Multifunctional Robot Car Using Arudino UNO and Node MCU.

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Introduction :

Bluetooth module and a smartphone, the robot is wirelessly controlled. Overall, this study shows the possibility for creating intelligent, effective robotic systems that can carry out a variety of duties, improving the convenience and ease of our lives

People are looking for multipurpose items in today's society, and robotic automobiles are a prime example of this. Several robotic cars were created in the past to carry out particular jobs. However, in this project, we have created a multi-functional robot that can carry out a variety of duties, including household chores, industrial applications, and military operations. We created a smartphone app using MIT App Inventor that has a variety of capabilities and can be used to control this robot. With the help of this app, users can effortlessly steer the robot with their cell phones and, with a simple click, put it in obstacle-avoidance mode.

The robot can detect impediments in its path and alter its course to avoid them while it is in obstacle-avoidance mode. The robot can also follow a track thanks to a feature called line-following. In order to enable remote control of the robot via a transmitter, we installed an 1838 IR sensor.

The objective of this project is to create a prototype for a strong, adaptable, multi-functional robot car that uses the least amount of technology possible. As the hub to which all other components are connected, we have utilised an Arduino UNO.

Definition :

The creation of an obstacle-avoidance robotic vehicle that can move utilising ultrasonic sensors is the main topic of this research article. A microprocessor from the ATmega328 family, which directs the vehicle's movement, is used. The goal is to create a vehicle that can recognise impediments in its route and adjust its course accordingly. To do this, a microcontroller receives an instruction from the ultrasonic sensor, which detects the obstruction. The microprocessor activates the motors attached to it using a motor driver to command the robot to move in a different direction based on the signal it receives. The project seeks to investigate the advantages of ultrasonic sensors over IR sensors, which although having their own uses, are incompatible with the project's specifications. The proposed robotic vehicle is made to be an intelligent device that can carry out duties automatically or with instruction, offering a safer and more effective approach to go through settings that are full of obstacles.

Objectives :

Through obstacle detection and avoidance, the research effort intends to create a robotic system that can safely navigate its way. In order to ensure accurate navigation, the system uses sensors to determine the precise path and may analyse sensor readings from various angles. The device also has a Bluetooth module that, when in automated mode, may send status updates

to an Android phone nearby. Additionally, the system can be controlled manually by detecting signals from the phone, providing more flexibility and control. Overall, the system provides cutting-edge functionality for effective and safe navigation in a variety of settings.

Literature Survey :

1) D. Vijendra Babu, D. C. Jenniffer, and R. Karthikeyan created the project "Line follower robot & obstacle detection using PID controller" in 2020. In this project, a line-following robot that can recognise impediments and change directions on its own is proposed. The robot can follow a predetermined line and identify obstacles using a PID controller. This system's advantage is that it can navigate on its own without assistance from a person.

2) Akhund and Newaz (2020) surveyed the literature on the "IoT Waiter Bot: A Low Cost IoT based Multi Functioned Robot for Restaurants." The robot's pros include obstacle recognition and waiting for clearance, while its cons are limited mobility along a predetermined black line path. The study highlights the robot's affordability and effective use of IoT technologies.

