



## AUTONOMOUS ROBOT VEHICLE: A Wireless Controlled Robot with An obstacle, Edge detection and

### Avoidance

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### ABSTRACT

Automation is the field, which is growing rapidly since last decades. Most of the industries are using robots to transport goods from one place to another inside the factory due to their high level of performance and reliability and which is a great help for human beings. The wireless controlled obstacle and edge avoidance robot is used for detecting obstacles or edges and avoiding the collision or fall respectively. This is an autonomous robot. The design of obstacle avoidance robot requires the integration of many sensors according to their task. The obstacle and edge detection and avoidance along with controlling it wirelessly is primary requirement of this autonomous robot. In this work robot gets the information from surrounding area through infrared sensor, ultrasonic sensors mounted on the robot. This autonomous robot can also be controlled through Bluetooth module HC-05.

**Key words:** *Wireless sensor, Arduino Microcontroller, automation robot.*

### I. Introduction

From its initiation in the 1950s, modern robots have come a long way and rooted itself as an immutable aid in the advancement of humankind. In the course of time, robots took many forms, based on its application, and its size varied from a giant 51 feet to microscopic level. In the course of technological developments of robots, one aspect remained instrumental to their function, and that is mobility. Robotics is the branch of technology that deals with the design, construction, operation, and application of robots. A machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer is defined as a robot. Obstacle avoidance is a primary requirement of any autonomous mobile robot. Obstacle avoidance Robot is design to allow robot to navigate in unknown environment by avoiding collisions.

Obstacle avoiding robot senses obstacles in the path, avoid it and resumes its running. There are some very famous methods for robot navigation like wall-following, edge detection, line following. Obstacle avoidance in robots can

bring more flexibility in maneuvering in varying environments and would be much more efficient as continuous human monitoring is not required.

This paper presents development of an obstacle avoiding robot which can move without any collision by sensing obstacles on its course with the help of ultrasonic distance sensors and a wireless controlled robot implemented Bluetooth module HC-05.

## II. Related Work

Obstacle detection and avoidance can be considered as the central issue in designing mobile robots. This technology provides the robots with senses which it can use to traverse in unfamiliar environments without damaging itself.

An Obstacle Avoiding Robot is designed which can detect obstacles in its path and maneuver around them without making any collision. It is a robot vehicle that works on Arduino Microcontroller and employs three ultrasonic distance sensors to detect obstacles. The Arduino board was selected as the microcontroller platform and its software counterpart, Arduino Software, was used to carry out the programming. The integration of three ultrasonic distance sensors provides higher accuracy in detecting surrounding obstacles. Being a fully autonomous robot, it successfully maneuvered in unknown environments without any collision. The hardware used in this project is widely available and inexpensive which makes the robot easily replicable [2].

Another study on edge avoiding robot which is named as "Surface Detection and Avoidance Robot", authors have designed a robot that will avoid absence of surface underneath automatically without any control. So human life is saved while driving an automobile if this arrangement is placed in front of driving automobiles. IR Sensor is used for detecting the surface below the robot. L293D motor driver is used for controlling the motors in the robot. They have avoided the use of microcontroller in this robot, so designing the circuit is much easier. IR Sensor is used for the detecting the surface below the robot. IR Sensor will give output if it finds any object in front of it. To perform the reverse operation of IR sensor they have used IC 7404. This IC is a NOT GATE IC. The IR Sensor is connected to this IC and from this IC the output is given to L293D motor controller. This Motor controller controls the motors. By this design the robot will be able to avoid falling if there is no surface underneath. [3]The only difference between our and their study is that we have used the microcontroller. So from here

we got a general idea of how the edge avoidance robot is made.

A study on Gesture Controlled Car where the robot can be controlled by simple human gestures. The user just needs to wear a gesture device in which a sensor is included. The sensor will record the movement of hand in a specific direction which will result in the motion of the robot in the respective directions. The robot and the Gesture instrument are connected wirelessly through radio waves. User can interact with the robot in a more friendly way due to the wireless communication. Car is controlled using accelerometer sensors connected to a hand glove. The sensors are intended to replace the remote control that is generally used to run the car. It will allow user to control the forward, backward, leftward and rightward movements, while using the same accelerometer sensor to control the throttle of the car. Movement of car is controlled by the differential mechanism. The mechanism involves the rotation of both forth & rear wheels of left or right side to move in the anticlockwise direction and the other pair to rotate in the clockwise direction which makes the car to rotate about its own axis without any kind of forward or backward motion. The main advantage of this mechanism is the car with this mechanism can take sharp turn without any difficulty. This hand gesture robot was basis for making wireless control robot [4].

In another study which is wireless communication using HC-05 Bluetooth module interfaced with Arduino [5], they discussed wireless communication using the HC-05 Bluetooth module, the Bluetooth network topology and interfacing Bluetooth with Arduino.

