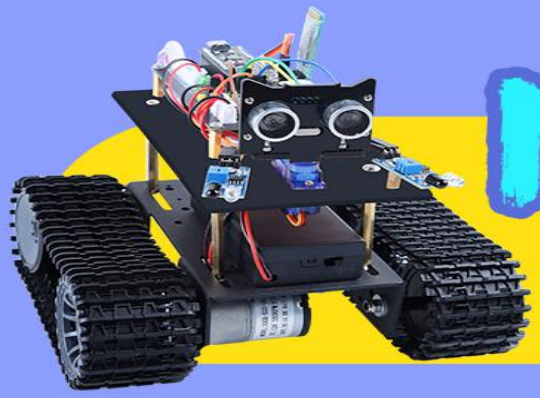
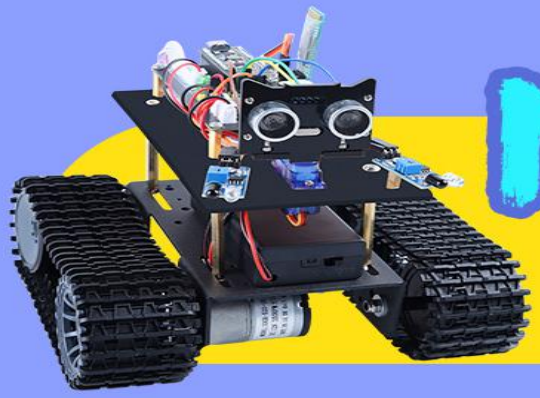


NANOBOT
ASSEMBLY TUTORIAL

Lesson 5
Infrared and ultrasonic obstacle avoidance

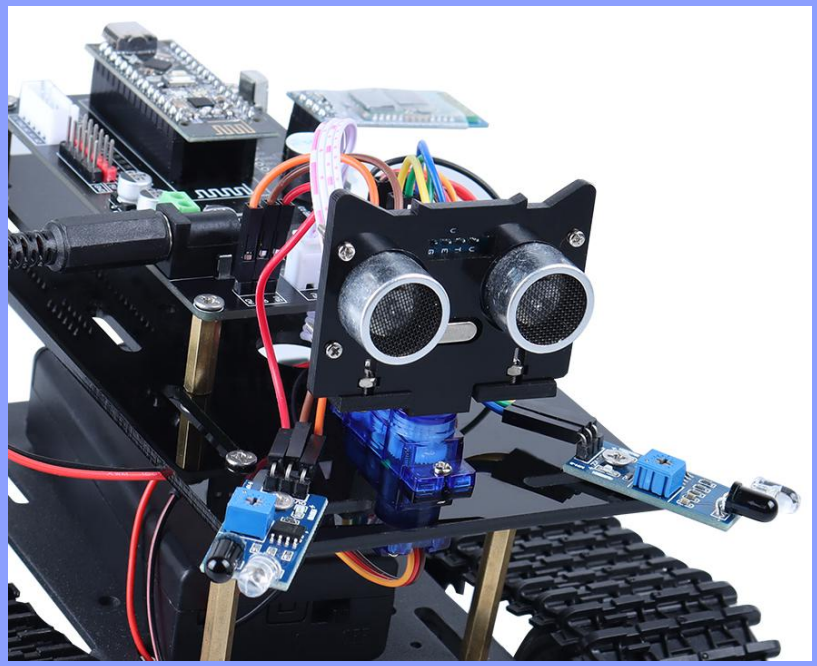
This lesson will learn the use of infrared obstacle avoidance sensors.
It allows cars to steer clear of obstacles.
Next, to understand how it works, prepare the materials:
This lesson will learn the use of infrared obstacle avoidance sensors and ultrasonic ranging.
The combination of these two obstacle avoidance sensors enables the car to avoid obstacles more flexibly.

