# Obstacle Avoidance Robot that uses Ultrasonic sensors and Arduino

Prof. Naresh K., Shivang Bokolia, Shreyas Gonjari, Sarthak Madaan, Yaashika Mahajan, Taranjit Bhinder

School of Computer Science and Technology

Vellore Institute of Technology, Vellore, India

naresh.k@vit.ac.in

***Abstract*— This paper presents the development and implementation of an obstacle avoidance robot and it also discusses about the implementation of neural networks and its application. The obstacle avoidance car uses an Arduino embedded platform for field sensors. For obstacle detection and avoidance there is extensive use of ultrasonic sensors. Moreover, a certain amount of research has also been done over how neural control system can be used to make human efforts much less compared to present time. This paper will also present the description on how neural networks can affect an obstacle avoidance car.**

***Keywords—neural control systems; arduino; ultrasonic sensors;***

## I. INTRODUCTION

In current times, robots have made great advancements and now are a technological boon to mankind. However, when it comes to mobile robots one of the most important and toughest problem we face is the navigation in mobile robots. The problem is worsened by the fact that conventional monitoring techniques are limited due to uncertainty of the environment in which the robot has to move. This makes it all the more important and useful to have a robot that can not only avoid obstacles but navigate them also and store the navigated path in its memory. This can be made easy by developing intelligent control strategies such as neural networks.

Consider a problem, where the vehicle is located in an environment that consists of goal and obstacles. These obstacles can be prevented using several methods. These methods may include the normal or the classical method such as route planning, etc. However coming up with these solutions and then producing an algorithm for the obtained solution is a time consuming as well as resource consuming process. On the other hand, the aforementioned problem can also be solved by Intelligent Control System based on Artificial Intelligence. These techniques may include neural network, fuzzy control, etc.

Neural Network is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurones) working in unison to solve specific problems.

Neural networks offer one of the best solutions to the problems because of their simple yet important ability to learn non-linear relationships between input values and sensor values output. A trained neural network can be considered as an expert in a specific category it has been given to analyze.

One of the major problems faced by today's world is the car accidents. Road traffic crashes rank as the 9$^{th}$ leading cause of death and account for 2.2% of all deaths globally. Nearly 1.3 million people die in road crashes each year, on average, 3,287 deaths a day. Additional 20-50 million are injured or disabled. This paper will provide with the ultimate solution that will not only help reduce accidents and road crashes, but will also help humanity come close to technology.

## II. SOME DEFINITIONS

*a) Sensors:* a device which detects or measures a physical property and records, indicates, or otherwise responds to it.

*b) Neural:* relating to a nerve or the nervous system.

*c) Artificial Intelligence:* the theory and development of computer systems able to perform tasks normally requiring human intelligence

*d) Arduino:* Arduino is an open-source electronics platform based on easy-to-use hardware and software.

*e) Ultrasonic sensor:* An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves.

## III. PROBLEM STATEMENT

This project proposes obstacle collision avoidance algorithm for a mobile robot. To navigate without colliding with obstacles the mobile robot uses both the vision system approach and edge detection approach using ultrasonic sensor. The vision system approach is used when the obstacle is located more than 2 meters away from the mobile robot and the edge detection approach using ultrasonic sensor is used for detecting obstacle remains within 2 meters range.

## IV. METHODOLOGY

This section of the paper includes the robot structure and implementation of the project.

### 4.1 Robot Construction:

The design of the robot is kept simple and light for ease of movement.

There are two large rear wheels attached to the body. These wheels are in turn attached to a motor each for enough power generation in order to propel the autonomous mobile robot at a decent pace. There is a small front wheel attached at the front, this wheel serves as a support and provides stability to the robot body. There is a single nine volt battery attached to the two motors which provides them with electrical energy and is instrumental in making the robot capable of mobility.

