**Basic course ---8.Tracking**

**!Note:**

**1. In order to avoid the interference of sunlight on infrared sensor, we need to carry out this experiment indoors.**

**2. In this experiment, you may need to modify the parameters in the program, please read the fifth part carefully.**

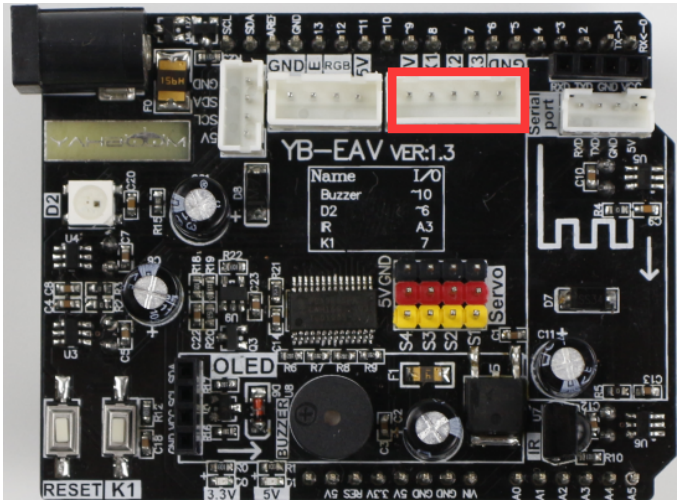
**3. The width of the black track is 1.6cm.**

## 1. Learning goal

In this lesson, we will learn how to use tracking module.

## 2. Preparation

2.1 The position of the tracking sensor port on the expansion board. As shown below.




2.2 The pin of UNO board is connected the pins on the expansion board .

## 3.Principle of experimental

The basic principle of the tracking sensor is to use the reflective nature of the object.

Our experiment is to tracking the black line. When the infrared light is emitted to the black line, it will be absorbed by the black line. When the infrared light is emitted to the other color line, it will reflected to the infrared receiver tube.

From the hardware interface manual, we can know that ultrasonic module are driven by Pin A0,A1,A2.

| Classification | Function | The number of Drive chip PCA9685 | Drive Method | Connection with CPU | Uno board |
|---|---|---|---|---|---|
| Left Motor | Left front motor forward | LINB(13) | PCA9685 | I2C_SDA/I2C_SCL | A4/A5 |
| | Left front motor reverse | LINA(12) | | | |
| | Left rear motor forward | RINB(15) | | | |
| | Left rear motor reverse | RINA(14) | | | |
| Right Motor | Right front motor forward | LED10 | | | |
| | Right front motor reverse | LED11 | | | |
| | Right rear motor forward | LED8 | | | |
| | Right rear motor reverse | LED9 | | | |
| Servo | Control S1 | LED0 | | | |
| | Control S2 | LED1 | | | |
| | Control S3 | LED2 | | | |
| | Control S4 | S1(3) | | | |
| LOGO light | Control bluelight | LED7 | | | |
| Tarcking sensor | Left tracking sensor | | | | A0 |
| | Middle tracking sensor | | | | A1 |
| | Right tracking sensor | | | | A2 |
| Ultrasonic sensor | Ultrasonic Echo | Uno board drive directly | | | 12 |
| | Ultrasonic RGB light | | | | 11 |
| Key | K1 | | | | 7 |
| IR | IR control | | | | A3 |
| Bluetooth interface | RX | | | | 0 |
| | TX | | | | 1 |
| On board RGB Light | RGB Light on expansion board | | | | 6 |
| Buzzer | Control buzzer | | | | 10 |

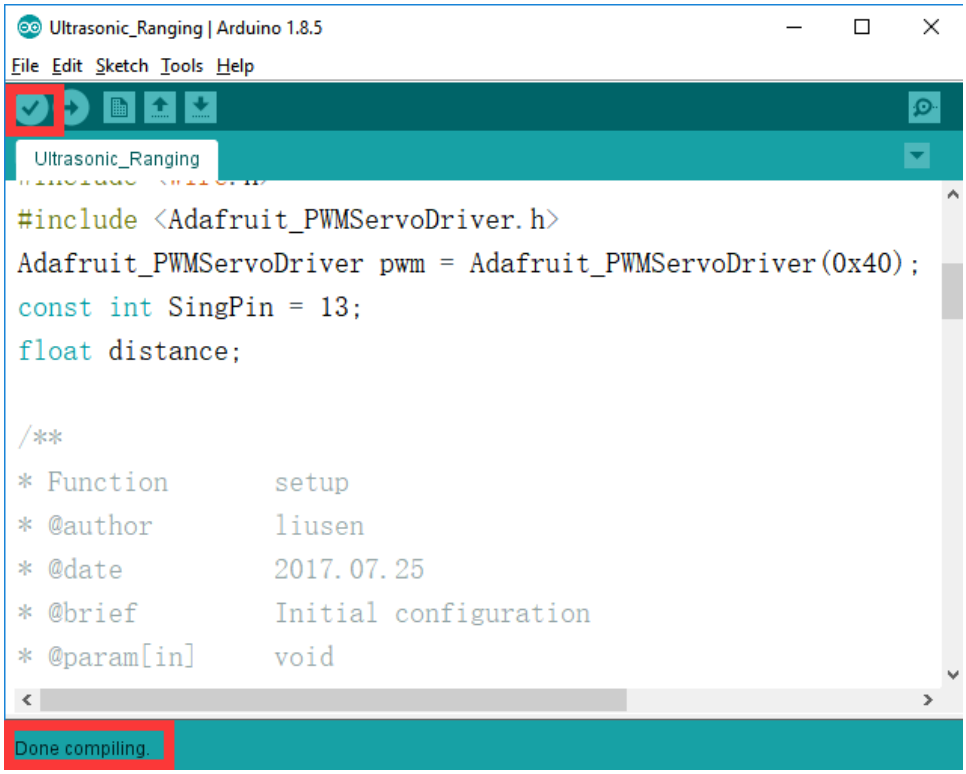
## 3. About code

We need provided three codes for this experiment.

