IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, December 2024

Obstacle Avoiding Robot using Arduino

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Abstract: *In the modern world, robotics is a rapidly expanding and fascinating field. Nowadays, the idea of robotics is applied in all fields, including manufacturing, healthcare, and transportation. One of the functions required for automated mobile robots is obstacle avoidance. The project's goal is to create a robotic vehicle that can avoid obstacles by moving with the help of ultrasonic sensors. The intended operation is accomplished by use of a microcontroller (ATmega328). A robot is a machine that can carry out tasks either on its own or under supervision. This robot is made out of an Arduino UNO (microcontroller) and a sensor that can identify obstructions. The Arduino software is used to program. When it comes to identifying impediments in the environment, the ultrasonic sensor is incredibly accurate. This robot has wheels. The robot will travel backward if the ultrasonic sensor detects the presence of an obstacle while it is moving forward. The robot will continue to advance until it detects an obstruction before stopping if it is unable to detect any obstacles, that is, if there is a large gap between it and an obstacle. The micro-controller uses a motor driver to interface with the motors and reroutes the robot to move in a different direction based on the input signal received. Since some projects use infrared sensors for specific purposes that are not compactable, we are using ultrasonic sensors in our project instead. In the study, two LEDs are*
used: one to show if the robot is traveling ahead and the other to show whether it is moving backward. The battery's level of charge is indicated by the third LED. Applications for Arduino boards employ C programming to create the code that controls the operation of the entire system. Additionally, a power source unit is utilized to charge the system's batteries..

Keywords: Arduino UNO, ultrasonic sensor HC- SR04, DC Motor, Driver-L298N-2A

I. INTRODUCTION

Every mobile robot has collision avoidance capabilities of some form. These range from simple algorithms that identify barriers and halt the robot to prevent a collision to more complex algorithms that allow the robot to avoid obstacles. These kinds of straightforward issues can become more complicated when applied to autonomous mobile robots that have to avoid obstacles. For example, it would be challenging for a mobile robot to recognize obstacles and determine how to avoid them, and the primary target (goal) may vanish from the camera's field of view.

An obstacle avoidance robot is an autonomous robot which detects and avoids the obstacle on its path through a sensor. These are extensively used in applications including surveillance, automation, and environments that are not easy for humans to access or practically difficult to operate. This can be done using algorithms and sensor data that prevent collision with objects.

The later methods are more intricate since they require both obstacle detection and quantitative measurements of the obstruction's dimensions

After identifying these, the robot must be guided around the obstruction by the obstacle avoidance algorithm before continuing on its way to the initial target. The micro-controller receives an instruction from an ultrasonic sensor that detects any obstacles in front of it [10]. Therefore, the robots may be able to get beyond some of the navigational issues that were previously mentioned and traverse smoothly while avoiding collisions. During navigation, the steering algorithm makes sure the robot doesn't have to halt in front of an obstruction. Any obstruction in front of it is detected by an ultrasonic sensor, which then instructs the microprocessor. As a result, the robots may be able to navigate smoothly and prevent collisions while overcoming some of the navigational issues that were previously discussed. Robots navigate by using a variety of techniques, such as line following, edge detection, and wall following. One of the commercial solutions uses a robot that follows walls to clean the floors of long halls. A more broad and widely used

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technique for obstacle avoidance is edge detection. After identifying these, the robot must be guided around the obstruction using the obstacle avoidance algorithm before continuing on toward the initial destination. This method combines a 360°C field of view from an omnidirectional camera with a broad field of view from a perspective camera to estimate.

The locations of obstacles in three dimensions. Previous research have examined a number of vision system implementations based on color sensors [85], camera sensors Pixy 2 CMUcam5 [86], and thermal cameras [87]. In addition, signal losses will happen at the amplifier circuit if an analog infrared sensor is employed. In the meanwhile, PIR motion sensors are sensitive to heat radiation and require a lengthy calibration period. In addition, PIR sensors are insensitive to objects in standing mode or to extremely slow motions [2]

II. LITERATURE SURVEY

Aamir Attar, Aadilansari, Abhishekdesai, Shahid Khan, and Dipashrisonawale have designed and developed a "line follower and obstacle avoidance bot using Arduino" to produce an autonomous robot that can recognize obstacles in its path and navigate based on user-specified commands.

By substituting robotic equipment for trained personnel, this system offers an alternative to the current one. This allows it to manage more patients in less time with more precision and at a lower cost per capita [1].

