INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad-500 043

Project Based Learning
(Prototype / Design Building)

External Evaluation Report

Title of your Idea : Obstacle Detection and Avoidance Robot

Thrust Area / Sector : Robotics

Branch : Electronics and Communication Engineering

Year / Semester : 3rd year, V Semester

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1. Background of the Idea:

Road accident is a major issue in many countries, mostly fast-moving vehicles face collision on roads. Another issue is the uncontrollable condition that if a person gets sleepy during the driving it can also cause collisions with nearby objects. Obstacle detection and avoidance can be considered as the central issue in designing mobile robots.

In this project we purpose the obstacle avoiding car which can automatically sense the obstacle in its way and avoid it by changing the direction. It is a robot vehicle that works on Arduino microcontroller and employs ultrasonic sensors to detect obstacles. On basis of sensor detection, the dc motor turns the wheel left or right and then moves forward according to the program which executing through Arduino software.

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. During technological developments of robots, one aspect remained instrumental to their function, and that is mobility. The term “Obstacle Avoidance” is now used in modern robotics to denote the capability of robot to navigate over an unknown environment without having any collision with surrounding objects.

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 project developed an obstacle avoiding robot which can move without any collision by sensing obstacles on its course with the help of ultrasonic distance sensors. It will move in a particular direction and avoid the obstacles coming in between the path of robot. These robots guided with this technology can be put into diversified uses, e.g., surveying landscapes, driverless vehicles, autonomous cleaning, automated lawn mower and supervising robot in industries.

2. Problem Statement:

a) Road accident is a major issue in many countries, mostly fast-moving vehicles face collision on roads. Usually, to avoid the collision and accidents on the road the road breakers and traffic police wardens are controlling the flow of traffic. Even if the person is cable of following the traffic rules sometimes the weather conditions abruptly change, and the driver cannot control the happenings.

b) Another issue is the uncontrollable condition that if a person gets sleepy during the driving it can also cause collisions with nearby objects.

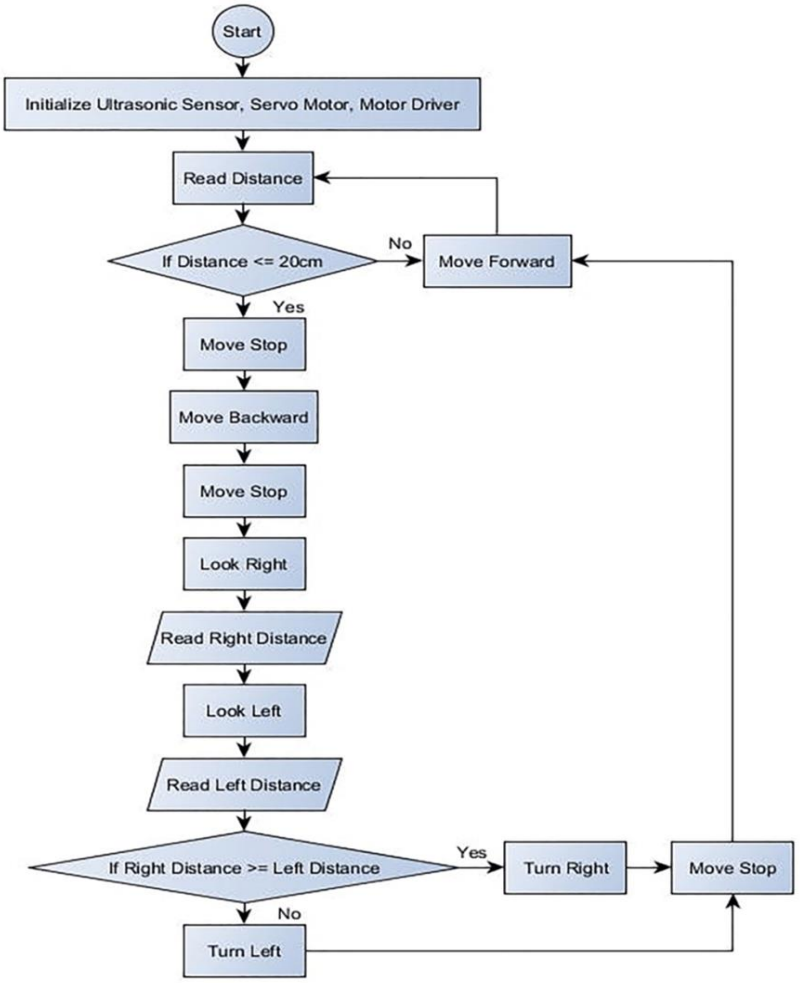
c) Need for the detection of obstacles that appear suddenly.