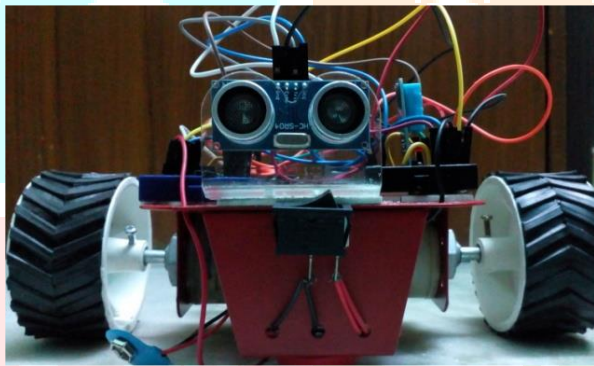
## III. Proposed work

The work proposes an autonomous robotic vehicle, in which no remote is used for controlling the robotic actions. It intelligently detects obstacles present on its path through the sensors, avoid it and take decision on the basis of internal code that we set for it. We can also control the robot movements through mobile phone interfacing Bluetooth with Arduino.

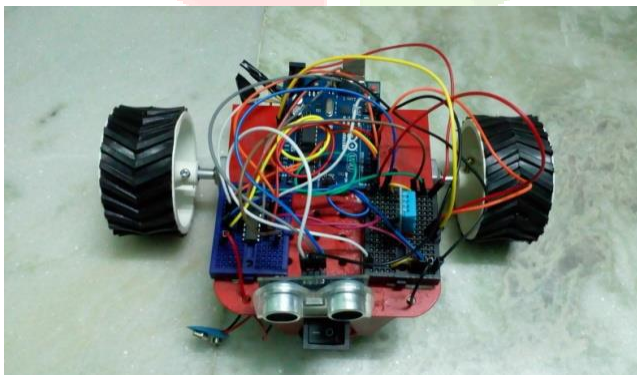
**IV. Description**

**A. Basic Design of Robot**

This robot was built on an Arduino development board on which microcontroller is placed. Arduino board is connected with DC Motor through Motor driver board(pin 2, pin 3, pin 4, pin 5).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 a input for further actions. The extra things here are the chasis, ultrasonic sensor holder, and the wheels. All the components are placed on the chasis. The wheels are connected to the DC- motors. Ultrasonic sensor is placed on the holder which is in turn connected to the Servo motor. Top and front view of the autonomous robot are as shown in fig. 4.1 and 4.2.



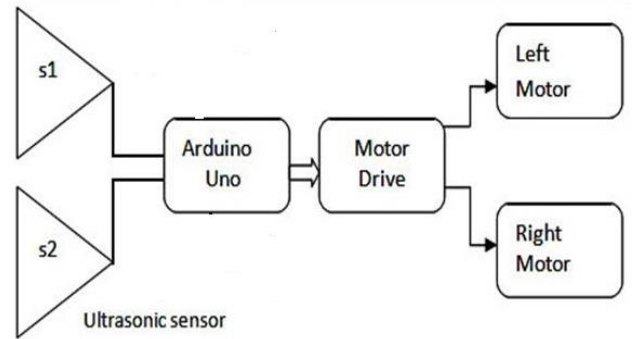
**Fig. 4.1 Front View of an autonomous robot.**



**Fig. 4.2 Top view of an autonomous robot.**

**B. Block Diagram**

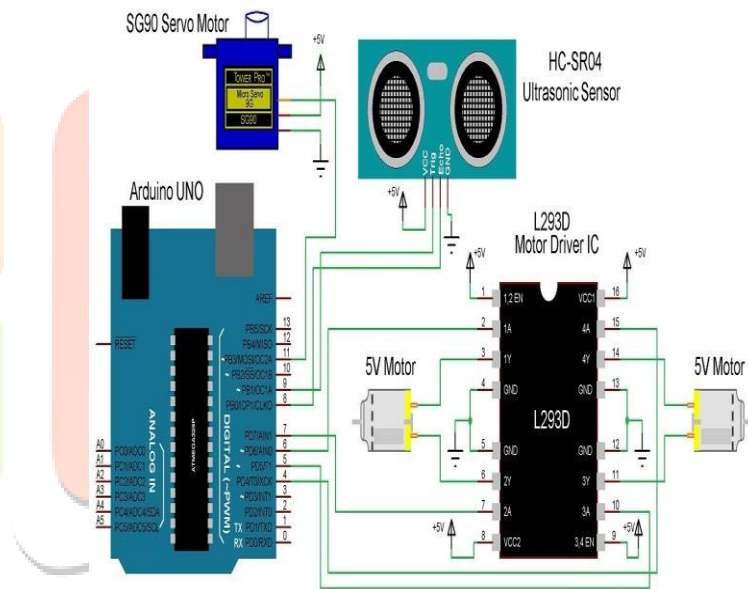
The block diagram for obstacle detection and avoidance robot is shown in fig 4.3, consist of ultrasonic sensors which senses the obstacle and which are connected to Arduino Uno board. Robot will move either left or right through motor drivers depending upon sensors result.