The developers of "Obstacle avoidance robot using Arduino" are Pavithra A. C. and Subramanya Goutham V. The robot can operate on its own [9].

Vaghela et al. have constructed and developed "Obstacle Avoidance Robotic Vehicle Using Ultrasonic Sensor, Android and Bluetooth for Obstacle Detection," which notes that a great deal of work has been done on wireless gesture controlling of robots. Under different operational and functional strategies, a variety of approaches have been examined and evaluated, along with their advantages and disadvantages.

Darshan S. and Chinnapu Charan Teja Reddy are the designers and developers of the "line follower and obstacle avoider robot." They suggested leveraging the idea of infrared and ultrasonic sensors to create a line-following and obstacle-avoiding robot that could navigate autonomously along a black line. The robot will be able to select the free path if crossing occurs. The line follower robot can only be controlled by altering its course. Although a WiFi module can be used to control the suggested device, more power will be used. Therefore, there is a potential that the battery will deplete quickly [7]. With a predetermined route, it can be applied to very long-distance applications.

Paul Kinsky conceived and developed the "Obstacle Avoidance Robot." According to Quan Zhou, the robot's primary body may perform two additional functions—that of holding a laptop and a camera— by adding a few mechanical parts. The AT89S52.

development board was used to seamlessly operate the motors after it was created, built, and extensively tested. For optimal computer vision calibration, the reasonably priced cameras are fastened and positioned on the camera holder. Through a USB port, users connect the upper laptop to the lower development board via serial communication. The development board will receive a signal from the laptop indicating the motor state [4]. They have numerous key properties for autonomous underwater operations which includes efficient movement, flexible bodies and to conduct intervention jobs. Computer vision algorithm is supplied to USRs to detect and to calculate position of probable impediments [10].

The literature survey on obstacle-avoiding robots using Arduino has shown several studies and projects that utilize Arduino microcontrollers for autonomous navigation. Researchers have explored the use of ultrasonic and infrared sensors to detect obstacles and implemented algorithms to process sensor data for real-time decision-making. Many studies emphasize the integration of L298D motor drivers for controlling the robot's movement and the use of PWM signals for speed modulation. Reviewed literature shows the versatility of Arduino-based robots in their application in autonomous vehicles, educational tools, and industrial automation, but it has pointed out challenges such as limitations in sensors, power management, and scalability of such systems for complex environments.

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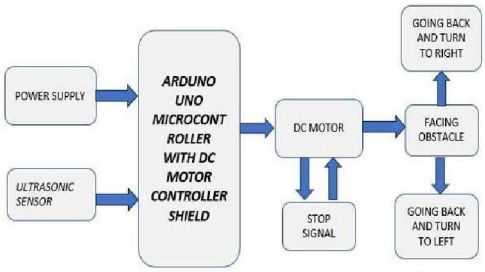
III. METHODLOGY

Figure depicts the fundamental block diagram for the project's implementation.



Block Diagram

The HC-SR04 ultrasonic sensor uses the sonar system to measure distance to an object, just like bats do. It has good non-contact range detection from 1 foot to 13 feet, or around 2 cm to 400 cm. Neither sunshine nor dark materials can interfere with its functionality. The high frequency signal is brief and is emitted by the ultrasonic sensor. The detection of obstacles is the primary purpose of obstacle avoidance robots. The Arduino microcontroller will read the data when you turn the system on using the ON/OFF switch. The robot will travel backward if the ultrasonic sensor detects the presence of an obstacle while it is moving forward. When ultrasonic sensors identify an obstruction in the robot's path, the movement will always stop. The microcontroller uses the time and duration provided by ultrasonic sensors as an input for subsequent actions.

IV. COMPONENTS

These are the component:

- Arduino UNO
- Ultrasonic Sensor
- L298D Motor Driver Shield
- Robot Kit

1. Arduino UNO

Belongs to the ATmega328P microprocessor board. Six analog inputs, fourteen digital input/output pins (six of which can be used as PWM outputs), a USB connector, a power jack, an ICSP header, a reset button, and a 16 MHz ceramic resonator (CSTCE16M0V53-R0) are among its features. Everything needed to support the microcontroller is included; all you need to do is plug it in using a USB cable, an AC-to- DC adapter, or a battery.

