Ultrasonic obstacle avoidance (servo gimbal version)

This tutorial is a comprehensive experiment combining multiple peripherals. You can first understand a single peripheral before performing this experiment.

1. Software-Hardware

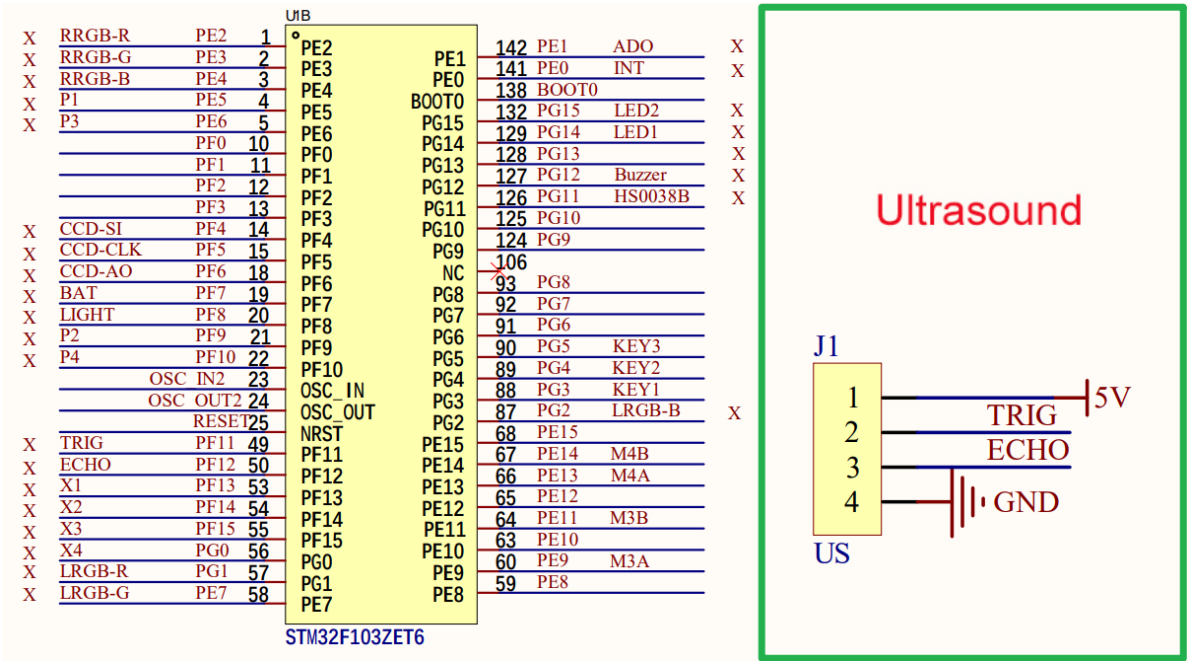
- **STM32F103CubeIDE**
- **STM32 Robot Development Board**

