

Ultrasonic Sensor Based Obstacle Avoiding Robotic Vehicle

Virender Kumar¹, Manoj Kumar², Kewal Kumar³, Saransh⁴

¹B.Tech. Mechanical Engineering (Evening) Scholar, School of Mechanical Engineering, Lingaya's Vidyapeeth, Faridabad, Haryana, India

²B.Tech. Mechanical Engineering (Evening) Scholar, School of Mechanical Engineering, Lingaya's Vidyapeeth, Faridabad, Haryana, India

³B.Tech. Mechanical Engineering (Evening) Scholar, School of Mechanical Engineering, Lingaya's Vidyapeeth, Faridabad, Haryana, India

⁴B.Tech. Mechanical Engineering (Evening) Scholar, School of Mechanical Engineering, Lingaya's Vidyapeeth, Faridabad, Haryana, India

Abstract – The purpose of this research report is to investigate the use of ultrasonic sensors in the creation of robot or vehicle obstacle avoidance systems. One of the key components of mobile robots is obstacle avoidance. Robotic movement would be very limited and delicate without it. The goal of this project is to create a robotic vehicle with built-in intelligence that can steer itself away from obstacles to prevent physical harm to the robot. This may be used to create a robotic vehicle that avoids obstacles with its movement using an ultrasonic sensor. A robotic vehicle that can avoid obstacles needs the right sensors and task-appropriate motors. The robot moves in an unidentified environment thanks to the Arduino Uno microprocessor, two DC motors, and an ultrasonic sensor. The robot's front-mounted ultrasonic sensor detects the existence of obstacles and relays the information it finds to the microcontroller. The robotic vehicle may travel in four directions: forward, backward, right, and left, depending on the information received by the controller. The primary functions of an Arduino microcontroller are vehicle control and achieving the intended detection and avoidance action.

Keywords: obstacle avoidance, DC motor, motor driver, ultrasonic sensor, Arduino UNO, etc.

1. INTRODUCTION

An intelligent machine that can recognise and avoid obstacles in its path automatically is called an obstacle-avoiding robot. The goal of the robotic discipline of obstacle avoidance is to move vehicles by using sensory data. Because of their many uses, these mobile robots are gradually becoming more numerous and sophisticated. The goal of an obstacle avoidance robot vehicle is to prevent crashes while navigating a foreign environment. Robot vehicle that avoids impediments in its route detects them, avoids them, and continues moving. It is an autonomous robot that can navigate around without running into any obstacles. In other words, it just stops travelling ahead and takes a step back when it encounters an obstruction while travelling forward. It then performs a little turn and continues travelling forward using the same loop. The foundational step of any

automated robotic vehicle is this project. We are showcasing an extremely useful robotic vehicle that avoids obstacles. This is a basic example of how complex machines and technology avoid obstacles. This robot vehicle is intelligent enough to occupy the whole available space. It is equipped with an ultrasonic sensor, which detects objects in the robotic vehicle's route. It will automatically look around for potential routes. It will go in a certain route, avoiding the obstruction in its path. The robotic car is now moving thanks to the use of two DC motors. The robot circuit is compact and simple to create. To accomplish the necessary processes, an Arduino-UNO is needed. A robot vehicle that avoids obstacles is made up of both hardware, such as motors, and software. Software uses the commands entered into the programme by the user. Our research validates that a car with integrated the capacity to navigate on its own whenever a challenge arises. This self-determining vehicle's primary need is hurdle detection. An autonomous obstacle-avoiding robot can complete the tasks without human assistance. As a result, this form of automation may be used to automobiles and other vehicles based on the needs, enabling them to detect obstacles and immediately switch to a free route to prevent accidents or other mishaps.

