Project: Arduino-Based Obstacle Avoiding Robot

1. Project Goal

The primary objective of this project is to construct a fully autonomous mobile robot capable of navigating an environment by detecting obstacles in its path and automatically changing its direction to avoid collision. This project integrates basic electronics, mechanical assembly, and microcontroller programming (Arduino).
Target Audience: STEM hobbyists, high school, or introductory college students (Inferred level: Intermediate).

2. Components Required

Component	Quantity	Description
Arduino Uno	1	The main microcontroller for processing sensor data and controlling motors.
HC-SR04 Ultrasonic Sensor	1	Used to measure the distance to objects in front of the robot.
DC Gear Motor	2	Motors to drive the wheels (usually 100 RPM to 300 RPM).
L298N Motor Driver Module	1	Required to interface the Arduino (low current) with the motors (high current).
Caster Wheel	1	A free-rotating wheel for balance and support.
Wheels	2	Mounted on the DC motors.
Robot Chassis	1	The frame of the robot (e.g., acrylic or 3D-printed).
Power Supply	1-2	A 9V or 7.4V battery pack for the Arduino, and a separate 6-12V battery for the motors (recommended for stability).
Jumper Wires	Varies	For making connections (Male-to-Male, Male-to-Female).

3. Circuit Wiring and Connections

The robot requires connections between the sensor, motor driver, and Arduino.

3.1. Ultrasonic Sensor (HC-SR04) to Arduino

Sensor Pin	Arduino Pin	Function
VCC	5V	Power supply
GND	GND	Ground
Trig (Trigger)	Digital Pin 9	Sends the ultrasonic burst (Output)
Echo	Digital Pin 10	Receives the reflected signal (Input)

3.2. Motor Driver (L298N) to Arduino

The L298N controls two motors (Motor A and Motor B) using four control pins (IN1, IN2, IN3, IN4) and two speed control pins (ENA, ENB).

L298N Pin	Arduino Pin	Function
ENA	Digital Pin 5 (PWM)	Speed control for Motor A (Left Wheel)
IN1	Digital Pin 4	Motor A - Direction Pin 1
IN2	Digital Pin 3	Motor A - Direction Pin 2
ENB	Digital Pin 11 (PWM)	Speed control for Motor B (Right Wheel)
IN3	Digital Pin 7	Motor B - Direction Pin 1
IN4	Digital Pin 6	Motor B - Direction Pin 2
12V/VCC	Motor Battery (+)	Motor Power Supply
GND	Motor Battery (-) & Arduino GND	Ground Connection (Crucial for common reference)

3.3. Circuit Visualization

Key Wiring Note: The grounds of the Arduino (Logic power) and the Motor Driver/Motor Battery (Motor power) **MUST** be connected together for the system to work correctly.

4. Working Principle (The Algorithm)

The robot follows a continuous loop of sensing, deciding, and acting.

1. **START:** Robot moves forward at a set speed.
2. **SENSE:** The ultrasonic sensor continuously measures the distance to the object directly ahead.
3. **DECIDE (Check Distance):**
   - **IF** Distance is greater than a pre-defined threshold (e.g., 20 cm):
     - **ACTION:** Continue moving **FORWARD**.
   - **ELSE** (Distance is less than or equal to the threshold):

- **ACTION:**
  1. **STOP** the robot.
  2. **REVERSE** for a short duration (e.g., 500 milliseconds).
  3. **STOP** again.
  4. **TURN:** Pivot in place (e.g., turn right) for a short duration (e.g., 400 milliseconds).
  5. **RESUME:** Start moving **FORWARD** again, repeating the loop.

5. Programming Logic (Arduino Pseudocode)

The Arduino code uses the measured distance to control the motor driver pins.