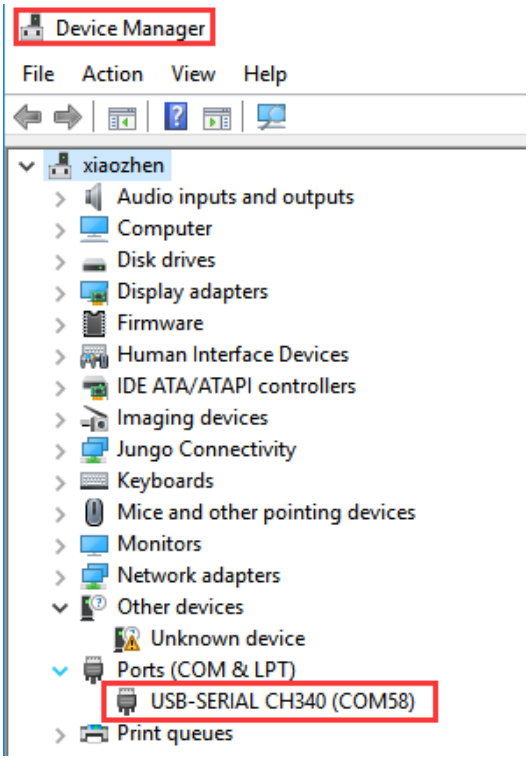
**TrackingSensorTest.ino** **Tracking_test.ino** **Tracking_PID_v1.ino**

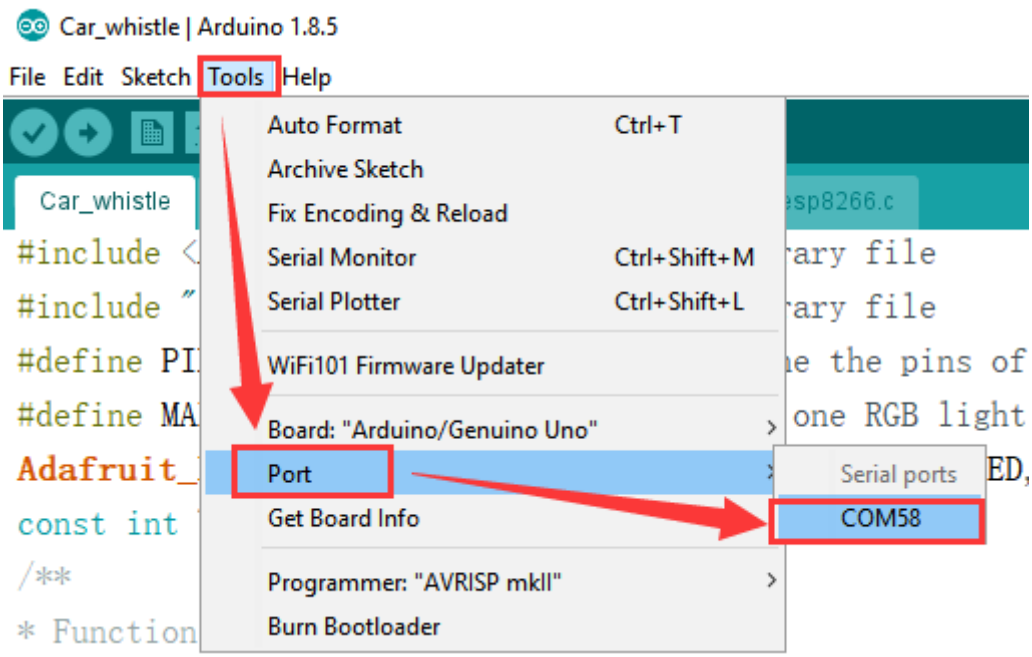
## 4. Compiling and downloading code

4.1 We need to open the code file by Arduino IDE software. Then click“√”under the menu bar to compile the code, and wait for the word "**Done compiling** " in the lower left corner, as shown in the figure below.

