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OBSTACLE AVOIDING ROBOT

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Abstract

The Obstacle Avoiding Robot is an autonomous robotic system designed to detect obstacles in its path and automatically change its direction to avoid collisions. The main objective of the project is to develop a simple and efficient mobile robot that can navigate through an environment without requiring continuous human control. Such robots can be useful in areas such as industrial automation, surveillance, material transportation, and educational robotics.

The system uses a microcontroller, ultrasonic sensor, motor driver, DC motors, wheels, and battery as its main components. The ultrasonic sensor continuously measures the distance between the robot and objects in front of it. The microcontroller processes the sensor readings and determines whether an obstacle is present within a predefined safe distance.

When an obstacle is detected, the controller sends appropriate signals to the motor driver to stop the robot and change its direction. The robot can turn left or right depending on the available space and then continue moving forward. This process is repeated continuously, allowing the robot to navigate through its surroundings while reducing the possibility of collisions.

The proposed system provides a low-cost, simple, and reliable solution for autonomous navigation. It reduces the need for manual operation and demonstrates the basic principles of sensor-based robotic decision-making and motor control.

Overall, the Obstacle Avoiding Robot demonstrates the application of embedded systems, sensors, automation, and robotics for autonomous navigation. The system can be further enhanced using multiple ultrasonic sensors, infrared sensors, cameras, LiDAR, artificial intelligence, path planning, and IoT connectivity to improve obstacle detection, navigation accuracy, and overall performance.

I. Introduction

An Obstacle Avoiding Robot is an autonomous mobile robot designed to detect obstacles in its path and change its direction automatically to prevent collisions. Robots with autonomous navigation capabilities are widely used in areas such as industrial automation, surveillance, transportation, healthcare, and service applications. The main objective of this project is to develop a simple and efficient robot that can navigate through an environment without continuous human control.

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The robot uses an ultrasonic sensor to detect objects present in its path. The sensor continuously measures the distance between the robot and nearby obstacles by transmitting ultrasonic waves and receiving their reflected signals. The measured distance is provided to a microcontroller, which acts as the main processing unit of the system.

When the robot detects an obstacle within a predefined safe distance, the microcontroller processes the sensor information and sends appropriate commands to the motor driver. The motor driver controls the DC motors connected to the robot's wheels. The robot can stop, turn left, or turn right depending on the detected obstacle and available path.

The system continuously monitors the surrounding environment while the robot is moving. This allows the robot to make movement decisions in real time and reduce the possibility of collisions. The control algorithm can be programmed to select a suitable direction and continue navigation after avoiding the obstacle.

The proposed system provides a low-cost and practical solution for autonomous navigation. It also demonstrates the basic concepts of embedded systems, sensor-based decision-making, motor control, and robotics. The design is simple enough for educational applications while providing a foundation for more advanced autonomous robots.

Overall, the Obstacle Avoiding Robot demonstrates how sensors and intelligent control can be combined to create an autonomous navigation system. The project can be further enhanced using multiple sensors, cameras, LiDAR, artificial intelligence, path-planning algorithms, GPS, and IoT connectivity to improve navigation accuracy and enable more advanced robotic applications.

II. Literature Survey

Research on Obstacle Avoiding Robots has developed significantly with advances in sensors, microcontrollers, embedded systems, and autonomous navigation. Obstacle avoidance is an important function in mobile robotics because a robot must detect objects in its surroundings and determine a safe path without continuous human intervention. Researchers have explored different sensing and control techniques to improve the reliability and efficiency of autonomous robot navigation.

Early obstacle-avoiding robots mainly used ultrasonic sensors to detect objects in front of the robot. Ultrasonic sensors measure the distance to an obstacle by transmitting sound waves and calculating the time taken for the reflected signal to return. These sensors are inexpensive, simple to interface with microcontrollers, and suitable for basic indoor robotic applications.

Several studies have investigated the use of infrared sensors for obstacle detection. Infrared sensors detect nearby objects using reflected infrared radiation and can provide fast responses for short-range detection. However, their performance can be affected by factors such as object color, surface properties, and environmental lighting.

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As a result, ultrasonic sensors are often preferred when distance measurement is required.

Researchers have also developed robots using multiple ultrasonic sensors positioned in different directions. Multiple sensors provide information about obstacles on the left, right, and front sides of the robot. The controller can compare these measurements and select a direction with a greater available distance. This approach improves navigation compared with using only a single forward-facing sensor.