3. Proposed Solution:

The obstacle avoidance robotic vehicle uses ultrasonic sensors for its movements. Arduino is used to achieve desired operation. The motors are connected through motor driver IC to Arduino. The ultrasonic sensor is attached in front of the robot. Whenever the robot is going on the desired path the ultrasonic sensor transmits the ultrasonic waves continuously from its sensor head. Whenever an obstacle comes ahead of it the ultrasonic waves are reflected from an object and that information is passed to the Arduino.

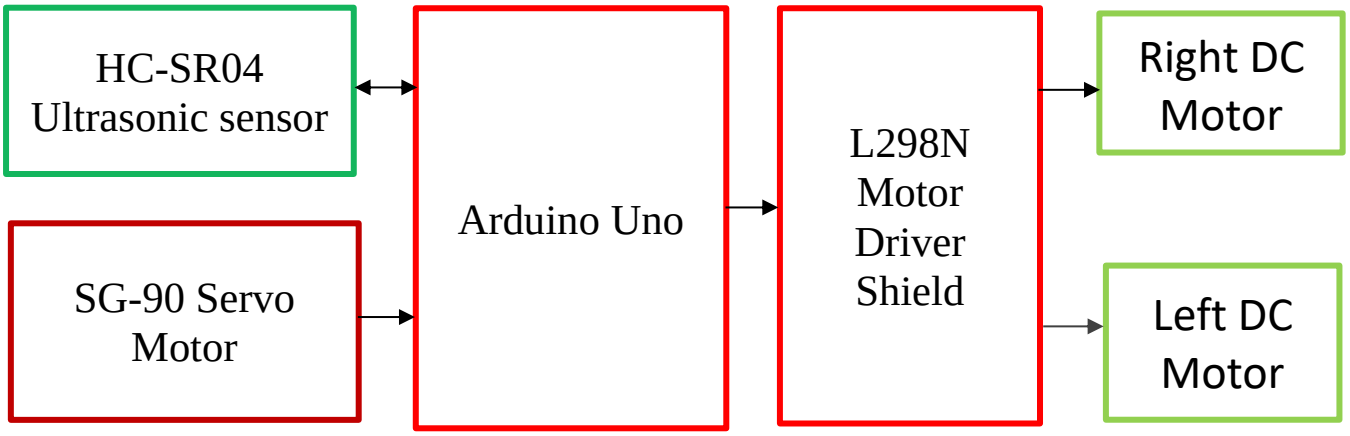
The Arduino controls the motors left, right, back, front, based on ultrasonic signals. To control the speed of each motor pulse width modulation is used (PWM). When ultrasonic sensor detects the object which is kept inside the path it will send the signal toward the Arduino uno and according to that it will rotate the motor M3 & M4 in forward direction and rotate the motor M1 & M2 in reverse direction such way that the car gets moving in left direction. Similarly in every time whenever an obstacle in found to be in path of car it will detect it and rotate the car in left direction to avoid the obstacle.