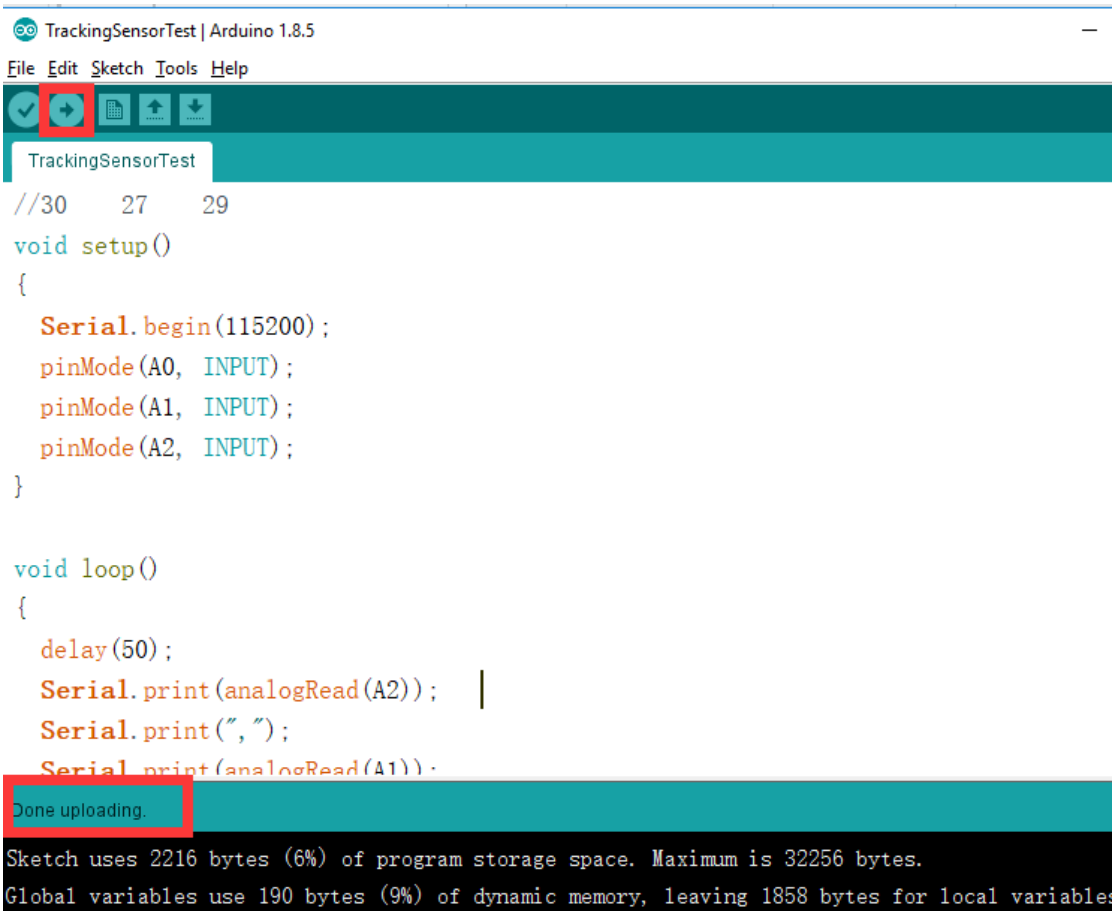



4.2 In the menu bar of Arduino IDE, we need to select 【Tools】---【Port】--- selecting the port that the serial number displayed by the device manager just now, as shown in the figure below.






4.3 After the selection is completed, you need to click "→"under the menu bar to upload the code to the UNO board. When the word "**Done uploading**" appears in the lower left corner, the code has been successfully uploaded to the UNO board, as shown in the figure below.