Another important area of research is microcontroller-based navigation. Platforms such as Arduino and other embedded controllers are commonly used to process sensor readings and control motors. The controller receives distance information, compares it with a predefined threshold, and generates movement commands such as forward, stop, left, or right. These systems provide a low-cost approach for developing autonomous mobile robots.

Research has also focused on combining obstacle detection with path-planning algorithms. Instead of simply turning whenever an obstacle is detected, advanced robots can evaluate possible paths and select a suitable route toward a destination. Algorithms such as wall-following, potential-field methods, and graph-based path planning have been investigated for autonomous navigation.

More advanced studies have introduced LiDAR and camera-based sensing for robotic navigation. LiDAR can provide detailed distance information about the surrounding environment, while cameras can provide visual information about obstacles and their positions. These technologies can improve navigation in complex environments but generally increase the cost and computational requirements of the robotic system.

Recent research has increasingly explored artificial intelligence and computer vision for autonomous obstacle avoidance. Machine-learning and deep-learning techniques can help robots recognize objects and learn suitable navigation behaviors. Such approaches are useful for environments where obstacles are dynamic or where simple distance-based decisions are insufficient.

Based on the existing research, the proposed Obstacle Avoiding Robot focuses on developing a simple and economical autonomous robot using an ultrasonic sensor, microcontroller, motor driver, DC motors, and power supply. The robot continuously measures the distance to obstacles and automatically changes its direction when an object is detected within the predefined safe range. The system provides a practical foundation for autonomous navigation and can be further improved using multiple sensors, LiDAR, cameras, AI-based object detection, and advanced path-planning algorithms.

III. System Analysis

System analysis is an important stage in developing the Obstacle Avoiding Robot. The system is designed to detect obstacles and navigate automatically without continuous human control. The main requirements include obstacle detection, distance measurement, movement control, and collision avoidance. An ultrasonic

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sensor is used to measure the distance between the robot and nearby objects. An Arduino microcontroller acts as the main control unit for processing sensor information. A motor driver is used to control the DC motors connected to the robot. The controller continuously compares the measured distance with a predefined safe limit. When an obstacle is detected, the robot stops and determines a suitable direction for movement. The robot can turn left or right and continue moving after avoiding the obstacle. The system is designed to provide quick responses to obstacles during navigation. The complete system is tested under different obstacle positions and distances. Overall, the system analysis defines the hardware, software, and functional requirements needed for reliable autonomous navigation.

Existing System

In the existing system, robots are commonly operated manually using remote controls or mobile applications. The operator continuously observes the robot's surroundings and controls its movement to avoid obstacles. Some basic autonomous robots use a single sensor to detect objects in front of them. These systems generally follow simple predefined instructions such as stopping or turning when an obstacle is detected. A single sensor provides limited information about obstacles located on the sides or behind the robot. Manual systems require continuous human attention and cannot operate independently for long periods. Fixed threshold-based systems may also make incorrect movement decisions in complex environments. Traditional robots may have limited navigation capabilities and may not select the most efficient path. Environmental factors can sometimes affect the accuracy of certain sensors. These limitations make conventional systems less suitable for dynamic environments. Therefore, an improved sensor-based autonomous navigation system is required for safer and more efficient robot movement.

Disadvantages of Existing System

- Requires continuous manual control.
- Depends heavily on human observation.
- Limited autonomous navigation.
- Single-sensor systems have limited coverage.
- May not detect side obstacles effectively.
- Simple systems use fixed movement decisions.
- Cannot select an optimal path.
- May perform poorly in complex environments.
- Limited real-time environmental understanding.
- Requires frequent human intervention.
- Collision risk can still occur.
- Limited adaptability to dynamic obstacles.

Proposed System

The proposed system focuses on developing an autonomous Obstacle Avoiding Robot that can detect obstacles and automatically change its direction. An Arduino microcontroller is used as the central control unit for processing sensor data and controlling the robot. An ultrasonic sensor continuously measures the distance

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between the robot and nearby objects. When an obstacle is detected within the predefined safe distance, the controller immediately stops the robot. The system then evaluates the available directions and selects a suitable path for movement. A motor driver receives signals from the Arduino and controls the DC motors accordingly. The robot can move forward, stop, turn left, or turn right based on the sensor readings. The control program continuously monitors the surroundings while the robot is moving. This allows the robot to respond quickly to obstacles and reduce the possibility of collisions. The proposed system is simple, economical, and suitable for basic autonomous navigation applications. Multiple sensors can be added to improve obstacle detection coverage. Overall, the system provides an effective solution for automatic obstacle detection and collision avoidance.

