

COLLISION EVASION ROBOT

¹Bandari Theja, ²K.Anitha, ³K.Raju, ⁴V. V. Ramana Rao

^{1,2,3,4}Department of Electronics and Communication,

St Martin's Engineering College, Hyderabad, Telangana, India-500100

Abstract: Trajectory planning is one among the foremost important pivotal point in pick and place tasks done by robotic manipulators. during this work, we've presented an Autonomous robot, which is compact, autonomous and fully functional. This robot or a smart-car is made to sense any obstacle in its path, to avoid it and resume its running involving the pre-computation of an obstacle free path. Ultrasonic sensors are deployed to execute a application obstacle avoidance system for four wheeled robots, in that the robot can continually control and detect surroundings, avoid obstacles, and move toward the target. it has much more applications such as vacuum cleaners, avoiding concealed paths, parking systems, assembling automobiles and in chemical industries, in scientific exploration, medical applications, emergency rescue and in other isolated environments. We use an Arduino UNO with a Motor Shield along side Stepper Motors to form the car, and for sensing we incorporate an Ultrasonic Sensor which accurately and efficiently detects any obstacles within the smart car's path. The Arduino is coded such the smart-car moves backward when an obstacle arises ahead of it with a maximum limit of 50cms in ideal testing conditions. Throughout the development of this model, we educated ourselves to the Arduino coding language, the Motor Shield functionality, and comprehensively, with the working of an ultrasonic sensor and its features. last, through this project, we aim to construct a model of a smart-car that's beneficial to the quotidian problems of this generation.

Key Words: Wheeled ROBOT, Autonomous, Intelligent, Arduino microcontroller, Artificial Intelligence

1. INTRODUCTION:

ARTIFICIAL INTELLIGENCE:

Artificial intelligence is a modern approach in computer science domain which aims to develop several machines and software with human-like intelligence [1]. It is the intelligence exhibited by was done same way as for software or machines. The main goals of artificial intelligence research include knowledge, reasoning, learning, planning, perception, problem solving, decision making the ability to manipulate and move objects and natural language processing [2]. The field was founded on the claim that a central property of humans is intelligence, and that it can be sufficiently well described to the extent that a machine can simulate it.

Robotics is a component of Today's communication. it's easiest method for up to date technology modification. Now a day's communication is a component of advancement of technology, so i made a decision to figure on ROBOTICS field, and style something which can make human life simpler in today aspect. An autonomous robot may be a robot that's capable of moving on its own in an unknown and unstructured environment [3]. It is provided with Artificial intelligence to sense its environment, control and monitor to detect obstacles in its path and move around a remote environment overcoming the obstacles. There are many robotic designs that are employed in designing of autonomous robots. These designs are usually developed considering the physical environment during which the robot has got to be deployed. we can see many such robots like snake robots, walking robots, autonomous drones, fire fighting robot and autonomous robotic cars or rovers [4]. This ROBOT has sufficient intelligence to hide the utmost area of provided space. it's an infrared sensor which are wont to sense the obstacles coming in between the trail of ROBOT. It will move during a particular direction and avoid the obstacle which is coming in its path. the most motto of designing such sort of Robot or the technology is that this technology are often utilized in today's in no time transportation to avoid the accident generally happen in congested by applying emergency break [5]. If we use this technology within the car or any vehicle, it'll automatically sense the obstacles then it'll take a side to the available free space.

An obstacle could also be a animate thing or any object. Autonomous Intelligent Robots are robots which will perform desired tasks in harsh environments without continuous human intervention [6].

2. SYSTEM DESIGN

2.1. Hardware System Design:

Arduino Uno Board:

Arduino is a popular programmable board accustomed create projects. It consists of an easy hardware platform also as a free source code editor which features a "one click compiles or upload" feature [7]. Hence it's designed in way that one can use it without necessarily being an expert programmer (Kushner 1987). Arduino offers an open-source electronic prototyping platform that's easy to use and versatile for both the software and hardware [8]. Arduino is in a position to sense the environment through receiving input from several sensors [9].