智熠 ZHIYI

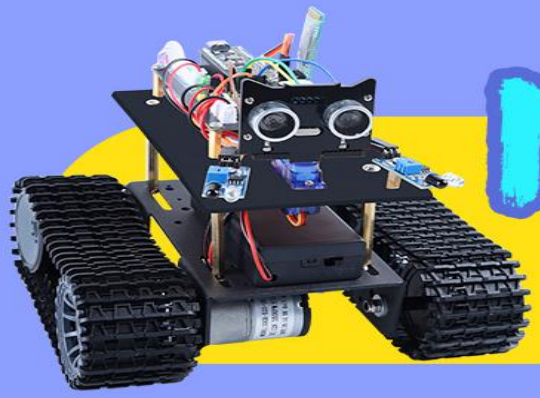


NANOBOT
ASSEMBLY TUTORIAL

Now, to see how it works,
Materials ready: Trolley *1(with battery)
Infrared obstacle avoidance sensor *2
Ultrasonic ranging sensor *1
Servo motor SG90 *1
USB data cable *1



智懿 ZHIYI

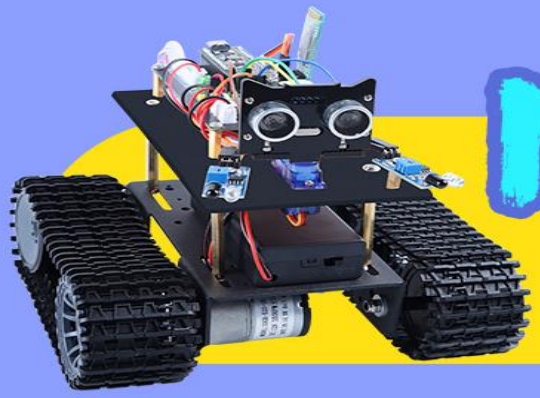


NANOBOT
ASSEMBLY TUTORIAL

Introduction of ultrasonic ranging sensor

1. IO trigger ranging, trigger signal input terminal (TRIG) input a high level signal above 10 microseconds, ultrasonic transmission port receives the signal automatically send 8 40Hz square waves, at the same time start the timer, when the sensor receives the echo, stop the timing and output the echo signal, echo signal pulse width is proportional to the measured distance.
According to the time interval, the distance can be calculated with the formula: distance =(high level signal time * sound velocity)/2, and the speed of sound propagation in the air is 340m/s.

智熠 ZHIYI

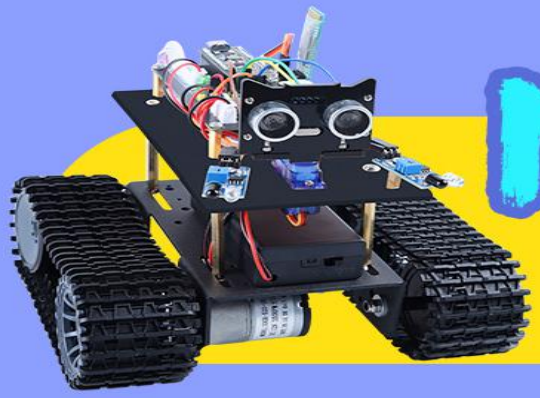


NANOBOT
ASSEMBLY TUTORIAL

Infrared Obstacle-Avoidance Sensor Introduction

The infrared obstacle avoidance sensor has three pins, namely: VCC, GND and OUT;Out is the output end of the signal, and there are only two states, zero and 1, namely the two states of high and low level (high level is 5V, low level is 0V;A high level reads as a "1" and a low level reads as a "0").This sensor is powered on, and the OUT pin will output high level by default. When an obstacle is detected, the OUT pin will output low level, so there will be a change from high level to low level.When the infrared tube detects an obstacle, it outputs a high-level signal, so as to judge the car encounters an obstacle, and then execute and write the obstacle avoidance program, so as to realize the car's automatic driving around the obstacle.