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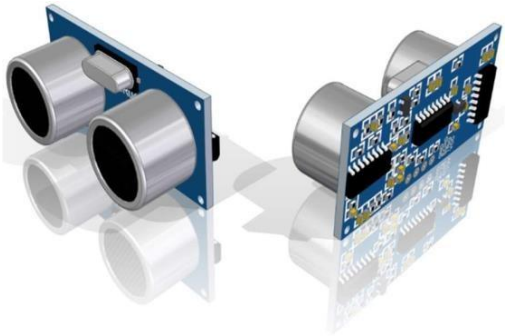
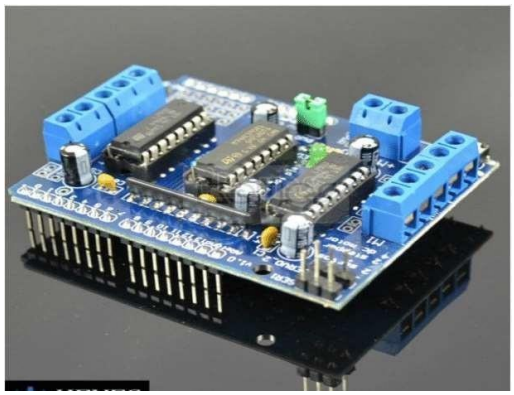
2. Ultrasonic Sensor

Sensors for Avoiding Obstacles There are several types of sensors that can be used to identify barriers. Among the most often used sensors are sonar, cameras that can be utilized in computer vision, ultrasonic sensors, and infrared (IR) sensors. It can measure between thousands and hundreds of points in its range of vision. Ultrasonic sensors are being used in robot design to identify and avoid obstacles. When an obstruction is discovered, the frequency signals that the ultrasonic sensors continually transmit are reflected back and are then regarded as input to the sensor.



3. L298D Motor Driver Shield:

The L293D is a 4-channel, monolithic integrated driver with high voltage and high current. This basically means that we can use this chip to drive DC motors with a power source of up to 36 volts, and it can give up to 600mA of current per channel. Another name for the L293D chip is an H-Bridge. An electrical circuit known as an H-Bridge allows a voltage to be applied across a load in either direction to an output, such as a motor.



V. RESULTS

The results of the implementation are produced and demonstrate the operation of the robot's circuit as a whole. The Arduino IDE, or integrated development environment, was used to construct the program. It was then translated from C into machine code (a hex file) for debugging. After that, the PROTEUS ISIS specialist tests it and runs simulations. Gum rubber was used to combine the components of the plastic rubber case, which was constructed according to dimensions.

The production of the implementation's findings shows how the robot's circuit functions overall. The application was created using the Arduino IDE, or integrated development environment. For debugging, it was then converted from C to machine code (a hex file). This is followed by simulations and testing by the PROTEUS ISIS specialist. The parts of the plastic rubber case were assembled using gum rubber, which was built in accordance with measurements.

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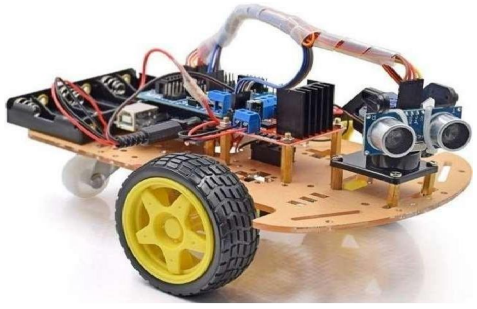

VI. CONCLUSION

This investigation has been completed and tested effectively [98]. The obstacle avoidance robot was tested to determine whether an obstruction was present. When this robot senses obstacles, it will move backward until it is far away from them, at which point it will move forward again in the direction of the obstacles. This useful tool has many applications in day-to-day living. This project offers an obstacle- avoiding robot that can recognize impediments in its path and change its direction to avoid them. Arduino is used in the construction of the robot to process data for different components. Ultrasonic sensors, which offer a larger field of view, have been employed for object detection. The sensor has been rotated by a servo motor. Two geared motors are used to move the robot. It is expertly dodging the impediments in its way. An obstacle-avoiding robot that can identify obstacles in its path and alter its course to avoid them is provided by this project. To process data for various components, Arduino is employed in the robot's construction. For object detection, ultrasonic sensors—which have a wider range of view—have been used. A servo motor has spun the sensor. The robot is moved by two geared motors. It is skillfully avoiding the obstacles in its path.

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