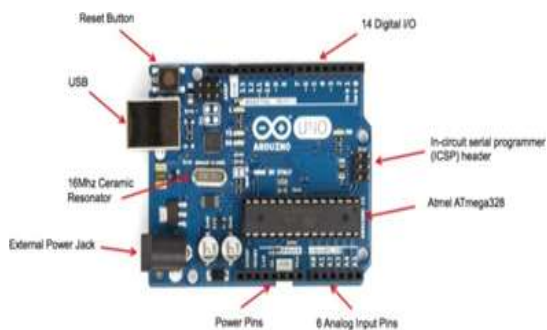


Figure 1. Arduino Uno Board

2.2. L298D Motor Driver Shield



Figure 2. Connect ultrasonic sensor Pins to the Motor Shield

2.3. Additional Hardware used Compatible to Arduino UNO R3:

For this application use of Arduino was not enough. For input and connectivity some extra other devices were required such as

- HC-SR04 Ultrasonic Sensor
- SG-90 Servo Motor
- L298D Motor Driver IC
- Power Supply
- Left DC Motor and Right DC Motor

Hardware Designing

Step 1 - HC-SR04 Ultra sonic Sensor: The ultrasonic sensor uses sonar to work out the space to an object [10]. Here's what happens:

- the transmitter (trig pin) sends a signal: a high-frequency sound
- When the signal finds an object, it is reflected and the transmitter (echo pin) receives it.

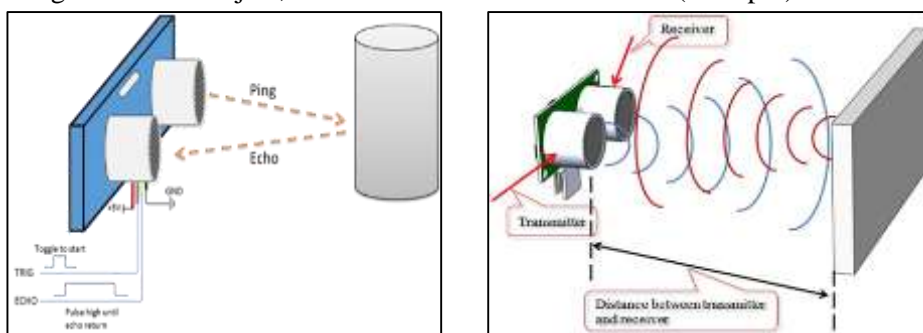


Figure 3. Block Diagram of Ultrasonic Sensor work

Step 2: L298D Motor Driver Shield –Overview



Figure 4. L298D Motor Driver Shield –Overview

Basically, this suggests using this chip we will drive DC motors with power supplier up to 36 Volts, and therefore the chip can supply a maximum current of 600mA per channel. L293D chip is additionally referred to as a kind of H-Bridge. The H-Bridge is usually an circuit that permits a voltage to be applied across a load in either direction to an output, e.g. motor [12].

B. SG- 90 Servo motor: A servo motor is an electrical device which can rotate right or left for an object with great precision [13].

Servo Mechanism: It consists of three parts:

- Controlled device
- Output sensor
- Feedback system

It is a closed loop system where it uses positive feedback system to control motion and final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