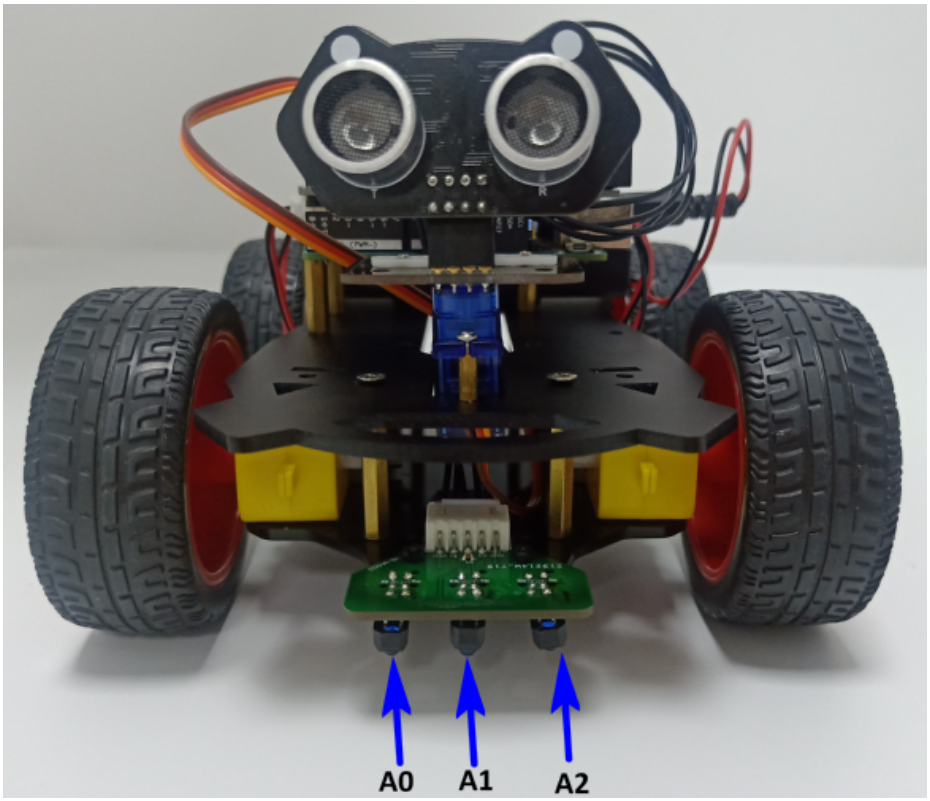

## 5. Experimental phenomena

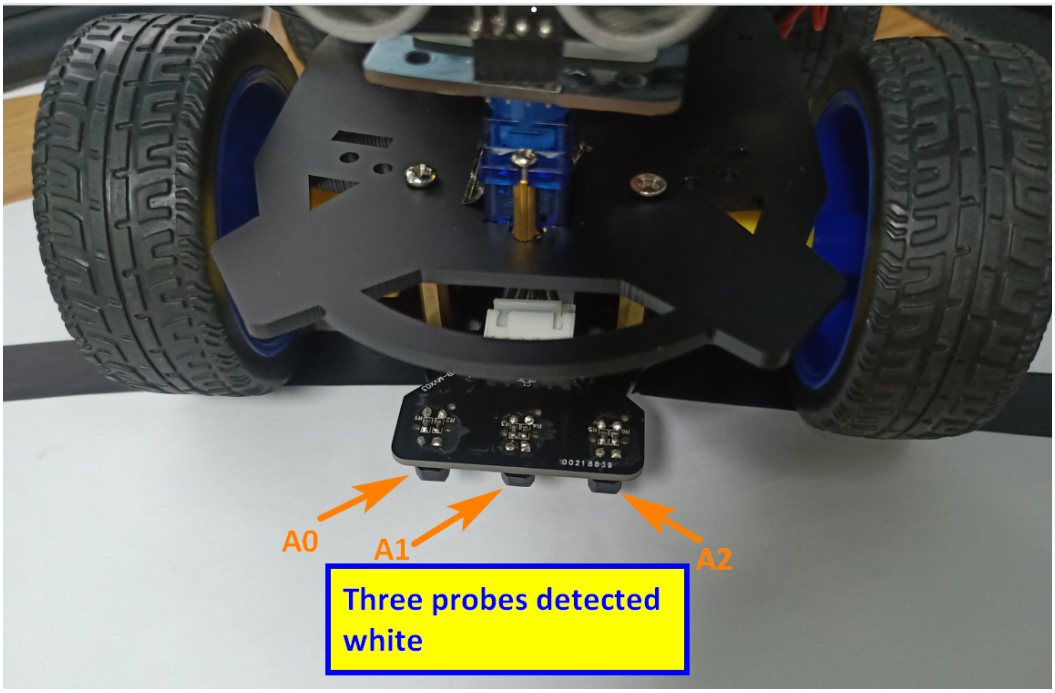
**For first code: Tracking_test.ino**

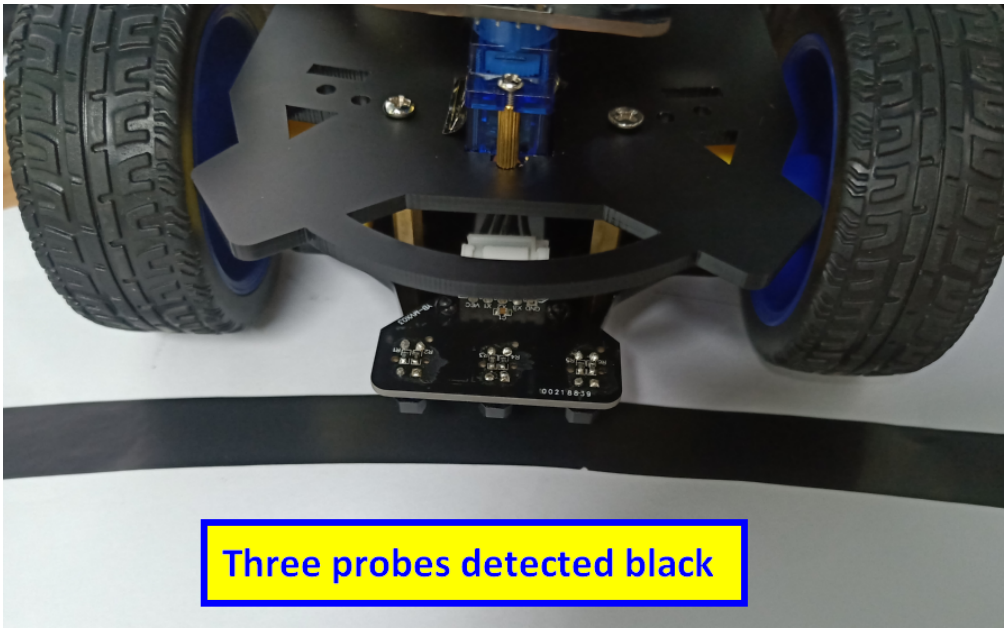
5.1.1 First, You need to open **TrackingSensorTest.ino** in the **TrackingSensorTest** folder. And connect the robot car with your computer by cable.

5.1.2 Then, you need to place three tracking probes on white **(must be the track where you will be conducting a tracking test).** As shown below.

