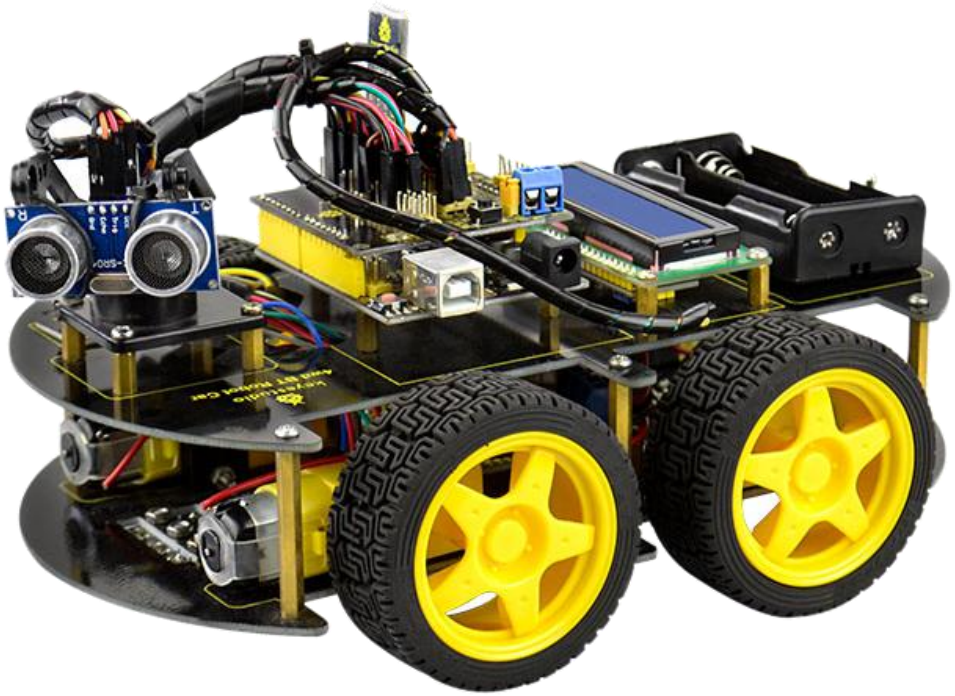
# keyestudio 4WD Bluetooth Multi-purpose Car



## Content

# 1. Introduction

keyestudio 4WD Bluetooth Multi-purpose Car is a learning application development system based on microcontroller and with ATmega-328 as core. It has functions of line tracking, obstacle avoidance, IR remote control, Bluetooth remote control and distance detection. This kit contains plenty of interesting programs and can extend an external circuit module to increase more functions of this car. The kit aims to disengage users from boring theories and to obtain capacity of system development when they are learning Arduino.

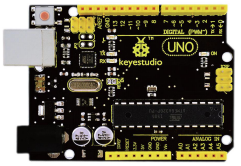
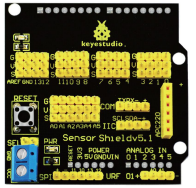
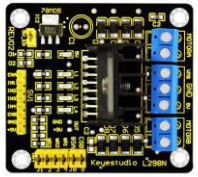
# 2. Parameters

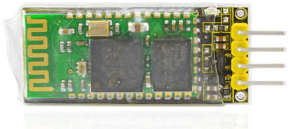
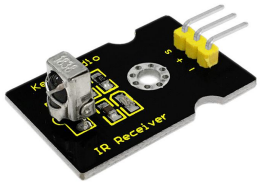
1.Motor: Voltage: 6-9V  Reduction Ratio: 1:48
2.Choosing L298N driver module as control motor, separated from microcontrollor
3.Three line tracking modules, having higher precision when detecting white and black lines, able to realize anti-falling.
4.IR remote control module making up a remote control system of the car
5.Using ultrasonic module to realize obstacle avoidance
6.Pairing mobile phone Bluetooth with Bluetooth remote control module to control the car
7.Able to connect with external voltage at 7~12V, and equipped with various sensors to complete different functions as much as possible.

