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Obstacle Avoiding Robot using Arduino Sensor

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Abstract: *The project is designed to build an obstacle avoidance robotic vehicle using ultrasonic sensors for its movement. Arduino is used to achieve the desired operation. A robot is a machine that can perform tasks automatically or with guidance. The project proposes a robotic vehicle that has an intelligence built in it such that it directs itself whenever an obstacle comes in its path. This robotic vehicle is built using Arduino. An ultrasonic sensor is used to detect any obstacle ahead of it and sends a command to the Arduino. Depending on the input signal received, the Arduino redirects the robot to move in an alternate direction by actuating the motors which are interfaced to it through a motor driver. At the same time, we can control steering gear to realize the obstacle avoidance function. The robot car uses front axle steering, rear wheel drive arrangement. Two drive tires are driven by two DC motors with gear reduction mechanisms.*

Keywords: Arduino UNO, motor shield L293d, ultrasonic sensor HC-SR04, DC Motor, servo motor

I. INTRODUCTION

Obstacle avoidance Robot is designed in order to navigate the robot in unknown environment by avoiding collisions. Obstacle avoiding robot senses obstacles in the path, avoid it and resumes its running. There are some very popular methods for robot navigation like wall-following, edge detection, line following and many more. A more general and commonly employed method for obstacle avoidance is based on edge detection. A disadvantage with obstacle avoidance based on edge detecting is the need of the robot to stop in front of an obstacle in order to provide a more accurate measurement. All mobile robots feature some kind of collision avoidance, ranging from primitive algorithms that detect an obstacle and some sophisticated algorithms that enable the robot to detour obstacles. The latter algorithms are more complex since they involve detection of an obstacle as well as some kind of quantitative measurements concerning the obstacle's dimensions. Once these have been determined, the obstacle avoidance algorithm needs to steer the robot around the obstacle and resume motion toward the original target. The steering algorithm ensures that the robot does not have to stop in front of an obstacle during its navigation. An ultrasonic sensor is used to detect any obstacle a head of it and sends a command to the microcontroller. Hence the robots may overcome some of the problems during navigation, which are discussed above and it can navigate smoothly during its operation avoiding the collisions. If we were use the IR sensor Infrared sensors detect the object's distance with infrared radiation. When the beam detects an object, the light beam returns to the receiver with an angle after reflection there is a limitations in sensor those limitations are Performance of IR sensors has been limited by their poor tolerance to light reflections such as ambient light or bright object colors. No object recognition at the dead zone area, for example Sharp GP2D12 IR distance sensor dead zone between 0 to 4 cm. IR sensors also give inaccurate detection result with transparent or bright color materials. Detection results also depend on the weather conditions and the sensing reliability of IR sensors decreases with moisture and humidity. Furthermore, IR sensors can sense IR radiation from the sunlight, which can cause correctable or non-correctable errors at output. Besides that, if analogue IR sensor is used, signal losses will occur at the amplifier circuit. Meanwhile, PIR motion sensor needs a long calibration time and is sensitive to thermal radiation. Besides that, PIR sensor is insensitive to very slow motions or to objects in standing mode

II. LITERATURE SURVEY

“line follower and obstacle avoidance bot using arduino” has been designed and developed by khan, Dipashrisona wale to create an autonomous robot which intelligently detects the obstacle in its path and navigates according to the actions

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that user sets forit. So this system provides an alternate way to the existing system by replacing skilled labor with robotic machinery, which in turn can handle more patients in less time with better accuracy and a lower per capita cost.

"Obstacle-avoiding robot with IR and PIR motion Sensors" has been designed and developed by Aniket D. Adhvaryu et al has proposed that developed robot platform was not designed for specific task but as a general wheeled autonomous platform. It can therefore be used for educational, research or industrial implementation. Students can use it to learn the microcontroller programming using C++, Arduino Uno 1.6.5 compiler, IR and PIR sensors characteristics, motor driving circuit and signal condition circuit design. Research on obstacle avoidance robot at the polytechnic level can help students to develop communication, technical skills and teamwork. The design of such robot is very flexible and various methods can be adapted for another implementation. It shows that PIR sensors are more sensitive compared to IR sensors while detecting human being.

"Obstacle Avoidance Robotic Vehicle Using Ultrasonic Sensor, Android and Bluetooth for Obstacle Detection" has been designed and developed by Vaghela et.al has mentioned that enormous amount of work has been done on wireless gesture controlling of robots. Various methodologies have been analyzed and reviewed with their merits and demerits under various operational and functional strategies. Thus, it can be concluded that features like user friendly interface, light weight and portability of android OS based smart phone has overtaken the sophistication of technologies like programmable glove, static cameras etc., making them obsolete. Although recent researches in this field have made wireless gesture controlling a ubiquitous phenomenon, it needs to acquire more focus in relevant areas of applications like home appliances, wheelchairs, artificial nurses, table top screens etc. in a collaborative manner.