**Fig 4.3 block diagram of obstacle avoidance robot.**

**C. Circuit Diagram**

An ultrasonic sensor placed on the servo motor is used for obstacle avoidance. The servo motor provides a neck like movement to rotate the ultrasonic sensor 180 degree to find an efficient route.



**Fig 4.4 Circuit diagram of obstacle detection and avoidance robot**

**D. Flow Chart**

Flow chart of the proposed work is as in Fig. 4.5.

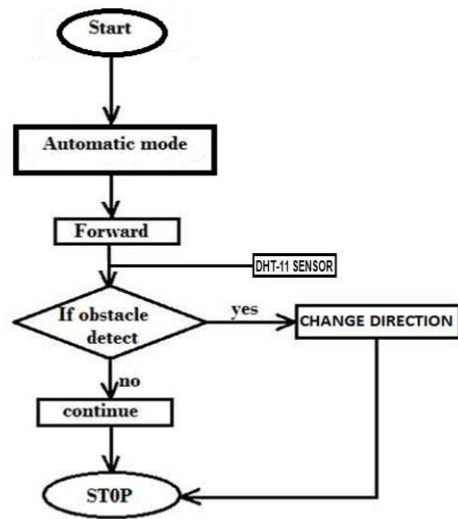


Fig 4.5 Flow chart of the proposed work

Robot will move in one particular direction, if obstacle is sensed through sensors that it will change the direction otherwise robot will move in the same direction.

### E. HC-05 BLUETOOTH MODULE

HC-05 is a Bluetooth device used for wireless communication with Bluetooth enabled devices (like smartphone). It communicates with microcontrollers using serial communication (USART). Default settings of HC-05 Bluetooth module can be changed using certain AT commands. As HC-05 Bluetooth module has 3.3 V level for RX/TX and microcontroller can detect 3.3 V level, so, there is no need to shift TX voltage level of HC-05 module. But we need to shift the transmit voltage level from microcontroller to RX of HC-05 module.

### F. IMPLEMENTATION OF HC-05 IN THE PROJECT:

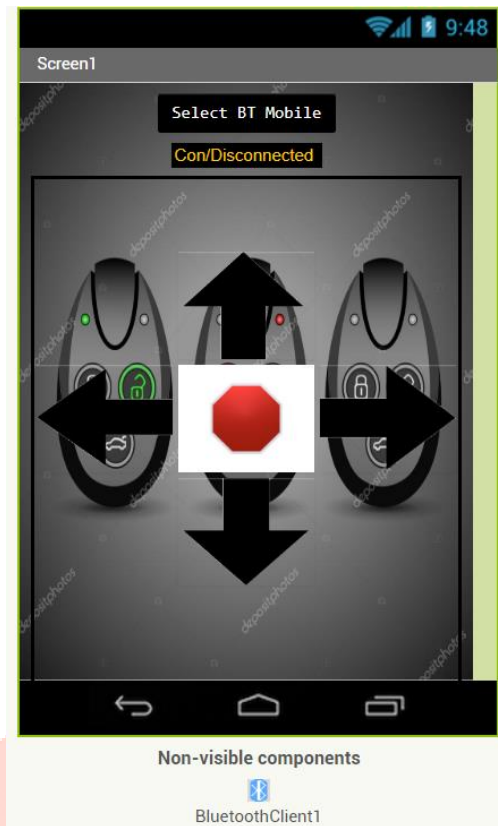


Fig. 4.6 App created for Bluetooth control

Fig. 4.6 is the app created in Mit App maker for connecting with the HC-05 Bluetooth module. Through this robot's movement can be controlled. On click on any of the buttons on the app, it transmits the information to Arduino. Now as the Arduino is controlling the motor driver it controls the movement of the wheels. When we click forward button in Bluetooth controller app then robot start moving in forward direction and moving continues forward until next command comes. On click of backward button in Bluetooth controller app then robot start moving in reverse direction and moving continues reverse until next command comes. On click of left button in Bluetooth controller app then robot start moving in left direction and moving continues left until next command comes. In this condition front side motor turns front side wheels in left direction and rear motor runs in forward direction. On click right button in Bluetooth controller app then robot start moving in right direction and moving continues right until next command comes. In this condition front side motor turns front side wheels in right direction and rear motor runs in forward direction. On click of stop button

robot will stop.

moving forward. Now when the robot comes to an edge, IR transmitter transmits the infrared light but it is not received by the receiver. Hence the robot will stop and avoid the edge. Fig 5.2 is the snap for obstacle identification. Here as soon as the distance is less than 18, it identifies the obstacle.