  9G servo gimbal, 310 motor*4: external
- **Type-C data cable or ST-Link**

  Download programs or simulate the development board

2. Brief principle

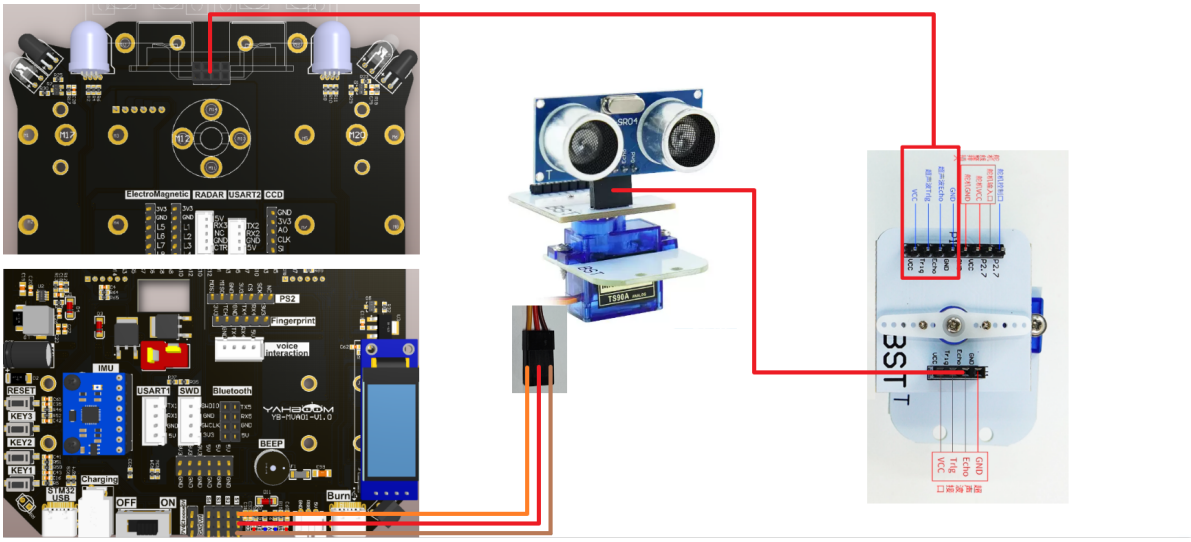
1. Hardware schematic diagram



2. Physical connection diagram

- **9G servo gimbal installation**

When installing, you need to pay attention to the color of the wiring silk screen and the servo interface



Note: The 9G servo gimbal and the ultrasonic interface on the development board are connected through a male-to-female DuPont cable

Ultrasonic module	STM32 development board
VCC	VCC
Trig	Trig
Echo	Echo
GND	GND

Note: Refer to the color of the servo wire for servo wiring. **This experiment requires connecting 5V and GND jumper caps**

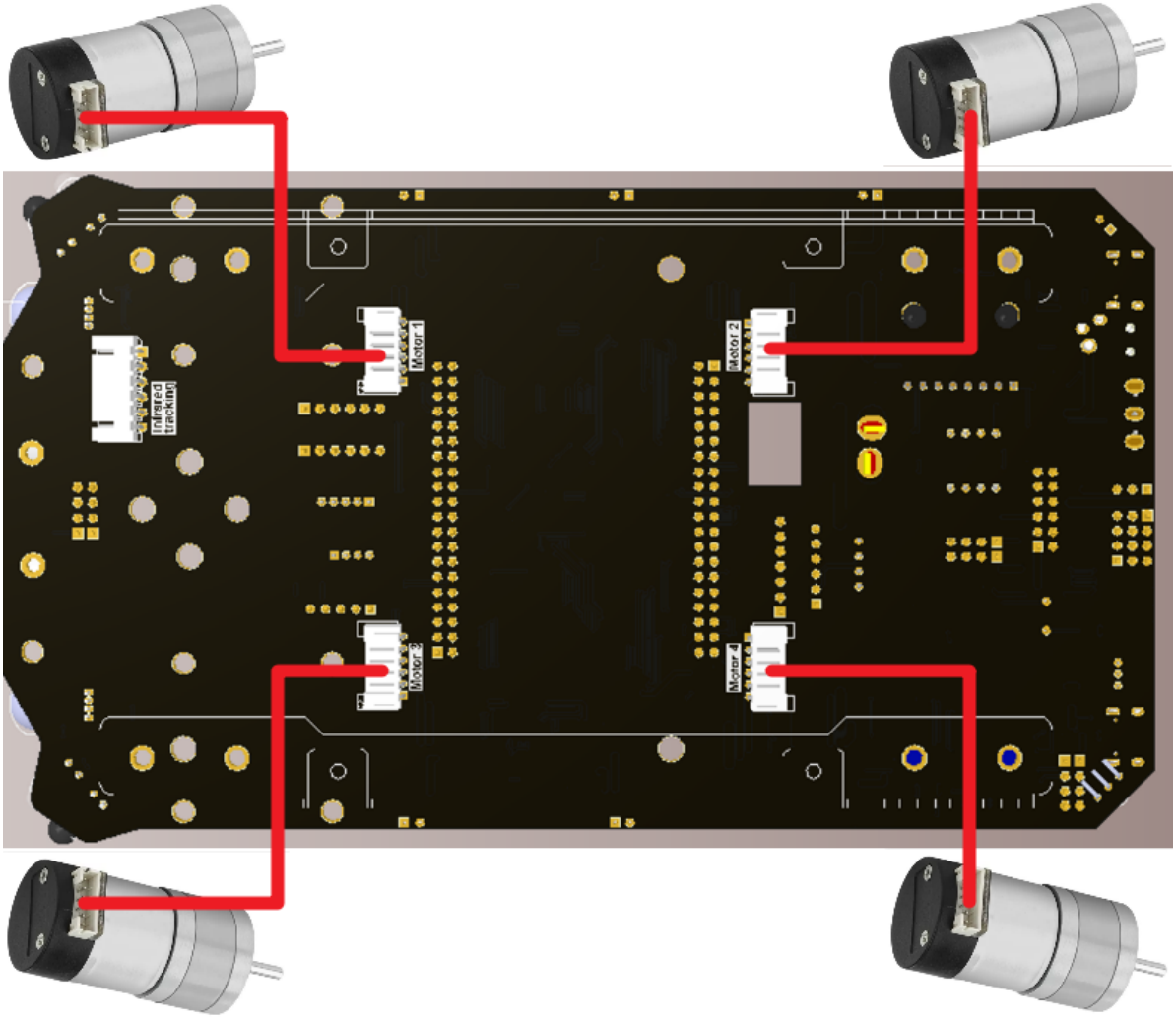
Steering gear	Development board
VCC(red)	5V
SIG(yellow)	S1
GND(brown)	GND