"Obstacle Avoidance Robot" has been designed and developed by Paul Kinsky, Quan Zhou mentioned that robot with a few mechanical components to add two more functions to the main body, namely the laptop holder and the camera holder. AT89S52 development board is designed, developed and tested in a large scale, which was used to control the motors smoothly. The cameras with relatively low cost are fixed and adjusted on the camera holder for good calibration of the computer vision. Users establish the serial communication method between the upper laptop and the lower development board with USB port. The laptop will send out a signal of the motor condition to the development board.

III. IMPLEMENTATION

The basic block diagram for the implementation of the project is as shown in figure1.

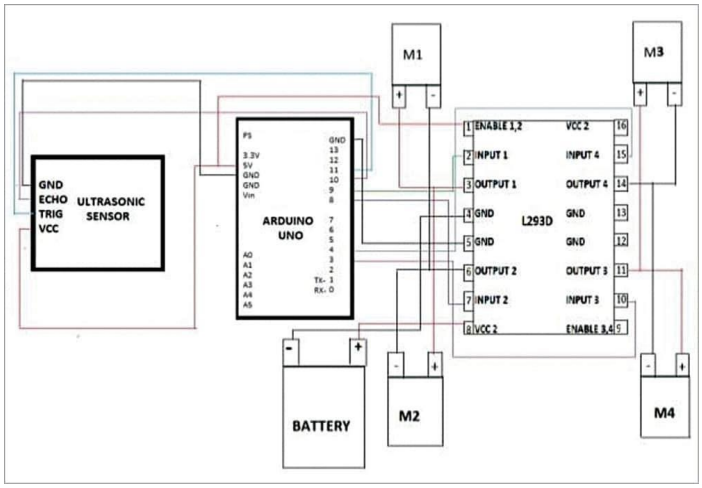

Fig 1: Block Diagram of the system

The sonar system is used in HC-SR04 ultrasonic sensor to determine distance to an object like bats do. It offers excellent non-contact range detection from about 2 cm to 400 cm or 1feet to 13 feet. Its operation is not affected by sunlight or black material. The ultrasonic sensor emits the short and high frequency signal. If they detect any object, then they reflect back echo signal which is taken as input to the sensor through Echo pin. Firstly user initialize Trigger and Echo pin as low and push the robot in forward direction. When obstacle is detected Echo pin will give input as high to microcontroller. Pulse In function is used for calculating the time of distance from the obstacle. Every time the

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function waits for pin to go high and starts timing, then timing will be stopped when pin goto low. It returns the pulse length in microseconds or when complete pulse was not received within the timeout it returns. The timing has been determined means it gives length of the pulse and will show errors in shorter pulses. Pulses from 10microseconds to 3 minutes in length are taken into consideration. After determining the time, it converts into a distance. If the distance of object is moderate then speed of robot get reduced and will take left turn, If obstacle is present in left side then it will take right turn. If the distance of object is short then speed of robot get reduced and will turn in backward direction and then can go in left or right direction. This robot was built with an Arduino development board on which microcontroller is placed Arduino board relates to DC Motor through Motor driver board (pin10, pin11, pin12, pin13) which provides power to the actuators. Actuators are used to move robots in Forward, Backward, Left and Right directions. A brief description of input pins for movement of robot is given in above in table. The movement of robot will 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 an input for further actions.

IV. RELATED WORK

Ultrasonic Sensor:

Sensors for Obstacle Avoidance Varieties of sensors are available which can be used for the detection of obstacles some of the very popular sensors are: Infrared sensors(IR), Ultrasonic sensors, Cameras, which can be used as a part of Computer Vision, Sonar. It can measure the distance in its field of view of about thousands to hundreds points In the design of robot, we are using ultrasonic sensors for obstacle detection and avoidance The ultrasonic sensors continuously emits the frequency signals, when obstacle is detected this signals are reflected back which then considered as input to the sensor.

Ultrasonic sensors are versatile devices that utilize ultrasonic waves for distance measurement, obstacle detection, and other applications. Operating on the principle of echolocation, similar to how bats navigate, these sensors emit ultrasonic pulses and measure the time it takes for the echoes to return, enabling accurate distance calculations.

Ultrasonic sensors play a crucial role in automation, robotics, and various industrial applications, providing reliable and non-contact distance measurement capabilities. As technology continues to advance, addressing challenges and refining sensor designs will likely enhance their performance and extend their applicability across diverse domains.

Its core components include a transducer, responsible for wave conversion, and piezoelectric crystals that enable the transformation between electrical signals and ultrasonic waves. In practical applications, these sensors find extensive use in non-contact distance measurement, obstacle detection, and various industrial scenarios. Whether employed for parking assistance in vehicles, liquid level measurements in tanks, or as a key element in robotics for obstacle avoidance, ultrasonic sensors showcase versatility and precision.

Fig: L298D Motor Driver Shield

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L298D Motor Driver Shield–Overview

L293D is a monolithic integrated, high voltage, high current, 4-channel driver. Basically, this means using this chip we can drive DC motors with power supplier upto 36 Volts, and the chip can supply a maximum current of 600mA per channel. L293D chip is also known as a type of H- Bridge. The H-Bridge is typically an electrical circuit that enables a voltage to be applied across a load in either direction to an output, e.g. motor.