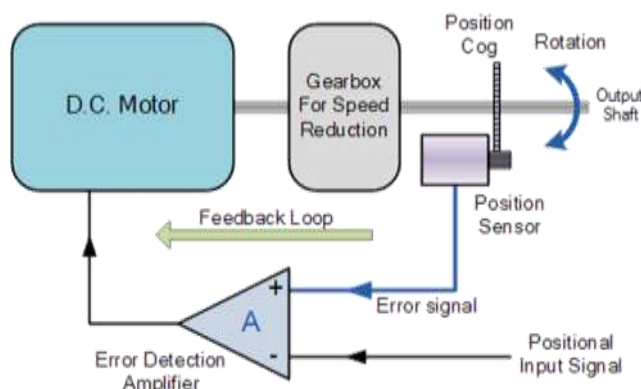


Figure 5. Diagram of Servo Closed Loop System

Here reference input signal is compared to reference output signal and the third signal is produced by feedback system [14]. And this third signal acts as input signal to control device unit. This signal is present as long as feedback signal is generated or there is difference between reference input signal and reference output signal. So, the main task of servomechanism is to maintain output of a system at desired value at presence of noises.

DC motor:

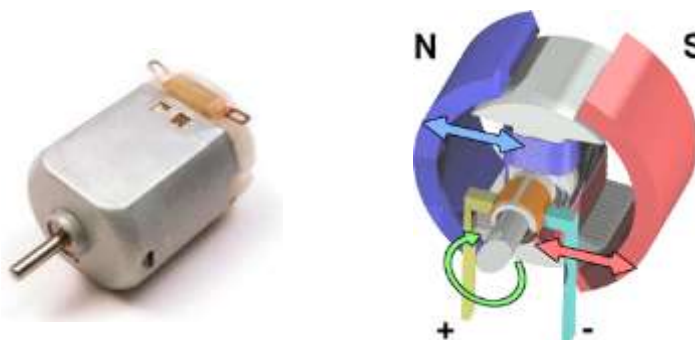


Figure 6. DC Motors

A Direct Current (DC) motor is a rotating electrical device that converts direct current, of electrical energy, into mechanical energy [15]. An Inductor (coil) inside the DC motor produces a magnetic field that creates rotary motion as DC voltage is applied to its terminal. Inside the motor is an iron shaft, wrapped in a coil of wire. This shaft contains two

fixed, North and South, magnets on both sides which cause both a repulsive and attractive force, in turn, producing torque.

3. IMPLEMENTATION:

Robot working principle

The robot uses the Ultrasonic distance sensor to measure the distance in front of it. When this distance reduces to a particular level, the robot interprets it to mean the presence of an obstacle in its path. When the robot detects an obstacle in its path, it stops, goes backward for a few cm, looks around (right and left) then turn towards the direction that shows more free space in front of it.

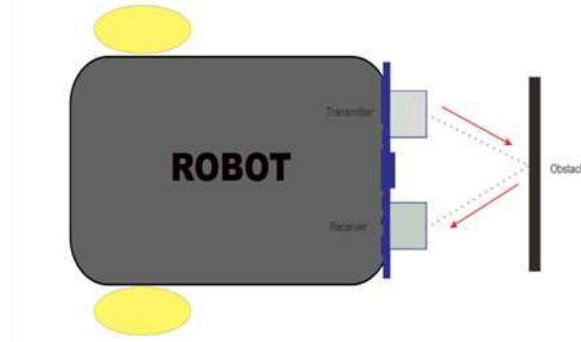


Figure 7. Block diagram of Robot working principle

Constructing the Chassis:

To begin, we do it by coupling the chassis of the robot. The robot parts, contains the chassis, two geared DC motors, the wheels, the front wheel, battery holder, some screws, and wires.



Figure 8. Chassis Robot Components

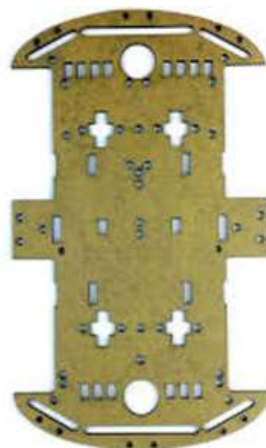


Figure 9. D Print chassis plate

Step 1. Connect the motor and wheels to the chassis.

To complete this step, we start by soldering the thick red and black wires to the positive and negative terminals of the motors as shown in the image below.

