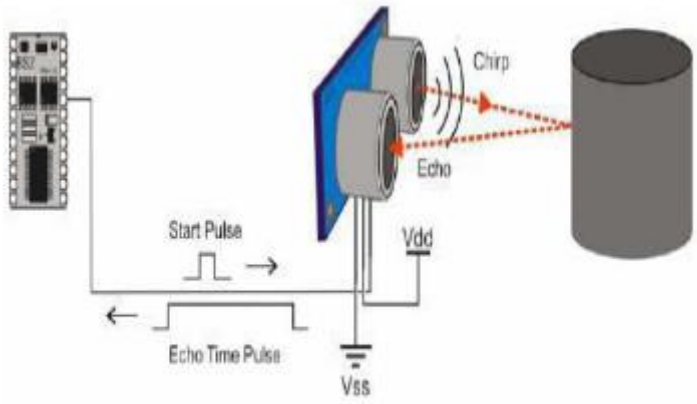
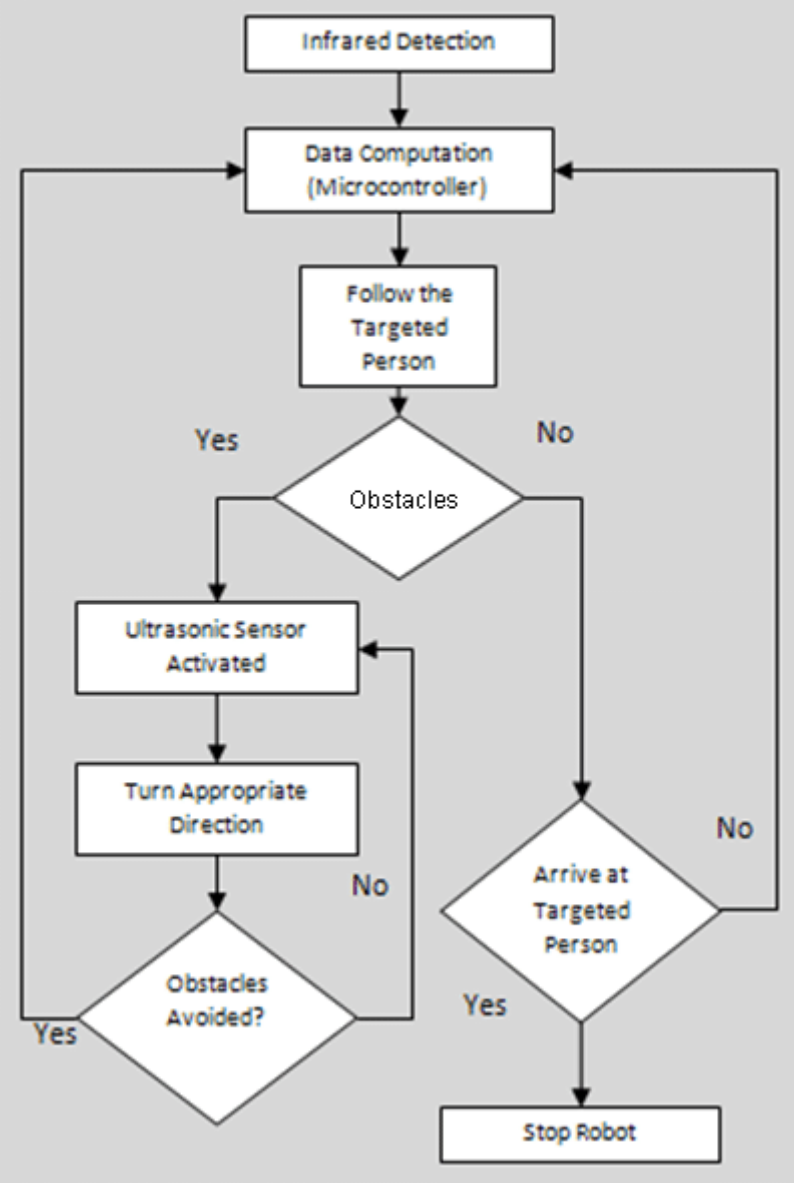


