Cyber Geeks

PROJECT REPORT

Arduino IoT-based Obstacle Detection & Avoidance Robotic Car

- *Prepared For:*

Project Exhibition at Techno Sapiens!

- *Prepared By:*

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ABOUT OUR PROJECT

Abstract: The Arduino IoT-based Obstacle Detection & Avoidance Robotic Car is a project aimed at developing a smart and autonomous robotic car capable of navigating through environments while detecting and avoiding obstacles. This project integrates Arduino microcontroller technology with Internet of Things (IoT) capabilities to enhance the functionality and control of the robotic car. The system utilizes ultrasonic sensors for obstacle detection and avoidance and employs a combination of motor control algorithms and IoT communication protocols for real-time control and monitoring.

Introduction: Robotic cars have gained significant interest in various applications, including surveillance, transportation, and exploration. However, navigating through dynamic environments poses challenges, particularly in detecting and avoiding obstacles in real-time. This Arduino Robotic Car with Integrated ultrasonic sensors for obstacle detection and avoidance, addresses these challenges by implementing an intelligent system that combines hardware components with IoT technology for enhanced functionality and performance.

MAKERS OF THE PROJECT ARE:

- Pratham Aggarwal

prathamaggarwal

- Dhruv Dhayal

dhruv-dhayal

MISSION AND VISION

Why we chose this Arduino Project?

Mission

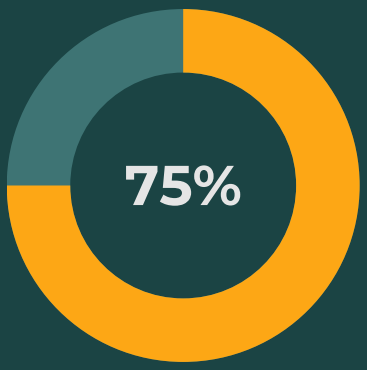
Our mission is to explore the realms of robotics & IoT technology, harnessing their potential to solve real-world challenges and advance innovation. Via this project, we aim to create a versatile and intelligent platform capable of navigating through the dynamic environments in real-time. Our mission extends beyond mere technical exploration; it encompasses a commitment to learning, creativity, and the pursuit of solutions that have practical implications in various fields and have different applications.

Vision

Our vision is to create a future where robotics and IoT technologies converge to revolutionize how we interact with the world around us. By choosing the Arduino project focused on obstacle detection and avoidance, we envision a world where autonomous systems seamlessly navigate complex env's, enhancing safety & productivity across industries. Our vision extends to empowering individuals & communities to embrace technology as a tool for innovation and positive change.

METHODOLOGY

Our way of making this project, based on particular principles and methods!

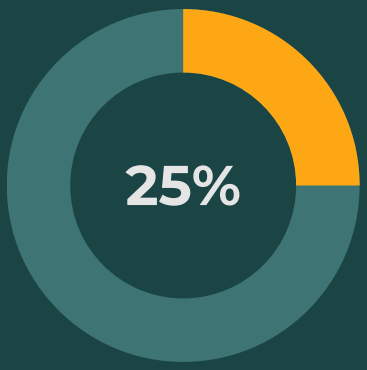


Hardware Setup

- Assembling robotic car chassis, mount motors, wheels, and ultrasonic sensors.
- Connecting components to Arduino Uno and motor driver, install Wi-Fi module for IoT.

Software Development

- Developing motor control algorithms for movement.
- Implementing obstacle detection & avoidance algorithms using ultrasonic sensor.
- Configuring Wi-Fi for external communication & developing a web-based control interface.



