Arduino based Obstacle Detection and Avoidance by Car

Dr.BUCIO PITTY

Department of Engineering, Sciences and Humanities (DESH)
Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India

Abstract—The Aim of our project is to implement Arduino based obstacle detection and avoidance system in a car so as to prevent accidents occurring which may be due to drivers negligence or his carelessness or due to suddenly occurring obstacles in the path of our car. Our car's mechanism is based on Arduino UNO R3, Ultrasonic Sensor HC-SR04, Motor Driver L298N, Servo Motor SG-90, DC gear motor. Our car's ultrasonic sensors main function is to detect obstacles that occur in the path of our car and relay the information to our microcontroller. After that our microcontroller i.e. Arduino would control the car and alter its pathway in another direction to avoid the obstacle with the help of motor drivers which controls the motors of our car which then change the direction of wheels accordingly.

Keywords — Arduino UNO R3, Ultrasonic Sensor HC-SR04, Motor Driver L298N, Servo Motor SG-90, DC gear motor,Obstacle Detection, Path alteration.

I. INTRODUCTION

Main motive of our project is to construct and implement a cheap and effective obstacle detection and avoidance system in our cars to prevent road accidents and form a template model for our successors or future us to enhance and improve our model to increase road safety. We used Arduino UNO R3 as our microcontroller to perform our needs because it is simple to learn, is also very cheap and since Arduino is open source, any one can learn it and improve our model. One of our goals is to make our model like a template so that the future generations can easily work with our model and thereby increase in chances of improving our project thereby increasing the road security. The disadvantage of our system is that whenever our system detects an obstacle, it would first stop in front of the obstacle for getting more accurate measurements. Now technology is rapidly evolving and we are experiencing changes nearly everyday in our life, sensors are also becoming a part of life as many of our electronic devices use sensors. Some sensors also convert energy forms into electrical energy while some other function as a connecting link between our surroundings and environment and various electrical devices. The environment can be of any type such as factories, hospital shopping malls, etc. Due to improvement in technology there are various sensors and some of them sense heat, while some others sense pressure etc. Now sensors are very much a part of our day to day life and used to make our life a comfortable one.

In current fast and rapidly evolving world, things are becoming automated as such it is becoming an integral part of our day to day

life. So fields like robotics and computerized things are growing fast. Robots are also gaining intelligence, AI bots are capable of doing human's work such as it is able to write an essay, able to recognize a person, website construction, able to translate language and what not. So there is a need of a fully automated car and our project is the first step in achieving it.

LITERATURE REVIEW

[1] Rajesh Mothe et al. "IOT Based Obstacle Avoidance Robot Using Ultrasonic Sensor And Arduino". In this project the authors actualized the obstacle discovery circuit which was utilizing both ultrasonic as well as IR sensors. The entire framework's association was done using breadboard.

[2] Pravin A. C. et al. "Obstacle Avoidance Robot using Arduino". This project proposes robotic vehicle that has an intelligence built in it such that it detects itself whenever an obstacle comes in path or whenever it detects obstacle in its path.

[3] Shivangi Patidar et al. "Obstacle Detection in Self Controlled Cars". This project highlights the need for a system that can detect obstacles and avoid them by moving in precomputed path through a system that can detect the appearances of suddenly appearing obstacles.

[4] Vaghela Ankit et al. "OBSTACLE AVOIDANCE ROBOTIC VEHICLE USING ULTRASONIC SENSOR, ANDROID AND BLUETOOTH FOR OBSTACLE DETECTION". The project relates the robot to devices so that it can be remotely operated.

[5] R. Vairavan et al. "OBSTACLE AVOIDANCE ROBOTIC VEHICLE USING ULTRASONIC SENSOR, ARDUINO CONTROLLER". Project was centered around building more effective system for obstacle detection and made it in such a way that it would be easy to incorporate or integrate various other systems like GPS, mapping technologies etc. for more effective navigation.

[6] Kolapo Sulaimon Ali et al. " DEVELOPMENT OF AN ARDUINO BASED OBSTACLE AVOIDANCE ROBOTIC SYSTEM FOR UNMANNED VEHICLES". The project's goal was to develop an autonomous system that can detect and avoid obstacles for an unmanned car.

[7] Hikma Shabani et al. "Smart Car Control System Based Arduino Uno for Obstacles Avoidance and Engine Temperature Control". In this Project, a smart car control system for obstacle avoidance and engine temperature control was developed in order to reduce car accidents considerably which occur mostly due to unexpected road obstacles and/or sudden car engine breakdown by overheating of engine leading to engine failure or sometimes lead to car catching fire.

[8] Yu-Huei Cheng et al. "Implementation of an Arduino Obstacle Avoidance Car for Automatic Drawing a Path Map". This project implements Arduino obstacle avoidance car and provides an automatic path map drawing function. L298 is used as driving circuit, PWM output from Arduino for speed control.