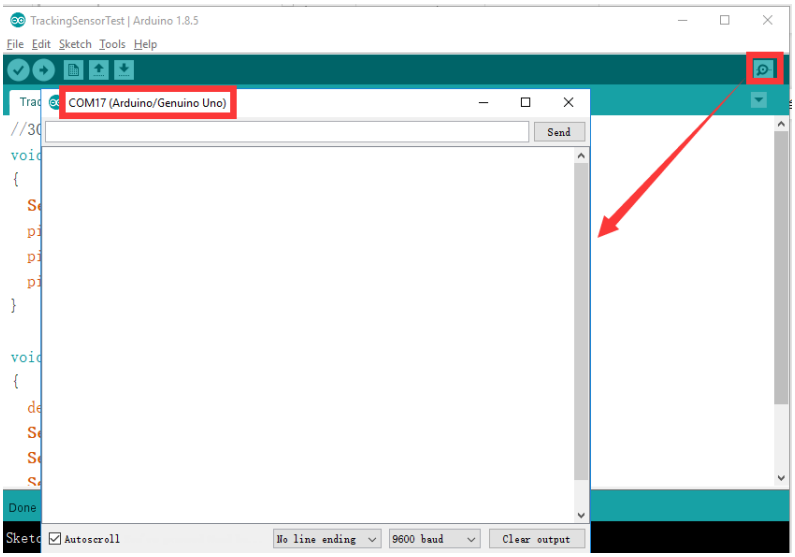
5.1.3 Then, you need to place three tracking probes on black line **(must be the track where you will be conducting a tracking test).** As shown below.

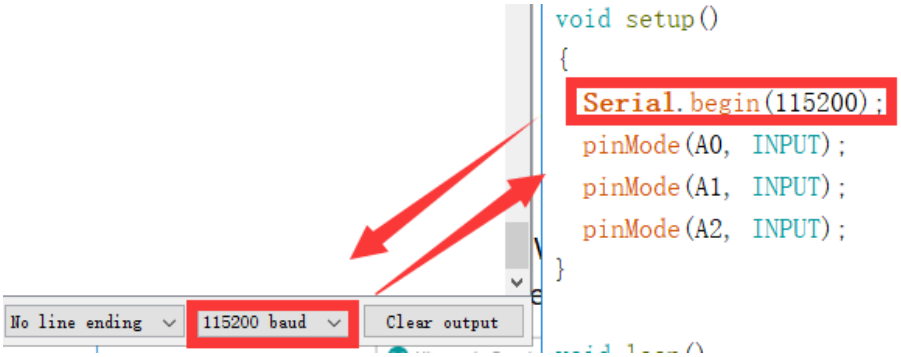





5.1.4 Next, We need to open the **Serial Monitor** in the upper right corner of the Arduino IDE interface. And we need to select the same baud rate as set in the program. As shown below.

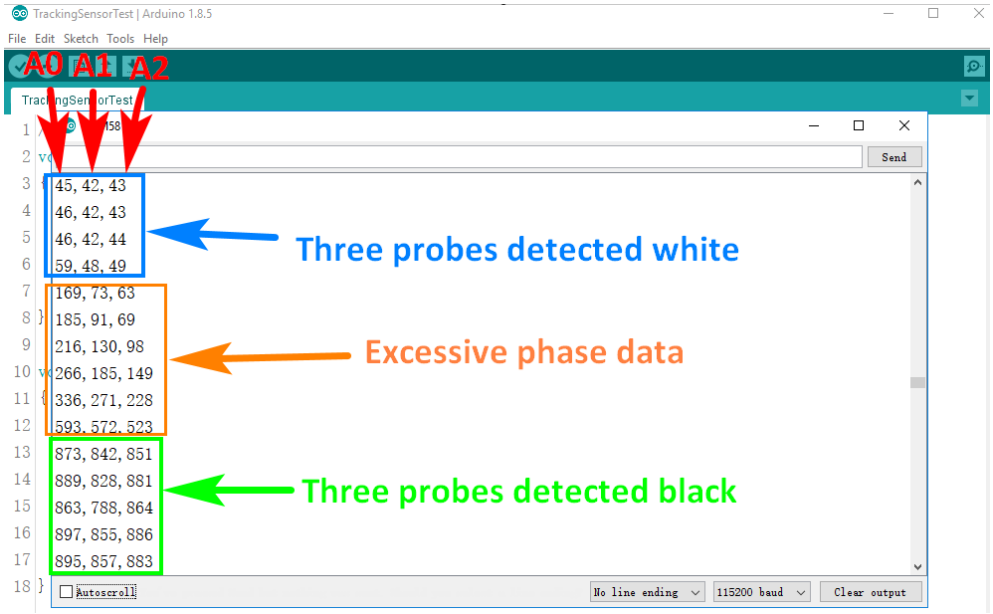



5.1.5 We can see that when the three probes of the tracking sensor detect white and detect black, the currently output analog value is printed out. As shown below.