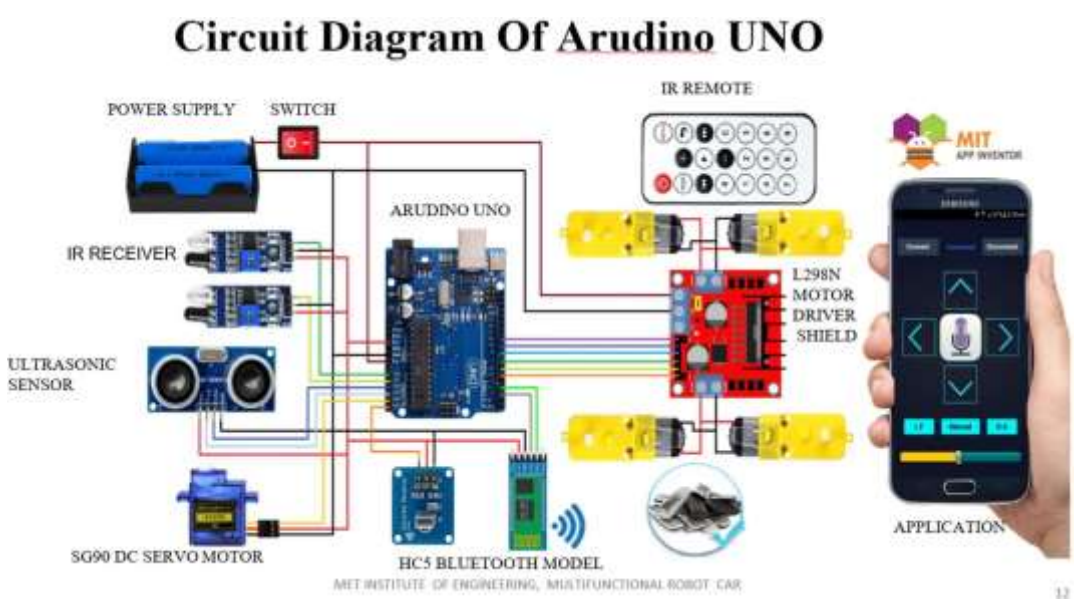
3) A study project titled "Line Following Robot Using Arduino for Hospitals" was released in September 2019 by Sushama Gavarskar and Jagruti Chaudhari. By utilising a line-following robot that can detect and follow a pre-defined course using sensors controlled by an Arduino microcontroller, this project intends to reduce the workload of transportation for hospital staff. The use of the technology can increase productivity, improve patient safety, and lighten the workload of hospital staff, among other benefits.

4) The "Building a Line Following Robot" project by Richard T. Vannoy (released December 2007) aims to create a robot that can navigate along a predetermined black line on the ground. This technology offers reliable transportation without human involvement, with the ability to be programmed for specific courses. It has potential applications in manufacturing, logistics, and transportation sectors.

5) In May 2020,Shubh Srivastav and Rajanish Singh produced a project that used less space and was more focused on monitoring and investigation. The goal of this project is to create a technology that can monitor and research different settings in a space-constrained manner. With this technology, less room is needed while yet having effective monitoring and investigation capabilities. To improve safety and reduce hazards, technology can be applied in a variety of industries, including security and surveillance.

6) The "Voice Control Robot Car using Arduino Uno" project, led by Mr. Vineeth Teeda, Mrs. K. Sujatha, and Mr. Rakesh Muthukuru in August 2016, focused on developing a voice-controlled robot car using an Arduino Uno microcontroller. This technology offers significant advantages in chemical industries where manual operation poses risks due to toxic substances. By reducing accidents and enhancing safety, the voice-controlled robot car shows promise in creating effective and secure automation solutions for high-risk areas.

Diagram Of Arduino UNO Circuit Diagram :



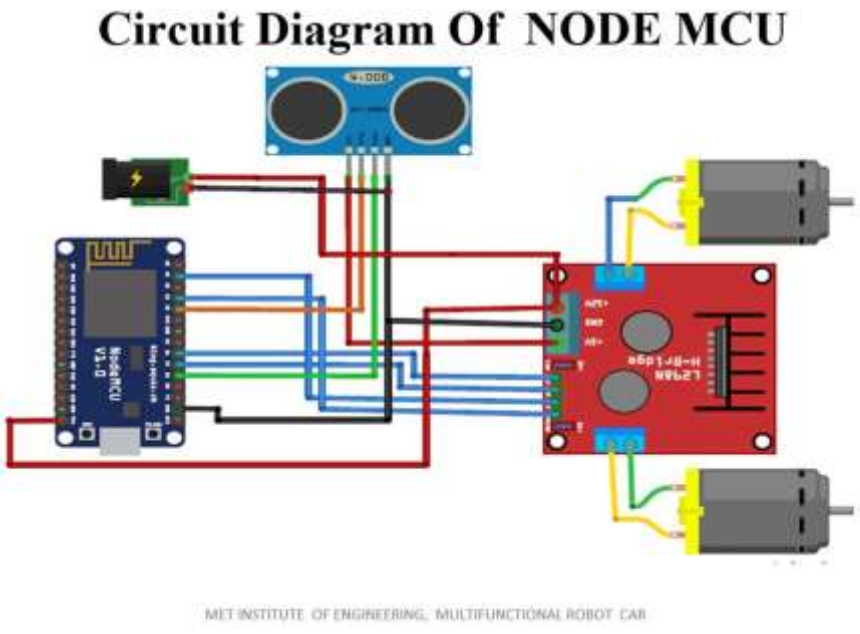
Explaniation of project using Arudino uno:

