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BLUETOOTH CONTROLLED ROBOT WITH OBSTACLE AVOIDANCE

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ABSTRACT –

This paper presents the design and implementation of a robot capable of avoiding obstacles and being wirelessly controlled through Bluetooth. The system combines autonomous movement with manual control, making it versatile for tasks such as surveillance, operation in hazardous areas, and educational demonstrations. An Arduino Uno microcontroller serves as the brain of the robot, interpreting signals from ultrasonic sensors to identify and navigate around obstacles. Using this real-time sensor input, the robot adjusts its movement to prevent collisions and ensure smooth operation, even in dynamic or unfamiliar settings. The inclusion of a Bluetooth module enables users to operate the robot remotely via a smartphone or computer, enhancing its user-friendliness and adaptability. Key hardware components include the Arduino Uno, Bluetooth module, BO motors, and a servo motor.

Keywords: Arduino Uno, Bluetooth Sensor, BO Motor, Servo Motor. I.

I. INTRODUCTION

Robots have become an integral part of modern life, from industrial automation to personal Avoiding Bluetooth-Controlled Robot offers a hands-on introduction to the world of robotics assistance. Mobile robots that can avoid obstacles are becoming increasingly popular because they can move through complex environments on their own. Many of these robots also include Bluetooth connectivity, enabling users to take manual control when necessary. This project focuses on developing a functional obstacle-avoiding robot using Arduino technology, enhanced with Bluetooth capabilities. The Arduino microcontroller acts as the central unit, handling input from sensors, controlling motor drivers, and managing Bluetooth-based communication. While this project serves as a valuable educational tool, it also has potential applications in areas such as home automation, surveillance, security, and delivery services. By combining autonomous navigation with remote control, the Arduino Obstacle and automation, making it an ideal project for hobbyists and beginners alike.

II. OBJECTIVE

The goal of this project is to create an Arduino-powered robot capable of avoiding obstacles and supporting Bluetooth-based remote control. This allows the robot to operate in both autonomous and manual modes. The project is intended to enhance knowledge and interest in robotics by demonstrating the use of sensors for obstacle detection, motor control systems, and wireless communication. Designed as a versatile and engaging platform, it is suitable for educational use as well as real-world applications.

III. PROPOSED MODEL

The designed system incorporates an Arduino microcontroller, ultrasonic sensors to identify obstacles, a Bluetooth module for remote operation, and motor drivers to control the robot's movement.The robot can operate autonomously by using its sensors to detect and avoid obstacles or be manually controlled through Bluetooth commands from a smartphone. This dual functionality ensures flexible operation, interactive control, and reliable navigation in various environment.