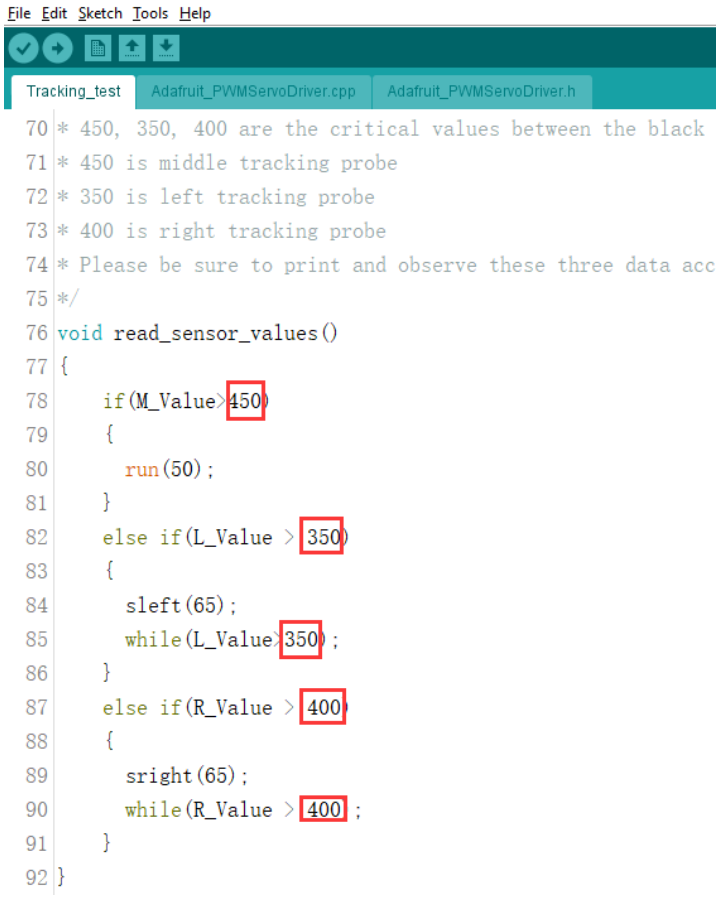
**(!!!Note: This data just for my experimental environment , you must record the**

**value you printed, wait until the data is stable)**




If the data shows a little fluctuation, that is normal.

5.1.6 We need to open the **Tracking_test.ino** file in the **Tracking_test** folder, and according to the value printed in the previous step, take an optimal threshold and modify the data in the program.