SG-90ServoMotor

A servo consists of a Motor (DC or AC), a potentiometer, gear assembly and a controlling circuit.
First, we use gear assembly to reduce RPM and to increase torque of motor. Say at initial position of servo motor shaft, the position of the potentiometer knob is such that there is no electrical signal generated at the output port of the potentiometer.

Now electrical

signal is given to another input terminal of the error detector amplifier. Now the difference between these two signals, one comes from potentiometer, and another comes from other source, will be processed in feedback mechanism and output will be provided in term of error signal. This error signal acts as the input for the motor and motor starts rotating. Now motor shaft is connected with potentiometer and as motor rotate so the potentiometer and it will generate a signal. So, as the potentiometer's angular position changes, its output feedback signal changes. After some time, the position of potentiometer reaches at a position that the output of potentiometer is same as external signal provided. At this condition, there will be no output signal from the amplifier to the motor input as there is no difference between external applied signal and the signal generated at potentiometer, and in this situation motor stops rotating.

DC Motor:

A Direct Current(DC) motor is a rotating electrical device that converts direct current, of electrical energy, into mechanical energy. 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 causes both a repulsive and attractive force, in turn, producing torque.

Arduino

The **Arduino Uno** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc.[2][3]The board is equipped with sets of digital and analog input/output(I/O) pins that may be interfaced to various expansion boards(shields)and other circuits.[1]The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the ArduinoIDE(Integrated Development Environment), via a type B USB cable.[4]It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts.
In practical applications, these sensors find extensive use in non-contact distance measurement, obstacle detection, and various industrial scenarios. Whether employed for parking assistance in vehicles, liquid level measurements in tanks, or as a key element in robotics for obstacle avoidance, ultrasonic sensors showcase versatility and precision.

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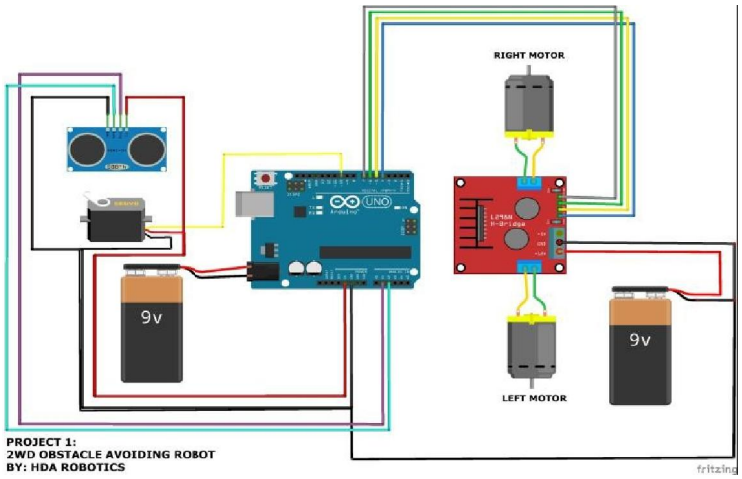
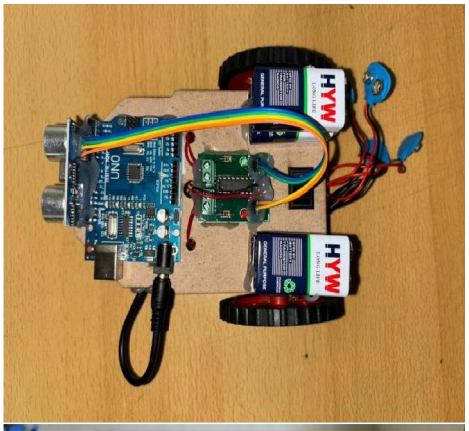
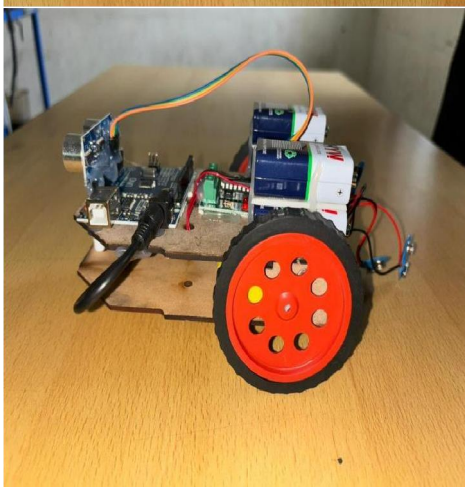


V. RESULTS

The result is obtained for obstacle avoid an cero bot using Arduino, if the robot moves forward if any obstacle detect it check for other directions and moves where there is no obstacles it moves in forward direction, to sense the obstacle ultrasonic sensor is used. We used servo motor to rotate the ultrasonic sensor





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VI. CONCLUSION

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

VII. ACKNOWLEDGEMENT

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