This project aims to create a Multi-Functional robot using sensors, motor driver, and Arduino. After powering on the robot and connecting the HC-05 Bluetooth module, the Multi-Functional robot app is opened. Commands are sent to the robot through the app, such as forward, reverse, right, and left. The app also features line following, obstacle avoiding, and manual modes. Voice control is implemented, allowing commands like "Move Forward," "Go Back," "Turn Left," and "Turn Right." The robot can be controlled using an IR remote by decoding the remote buttons. Each button has a predefined function, such as forward, reverse, left, right, line following mode, obstacle avoiding mode, manual mode, and stop.

Explaniation of project using Node MCU:

A Node MCU-based line following and Wi-Fi control robot car can be built using the open-source firmware and development kit. With a Node MCU board, motor driver module, DC motors, line sensor module, and battery pack, the hardware setup can be established. The Node MCU board can be programmed using the Arduino IDE, enabling control over motor speed and direction as well as line detection. To enable Wi-Fi control, the board can connect to a network and receive commands through an IP address assigned to it. A mobile app or web page can be developed to send instructions such as moving forward, backward, turning left or right, or stopping. The code in the Node MCU board interprets and executes these commands, controlling the motors and line sensor accordingly. This allows the robot car to follow lines and be remotely controlled via a smartphone or computer.

Diagram of Node MCU with Mobile Control And Line Following:



Component's:

1) Arduino UNO:

Arduino is an open-source electronics platform known for its user-friendly interface and versatility. It allows users to easily connect sensors and buttons to generate motor or LED outputs. Developed at the Ivrea Interaction Design Institute, Arduino enables fast prototyping and is accessible to beginners and advanced users. It is widely used in various projects, from everyday objects to scientific instruments. Arduino's compatibility with different operating systems makes it accessible to a wide range of users. Its simplicity and flexibility have made it a popular choice for educators, students, and hobbyists interested in physical computing.

2) Ultra Sonic Sensor:

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3) Servo Motor:

A Servomotor is an actuator used for precise control of position, acceleration, and velocity. It consists of a sensor, motor, and controller. In an obstacle-avoiding robot, a servomotor rotates the ultrasonic sensor to scan for obstacles.

4) Motor Drive:

A motor driver is an electronic component used to control motors in robots. The L293 series, like L293D and L293NE, are common motor drivers for controlling two DC motors. L293D has two H-bridges and interfaces with microprocessors. It supplies voltage to motors and draws current for its operation. L293D is crucial in robotics for precise motor control, compactness, low power consumption, and high efficiency.

5) HC 05 Bluetooth Module:

The HC-05 Bluetooth module is a popular wireless communication device used in robotics, home automation, and industrial control systems. It supports Bluetooth 2.0+EDR, has a 10-meter range, operates at 2.4GHz, and uses a serial interface. It is easy to configure with AT commands and has master and slave modes for versatility. The HC-05 module is reliable and widely used for wireless data transfer and control.

6) IR Sensor:

An IR proximity sensor detects objects by emitting and measuring reflected infrared light. It uses an LED to emit light and a photodiode to detect reflected light. The strength of the reflected light indicates the object's distance. The sensor sends a low signal when active, which can be used by a microcontroller. It is useful in robotics, security, and automation. It has built-in LEDs for visual feedback and is compact, low-power, and easy to use.

7) Node MCU:

The Node MCU is an open-source development platform based on the ESP8266 microcontroller. It is widely used for IoT projects due to its integrated components and cost-effectiveness. The Node MCU comes in different package styles with the ESP8266 at its core. It supports various programming languages and has built-in Wi-fi capabilities for easy integration with cloud services. The Node MCU simplifies IoT project development and is popular among hobbyists, students, and professionals.