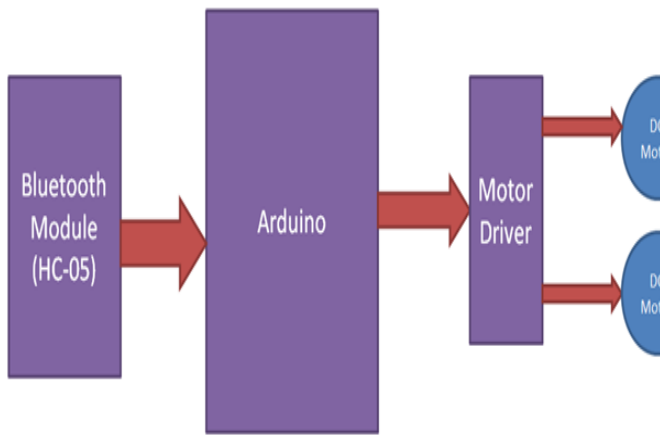


Fig. 4.7 Bluetooth Module Block diagram

Fig. .7 shows the block diagram of design of Bluetooth Module

### V. Results and Discussion

The Ultrasonic sensor is mounted on the Servo Motor SG90 so that it can help the ultrasonic sensor to rotate 180 degree. Now when an obstacle is at a distance less than 18 cm then the robot will stop and the servo motor rotates the ultrasonic sensor to the right and then left. Ultrasonic sensor will calculate the more feasible path and then moves in that path. Fig. 5.1 is the snap for obstacle identification. Here as soon as the distance is less than 18, it identifies the obstacle.

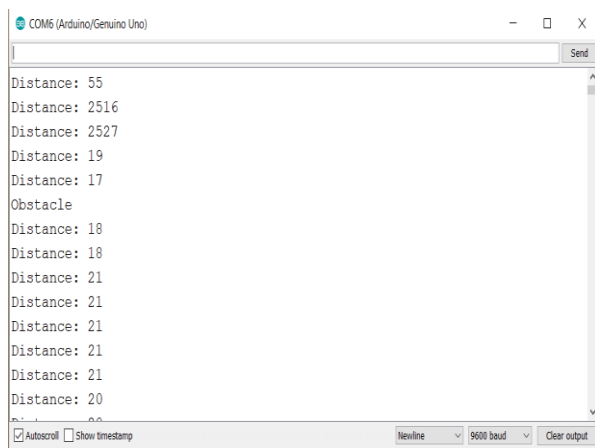


Fig. 5.1 Snapshot for obstacle Identification

IR sensor working on a black surface concept is used in edge avoidance. We have used IR transmitter and receiver also called photo diodes are used for sending and receiving light. IR transmits infrared lights. When infrared rays falls on any surface except black or much dark surfaces, it's reflected back and caught by photodiode and generates some voltage changes and the data is passed as 0 (or 1 depending on construction of IR sensor) to Arduino and the robot keeps on

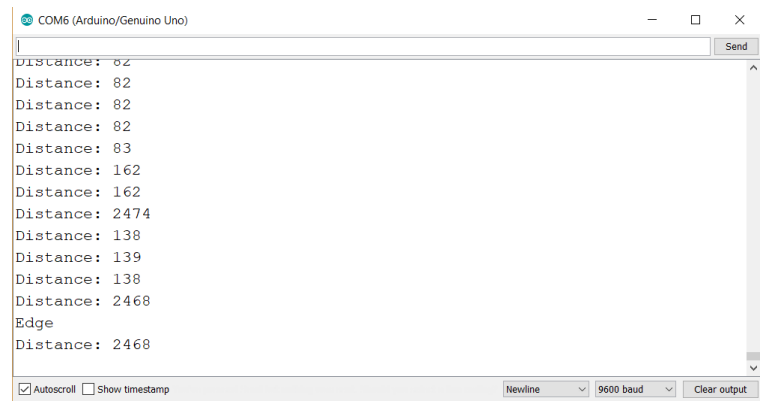


Fig. 5.2 IR sensor on identifying an edge

Fig 5.3 and 5.4 depicts the working of proposed work.



Fig. 5.3 The robot before detecting an obstacle



Fig. 5.4 The robot after detecting an obstacle

### VI. Conclusion and Future enhancement

The project is programmed in order to provide a safety tool to avoid obstacle and prevent itself from falling from a height and can be wirelessly controlled. Almost all navigation robot demands the some sort of obstacle and edge detection, hence obstacle and edge avoidance strategy is of most

importance. Obstacle and edge Avoidance robot with wireless control has a vast field of application. They can be used as services robots, for the purpose of household work and so many other indoor applications.

#### Future Enhancement

- With more powerful sensors we can detect long distance obstacles.
- With adding extra features like security, video recording, collecting pictures it can be a powerful army tool.

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