智熠 ZHIYI



NANOBOT
ASSEMBLY TUTORIAL

First of all, let’s learn about the SG90 Servo:

SG90 Servo 180

angle steering gear

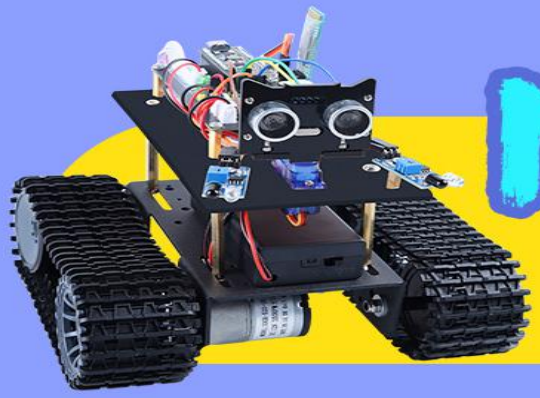
Rototion angle is from 0 to 180

Brown line --- GND

Red line --- 5V

Orange line --- signal(PWM)

智熠 ZHIYI



NANOBOT
ASSEMBLY TUTORIAL

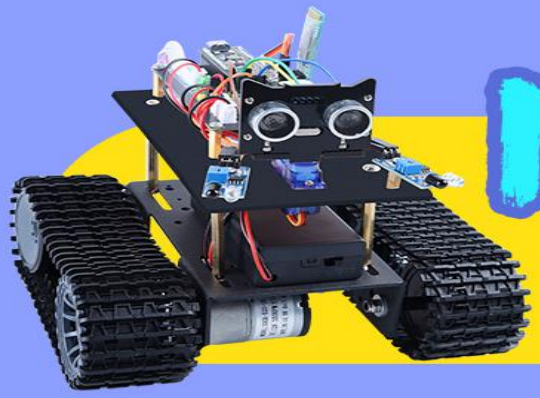
Classification: 180 servo

Normally the servo has 3 controlling wires: power wire, ground wire and signal wire. Definition of the servo pins: brown line———GND, red line———5V, orange line———signal.

How does servo work:

The signal modulation chip in the servo receives signals from the controller board then the servo will get the basic DC voltage. There is also a reference circuit inside the servo which will produce a standard voltage. These two voltages will compare to each other and the difference will be output. Then the motor chip will receive the difference and decide the rotational speed, direction and angel. When there is no difference between the two voltages, the servo will stop.

智懿 ZHIYI



NANOBOT
ASSEMBLY TUTORIAL

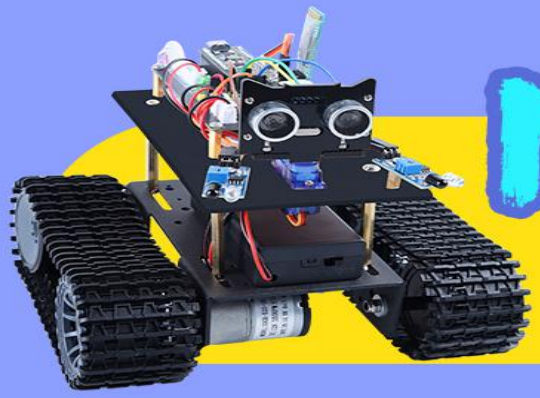
How to control the servo:

To control the servo rotation, you need to make the time pulse to be about 20ms and the high level pulse width to be about 0.5ms~2.5ms, which is consistent with the angle limited of the servo.

Taking 180 angle servo for example, corresponding control relation is as below:

0.5ms---------- 0 degree
1.0ms----------45 degree
1.5ms---------- 90 degree
2.0ms----------135 degree
2.5ms---------- 180 degree