Test case for Arudino uno:

Condition	Test Case Result	Output
Obstacle Avoidance	Successful	The robot car is equipped with a servo motor that measures the distance of all sides. When an obstacle is detected and the distance is calculated, the robot compares the distance to a threshold of 20. If the distance is less than 20, the robot will turn in the direction of the obstacle and continue moving forward. This functionality allows the robot to successfully avoid obstacles and navigate its environment.
Line Following	Successful	The robot car is equipped with IR sensors that allow it to detect and follow a black line. When the sensors detect the black line, the robot will move forward along the line. If an object is present on the line, the robot will stop and wait for the object to be moved. Once the object is moved, the robot will continue to follow the line. This functionality allows the robot to successfully follow a line and react appropriately when an object is detected on the line.
Bluetooth and Voice Control	Successful	The robot car is controlled using an open source mobile application that communicates with the car through Bluetooth. The application allows for both voice control and navigation control, allowing the user to give voice commands or manually control the car's movements using a virtual joystick or directional buttons on the app. This functionality allows for easy and flexible control of the robot car using a mobile device, making it accessible and user-friendly.

Test case for NODE MCU:

Condition	Test Case Result	Output
WiFi Control	Successful	The robot car is controlled using a Node MCU, which allows for WiFi control of the car from anywhere. This means that the user can control the car from a remote location, without being limited by the range of Bluetooth or other short-range communication methods. The Node MCU can connect to any available WiFi network, allowing the user to control the car from virtually anywhere with an internet connection. This functionality greatly enhances the versatility and convenience of the robot car, making it suitable for a variety of applications and use cases.
Line Following	Successful	The robot car is equipped with IR sensors that allow it to follow a black line on the ground. The sensors detect the contrast between the black line and the lighter background, and adjust the direction of the car accordingly. The car is able to follow the line accurately and smoothly, with no significant deviations or disruptions. Additionally, the car is able to detect and respond appropriately to obstacles that may be present on the line, such as by stopping or adjusting its direction. Overall, the line following functionality of the robot car is effective and reliable, making it suitable for a variety of applications that require precise and automated movement.

Advantages:

- The system can be used in various applications such as automated vehicles, space missions, and mines.
- The system can be controlled wirelessly using an Android phone, allowing for remote operation.
- The system is relatively low cost compared to other advanced navigation systems.
- The line following functionality allows for precise and accurate movement along a predefined path, which can be useful in various applications.
- The system is based on widely available and easy to use components such as IR sensors, Arduino boards, and motors, making it easy to replicate and modify for different purposes.
- Industrial Applications: These robots can be used as automated equipment carriers in industries replacing traditional conveyer belts.

- Automobile applications: These robots can also be used as automatic cars running on roads with embedded magnets.
- Domestic applications: These can also be used at homes for domestic purposes like floor cleaning etc.
- Guidance applications: These can be used in public places like shopping malls, museums etc to provide path guidance.

Disadvantages:

- Robotics systems may require regular maintenance and calibration to ensure proper functioning, which can be time-consuming and expensive.
- Robotics systems may have limited flexibility and adaptability to changing environments or tasks, as they are designed for specific purposes.
- Robotics systems may face safety concerns, especially when they interact with humans or operate in hazardous environments.
- Robotics systems may rely on advanced technologies, which may limit their accessibility or reliability in certain situations.
- Robotics systems may face legal and ethical challenges, especially when it comes to issues such as privacy, security, and accountability.

Conclusion:

In this research paper, we have explored the field of Robotics and presented a robotic car that is equipped with various advanced features. The proposed model operates on wireless remote control via an Android application that is connected to a Bluetooth module. It also incorporates features such as obstacle avoidance, line following, voice control, and remote control.

Throughout the project, we have gained a deep understanding of the Arduino UNO and various sensors, which has helped us to develop our coding and designing skills. The project has provided us with valuable insights into different technologies and tools that can be used to enhance the capabilities of the robotic car. Overall, the project has been a great learning experience and has broadened our knowledge in the field of Robotics.

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