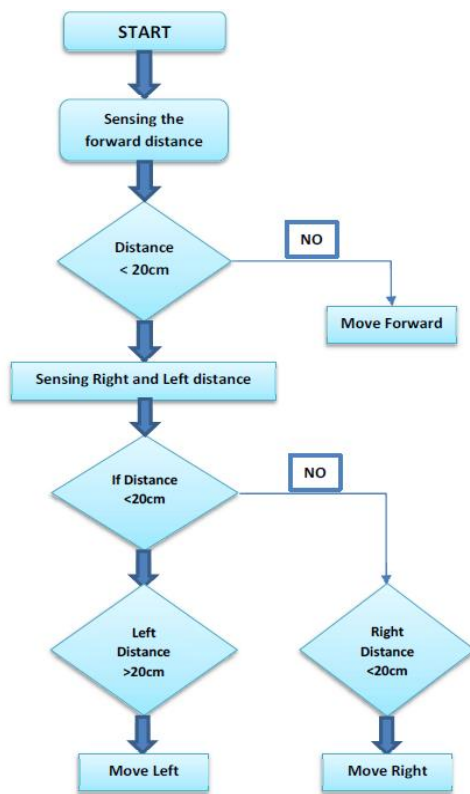


Fig. 1: Robot Vehicle with Obstacle Avoidance Flowchart

2. BASIC OPERATION

The robot vehicle is configured to find things inside the designated area. The car will veer away from the thing if it detects it. The sensor pauses when it detects an item moving and looks to see whether there are any obstacles to the left or right. It veers into the hurdle-free route if there are any obstacles in the right-side direction that are close together. The self-determining hurdle avoider acts in a similar manner in the event that an item is in the left direction. The robot employs an HC-SR04 ultrasonic sensor to identify obstacles, and an Arduino code-written motor driver drives the motor in response to the ultrasonic signal.

2.1 Hardware Parts

The following materials are being used in this robotic project:

- ❖ The Arduino UNO,
- ❖ two wheel drive robotic chassis,
- ❖ two DC BO motors,
- ❖ an L293 motor driver,
- ❖ an HC-SR04 ultrasonic sensor,
- ❖ a switch,
- ❖ nine-volt batteries and a connection,
- ❖ jumper wires, a castor,
- ❖ nuts, bolts and spacers,
- ❖ among other supporting parts and tools.

2.1.1 Overview of the Components

Ultrasonic Sensor HC-SR04: This sensor consists of a receiver and a signal generator. The signal generator broadcasts in a forward direction while producing an ultrasonic pulse. When the transmitted wave encounters an obstruction along its route, a significant portion of it is reflected. The ultrasonic gadget transmits an ultrasonic movement from the sensor and then picks up an ultrasonic signal that the body reflects back. The reflected wave is received by the recipient.

To acquire useful data (distance), the ultrasonic sensor's collected readings must be calibrated. The time it takes the wave to complete its transmission, reflection, and collecting processes is used to compute the object's distance.



Figure 2: HC-SR04 Ultrasonic Sensor Structure

Arduino UNO ATmega328P: Based on the ATmega328P, the Arduino UNO functions as a microcontroller. There are fourteen digital input/output pins on it. Six of the device's fourteen pins are used as a USB port, six analogue inputs, a power connector, an ICSP header, a reset button, a USB connection, and a 16MHz quartz crystal oscillator.

The open-source electronics platform Arduino is built on user-friendly hardware and software. An Arduino board can read an input (such as a sensor's light, a button's signal, or a signal from another sensor, etc.) and convert it to an output (such as starting a motor, turning on an LED, posting anything online, etc.). By giving the board's microprocessor a set of instructions, we may direct it what to do. We do this by using the Arduino Software (IDE) and the Arduino programming language.

In order to avoid the barrier in the project's route, a condition is added to the system that states: halt the robot, reverse its course, and restart the loop if the robot's distance from the item falls below a certain threshold. Writing code in the Arduino programming language allows this logic to be applied to the system.



Figure 3: Arduino-UNO ATmega328P microcontroller structure



Figure 5: BO Motor 100 RPM Structure

L293 Motor Driver Module: Designed to operate DC motors and stepper motors, this motor driver module has a medium power output. The well-liked L293 motor driver IC is used in it. It has the ability to turn on and off four DC motors or to regulate the direction and speed of two DC motors. .

This technique makes use of the Left Motor and the Right Motor, two BO motors. Both motors are activated in order to propel the robot vehicle ahead. Both motors must run in the opposite direction in order to take a backward stride. One motor is temporarily reversed in order to manoeuvre the robot vehicle to avoid obstacles while maintaining the other motor's forward motion.