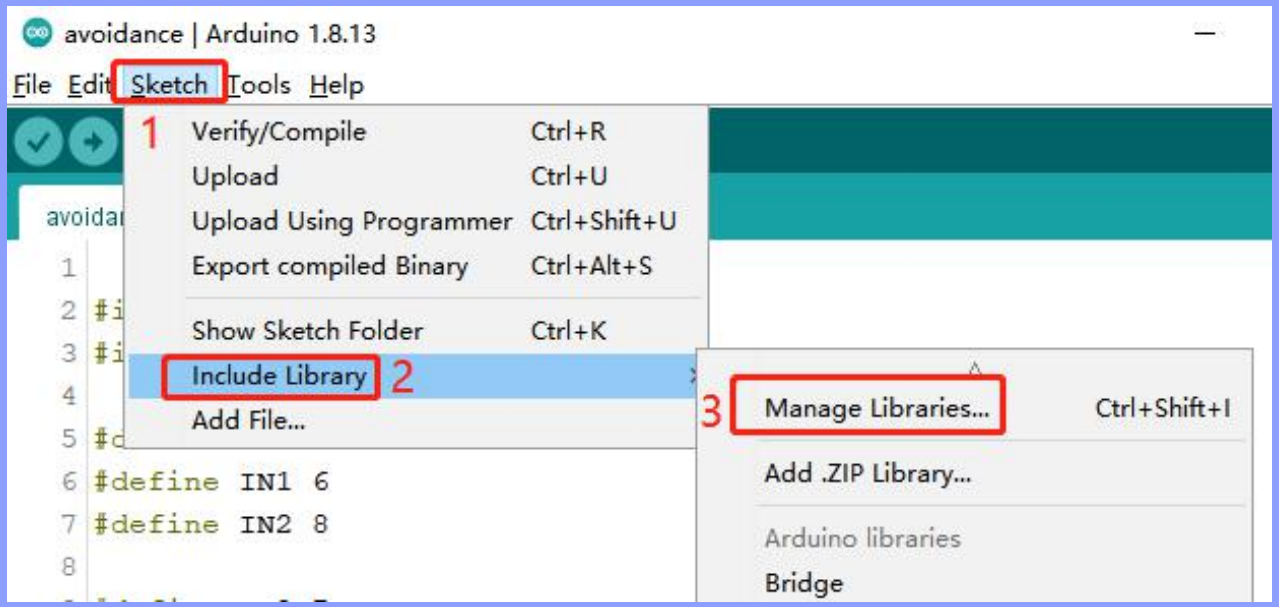
智熹 ZHIYI



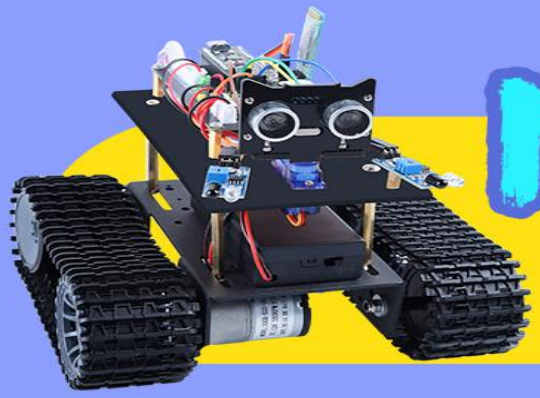
NANOBOT
ASSEMBLY TUTORIAL

Due to the use of servo motor program, need to install the servo library

Select Sketch -> Include Library -> Manage Libraries