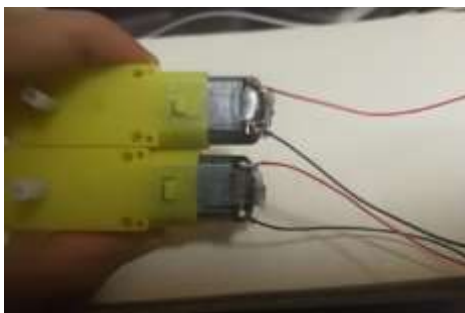


Figure 10. Soldering the DC Motors

- attach the front wheel as shown in the image below.



Figure 11. Attach the front wheel

- attach the rear wheels to the chassis
we add a switch to the battery holder so that we will be able to turn the robot on or off. The switch is connected according to the schematics shown below and attached to the case using a hot glue. The Battery case is attached to the chassis using a double-sided tape to ensure everything sticks together.

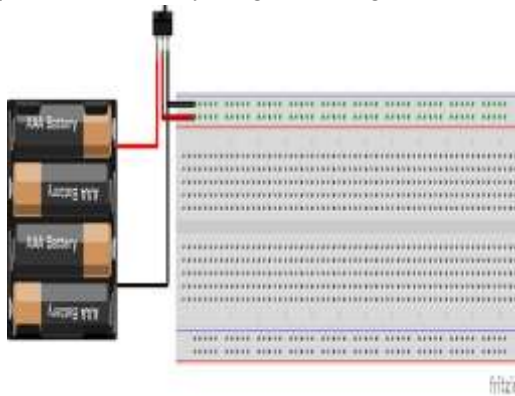


Figure 12. Schematic circuit diagram of the switch and the power source



Figure 13. Soldering the ON/OFF Switch

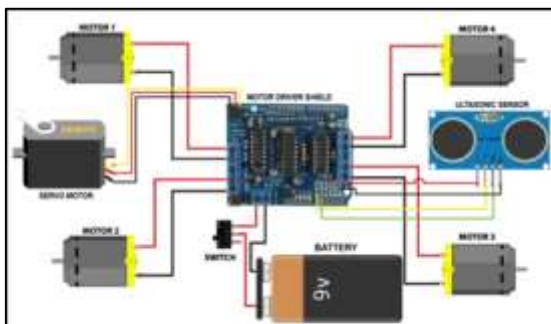
Step 3. Installation the others parts of the robot: This step is to mount other parts of the robot before we start connecting their wires. The motor shield is stacked on the Arduino and it is mounted on the chassis using a double-sided tape. The current requirements of the motors are often higher than what the Arduino can provide, that is why it's important to use the motor shield as it is equipped with additional circuitry to provide up to 600mA current to each of the motors. This shield provides power to the motors and the servo motor and ultrasonic sensor and makes it much

easier. The Ultrasonic sensor is also mounted on the top of the servo motor which is then mounted on the chassis using some screws.



Figure 14. The hardware model depicting my project model (Obstacle Avoiding Robot).

Step 4: Wire up the components: To simplify the connections, below is a pin map of how the components connect, one to the other. Wire up the components together as shown in the image below.



1. Ultrasonic Sensor ▶ Motor Shield
 - a. VCC ▶ 5v, b. Gnd ▶ Gnd,
 - c. Trig ▶ A4, d. Echo ▶ A5



Figure 15. Connect ultrasonic sensor Pins to the Motor Shield



Figure 16. Block Diagram of connect ultrasonic sensor Pins to the Motor Shield.