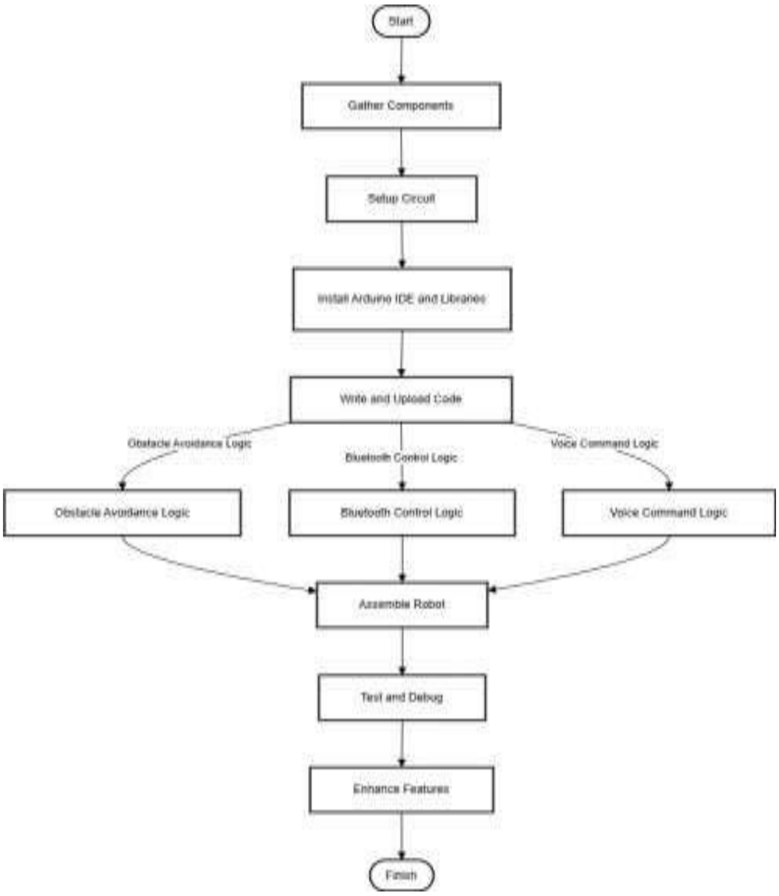


Fig 1: Block diagram

Materials Required

• Bluetooth Module Arduino Uno Board: The Arduino Uno is an affordable and flexible microcontroller board that supports a variety of electronic projects. It is compatible with other Arduino boards, shields, and can also interface with platforms like the Raspberry Pi.The Arduino Uno is capable of controlling various outputs such as LEDs, servos, motors, and communication modules like Bluetooth. At its core, the board features the ATmega328 AVR microcontroller, which includes 14 digital input/output pins and 6 analog input pins

The board also includes a USB port for connecting to a computer and is programmed using the Arduino IDE (Integrated Development Environment). It includes 32KB of flash memory, which is used to store the program code.2KB of SRAM, and 1KB of EEPROM. The operating voltage is 5V, and the board is designed to handle an input voltage range between 6V and 20V, with a recommended supply of 7V to 12V. This makes the Arduino Uno ideal for building small, efficient control systems, including those that incorporate Bluetooth communication for wireless control.

Fig 2: Arduino Uno board

Ultrasonic Distance Sensor

An ultrasonic distance sensor determines the gap between itself and an object by sending out ultrasonic waves. It typically includes two primary parts: a transmitter and a receiver: a transmitter (or emitter) that sends out the ultrasonic waves, and a receiver that detects the waves after they bounce back from the object. These waves travel at the speed of sound, and by calculating the time it takes for the waves to return, the sensor can determine the distance to the object. The distance is calculated using the formula:

Distance = (Speed of Sound × Time) / 2:The time is divided by two to reflect the round-trip journey of the ultrasonic waves to the object and back. These sensors are commonly used in obstacle detection because they offer dependable and precise measurements.

Fig 3: Ultrasonic distance sensor

Servo Motor: A servomotor (or servo motor or actually servo) is a rotary or linear actuator that lets in for particular control of angular or linear role, velocity, and acceleration in a mechanical machine[3]. It constitutes part of a servomechanism, and consists of a appropriate motor coupled to a sensor for role comments. It also calls for a rather state-of-the-art controller.

Fig 4: BO Motor

BO Motor: A BO (Brushed DCA motor is a type of electrical device that converts electrical energy into mechanical motion. featuring a central rotor surrounded by magnets and a commutator to switch current direction.[4] Commonly used in robotics and small- scale automation, it offers simplicity, affordability, and moderate torque suitable for various mechanical applications.

Fig 5: Photo Resistor

Bluetooth Sensor

A Bluetooth module, like the HC-05 or HC-06, facilitates wireless communication etween devices. It interfaces with the Arduino through the TX (transmit) and RX (receive) pins, enabling control via a smartphone or any Bluetooth-enabled device. These modules can be configured using AT commands and support both command inputs and data exchange, making them ideal for various applications, including robotics, smart home devices, and IoT (Internet of Things) systems.

FIG 6: Bluetooth Sensor

IV. CIRCUIT OF OUR PROPOSED SYSTEM

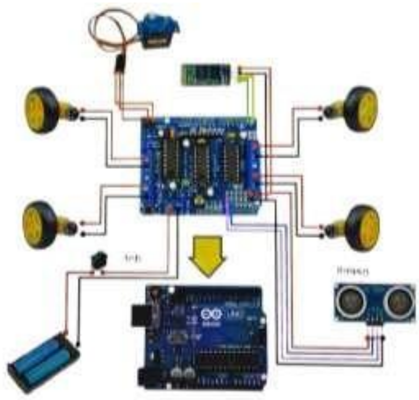


Fig 7: Circuit of our proposed system

Attach the positive terminal of the battery to the Vin pin of the Arduino. Connect the battery-ground terminal with the GND pin of the Arduino. Then connect VCC to the Arduino 5V pin.[2] GND Connect to the GND pin on Arduino Make the signal pin to a digit pin (for example, on D2 the Arduino) Power the VCC pin to the 5V pin on the Arduino. GND -> GND pin of ArduinoGND -> GND pin on Arduino To read the output of the sensor just connect the signal pin to an analog pin on the Arduino (for example A0). Connect IN1, IN2, IN3, and IN4 to the Arduino digital pins (in/digital pins 3,4,5 and 6 or other as you wish)EN A and EN . JOIN THE TWO MOTOR TERMINALS TO THE OUT1, OUT2, OUT3.OUT4. pins on the L298N.Connect the power supply (battery) to the 12V and GND pins on the L298N.