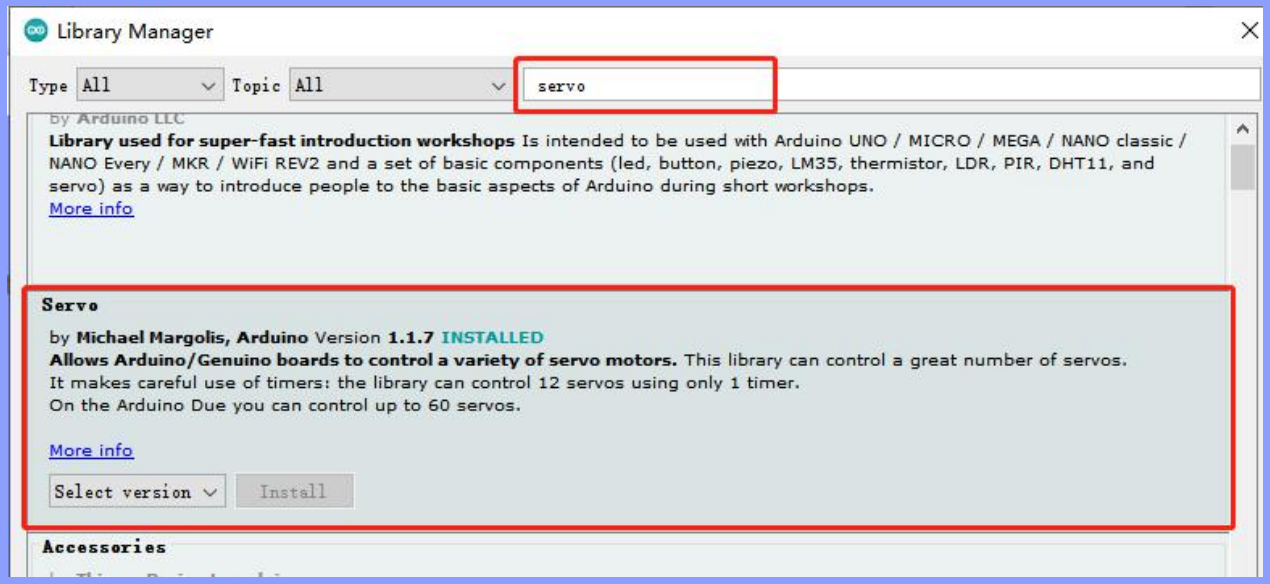


智熠 ZHIYI

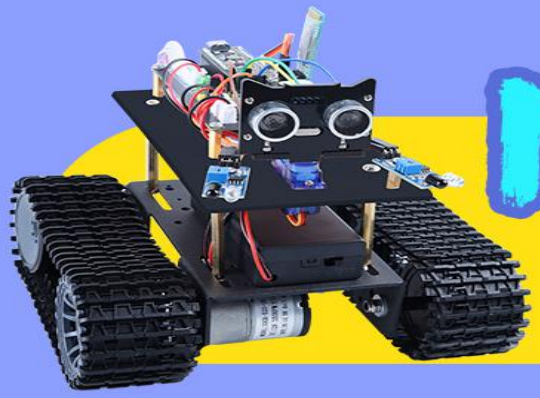


NANOBOT ASSEMBLY TUTORIAL

Search servo and then install the newest version. The following picture shows that the Servo library is already installed.