It has simple requirements such as:

1. A basic chassis to act as the body for 2 large rear wheels and 1 small front wheel in order to help the robot be mobile
2. A control board formed by the Arduino board
3. 2 motors to rotate the wheels
4. A 9V battery to provide electrical energy
5. A L293B motor driver for driving the motors
6. 3 Ultrasonic sensors:-
7. a)SR04 sensor left
8. b) Central SRF04 sensor
9. c) SR04 sensor right
10. A computer with Arduino software in order to write the basic code
11. Bread board to help connect Arduino to the rest of the robot
12. and jumper cables (male- male and male-female)

### 4.2 Arduino Board:

This is the central command unit of the robot. The coded program is stored in the Arduino. The Arduino in turn reads and judges the situation and reacts as instructed by the code. It is connected to the ultrasonic sensors and takes the input values from them and sends the resulting appropriate command to the output ports.

Figure 1 shows the Arduino Board used in Robot.

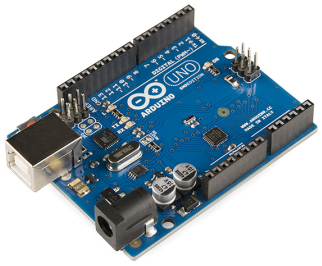


Figure 1. Arduino UNO

### 4.3 Motor Driver L293B:

The L293 is an integrated circuit motor driver that can be used for simultaneous, bi-directional control of two small motors. The L293 comes in a standard 16-pin, dual-in line integrated circuit package.

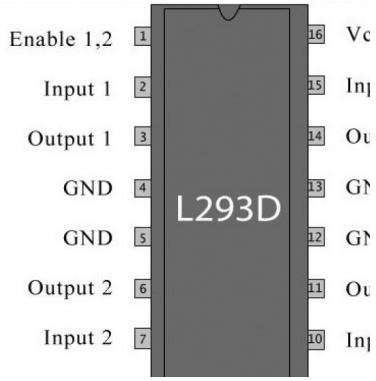


Figure 2. L293D Motor Driver

### 4.4 Ultrasonic Sensor:

These sensors use ultrasonic sound signals to detect the presence of an obstacle and relay the information to the Arduino board.


Figure 3. Ultrasonic Sensor

4.5 Gear Motor:

The Gear Motors help the wheels of the car to move forward. The motor can be tuned to move the wheels of the car in forward or reverse direction.

Figure 4. Gear Motor

4.6 Wheels:

The wheels of the Robot help the Robot to move forward or Backward depending upon the situation.

Figure 5. Wheels for Robot

4.7 Diagram of Connections:

These diagrams include all the connections that have been made inside the Robot.

Figure 6 shows the connection of Arduino and all the sensors.

Figure 7 shows the connection between Arduino and rest of the Modules.

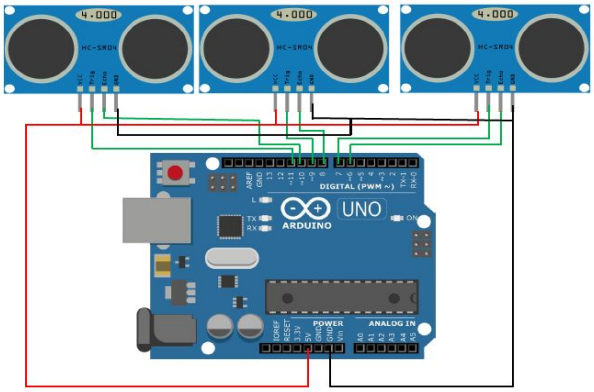


Figure 6. Connections of Arduino and sensors

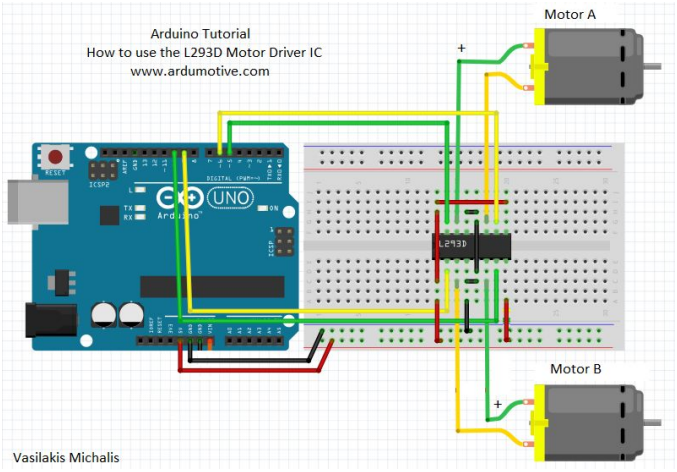


Figure 7. Connections between Motor and Arduino

4.8 Code for Arduino and Sensors:

The Minimum distance for the left, right and front sensors are initialized at the beginning of the program. All the sensors are kept in place. The sensors are coded to follow the given algorithm:

The car moves forward until the following conditions are met:

If (distance from front sensor, left senor, right sensor <= min):
    The car stops;

else if (distance from front and left sensor <= min(front,left):
    The car turns right;

else if (distance from front and right sensor <= min(front,right)):
    The car turns left;

else if (distance from front <= closemin):
    The car stops;

Working of the Code:

The code takes input from the sensors in binary form. If the sensors detect an obstacle, they send the binary digit 0,otherwise if they do not detect an object and the path is free they send the binary digit 1. This is processed by the code in

the Arduino and it accordingly separates the inputs received from the three sensors and selects the path of the sensor which sent the binary digit 1 as its input and ignores the 0.

## V. Physical Implementation and Analysis

Figure 8 shows the final Model of the car that was prepared after assembling all the parts. The robot was able to move smoothly and was able to avoid all the obstacles in it's way.

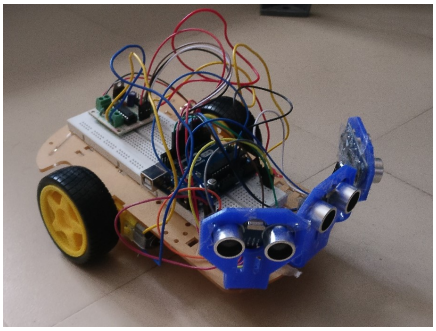

Figure 8. The Final Model

## VI. Results

1. The working model of the autonomous robot is ready.
2. The code is compiled, verified and implemented.
3. The robot is able to move around and is able to avoid all the obstacles that are present in its path.
4. An efficient way to reduce car accidents was developed.

## VII. Cost Analysis

Table 1 provides a detailed cost analysis on the required components:

| Components | Cost (Rs.) |
|---|---|
| Wheels (2+1) | 50 |
| Arduino UNO | 550 |
| 9V Battery (2) | 30 |
| Bread Board | 125 |
| Ultrasonic Sensor (3) | 450 |
| Gear Motor(2) | 200 |
| L293D Motor Driver | 205 |
| chassis | 50 |
| TOTAL | 1660 |

## VIII. Design Constraints

1. Implementation of robot for long distances is really difficult and not done yet.

2. The autonomous robot requires constant human supervision.

3. Implementation on a small body is easy but implementing it on a large body like a car will be challenging.

4. Small time implications itself require considerable energy so large time implications would consume a large amount of energy.

## IX. Applications

These types of autonomous robots have great importance in driverless cars. They can store routes in them through the means of different kind of GPS. Although the main and the most important application will be to keep the passenger safe at all times.

These robots will also be able to help the people who are physically disabled and cannot drive on their own.

These robots will also help in path planning.

Autonomous robots can also serve military purposes as they can scout through an enemy territory avoiding obstacles and sending the best possible route to invade and the territory.

## X. Conclusion

The applications are varied and extremely useful. The coding is simple and straightforward, hence it is very easy to implement. It further has great usage in advancement of the general robotics field. It is being greatly researched and its applications are being studied. Large scale implementation of autonomous robots would truly be a boon for mankind as it would greatly reduce human effort. It can also reduce the number of accidents on road as obstacle avoidance technology would prevent from ramming into each other or pedestrians, moreover problems such as drunk driving would become history.

Like all technologies previously discovered or invented, this one too has a few problems. However with a little more study, research and implementation they can be corrected to fulfill our requirement and needs and hence be finally applied in our day to day life.

## XI. Acknowledgment

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