Figure 4: Motor Driver L293 Module Structure

3. METHODS

The driver makes controlling motors, relays, and other devices from micro-controllers more easier and more straightforward. Up to 12V motors with a maximum DC current of 600mA may be driven by it. A robotic car would be ideal for this motor motorist.

The HC-SR04 project uses an ultrasonic sensor to measure an object's or obstacle's distance. Excellent characteristics of the HC-SR04 include contactless range observation from 2 to 400 cm, or 1 to 13 feet. The ultrasonic gadget would emit the frequency signal. The vehicle will return the echo signal by grasping the I/P and sending it to the sensor's direct echo pin if it detects any obstacles. When the user sets the active and echo pins to 0, the car enters forward observation. The echo pin will indicate to the microcontroller that I/P is 1 when an obstacle is detected. Pulse signals are used to quantify the time space via the hurdle. Every time the duty is held until the pin becomes large, at which point timing begins, the regulation will end when the pin gets tiny. Until the whole pulse is not captured within the allotted period, the pulse duration in microseconds is provided. Timing has a predetermined significance; it indicates the pulse's length and introduces error into brief pulses.

BO Motor: A lightweight DC geared motor with adequate torque and RPM at lower voltages is a battery-operated motor, or BO motor. This motor may be powered by a single Li-Ion battery and operate at around 100 RPM.

The pulse length, which ranges from 10 microseconds to three minutes, is taken into account. It turns into space after the time is established. If there is little room for the item, the robot will move more slowly and divert to the left; if there is a barrier to the left, the right turn is seen to be hinted at. When there is insufficient room between the deviator and the object, the vehicle slows down, reverses direction, and may go in either left or right direction under supervision.

Based on signals or I/P indicated by an ultrasonic sensor, a microcontroller controls the hurdle avoider's left, right, reverse, and forward supervision. The usage of PWM (Pulse Width Modulation) controls the speed of motors.

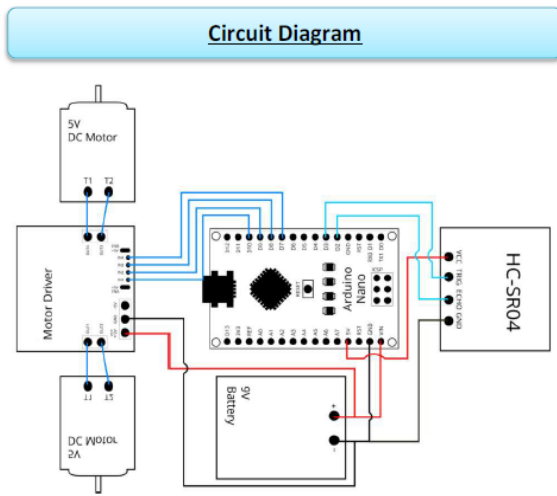


Figure 6: Obstacle Avoiding Robotic Vehicle's Working Circuit Diagram

4. OBSTACLE AVOIDING ROBOTIC VEHICLE BLOCK DIAGRAM

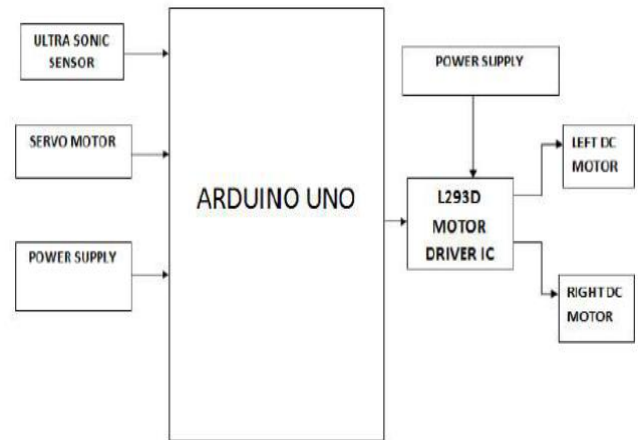


Fig.8 Block Diagram of the System

Utilising the software to help fix the HC-SR04 sensor and send signals to motor pins to move in desired area is known as obstacle avoid-er operation. In the programme plan, we first modify the trig and echo pins of the HC-SR04 ultrasonic sensor. Hardware connection trig pin nine on the Arduino panel is assigned to it, and echo pin is configured as I/P. If there is greater room, there is no obstacle and forward surveillance is possible. whether there is less room, it determines that there is a barrier in the path. The robot car then pauses to check whether there is another barrier on the opposite side, and if not, it continues on.