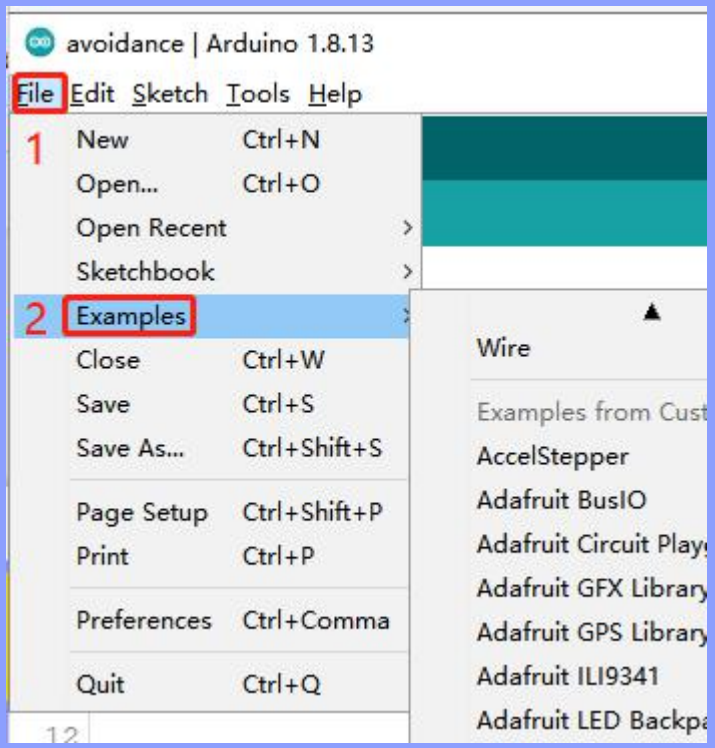


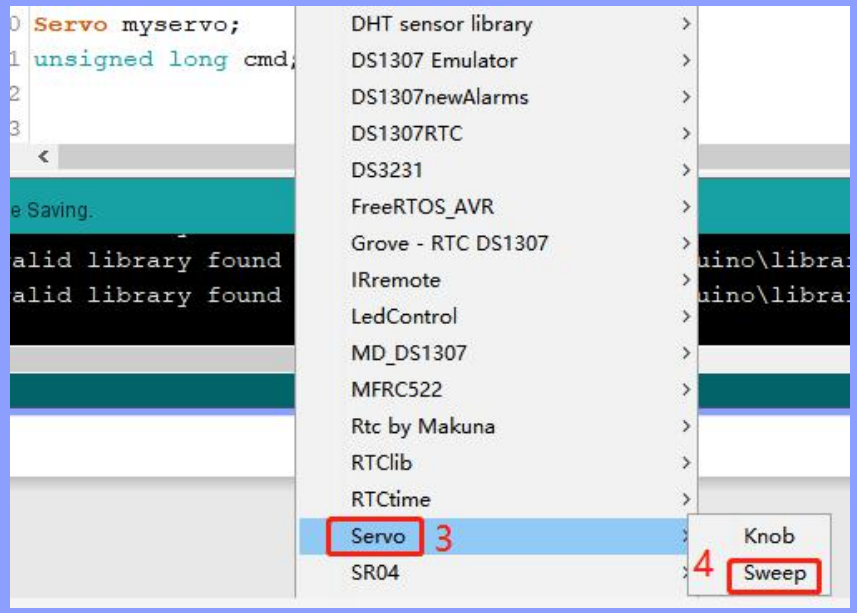
智熠 ZHIYI



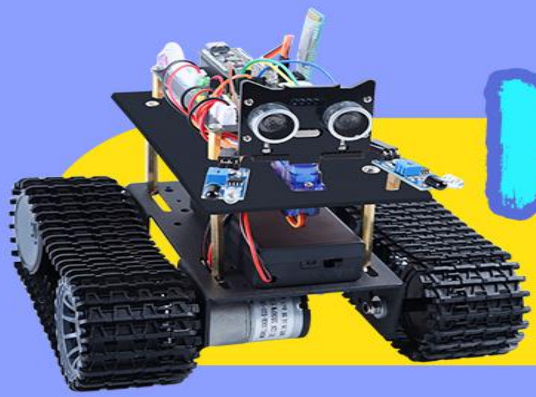
NANOBOT
ASSEMBLY TUTORIAL

The example program: Open Arduino IDE and select “File->Examples->Servo->Sweep”