[9] Yun Jin et al. "Design of an intelligent Active Obstacle Avoidance Car Based on Rotating Ultrasonic Sensors". In this project, an omnidirectional intelligent obstacle avoidance system was designed to control ultrasonic sensor rotating for

measuring distance. PWM drives the servo actuators in this project to control rotation measurement of sensor.

[10] Sushmita M. Rathod et al. "Obstacle Detection and Avoidance for Autonomous Electric Vehicle using Arduino". This project puts forward obstacle avoider robotic vehicle that uses sharp distance IR sensor for this purpose the system uses ATmega2560 Arduino microcontroller to achieve functionality.

II. METHODOLOGY/EXPERIMENTAL

A. Components

The methodology for our project i.e. Obstacle Detection and Avoidance by car is achieved or implemented by using a combination of hardware and software components.

Below is the general outline of our projects methodology:

HARDWARE COMPONENTS

1) <u>Ultrasonic Sensors:</u> These sensors are one of the most commonly used sensors for obstacle detection. They would emit ultrasonic waves which would return back to it when it collides with the obstacle. They also measure the time it takes for the wave to bounce back to it after hitting obstacle and relay the information to the microcontroller.

2) <u>Microcontroller:</u> We used Arduino UNO R3 as our microcontroller in this project but we can also use similar type of controllers like Raspberry Pi, ATmega328, etc.

3) <u>Motor Controllers:</u> If our car's model is used as a template for making similar types of roboticvehicle for space exploration, deep sea diving, etc. then it would require motor controllers for regulating its movement of wheels or limbs by controlling the motor connected to its wheels or limbs based on the obstacle detection and rerouted path.

4) <u>DC Gear Motors:</u> They are one of the most common electrical motors that convert electrical energy to mechanical energy. Gear motor is an all-in-one combination of a motor and a gearbox and due to the addition of a gear head to the motor, it would reduce the speed while also increasing the torque output of the motor. Some of the most important parameters of the gear motors are: speed (in rpm), torque, and efficiency of motor.

SOFTWARE COMPONENTS

1) <u>Motor Control Code:</u> This component is used for controlling motors that drive the wheels of the car. It would include basic control functions like to move the car in forward direction, backwards, to turn it left and right or to stop it.

2) <u>Obstacle Detection Code:</u> This is the software component i.e. code which would utilize the data from Ultrasonic Sensors for detection of obstacle which are in car's path. So when obstacle is detected, the code will be activated and car will take the

necessary action such as stopping, reversing or turning.

3) Decision Making Algorithm: This would be a crucial component as it would decide how the car responds to detected obstacle. It could be a simple set of rules such as "if obstacle is detected, turn left" or it could be complex, a more sophisticated algorithm which uses various complex concepts like proportional-integral-derivative (PID) control.

4) Debugging Code: In our project, this would work by using Serial Library to communicate with the Serial Monitor in the Arduino IDE.

5) Arduino IDE: Arduino Integrated Development Environment (IDE) is a primary software which is used to write, compile and upload code into the Arduino board.

6) Arduino Sketch: It is actually the program or the code on the Arduino.

7) Arduino Libraries: Basically, Libraries are actually nothing but a set of pre-written code that simplifies our tasks and programming process.

8) Integration: It involves the integration or combining the sensor data processing, car or obstacle detection, and all Decision Making Algorithms into a single cohesive system.

9) User Interface: Make an user interface for monitoring and controlling the system, allowing manual override if required.

The motility of our project's car is achieved by the integration of various components of cars and allow it to efficiently maneuver around obstacles. The major components utilized in our project includes a microcontroller (Arduino UNO R3), Ultrasonic Sensor (HC-SR04), Servo Motors (SG-90), and a power source (of 6 volts on board) and an external power bank is also connected to supply it with electrical energy. All these components are crucial and they works together to enable car to navigate the environment while simultaneously avoiding the obstacles in its path.

The car would work in following way:

1) Firstly our Ultrasonic sensors would detect the obstacle that is in our path and it would then calculate the distance between the car and obstacle with help of the microcontroller.

2) The microcontroller will then send all the data as a signal to the servo motors to control the ultrasonic once more.

3) Afterwards, the ultrasonic sensor will once more detect the obstacle in its path.

4) Then microcontroller would calculate the distance between our car and obstacle once more and compare the two distances.

5) If the new distance is less than the earlier calculated one, the microcontroller would send signals to the DC motors commanding it to turn the car towards the obstacle.

6) Our car is able to detect and sense the obstacle from a distance of 20

cm from left side and 30 cm from right side.