4. Technology concept formulation:

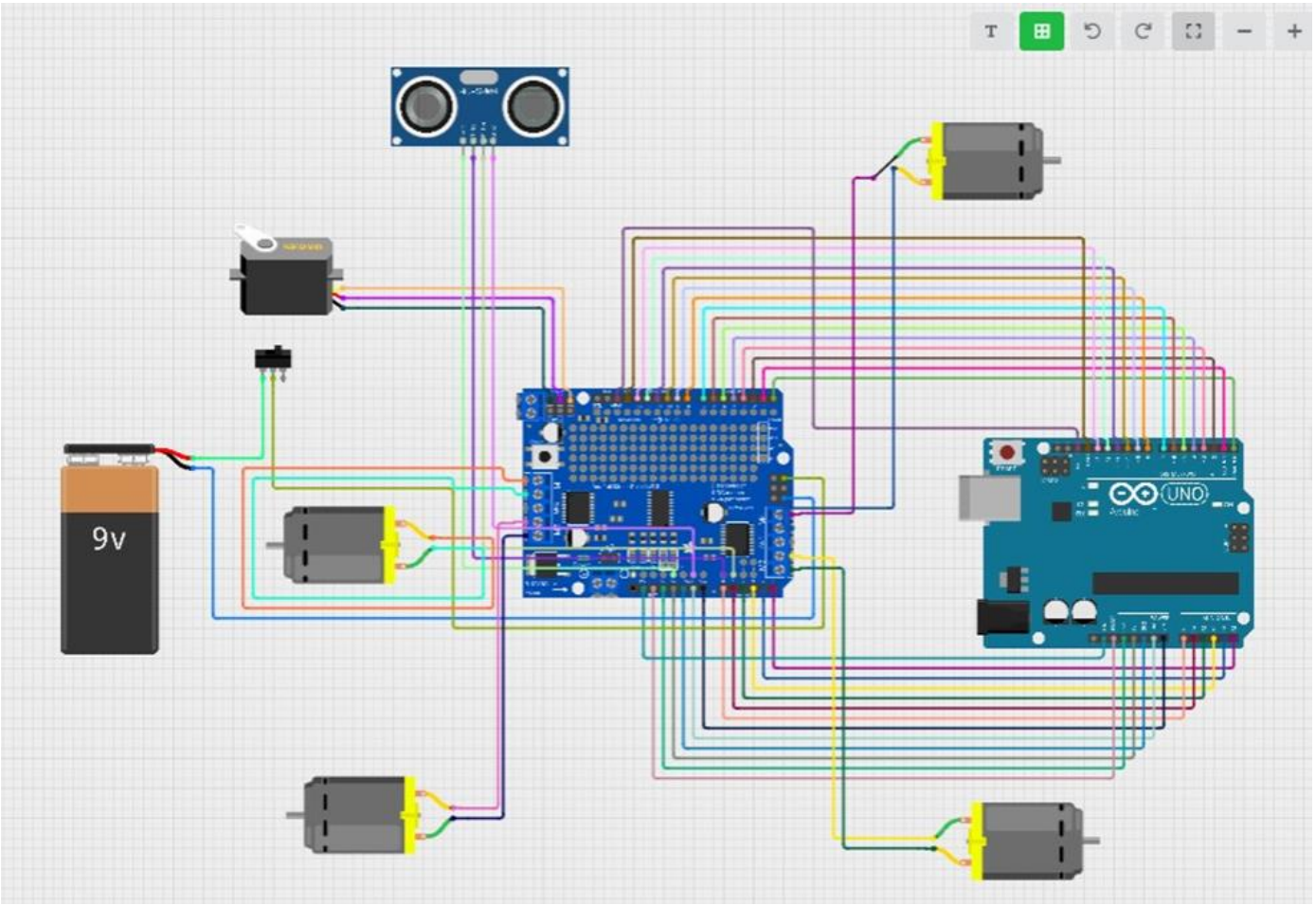


5. **Prototype of proposed system (UI screens / block diagrams / circuits / designs):**

Block Diagram:



Circuit Diagram:



6. Detailed description of prototype / product / project:

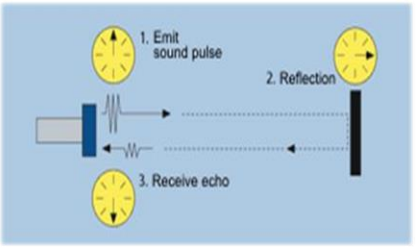
This project developed an obstacle avoiding robot which can move without any collision by sensing obstacles on its course with the help of ultrasonic distance sensors. Robots guided with this technology can be put into diversified uses, e.g., surveying landscapes, driverless vehicles, autonomous cleaning, automated lawn mower and supervising robot in industries. The robot developed in this project is expected to fulfill the following objectives:

• The robot would have the capacity to detect obstacles in its path based on a predetermined threshold distance.
• After obstacle detection, the robot would change its course to a relatively open path by making autonomous decision.
• It would require no external control during its operation.
• It can measure the distance between itself and the surrounding objects in real-time.
• It would be able to operate effectively in unknown environment.

Working Principle:

The ultrasonic sensor emits the short and high-frequency signal. These propagate in the air at the velocity of sound. If they hit any object, then they reflect an echo signal to the sensor. The ultrasonic sensor consists of a multivibrator, fixed to the base. The multivibrator is a combination of a resonator and a vibrator. The resonator delivers ultrasonic wave generated by the vibration. The ultrasonic sensor consists of two parts; the emitter which produces a 40 kHz sound wave, and the detector detects a 40 kHz sound wave and sends an electrical signal back to the microcontroller.

When an electrical pulse of high voltage is applied to the ultrasonic transducer it vibrates across a specific spectrum of frequencies and generates a burst of sound waves. Whenever any obstacle comes ahead of the ultrasonic sensor the sound waves will reflect in the form of echo and generates an electric pulse. It calculates the time taken between sending sound waves and receiving the echo. The echo patterns will be compared with the patterns of sound waves to determine the detected signal's condition.



The main equipment used in this project are Arduino, L298D Motor Driver Shield, Ultrasonic sensors, Servo motor and DC motor.

Arduino UNO:

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output.