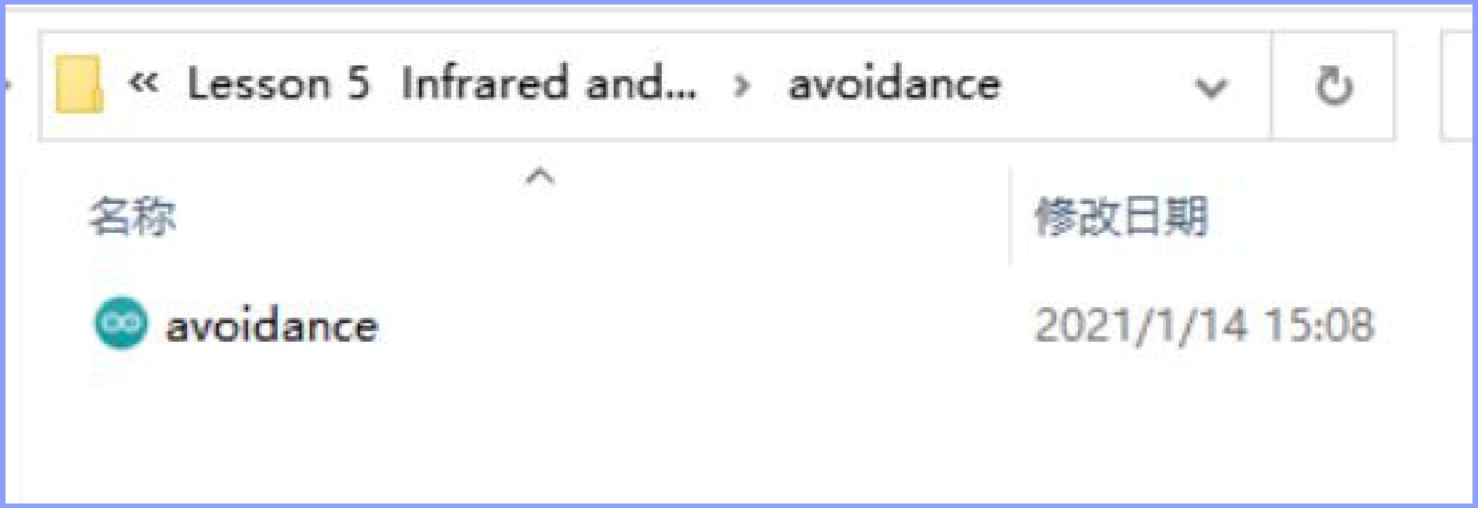




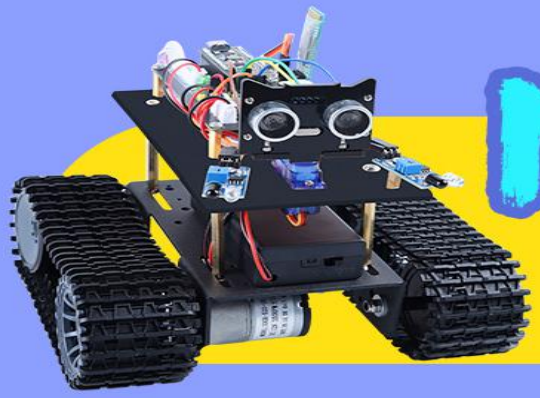
智熠 ZHIYI



Open Lesson 5 and upload the program to the NANO_NRF control board.



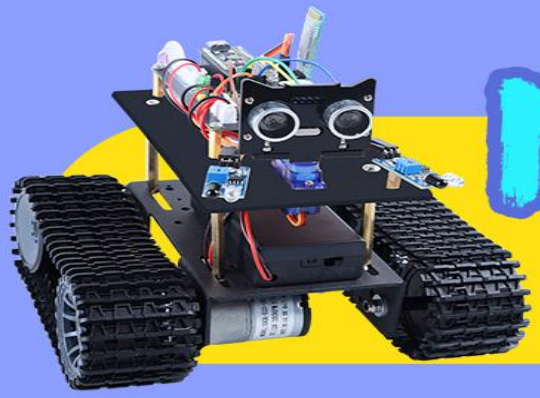
智懿 ZHIYI



NANOBOT
ASSEMBLY TUTORIAL

After uploading the program to the Nano-NRF control board, disconnect the cable, place the vehicle on the ground, and switch on the power.
If there is no obstacle, you will see the car moving forward. If there is an obstacle in front, the servo motor will rotate with the ultrasonic sensor and record the distance from the car to the obstacle. The vehicle will change direction to bypass the obstacle.

智懿 ZHIYI



NANOBOT
ASSEMBLY TUTORIAL

Change the pin to 3;

Attaches the servo on pin 9 to the servo object;

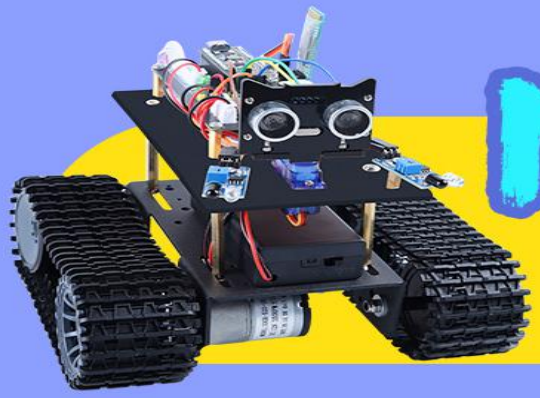
myservo.attach(3);

File Edit Sketch Tools Help

Sweep §

```
10 #include <Servo.h>
11
12 Servo myservo;  // create servo object to c
13 // twelve servo objects can be created on m
14
15 int pos = 0;    // variable to store the se
16
17 void setup() {
18   myservo.attach(3);  // attaches the servo
19 }
20
```

智嶧 ZHIYI



NANOBOT
ASSEMBLY TUTORIAL

Next, let’s have a look at the ultrasonic sensor module.

