Arduino Car Simulation Project Requirements

(with IR Remote, Buzzer Horn, LED Functions, Parking Sensor, and Required Lights)
Objective

Design and build an **Arduino-based car simulation system** using an **IR remote control**. The system will simulate basic automotive features such as **turn signals**, **horn**, **windshield wipers**, **windows**, **reverse light**, **brake lights**, **headlights**, and a **parking sensor**. Various **LEDs** and a **buzzer** will be used to represent the car's functions.

Required Hardware

- **Arduino Uno** (or compatible board)
- **IR Receiver Module** + **IR Remote**
- **Ultrasonic Sensor** (e.g., HC-SR04)
- **Buzzer** (for horn)
- **LEDs**:
    - **Turn Signals**: 2× **Yellow LEDs**
    - **Windshield Wipers**: 1× **Blue/White LED**
    - **Windows**: 1× or 2× **LEDs** (for window UP/DOWN)
    - **Parking Sensor LEDs**: 3 LEDs for proximity indicator:
        - **Green** (safe distance)
        - **Yellow** (medium distance)
        - **Red** (dangerous distance)
    - **Headlights**: 2× **White LEDs**
    - **Brake Lights**: 2× **Red LEDs**
    - **Reverse Light**: 1× **White LED**

- **Resistors** (220Ω–330Ω for LEDs)
- **Breadboard** and **Jumper Wires**
- **USB Cable** / Power Supply (battery or USB)

Functional Requirements

1. Turn Signals (Left & Right)

- **Control:** IR Remote buttons (e.g., Left = **A**, Right = **B**)
- **LED Simulation:**
    - **Yellow LED** for left turn
    - **Yellow LED** for right turn
- **Behavior:**
    - LED blinks at ~1 Hz (1 blink per second)
    - Only one signal should be active at a time (hazard lights are optional, but can be implemented by triggering both signals simultaneously)

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2. Horn (Using Buzzer)

- **Control:** IR Remote button (e.g., **C**)
- **Behavior:**
    - **Buzzer** sounds when the horn button is pressed
    - Turns **OFF** immediately when the button is released

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3. Windshield Wipers (LED Simulation)

- **Control:** IR Toggle button (e.g., **D**)
- **LED Simulation:** 1 LED (blue or white)
- **Behavior:**
    - **LED blinks rapidly** (3–4 times per second) when ON (simulating wiper motion)
    - **LED stays OFF** when wipers are OFF

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4. Windows (Open/Close Simulation with LED)

- **Control:**
    - **Window UP** = IR button **E**
    - **Window DOWN** = IR button **F**
- **LED Simulation:**
    - **Option A:** 2 LEDs (Green = window closed/up, Red = window open/down)
    - **Option B:** Single LED (ON = window closed, OFF = window open)
- **Behavior:**
    - Pressing **UP** turns the LED Green (indicating window closing)
    - Pressing **DOWN** turns the LED Red (indicating window opening)

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5. Parking Sensor (Ultrasonic Distance Detection)

- **Control: Ultrasonic Sensor (HC-SR04)** continuously monitors the distance from objects.
- **LED Simulation:**
    - **Green LED** = Safe distance (object far away)

- **Yellow LED** = Medium distance (warning)
- **Red LED** = Very close (dangerous proximity)

- **Distance Ranges:**

Distance Range	LED Output	Meaning
> 30 cm	**Green ON**, Yellow OFF, Red OFF	Safe
15–30 cm	Green OFF, **Yellow ON**, Red OFF	Warning
< 15 cm	Green OFF, Yellow OFF, **Red ON**	Danger

Continuous Monitoring:
The ultrasonic sensor should continuously update the parking sensor LEDs based on proximity to nearby objects. The parking sensor must operate independently of the IR-controlled features.

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6. Reverse Light

- **Control:** Reverse light is automatically triggered when a button on the IR remote (e.g., **G**) is pressed.
- **LED Simulation:**
  - **White LED** to simulate the reverse light
- **Behavior:**
  - When **Reverse** is ON (IR button pressed), the **White LED** turns ON, simulating the reverse light.
  - The LED turns OFF when the button is released.

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7. Brake Lights

- **Control:** The brake lights are activated when the **brake pedal** is simulated using an IR button (e.g., **H**).

- **LED Simulation:**
    - **Red LEDs** for brake lights
- **Behavior:**
    - Pressing the **Brake** button will turn ON both **Red LEDs**, simulating brake lights.
    - The LEDs turn OFF when the brake button is released.

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8. Headlights

- **Control:** Headlights are controlled by an IR button (e.g., **I**).
- **LED Simulation:**
    - **White LEDs** for headlights
- **Behavior:**
    - Pressing the **Headlights** button will turn ON both **White LEDs**, simulating the car's headlights.
    - The LEDs turn OFF when the button is released.

IR Remote Requirements

- **IRremote library** will be used to decode signals from the IR remote.
- Each IR button must be mapped to a specific function in the system.
- Ensure **non-blocking** operation for all features (e.g., use `millis()` instead of `delay()`).