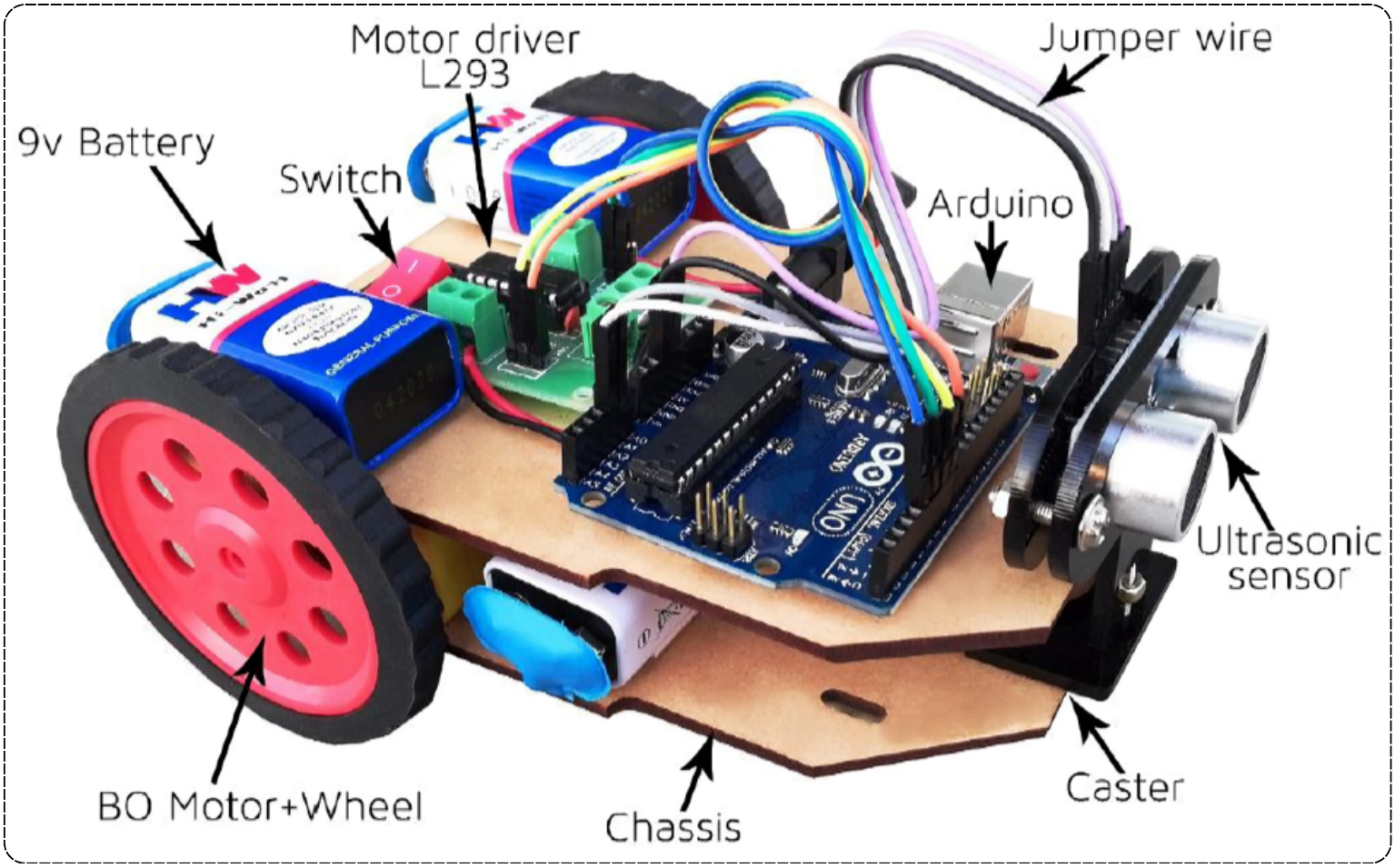
Integration & Testing

- Integrating hardware and software for a functional prototype.
- Conducting comprehensive testing for reliability & seeking feedbacks.

IN-DEPTH ANALYSIS

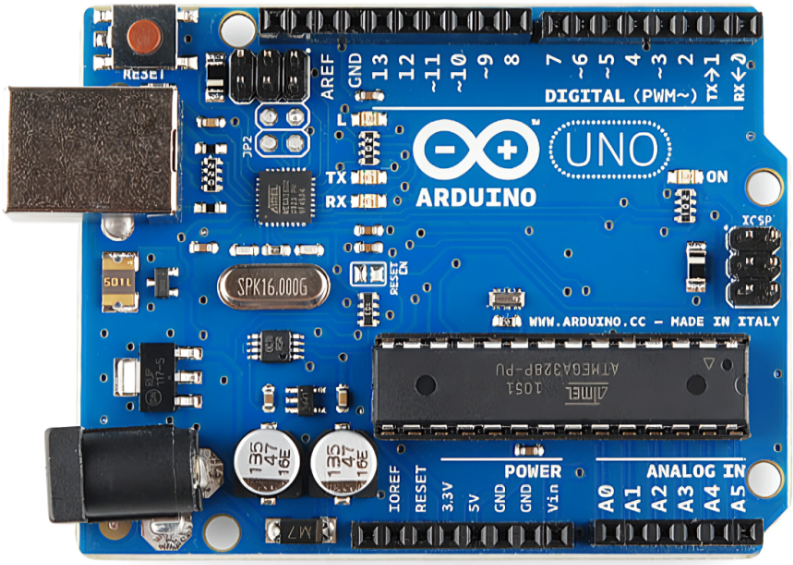
Basic principle: The robot uses Ultrasonic sensor to detect the obstacle and motor driver is used to drive the motor according to the ultrasonic signal as per code written in the Arduino.

Ultrasonic sensor: The ultrasonic sensor has a signal generator and a receiver. The signal generator generates an ultrasonic wave and transmits in the forward direction. The transmitted wave strikes any obstacle in its path and a huge part of it gets reflected. The receiver receives the reflected wave.



The obtained values from the ultrasonic sensor need to be calibrated in order to get a meaningful data (distance). The distance of the object is calculated on the basis of the time taken by the wave in the process of transmission, reflection and collection.

COMPONENTS USED



Arduino: Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs (Like-light on a sensor, a signal of a button, or a signal from sensor etc) and turn it into an output (Like- activating a motor, turning on an LED, publishing something online etc). We can tell our board what to do by sending a set of instructions to the microcontroller on the board. To do so we use the Arduino programming language and the Arduino Software (IDE).

In this project, to avoid the obstacle in the path, a condition is put in the system which says: if the distance between the robot and the object gets below a certain level, stop the robot and take a backward motion and then turn the robot into other direction and continue the loop. This logic is applied to the system by writing the code in the arduino.