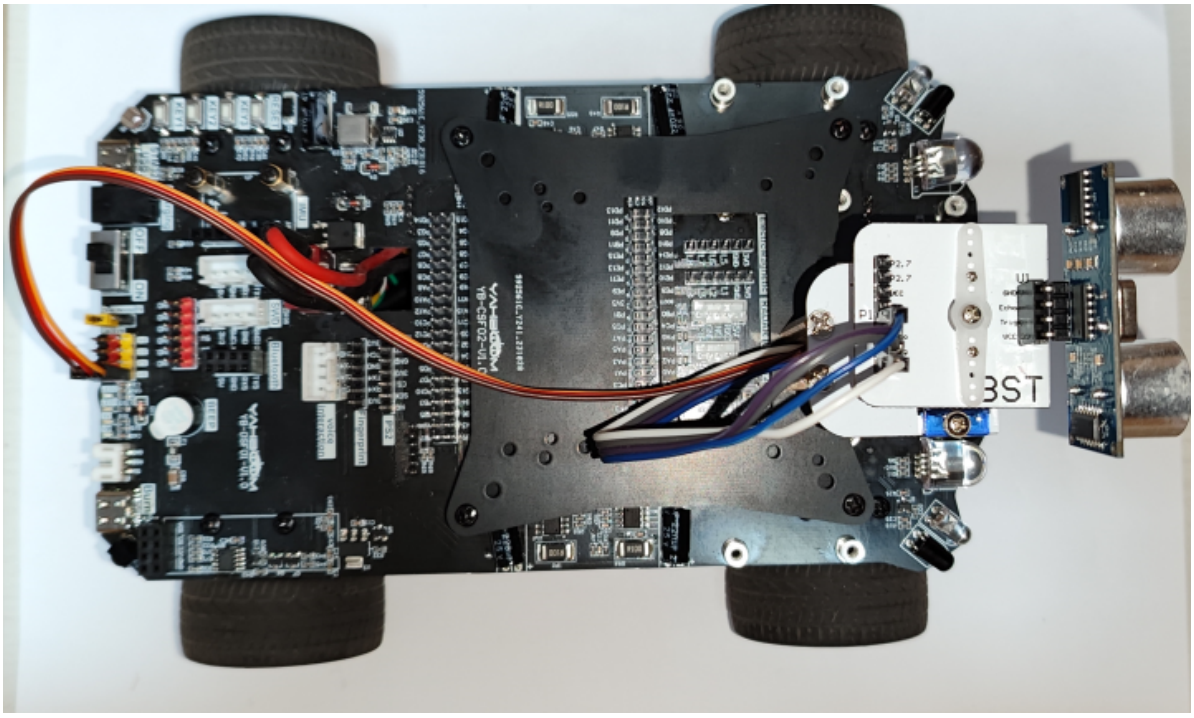
- **Ultrasonic servo gimbal calibration**