3.1. How the Ultrasonic Sensor (HC-SR04) Works

An increased voltage pulse applied to the ultrasonic transducer causes it to vibrate and produce sound waves. Sound waves are reflected back as a signal and produce an electric pulse when an ultrasonic sensor detects obstacles. The ultrasonic receiver will detect when the sent waves and signal from the ultrasonic transmitter hit a hurdle. When these two are combined, the car can identify obstacles in its path.

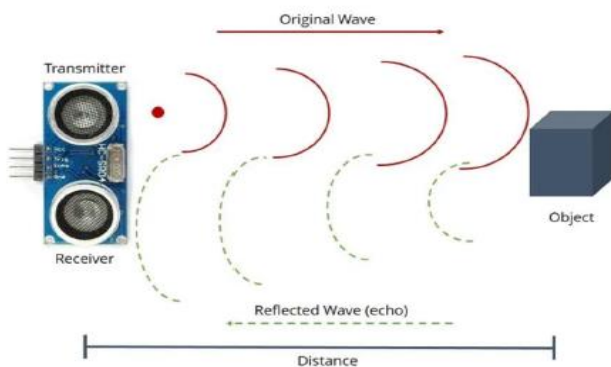


Fig. 7: Principle of Operation of an Ultrasonic Sensor

5. RESULT AND DISCUSSION

The designed vehicle has to be switched on and then the vehicle moves, as soon as the vehicle encounters any obstacle in front of it the vehicle will deviate its path from the obstacle and chose another path where obstacle doesn't exist, or the path where there is fewer obstacles.

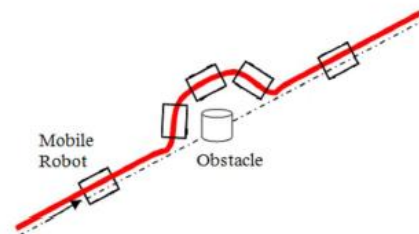


Fig. 9: The vehicle's route

6. CONCLUSIONS

In order to recognise and avoid impediments in its route, this team built a robot vehicle that can avoid them. The Arduino platform, on which the robot vehicle is based, is used for data processing, and its software equivalent assisted in communicating with the robot to provide movement-guiding parameters.

Ultrasonic sensors, which offered a larger field of detection, were employed for obstacle detection. The robot car operates entirely on its own without the need for human involvement after the programming has been loaded. When put in an unfamiliar area with impediments, it navigated with remarkable precision, avoiding every obstacle.

The evaluation of the free framework demonstrates that it can avoid obstructions, stay distant from collisions, and

change its location. It is obvious that this structure will make it much more convenient to achieve different goals with almost little human interaction. This project will be helpful in regions of the country with unfavourable climates for security and protection.