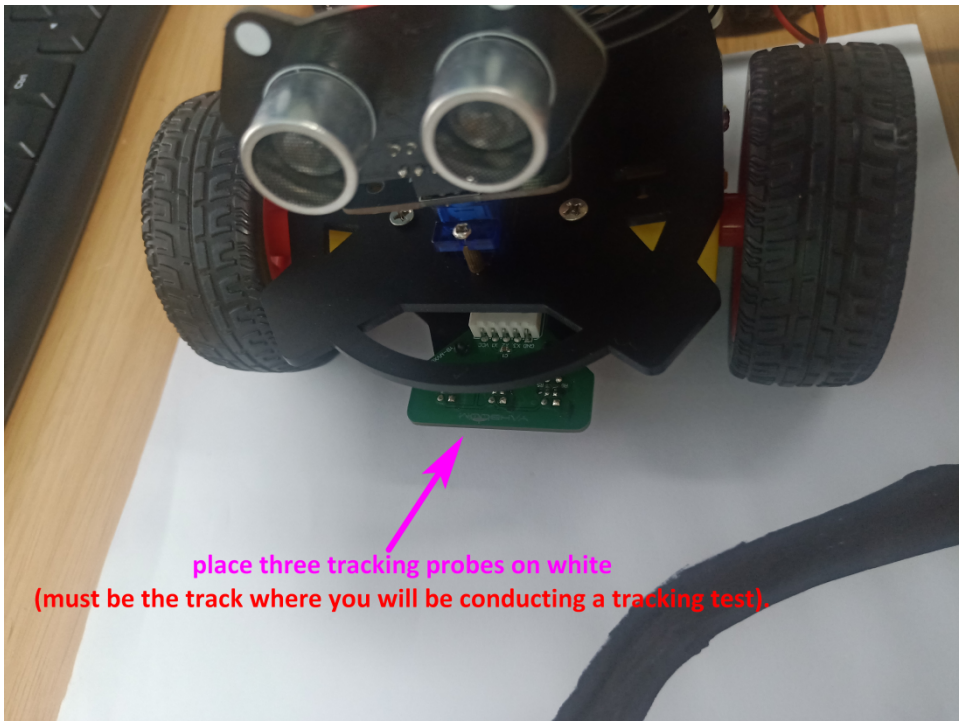


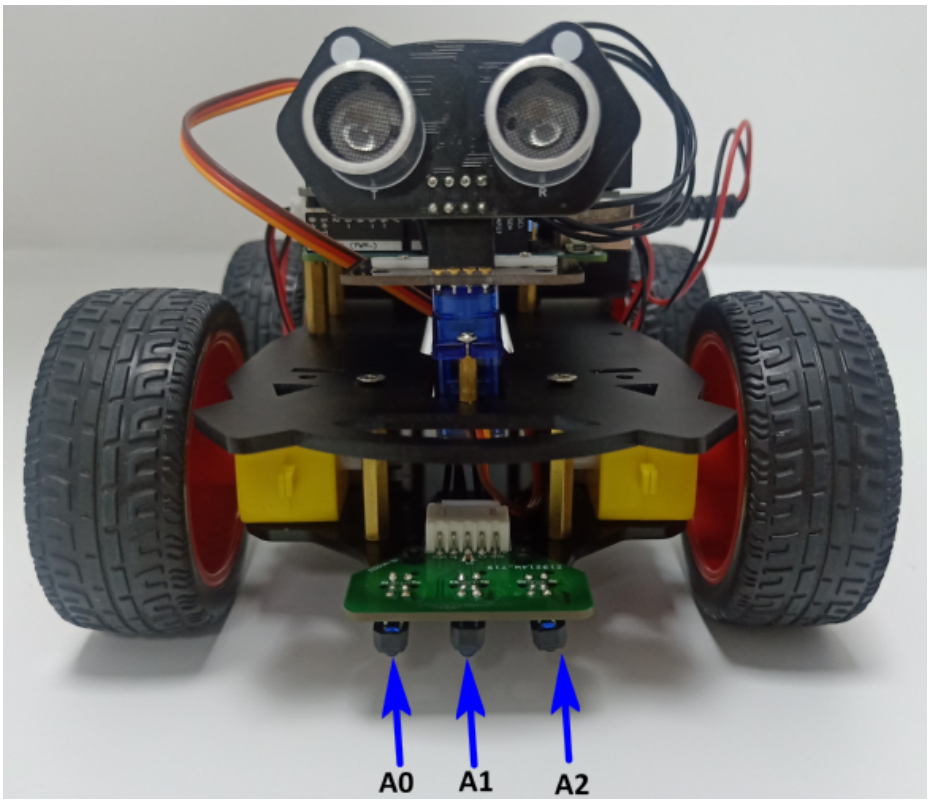

5.1.7 After the modification is complete, save the program and download the program to the robot car.

**For second code: Tracking_PID.ino**

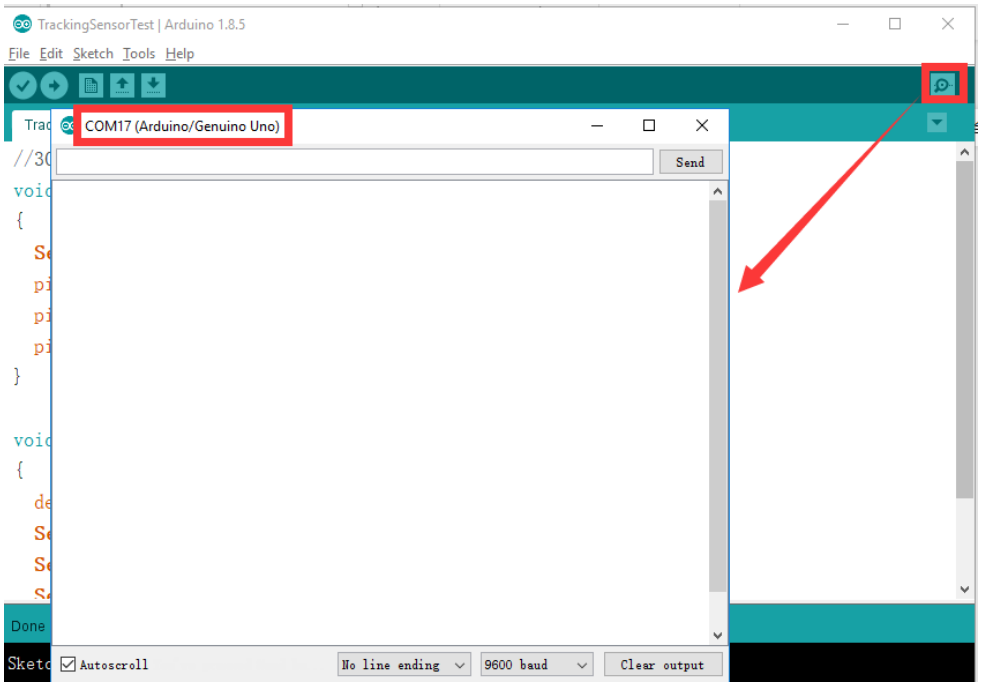
5.2.1 First, You need to open **TrackingSensorTest.ino** in the **TrackingSensorTest** folder. And connect the robot car with your computer by cable.

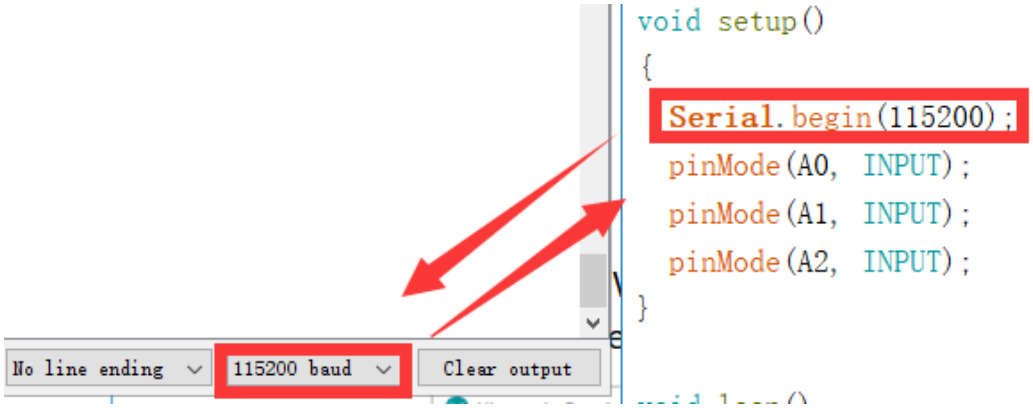
5.2.2 Then, you need to place three tracking probes on white **(must be the track where you will be conducting a tracking test).** As shown below.