1. Servo ▶ Motor Shield (Servo_2 port)
 - a. Signal (yellow wire) ▶ S
 - b. Vcc (Red wire) ▶ +
 - c. Gnd (Blow wire) ▶ -



Figure 17. Wire up the Servo Motor to Motor Shield (Servo _ port 2)

1. DC motors contain ▶ Motor Shield

- a. Left Motor ▶ M1, b. Left Motor ▶ M2, c. Right Motor ▶ M3, d. Right Motor ▶ M4

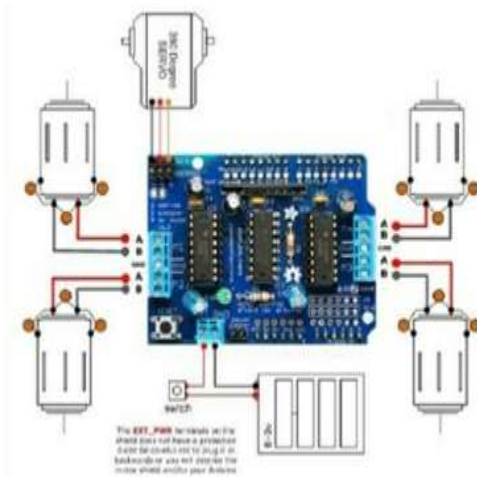


Figure 18. Wire up the DC motors to Motor Shield.

4. Processes and flow of program:

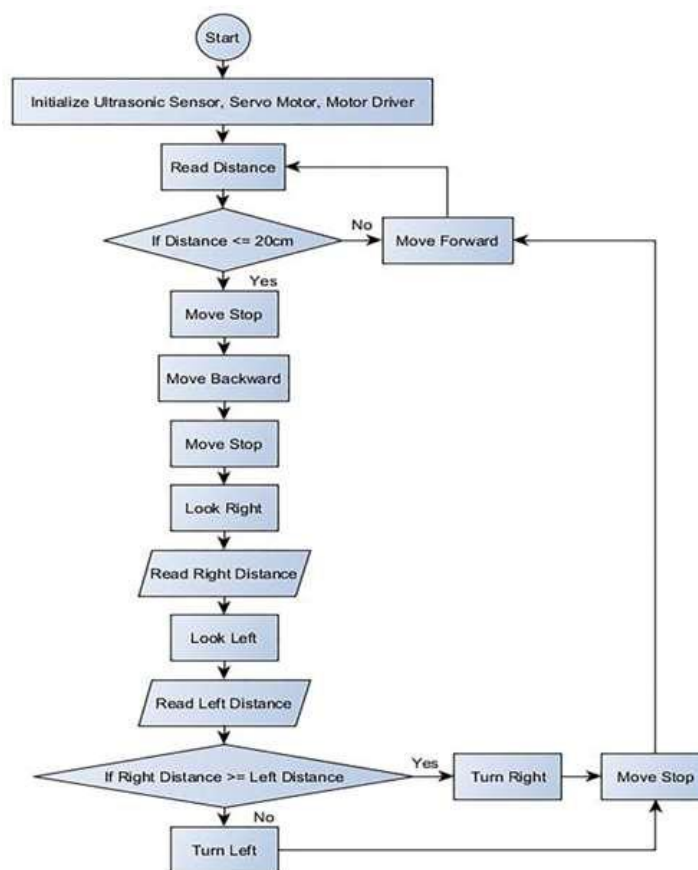


Figure 19. The Algorithm/ Flowchart Diagram of The Obstacle-avoiding Robot Car Based on Arduino Microcontroller.

5. RESULT:

The total block of the system is to be kept on road or unmanned areas and the ultrasonic sensor will detect the obstacle on the road side where the obstacle is present and identified robot has to turn left, right, front and backward directions. Ultrasonic sensor is kept to vehicle and hence controlling and monitoring is well done to avoid accidents. The detail description of the Operation flow of the obstacle avoidance robot is done using HC-SR04 Ultrasonic sensor and Servo motor SG 90 is given done.



Figure 20. Obstacle Avoidance Robot Making Turn Left, right, backward and front after identification of Obstacle using Ultrasonic sensor as shown in the above fig.

