**OMNIDIRECTIONAL OBSTACLE AVOIDANCE BOT**

1. **Pin Selection**
   * *For Motors (PWM Outputs):*
     + Motor 1 PWM: PA0
     + Motor 2 PWM: PA1
     + Motor 3 PWM: PA2
   * ***For Ultrasonic Sensors***:
     + Ultrasonic Sensor 1 Trigger: PC13
     + Ultrasonic Sensor 2 Trigger: PC14
     + Ultrasonic Sensor 3 Trigger: PC15
     + Ultrasonic Sensor 1 Echo: PA3
     + Ultrasonic Sensor 2 Echo: PA4
     + Ultrasonic Sensor 3 Echo: PA5
2. **PIN configuration**

**Step 1: Configure GPIO Pins in CubeMX**

1. **Open CubeMX** and select the STM32F401CCU6 microcontroller.
2. **GPIO Configuration for Motors (with IRF540 MOSFET module):**
   * Set **PA0**, **PA1**, and **PA2** as **PWM outputs** in the Timer configuration.
3. **GPIO for Ultrasonic Sensors:**
   * Configure PC13, PC14, and PC15 as **GPIO Output** for the Trigger pins.
   * Configure PA3, PA4, and PA5 as **GPIO Input** for the Echo pins.

**Step 2: Configure Timers for PWM (for Motors)**

1. Select **TIM2** (or any available timer) and enable PWM channels for motor control.
2. Configure TIM2 with a frequency appropriate for motor speed control (e.g., 1 kHz).
3. Assign **PA0**, **PA1**, and **PA2** as PWM outputs.

**Step 3: Configure Timer for Ultrasonic Sensors (Optional)**

* Configure **TIM3** in **Input Capture mode** to calculate the time delay of Echo signals, which will help determine the distance.

**Step 4: Configure NVIC for Interrupts**

* Enable interrupts for Echo pins if you are using a timer for ultrasonic sensing.

**Step 5: Generate Code and Open in CubeIDE**

**Circuit Connections**

1. **Ultrasonic Sensors:**
   * **Sensor 1:**
     + TRIG pin to PC13
     + ECHO pin to PA3
   * **Sensor 2:**
     + TRIG pin to PC14
     + ECHO pin to PA4
   * **Sensor 3:**
     + TRIG pin to PC15
     + ECHO pin to PA5
2. **Motors (via IRF540 MOSFETs for PWM control):**
   * **Motor 1 Control (PWM):** Connect the gate of IRF540 for Motor 1 to TIM3 Channel 1.
   * **Motor 2 Control (PWM):** Connect the gate of IRF540 for Motor 2 to TIM3 Channel 2.
   * **Motor 3 Control (PWM):** Connect the gate of IRF540 for Motor 3 to TIM3 Channel 3.
3. **Power Supply:**
   * Connect the ultrasonic sensors, STM32 board, and motor drivers to a suitable power source (e.g., 5V for sensors and STM32, 12V or higher if needed for motors).

ve added the obstacle avoidance logic to your code. Here are the key components and features:

1. **Ultrasonic Sensor Reading**:
   * read\_ultrasonic() function handles reading from each sensor
   * Uses GPIO pins to generate trigger pulse and read echo
   * Calculates distance using time of flight
2. **Motor Control**:
   * set\_motor\_speed() function controls individual motor speeds using PWM
   * Uses Timer2 channels for PWM output to the IRF540 modules
   * PWM frequency is set to 50% duty cycle for normal operation
3. **Obstacle Avoidance Logic**:
   * Checks all three sensors (front, left, right)
   * Safe distance threshold set to 20cm
   * Robot responds by:
     + Stopping the motor facing the obstacle
     + Adjusting other motors to move away from obstacle
     + Choosing direction with more space when front obstacle detected
4. **Pin Configuration**:
   * PC13, PC14, PC15: Ultrasonic sensor trigger pins
   * PA3, PA4, PA5: Ultrasonic sensor echo pins
   * Timer2 channels: PWM output for motors
5. **Main Loop**:
   * Continuously reads sensors and updates motor speeds
   * Includes small delay between iterations

To use this code:

1. Make sure your hardware connections match the pin configurations
2. The IRF540 modules should be connected to the Timer2 PWM outputs
3. Ultrasonic sensors should be connected to the specified GPIO pins
4. Verify your power supply can handle all three motors

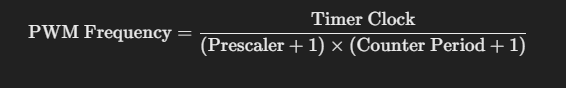
ADDITONAL SERVO MOTOR IMPLEMENTATION AND PIN CONFIGURATION

**Hardware Connections**

1. **Servo Motor 1 (SG90)**: Connect the signal pin of Servo Motor 1 to **PA6** (TIM3\_CH1).
2. **Servo Motor 2 (SG90)**: Connect the signal pin of Servo Motor 2 to **PA7** (TIM3\_CH2).
3. **Servo Motor 3 (SG90)**: Connect the signal pin of Servo Motor 3 to **PB0** (TIM3\_CH3)

**STM32CubeMX (.ioc) File Modifications**

1. **Enable TIM3 PWM Channels**:
   * Open the TIM3 configuration and enable PWM output for **Channel 1 (PA6)**, **Channel 2 (PA7)**, and **Channel 3 (PB0)**. This will allow you to control the three servos.
2. **Set Timer Prescaler and Period**:
   * For servo control, the frequency should be approximately **50 Hz** (standard for SG90 servos).
   * Set TIM3's Prescaler and Period to achieve a 50 Hz PWM frequency.
3. **GPIO Configuration**:
   * Set **PA6**, **PA7**, and **PB0** as **Alternate Function** with **TIM3\_CH1**, **TIM3\_CH2**, and **TIM3\_CH3** respectively.



**Final Values**

* **Prescaler** = 839
* **Counter Period** = 1999

This configuration provides a 50 Hz PWM signal.

**Duty Cycle Control**

For a servo, you’ll need to set the **duty cycle** (compare value) to position the servo, typically between:

* **5% duty cycle** (~1 ms pulse) for 0°,
* **7.5% duty cycle** (~1.5 ms pulse) for 90°,
* **10% duty cycle** (~2 ms pulse) for 180°.