Advantages of Proposed System

- Provides autonomous navigation.
- Reduces the need for manual control.
- Detects obstacles automatically.
- Provides real-time distance measurement.
- Reduces collision risk.
- Provides quick response to obstacles.
- Uses low-cost components.
- Simple Arduino-based implementation.
- Can operate continuously.
- Supports automatic directional movement.
- Multiple sensors can be added.
- Can be enhanced with AI and advanced navigation.

IV. Methodology

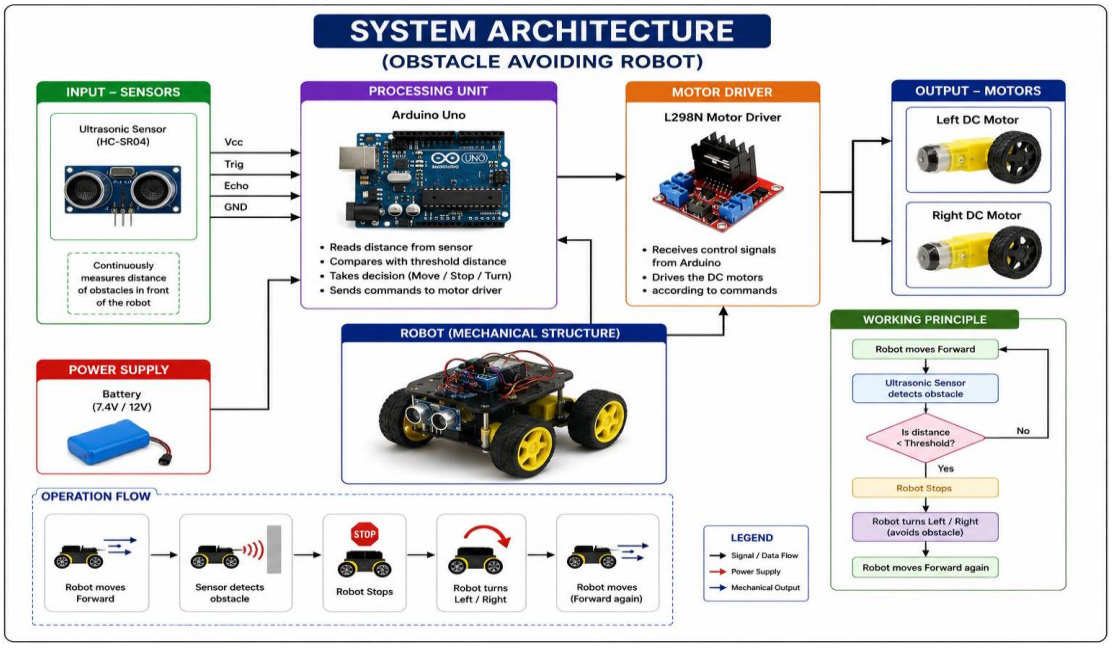
The methodology begins with identifying the requirements for autonomous obstacle detection and navigation. Suitable components such as an Arduino microcontroller, ultrasonic sensor, motor driver, DC motors, wheels, chassis, and battery are selected. The ultrasonic sensor is mounted at a suitable position on the robot to detect obstacles in its path. The sensor is connected to the Arduino so that distance measurements can be obtained continuously. The DC motors are connected to the motor driver, which receives movement commands from the Arduino. A control program is developed to process the distance values and determine the required robot movement. When the measured distance is greater than the safe limit, the robot continues moving forward. When an obstacle is detected, the robot stops and checks for an available direction. The controller then commands the motors to turn the robot left or right before continuing forward. The sensor and motor operations are tested under different obstacle conditions. The robot's response time, detection range, movement accuracy, and collision avoidance are evaluated. Finally, the control parameters and sensor positions are adjusted to improve the overall navigation performance.

System Architecture

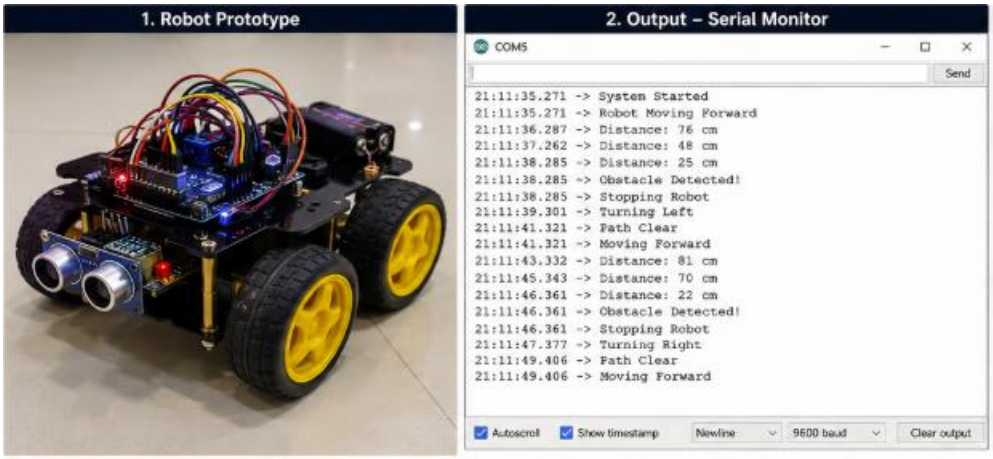
The system architecture represents the complete operation of the Obstacle Avoiding Robot from obstacle detection to automatic movement. The process begins with the