V.APPLICATIONS

This project offers a wide range of practical applications:

- It provides an interactive, hands-on platform for learning robotics, programming, and sensor integration. Being budget-friendly, it is accessible to a wider audience, making it ideal for educational use.
- The robot can function as a remote-controlled device for observing locations that are hard to reach, offering a highly energy-efficient solution for surveillance tasks.
- It can be adapted for simple tasks such as delivering small items or assisting with cleaning, making it useful in homes or offices.
- In industrial settings, the robot can help with navigating and transporting goods within warehouses, improving efficiency and reducing manual labor.

VI.RESULTS

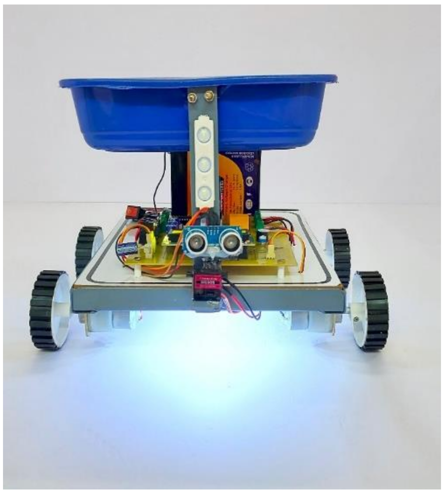
The completed robot successfully operates in two modes: (1) **Manual Bluetooth control** via a smartphone app (commands: forward, reverse, left, right, stop), and (2) **Autonomous obstacle-avoidance** using ultrasonic sensors. During tests the robot reliably navigates a cluttered course, switches between manual and autonomous modes without rebooting, and avoids collisions by stopping or steering away when an obstacle is detected within the programmed threshold.

Key outcomes

- Manual control: All motion commands sent via Bluetooth are executed with an average response latency of ~100 cm (controller → robot).
- Obstacle detection: Ultrasonic sensors detect obstacles down to 15 cm accuracy; robot begins avoidance Movements when obstacles are within the set threshold.
- Autonomous behaviour: On encountering obstacles, the robot either stops and waits for manual input or performs an avoidance routine

(reverse + turn + forward) depending on selected mode.

- Mode switching: Switching between manual and autonomous modes works reliably via a command from the app



VII. CONCLUSION

The Bluetooth-controlled robotic vehicle with obstacle detection represents a significant step forward in the field of wireless robotics and automation. By combining Bluetooth technology for remote control with advanced obstacle detection sensors, this project offers a reliable and efficient solution for navigating complex environments without human intervention. The system's ability to detect obstacles in real time and adjust its movement accordingly ensures enhanced safety and operational accuracy, reducing the risk of collisions and damage. Moreover, the use of Bluetooth communication provides a convenient and flexible interface for users to control the vehicle from a distance, making it highly adaptable to various practical scenarios such as surveillance, exploration, and educational purposes. This project not only showcases the effective integration of hardware and software components but also highlights the potential for future developments, including improved sensor accuracy, longer-range communication, and autonomous decision-making capabilities. Overall, this robotic vehicle serves as a strong foundation for advancing smart robotic systems and paves the way for innovative applications in both industrial and everyday contexts.

VIII. FUTURE SCOPE

- Integration with AI: The vehicle can be enhanced with artificial intelligence algorithms for smarter decision-making and autonomous navigation without human intervention.
- Advanced Sensor Systems: Incorporating more sophisticated sensors such as LIDAR, ultrasonic arrays, or infrared cameras can improve obstacle detection accuracy and range.
- IoT Connectivity: Future versions can connect to the Internet of Things (IoT) platforms, enabling remote monitoring and control over long distances via cloud services.
- Voice Control: Adding voice recognition features can allow users to control the vehicle through voice commands, making the system more user-friendly.
- Enhanced Power Management: Development of energy-efficient systems or integration of renewable energy sources like solar panels can increase operational time.
- Autonomous Mapping: The vehicle could be upgraded to perform simultaneous localization and mapping (SLAM) to create maps of unknown environments.
- Multi-Robot Coordination: Future projects could involve networking multiple robotic vehicles to work collaboratively on complex tasks or large area surveillance.
- Commercial Applications: The technology can be adapted for commercial use in fields such as delivery services, agricultural automation, or industrial inspection.

VII. REFERENCES

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