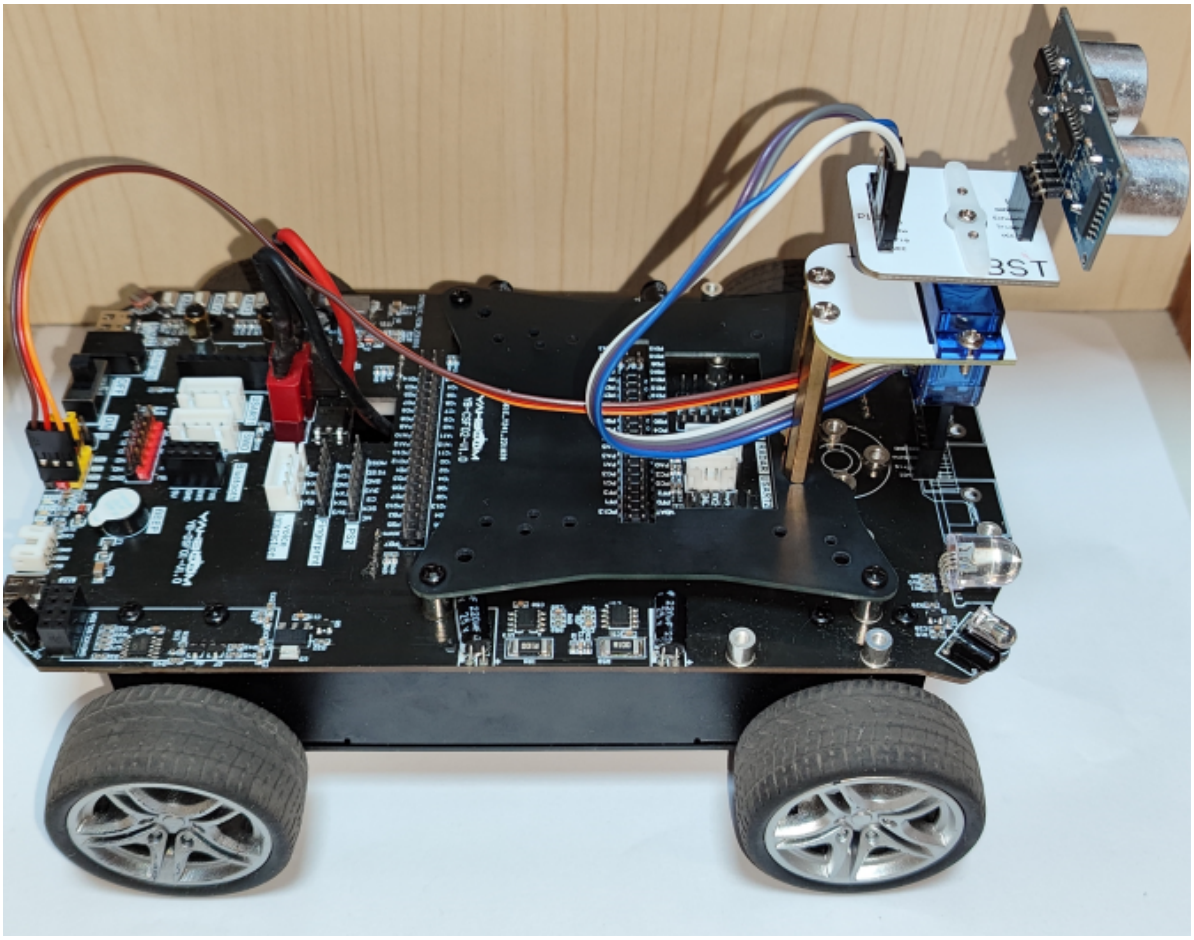
When installing, be sure to center the servo before installing;

The [ultrasonic_servo_calibrating.hex] file is provided under the tutorial folder for calibration. After burning this program, the servo will rotate to 90°. At this time, install the connecting plate of the ultrasonic and servo gimbal (the actual picture is as shown below) to the servo. The ultrasonic installation needs to be facing straight ahead (it will have no effect if it is slightly off).