Arduino UNO	9v Batteries & Connector
Jumper wires	L293 motor driver
2 Wheel Drive Robotic Chassis	HC-SR04 Ultrasonic Sensor
2 DC BO Motors	Switch
Caster	Nut-Bolts, Spacer

CONNECTIONS

L293 motor driver: We now have the conditions set up for the robot car but it needs to be executed/implemented on the hardware. The hardware used is the DC motor. To drive these DC BO Motors, we need motor driver. In this project we are using L293 motor driver. Motor driver is used to send the commands to motors according to signal received from Arduino.

BO Motors: Two motors are used in this process: left motor and right motor. To move the robot car forward, both the motors are turned on. For backward step, both motors need to run in opposite direction. To turn the robot car to avoid obstacle, one of the motor is reversed for a while, keeping the other motor forward.

Results & Discussion: The Arduino IoT-based Obstacle Detection & Avoidance Robotic Car successfully demonstrated autonomous navigation capabilities in dynamic environments. The integration of ultrasonic sensors enabled real-time obstacle detection and avoidance, ensuring safe and efficient movement. The IoT capabilities provided remote control and monitoring features, allowing users to interact with the robotic car from a distance via a web-based interface.

Types

Motor Driver connection:

- Vin → 9v Battery (+) ve
- GND → 9v Battery (-) ve
- M1 → Left Motor connection
- M2 → Right Motor connection
- IN1 & IN2 → Arduino 4 and 5 (If motor runs in wrong direction, connection is swapped)
- IN3 & IN4 → Arduino 6 and 7 (If motor runs in wrong direction, connection is swapped)

Ultrasonic connection:

- Gnd: Arduino GND
- Echo: Arduino A2
- Trig: Arduino A1
- Vcc: Arduino 5V

SOURCE CODE

The following code is intentionally omitted for privacy & security reasons!

```
#include <Servo.h>
#include <NewPing.h>

//our L298N control pins
const int LeftMotorForward = 7;
const int LeftMotorBackward = 6;
const int RightMotorForward = 4;
const int RightMotorBackward = 5;

#define trig_pin A1 //analog input 1
#define echo_pin A2 //analog input 2

#define maximum_distance 200
boolean goesForward = false;
int distance = 100;

NewPing sonar (trig_pin, echo_pin,
maximum_distance);
Servo servo_motor;

void setup(){

 pinMode(RightMotorForward, OUTPUT);
 pinMode(LeftMotorForward, OUTPUT);
 pinMode(LeftMotorBackward, OUTPUT);
 pinMode(RightMotorBackward, OUTPUT);
}

void loop(){

 int distanceRight = 0;
 int distanceLeft = 0;

 if (distance <= 25) {
  moveStop ();
  delay(100);
  moveBackward ();
  delay (400);
  moveStop ();
  delay (300);
  distanceRight = lookRight();
  delay (300);
  distanceLeft = lookLeft();
  delay (300);

  if (distance >= distanceLeft) {
   turnRight();
   moveStop();
  }
  else{
   turnLeft();
   moveStop();
  }
 else{
  moveForward();
 }
  distance = readPing();
}

int lookRight() {
 servo_motor.write (50);
 delay (500);
 int distance = readPing();
 delay (100);
 servo_motor.write (115);
 return distance; }

int lookLeft(){
 servo_motor.write (170);
 delay(500);
 int distance = readPing();
 delay (100);
 servo_motor.write (115);
 return distance;
 delay (100);
}

void turnLeft(){

 delay (900) ;
 digitalWrite(LeftMotorForward, HIGH);
 digitalWrite(RightMotorForward, HIGH);
 digitalWrite(LeftMotorBackward, LOW);
 digitalWrite(RightMotorBackward, LOW);
}
```

ENDING NOTES

Programming Arduino UNO:

1. Download and Install the Arduino Desktop IDE.
2. Download and paste NewPing library (Ultrasonic sensor function library) file to the Arduino libraries folder.
3. Paste files to the path (Example) - C:\Arduino\libraries.
4. Write Arduino code for the robot functioning.
5. Upload the code to the arduino board via a cable.

Power the Robot: We will use pack of 9V batteries to power our robot and Arduino.

Demonstration: When we put the robot and turn ON the switch, it goes forward. The robot detects the obstacle in its path and takes a backward step and then takes a turn and then moves forward with the same loop.

In conclusion, our Arduino IoT-based Obstacle Detection & Avoidance Robotic Car project represents a step towards intelligent, autonomous systems, poised to navigate dynamic environments with precision and efficiency.

References for the Project

- Arduino Official Website: https://www.arduino.cc/
- Internet of Things (IoT) Overview: https://www.internetsociety.org/resources/iot-overview/
- Ultrasonic Sensor Tutorial: https://www.arduino.cc/Tutorial/LibraryExample/UltrasonicSensor

This project report outlines the design, development, and implementation of our Arduino IoT-based Obstacle Detection & Avoidance Robotic Car, highlighting its components, methodology, results, and potential future enhancements.

Thankyou!