REFERENCES

- [1] Turkish Journal of Computer and Mathematics Education Vol.12 No.12 (2021), 2358-2362 research article "Obstacle Avoidance Robotic Vehicle Using HCSR04 Ultrasonic Sensor" by Shashank Venkatesh, Shiva Kundan, Alla Srija.
- [2] IOP Conference Series: Materials Science and Engineering 707 (2019) 012012 doi:10.1088/1757-899X/707/1/012012 "Obstacle detection using ultrasonic sensor for a mobile robot" by Joseph Azeta, Christian Bolu, Daniel Hinvi, and Abiodun A Abioye.
- [3] Year 2020, Volume 8, Issue 4 "Design and Development of a IOT based Obstacle Avoider Robot for Residential Applications" by Bhavya B. Agarwal, Rydham M Goyal, IGCSE J.G. International School, Ahmedabad, India.
- [4] Amir Attar, Aadilansari, Abhishek Desai, Shahid Khan, dip ashisonawale "line follower and obstacle avoidance bot using arduino" International Journal of Advanced Computational Engineering and Networking, vol. 2, pp. 740- 741. April 2017.
- [5] 2021 JETIR June 2021, Volume 8, Issue 6 OBSTACLE AVOIDING ROBOT USING using Arduino ch. vinay kumar1, B. Rakesh2 , s.shyam3 , manjula4 ECE students1,2,3 Guide name4 Electronics and communications engineering J B INSTITUTE OF ENGINEERING AND TECHNOLOGY AUTONOMOUS COLLEGE Moinabad, RR district, hyderabad-500075
- [6] J Seja and M Banshidhar 2013 Obstacle detection and avoidance by a mobile robot. National Institute of Technology, Rourkela. B.Sc. thesis. 1-9.
- [7] International Journal of Advances in Engineering and Management (IJAEM) Volume 3, Issue 7 July 2021, pp: 4094-4101 www.ijaem.net ISSN: 2395-5252 "Obstacle Avoiding Robot Car by Using GSM Modem to Get Alert Message" Yashashvi Gour1, Unnati Ninawe2, Ruchita Tetu3, Mohit Bhoge4, Prof. Mr. Harish Gorewar. 1,2,3,4,5, Department of Information Technology, KDK College of Engineering, Nagpur, Maharashtra, India.
- [8] Nat. Volatiles & Essent. Oils, 2021; 8(5): 3412-3421 "Obstacle Avoidance Robotic Vehicle" Vishwa Priya V, Gokul S, Jeevanandham M B, Sanjay Johnson W, Sri Ram R T, Surya Prakash L Robotics and Automation Engineering PSG College of Technology, Coimbatore, India.
- [9] R. Gowtham, "Obstacle Detection and Avoidance Methods for Autonomous Mobile Robot", International Journal of Science and Research, vol. 5, pp. 1245-1249, January, 2016.
- [10] An Autonomous Obstacle Avoidance Robot Using Ultrasonic Sensor Article in Journal of Computer Science and Its Application · August 2020 DOI: 10.4314/jcsia.v27i1.15 Author: Abayomi O. Agbeyangi, Olaitan Alashiri, Joseph
- [11] O. Odiete, Olujide A. Adeneken.
- [12] Obstacle Avoidance of Multi-Sensor Intelligent Robot Based on Road Sign Detection Jianwei Zhao, Jianhua Fang, Shouzhong Wang, Kun Wang,
- [13] Chengxiang Liu and Tao Han.
- [14] Arduino Robotics Copyright © 2011 by John-David Warren, Josh Adams, and Harald Molle President and Publisher: Paul Manning Lead Editor: Michelle Lowman and James Markham.
- [15] Arduino Kit "An introduction of Basic Arduino for Improve Your Knowledge" - Akshay D. Shelke.
- [16] Arduino Project Handbook. Copyright © 2016 by Mark Geddes. Publisher: William Pollock Production Editor: Serena Yang.
- [17] Cytron Technologies, Robot Head to Toe, Product User's Manual – HCSR04 Ultrasonic Sensor User's Manual V1.0 May 2013
- [18] INTERNATIONAL RESEARCH JOURNAL OF ENGINEERING AND TECHNOLOGY (IRJET) VOLUME: 07, SPECIAL ISSUE | JUNE 2020 Obstacle Avoiding Vehicle Bhuvan MS1, Manjaunath K2 1Electronics and Communication Dept., ATME College of Engineering, Mysore, India
- [19] "Obstacle Avoidance Robotic Vehicle Using Ultrasonic Sensor, Android And Bluetooth For Obstacle Detection" 1Vaghela Ankit, Dept. Of E&C Engineering, Sigma Institute & technology, Gujarat, India 2Patel Jigar, Dept. Of E&C Engineering, Sigma Institute & technology, Gujarat, India 3Vaghela Savan, Dept. Of E&C Engineering, Sigma Institute & technology, Gujarat, India