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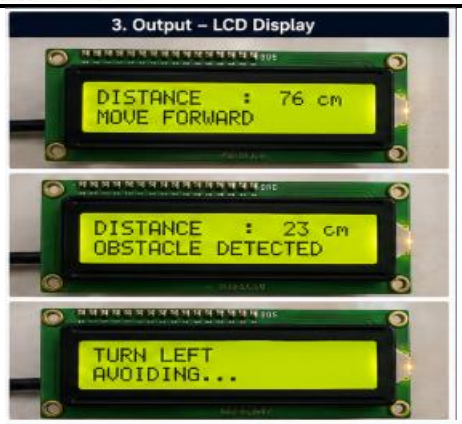
robot moving through its surrounding environment. The ultrasonic sensor continuously sends signals and receives reflected signals from nearby objects. The sensor calculates the approximate distance between the robot and the detected obstacle. This distance information is sent to the Arduino microcontroller for processing. The Arduino compares the measured distance with the predefined safety threshold. If no obstacle is detected within the safe range, the controller commands the motor driver to move the robot forward. If an obstacle is detected, the controller sends a stop command to the motor driver. The robot then determines a suitable direction based on available space. The motor driver operates the left and right DC motors to turn the robot in the selected direction. After avoiding the obstacle, the robot resumes forward movement. This sensing and decision-making process continues throughout the robot's operation.

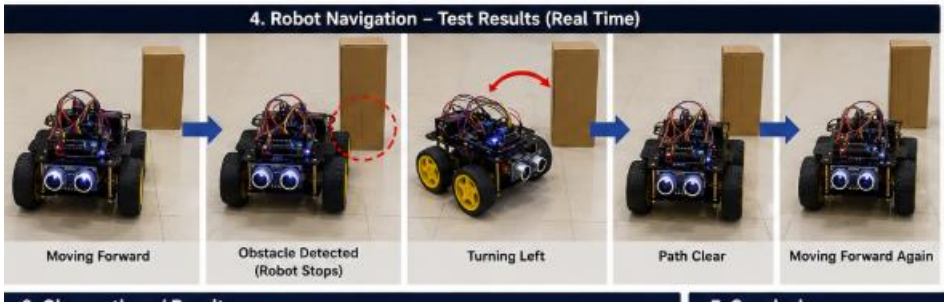


V. Result and Output



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5. Test Results Table

Test No.	Obstacle Distance (cm)	Action Taken	Result
1	75	Move Forward	Pass
2	28	Stop & Turn Left	Pass
3	22	Stop & Turn Right	Pass
4	65	Move Forward	Pass
5	18	Stop & Turn Left	Pass
6	70	Move Forward	Pass

IV. Conclusion

The Obstacle Avoiding Robot project successfully demonstrates the development of an autonomous robotic system capable of detecting obstacles and avoiding collisions without continuous human control. The ultrasonic sensor continuously measures the distance between the robot and obstacles, while the Arduino microcontroller processes the sensor data and makes appropriate movement decisions.

When an obstacle is detected within the predefined safe distance, the robot automatically stops and changes its direction by turning left or right. After avoiding the obstacle, the robot resumes its forward movement. The integration of the ultrasonic sensor, Arduino controller, motor driver, DC motors, and power supply provides a simple and effective solution for autonomous navigation.

The proposed system reduces manual intervention and provides a low-cost, reliable, and efficient approach to obstacle detection and avoidance. The project also demonstrates important concepts of embedded systems, robotics, sensor-based decision-making, and motor control.

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Overall, the system can be further improved by using multiple sensors, cameras, LiDAR, artificial intelligence, advanced path-planning algorithms, and GPS. These enhancements can make the robot more intelligent, accurate, and suitable for real-world autonomous navigation applications.

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