L298D Motor Driver Shield:

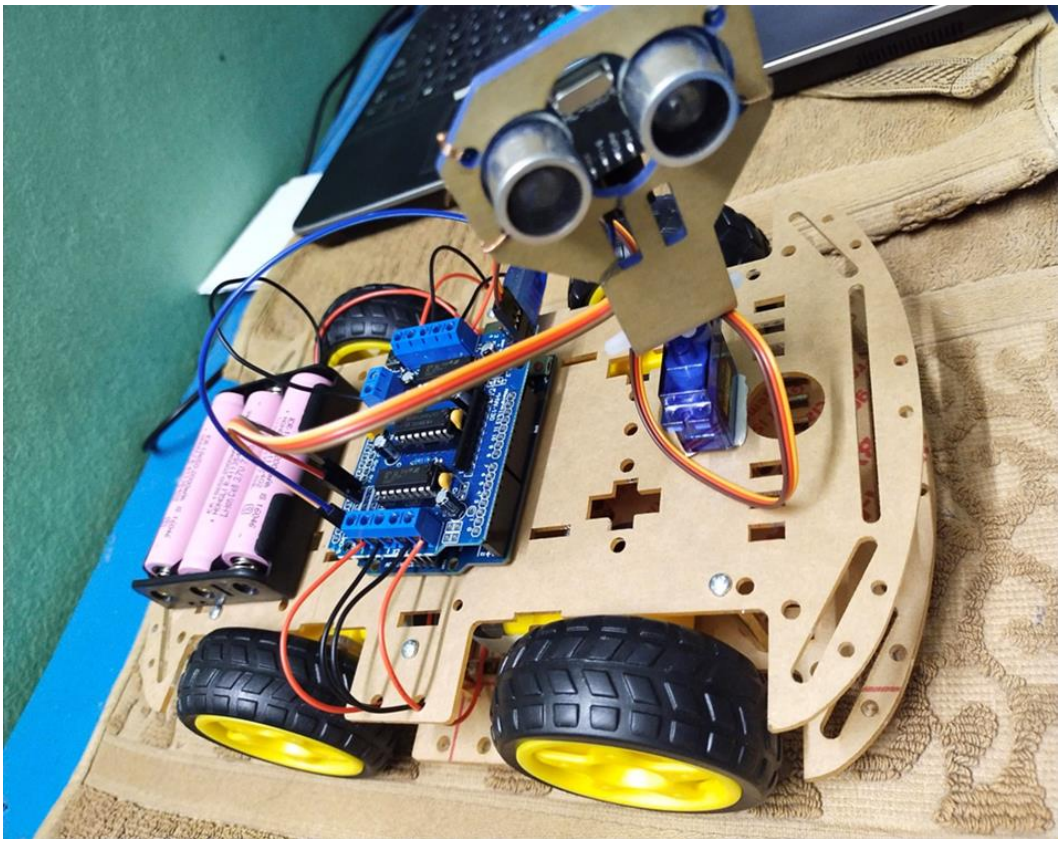
L298 is a high voltage and high current motor drive chip which receives TTL logic signals. They are mostly used when it is needed to operate different loads like motors and solenoid etc where an H-Bridge is required. High power motor driver is required. Control unit can only provide TTL outputs. Current control and PWM operable single-chip device are needed. It has two enable inputs to enable or disable the device attached at its output independently. Thus, H-Bridge is basically used to control the rotating direction in DC motors.

Servo motor:

Servo motor works on PWM (Pulse width modulation**)** principle, means its angle of rotation is controlled by the duration of applied pulse to its Control PIN. Basically, servo motor is made up **of** DC motor which is controlled by a variable resistor (potentiometer) and some gears. High speed force of DC motor is converted into torque by gears. The potentiometer is connected to the output shaft of the Servo, to calculate the angle and stop the DC motor on the required angle.

An Obstacle Avoiding Robot is a type of autonomous mobile robot that avoids collision with unexpected obstacles. In this project, an Obstacle Avoiding Robot is designed. It is an Arduino based robot that uses Ultrasonic range finder sensors to avoid collisions.

7. **Final version of prototype / product (only images):**



8. **Any other information:**

The obstacle detecting and avoidance robot is designed successfully. This design allows the robot to navigate in unknown environment by avoiding collisions which is primary requirement for autonomous mobile vehicle. Its designed as four wheeled cars having board at its top and ultrasonic senor at the front to avoid the obstacles. Further improvement can be achieved by adding sensors on the left and right side of the robot. Besides that, computer vision with camera features can be implemented for monitoring applications. For further improvement, to implement the obstacle avoidance in aerospace, well-suited sensors should be used to gather the accurate information about the environment and obstacles. Just by making small changes in software this system can be used for avoiding concealed paths. This robot can efficiently sense the obstacles and find out the correct path. The recent advancement in LIDAR technologies allows researchers and practitioners to examine the environment with higher precision, accuracy, and flexibility than before. LIDAR sensor is considered as an effective solution to the problem of obstacle detection and recognition.

References:

1. R. Chinmayi et al., "Obstacle Detection and Avoidance Robot," 2018 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), 2018, pp. 1-6, doi: 10.1109/ICCIC.2018.8782344.
2. D. C. Putri, H. Gustian, Y. Permadi and P. Musa, "Visual Based Path Detection for Obstacle Avoidance," 2018 Third International Conference on Informatics and Computing (ICIC), 2018, pp. 1-5, doi: 10.1109/IAC.2018.8780433.

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