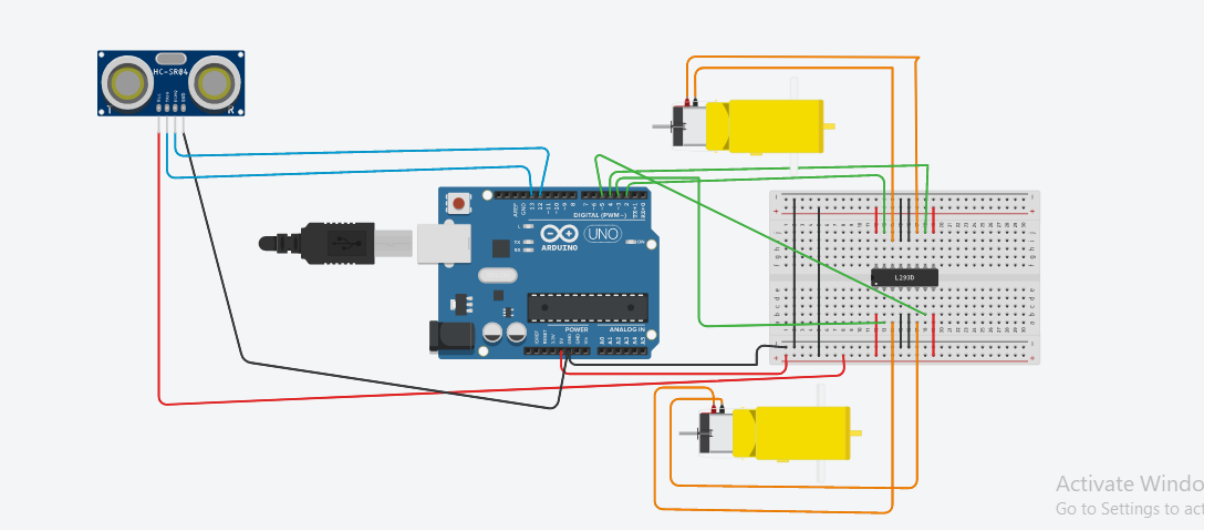

Fig. 2. Ultrasonic Sensor

The ultrasonic sensor consists of a multi vibrator, which fixed at its base. The multi vibrator is combination of a resonator and vibrator the ultrasonic waves generated by the vibration are delivers to the resonator. Ultrasonic sensor actually consists of two parts: the emitter which produces a 40 kHz sound wave and detector which detects 40 kHz sound wave and sends electrical signal back to the microcontroller. HC-SR04 ultrasonic sensors are used which consist of 4 pins VCC, Trigger, Echo and GND.

## Flow chart of obstacle avoidance robot



# Circuit Diagram




# Code:

```
const int trigPin=13;
const int echoPin=12;
const int int1=3;
const int int2=5;
const int int3=4;
const int int4=2;

void setup()
{
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(int1, OUTPUT);
  pinMode(int2, OUTPUT);
  pinMode(int3, OUTPUT);
  pinMode(int4, OUTPUT);

  Serial.begin(9600);
}
```

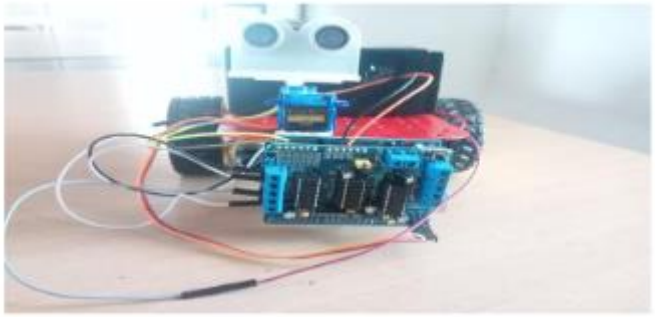
```
long duration;
int distance;

void loop()
{
 digitalWrite(trigPin, LOW);
 delay(2);
 digitalWrite(trigPin, HIGH);
 delay(10);
 digitalWrite(trigPin, LOW);
 duration = pulseIn(echoPin, HIGH);
 distance = duration * 0.034/2;
 Serial.println(distance);

 if (distance<50){
  digitalWrite(int1, LOW);
  digitalWrite(int2, HIGH);
  digitalWrite(int3, HIGH);
  digitalWrite(int4, HIGH);
 }
 else {
        digitalWrite(int1, LOW);
  digitalWrite(int2, HIGH);
  digitalWrite(int3, HIGH);
  digitalWrite(int4, HIGH);
 }
 delay(500);
}
```

## RESULT

The result is obtained for obstacle avoidance robot using Arduino, if the robot moves forward if any obstacle detect it check for other directions and moves where there is no obstacles it moves in forward direction, to sense the obstacle ultrasonic sensor is used. We used servo motor to rotate the ultrasonic sensor.



## CONCLUSION AND FUTURE SCOPE

This project developed an obstacle avoiding robot to detect and avoid obstacles in its path. The robot is built on the Arduino platform for data processing and its software counterpart helped to communicate with the robot to send parameters for guiding movement. For obstacle detection, three ultrasonic distance sensors were used that provided a wider field of detection. The robot is fully autonomous and after the initial loading of the code, it requires no user intervention during its operation. When placed in unknown environment with obstacles, it moved while avoiding all obstacles with considerable accuracy. In order to optimize the movement of the robot, we have many considerations for improvement. However, most of these ideas will cost more money and time as well. In future cameras can be used to detect the obstacle however, it is better to get CCD or industrial use ones to get clear and fast pictures. Even the ones we mentioned in the camera holder part will be better because of the special software.

## REFERENCES

[1] Amir attar, aadilansari, abhishek desai, shahid khan, dip ashrisonawale “line follower and obstacle avoidance bot using arduino” International Journal of Advanced Computational Engineering and Networking, vol. 2, pp. 740-741, August 1987.

[2] Aniket D. Adhvaryu et al “Obstacle-avoiding robot with IR and PIR motionSensors” IOP Conference Series: Materials Science and Engineering, vol. A247, pp. 529-551, April 2005.

[3] Vaghela Ankit1, Patel Jigar2, Vaghela Savan3 “Obstacle Avoidance Robotic Vehicle Using Ultrasonic Sensor, Android And Bluetooth For Obstacle Detection” International Research Journal of Engineering and Technology (IRJET), vol. A247, pp. 29-32, 2005.

[4] Paul Kinsky,Quan Zhou “Obstacle Avoidance Robot” Worcester polytechnic institute.

[5] FaizaTabassum, SusmitaLopa, Muhammad MasudTarek& Dr. Bilkis Jamal Ferdosi “obstacle avoidance car”Global Journal of Researches in Engineering: HRobotics & Nano-Tech.

[6] Bhagya shree S R , Manoj kollam “Zigbee Wireless Sensor Network For Better Interactive Industrial Automation” , proc.of IEEE ICoAC-2011,pp 304-308,2011.