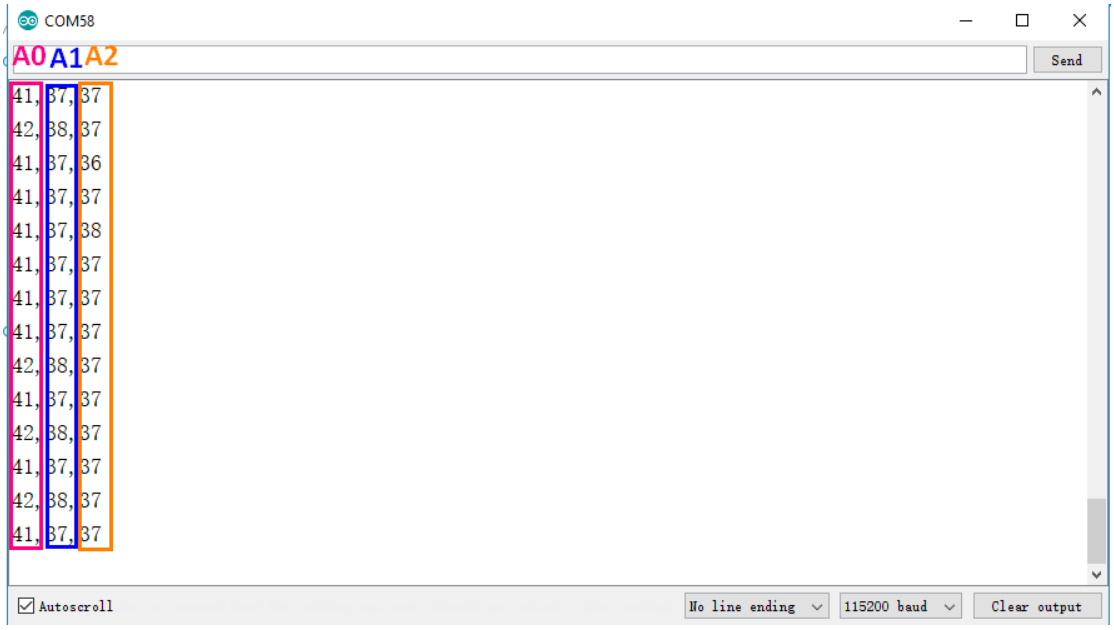
5.2.3 Next, We need to open the **Serial Monitor** in the upper right corner of the Arduino IDE interface. And we need to select the same baud rate as set in the program. As shown below.




5.2.4 We can see that when the three probes of the tracking sensor detect white, the currently output analog value is printed out. As shown below.

**(!!!Note: This data just for my experimental environment , you must record the value you printed, wait until the data is stable)**

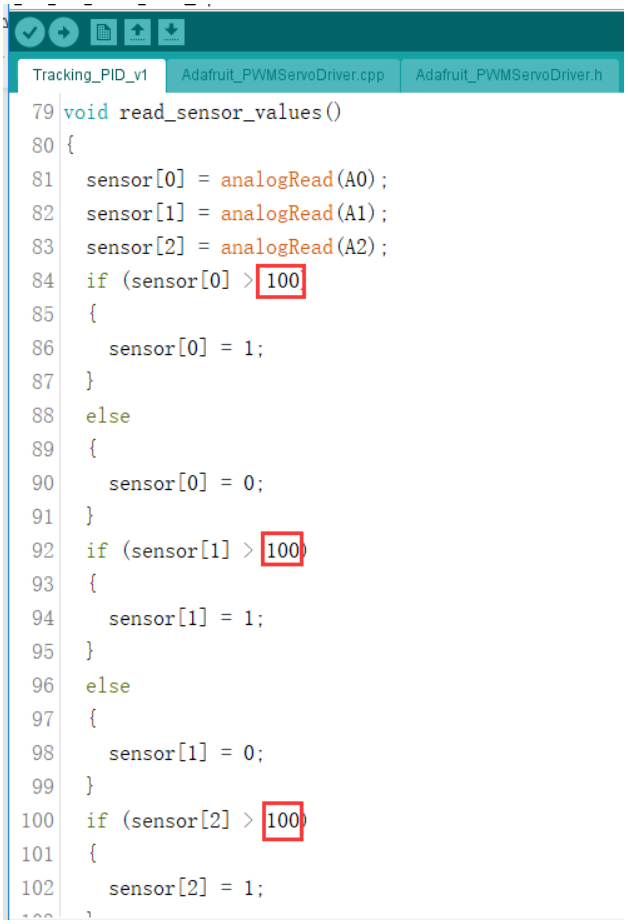



If the data shows a little fluctuation, that is normal, you can take the average of the five data.

5.2.5 You need to open **Tracking_PID.ino** in the **Tracking_PID** folder. And modify the three parameters in the program.

According to 5.2.4, you can see the data I printed is 41,37, 37. So the three parameters in the red coil in my program need to be changed to 100, 100, 100.

**(In other words, the parameters you modify are larger than the values you print.)**



5.2.6 For this program, you need to modify Kp, Ki, Kd according to actual condition.

```
#include <Adafruit_PWMServoDriver.h>
Adafruit_PWMServoDriver pwm = Adafruit_PWMServoDriver(0x40);

float max = 3.85;
float s = 100;
float Kp = 37, Ki = 4, Kd = 60;
float error = 0, P = 0, I = 0, D = 0, PID_value = 0;
```

5.2.7 After the modification is complete, save the program and download the program to the robot car.