6. CONCLUSION:

Today we are within the world of robotics. Knowingly or unknowingly, we've been using differing types of robots in our lifestyle. The project is "obstacle detection and therefore the avoidance robot" is practically proved by using the Ultrasonic sensor for sensing the robot, Motor Shield Driver for the driving the dc motors, dc motor is employed for the movement of the robot with the assistance of the Arduino Microcontroller. A lot of things determined the accuracy of the robot we designed. These factors were the environmental phenomenon during which the robot was tested, the amount of obstacles present making the test space crowded or relatively less crowded the sort and shape of the obstacle (the robot is meant for a consistent shaped obstacle). These factors majorly affected the sensors. The accuracy of the robot depends on the sensors used. Thus, the character of the sensor and its accuracy defined the accuracy of my robot. Future Recommendations:

- Adding a Camera: If the current prototype is interfaced with a camera (e.g. a Web cam) robot can be driven beyond line-of-sight & range becomes practically unlimited as networks have a very larger range.
- We can use as an fire fighting robot: By adding temperature sensor LM35, water tank and making some sort of changes in programming we can use this robot as fire fighting robot.
- We can extend this with wireless technology by IR (or) RF (or) ZIGBEE.
- We can also use the DTMF receiver by using the mobile phone.
- This robot can be used for pick and place the required object by giving instructions like directions to the robot but ultrasonic sensor should be replaced depending upon the application needs.

REFERENCES:

1. Luxton, David D. "Artificial intelligence in psychological practice: Current and future applications and implications." *Professional Psychology: Research and Practice* 45.5 (2014): 332.
2. Pomerol, Jean-Charles. "Artificial intelligence and human decision making." *European Journal of Operational Research* 99.1 (1997): 3-25.
3. Rencken, Wolfgang D. "Autonomous sonar navigation in indoor, unknown and unstructured environments." *Proceedings of IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'94)*. Vol. 1. IEEE, 1994.
4. Shukla, Amit, and Hamad Karki. "Application of robotics in onshore oil and gas industry—A review Part I." *Robotics and Autonomous Systems* 75 (2016): 490-507
5. Singer, Peter Warren. *Wired for war: The robotics revolution and conflict in the 21st century*. Penguin, 2009.
6. Louis, Leo. "WORKING PRINCIPLE OF ARDUINO AND USING IT." *Int. J. Control. Autom. Commun. Syst* 1 (2016): 21-29.
7. Ozer, Jonathan, and Hugh Blemings. *Practical Arduino: cool projects for open source hardware*. Apress, 2011.
8. Bonarini, Andrea, et al. "R2P: An open source hardware and software modular approach to robot prototyping." *Robotics and Autonomous Systems* 62.7 (2014): 1073-1084.
9. Warren, John-David, Josh Adams, and Harald Molle. "Arduino for robotics." *Arduino robotics*. Apress, Berkeley, CA, 2011. 51-82.
10. Nagatani, Keiji, Howie Choset, and Nicole Lazar. "The arc-transversal median algorithm: an approach to increasing ultrasonic sensor accuracy." *Proceedings 1999 IEEE International Conference on Robotics and Automation (Cat. No. 99CH36288C)*. Vol. 1. IEEE, 1999.
11. Kaura, Harish Kumar, et al. "Gesture controlled robot using image processing." *International Journal of Advanced Research in Artificial Intelligence* 2.5 (2013).
12. Baker, John M. "Class AB H-bridge using current sensing MOSFETs." U.S. Patent No. 6,445,530. 3 Sep. 2002.
13. Mitchell, Lawrence Hardy. "Commutation converter for a brushless servo motor." U.S. Patent No. 7,005,812. 28 Feb. 2006.
14. Kankeleit, E. "Feedback in electromechanical drive systems." *Mössbauer effect methodology*. Springer, Boston, MA, 1965. 47-66.
15. Hubert, Charles I. *Electric machines*. Prentice Hall, 1990.