We have done our project on an autonomous robotic vehicle which can detect the obstacles in front of it and avoid itself from it, therefore given the project's name "ARDUINO BASED OBSTACLE DETECTION AND AVOIDANCE BY CAR"

Our system basically performs three processes:
1) Collects the information from the environment (through sensors).
1) Use and process the information (processing through codes in microcontroller).
2) Follow instructions to perform actions or works (output).
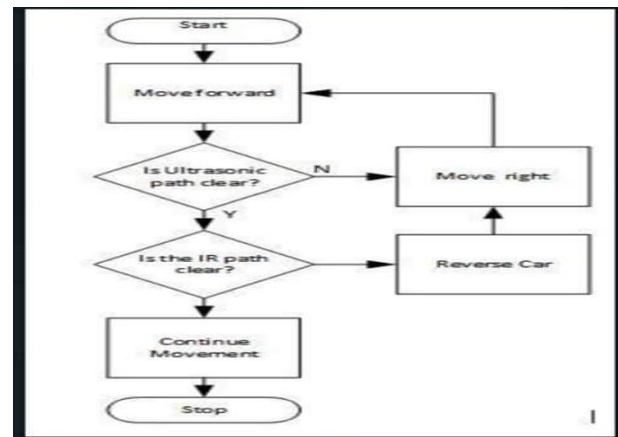
Major required components and technology:
1) Microcontroller (Arduino)
2) Ultra sonic sensor (HC-SR04)
3) Motor-Driver (L298N)
4) DC motors – gear motors
5) Arduino board programming technique
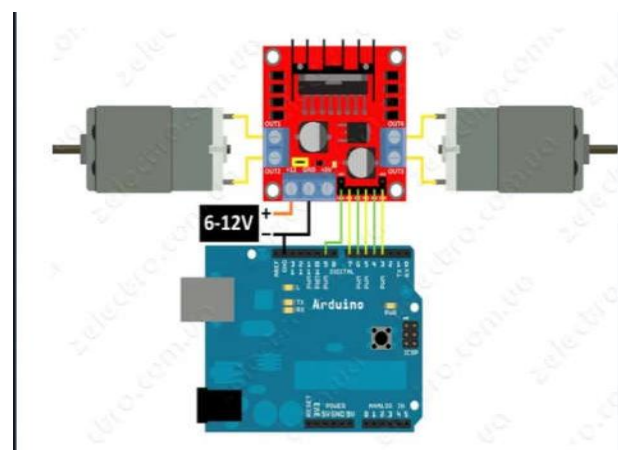6) Robot design concept.
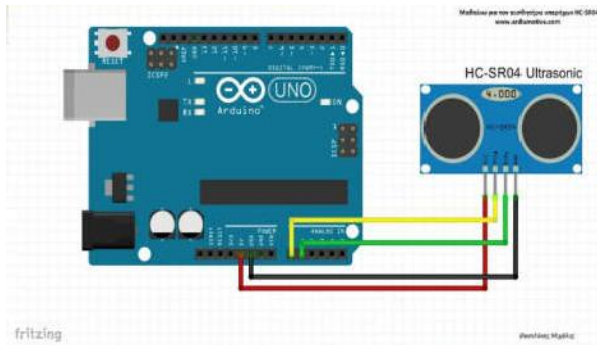7) Power source

FIGURES:-
Block Diagram:
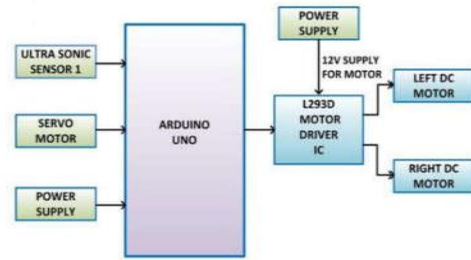
Flowchart:

Circuit Diagrams:

III. RESULTS AND DISCUSSIONS

We first connected or installed our components into a dummy skeleton to see whether the code is working or not, do we have to make any necessary adjustments to code, wiring or the connectivity of various components with each other.

Our system successfully detects and avoids various obstacles which comes in its path. We have also made an algorithm that calculates the best route or trajectory for car to avoid the obstacle.

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IV. FUTURE SCOPE

1) First we can use to explore hazardous environment which is unsafe for humans to personally go and experience it.
2) We can also install various other components to facilitate an interaction with humans.
3) We can also use some high quality sensors for more effective detection of the system
4) We can also incorporate machine learning algorithm so as to enhance the system's auto avoidance capability over time. The machine learning algorithm would also enhance the system's ability to learn from the real time data.

We can also install Bluetooth modules so as to foster communication between 2 neighboring vehicles.
1)

V. CONCLUSION

This project developed an obstacle avoiding robotic car to detect and avoid obstacles in its path. The robotic car is built on an Arduino platform for data processing and its software counterpart helped to communicate with the robot to send parameters for guiding movement. For obstacle detection, four ultrasonic sensors 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 places in unknown environment with obstacles, it moved while avoiding all the 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.

The above Arduino controller and ultrasonic sensor were studied and the HcSR-04 ultrasonic sensor was selected, as the controlling result are satisfying for its use in the automobile prototype system being developed. It was used to sense the obstacle and avoid them. On successful implementation of obstacle avoidance algorithm was successfully carried out too with minimal errors, by coding the algorithm. Obstacle avoidance is a very good application to be used in vehicle preventing many accidents and loss of life.

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