- **Motor Wiring**







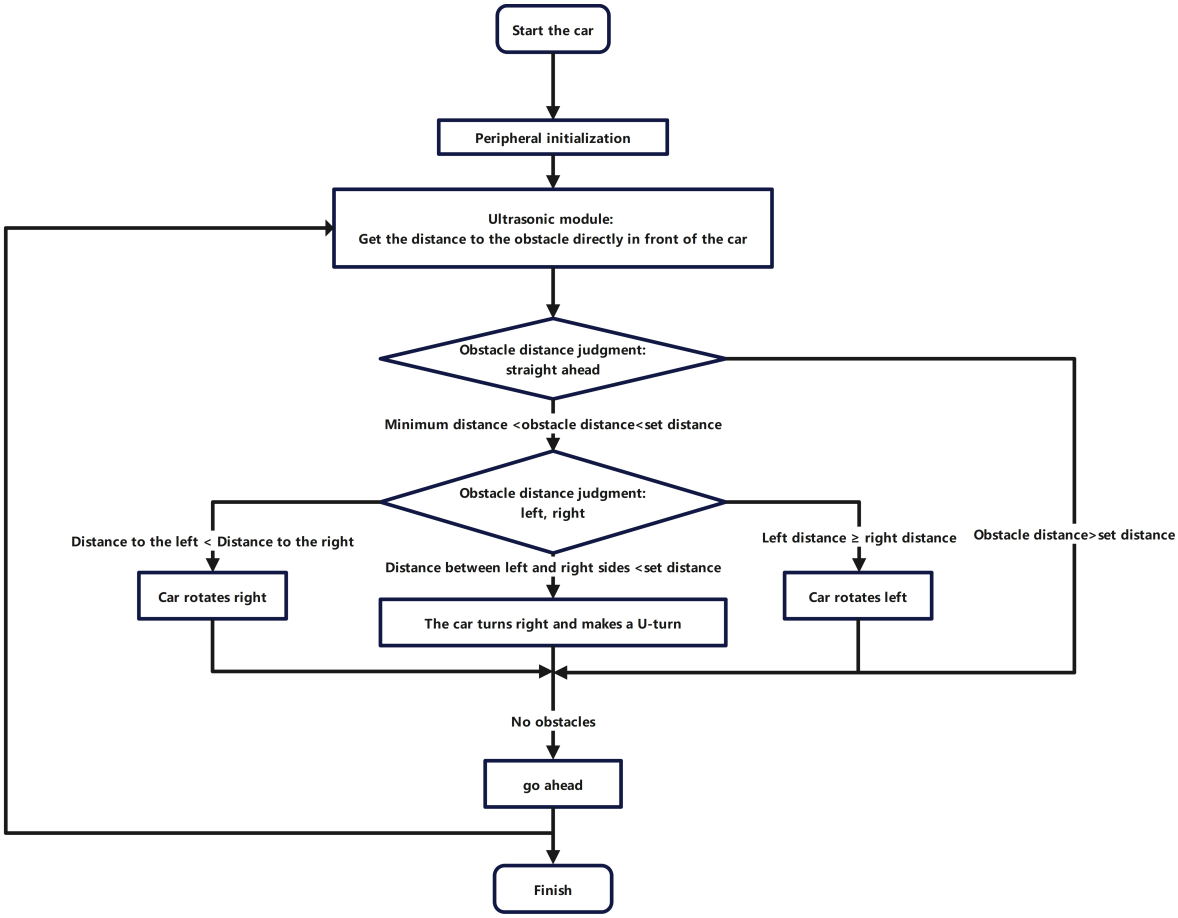
For battery pack assembly, please see [5. Smart Car Experiment: Car Line Patrol]

3. Control principle

Through the ultrasonic module of the 9G servo gimbal, the distance of the object in front is obtained, the servo controls the distance to the left and right and the front, and the car is controlled to move forward, backward, turn left, and stop based on the distance.

The ultrasonic module can obtain the distance of the obstacle in front, and we use this distance to determine the position of the obstacle on the car:
When there is an obstacle directly in front of the car, the servo of the 9G servo gimbal will rotate to the left and right sides, and finally the distance to the left and right sides of the car is obtained. We control the car to turn left or right based on this distance. As for this initial The angle and the angle of rotation on the left and right sides can be modified by modifying the code.

- **Program flow chart**



Module	Function
Ultrasonic module	External information collection: Obtaining the distance to obstacles
Steering gear	Control the steering of the ultrasonic module
Motor	Motion Control

3. Main functions

This tutorial does not use PID to control the movement of the car

The functions introduced before will not be introduced again!

> **Function: Ultrasonic_servo_avoidance**

Function prototype	void Ultrasonic_servo_avoidance(uint16_t distance)

Function prototype	void Ultrasonic_servo_avoidance(uint16_t distance)
Function description	Ultrasonic following
Input parameters	**distance**: maximum obstacle avoidance distance
Return value	None

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For the underlying driver, you can refer to the tutorials in Chapter 3 and
Chapter 4.
For the application layer, you can read the source code in the project file
yourself
```

4. Experimental Phenomenon

After successfully downloading the program, press the RESET button on the development board to observe the effect of the car!

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For program download, please refer to [2. Development environment construction
and use: program download and simulation]
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Phenomenon:

Obstacles: The car stops first and then judges the distance to the left and right, and then turns left and right according to the distance.

No obstacles: Car moves forward

For specific judgment, you can refer to the flow chart or code.

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You can see the experimental phenomenon [Ultrasonic obstacle avoidance (servo
gimbal version)_Experimental phenomenon.mp4]
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