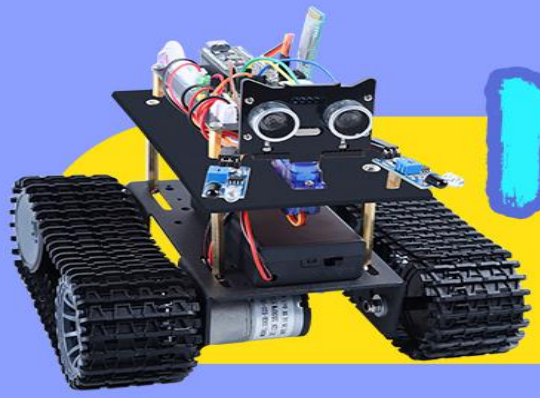
Feature of the module: testing distance, high precision module. Application of the products: obstacle-avoidance robot、object distance testing、liquid testing、 public security、parking lot testing. Main technical parameters

(1): voltage used: DC---5V
(2): static current: less than 2mA
(3): level output: higher than 5V
(4): level output: lower than 0
(5): detection angle: not bigger than 15 degree
(6): detecting distance: 2cm-450cm
(7): high precision: up to 0.2cm.

Method of connecting lines:

VCC, trig (the end of controlling),
echo (the end of receiving), GND.

智懿 ZHIYI

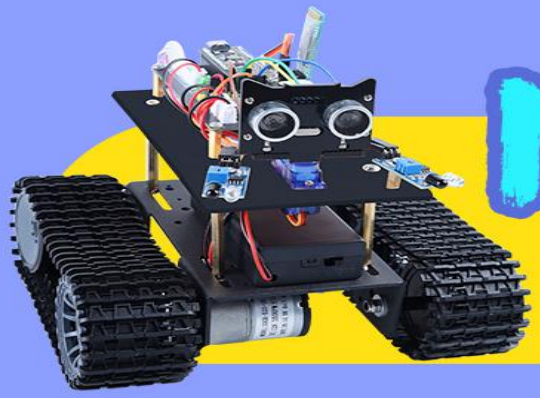


NANOBOT
ASSEMBLY TUTORIAL

The principle of the obstacle avoidance vehicle is very simple. Infrared obstacle avoidance sensor and ultrasonic sensor module will constantly detect the distance between the car and the obstacle, and send the data to the control board, and then the car will stop and rotate the servo to detect the left and right sides. After comparing the distances from the different sides, the car swerved to the farther side to drive forward. The ultrasonic sensor module then continues to detect the distance between the surrounding obstacles and itself.

If the infrared obstacle avoidance sensor detects an obstacle, it will immediately avoid, indicating that the distance between the car and the obstacle is very close.

智嶧 ZHIYI

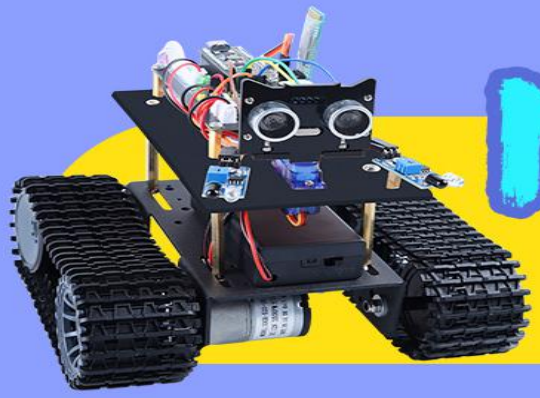


NANOBOT
ASSEMBLY TUTORIAL

Code preview:

```
101         if(dis[0] < dis[2] || digitalRead(IR_Senor_R) == 0)
102         {
103             motorRun(BACKWARD);
104             delay(200);
105             motorRun(TURNLEFT);
106             delay(100);
107         }
108         else if (dis[0] > dis[2] || digitalRead(IR_Senor_L) == 0)
109         {
110             motorRun(BACKWARD);
111             delay(200);
112             motorRun(TURNRIGHT);
113             delay(100);
114         }
```

智熠 ZHIYI



NANOBOT
ASSEMBLY TUTORIAL

Thanks for watching!

智熠 ZHIYI