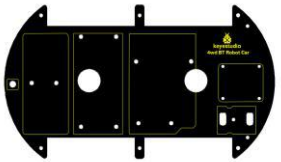
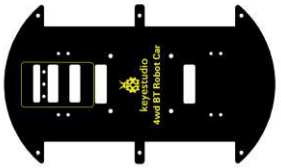
## 3. Project List

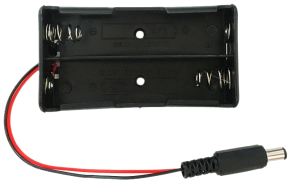
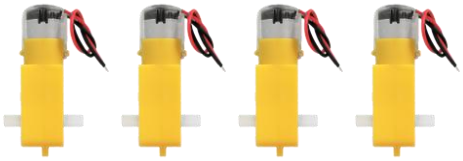
Project 1: Line Tracking Sensor
Project 2: Ultrasonic Sensor
Project 3: Digital IR Receiver Module
Project 4: Servo Motor
Project 5: Bluetooth Module
Project 6: L298N Motor Driver
Project 7: I2C 1602 LCD
Project 8: Line Tracking of Smart Car
Project 9: Obstacle Avoidance of Smart Car
Project 10: IR Remote Control of Smart Car
Project 11: Distance Detecting of Smart Car
Project 12: Bluetooth Remote Control of Smart Car
Project 13: 5 in 1 Multi-purpose Car

## 4. Component

| No. | Product Name | Quantity | Picture |
|---|---|---|---|
| 1 | keyestudio UNO R3 | 1 |  |
| 2 | keyestudio Shield V5 | 1 |  |
| 3 | keyestudio L298N Motor Shield | 1 |  |

| | | | |
|---|---|---|---|
| 4 | keyestudio Bluetooh HC-06 | 1 |  |
| 5 | I2C 1602 LCD | 1 |  |
| 6 | keyestudio Line Tracking Sensor | 3 |  |
| 7 | HC-SR04 Ultrasonic Sensor | 1 |  |
| 8 | keyestudio Digital IR Receiver Module | 1 |  |

| | | | |
|---|---|---|---|
| 9 | 4WD Top PCB | 1 |  |
| 10 | 4WD Bottom PCB | 1 |  |
| 11 | Servo Motor | 1 |  |
| 12 | Servo Plastic Platform | 1 |  |

| | | | |
|---|---|---|---|
| 13 | Remote Control of Chip | 1 |  |
| 14 | Toggle Switch | 1 |  |
| 15 | 18650 Battery Holder | 1 |  |
| 16 | Metal Motor | 4 |  |
| 17 | Motor Fixed Parts | 4 |  |

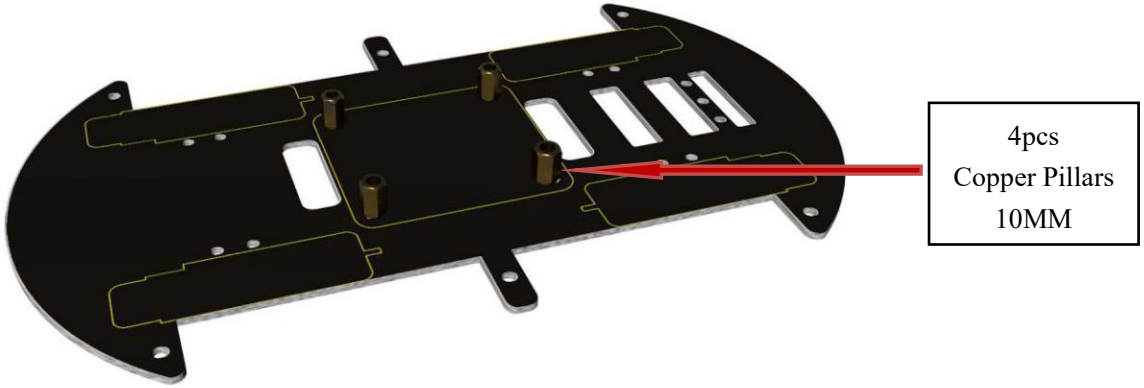
| | | | |
|---|---|---|---|
| 18 | Plastic Tire | 4 |  |
| 19 | Copper Pillar 40MM | 6 |  |
| 20 | Copper Pillar 10MM | 16 |  |
| 21 | USB Cable | 1 |  |

| | | | |
|---|---|---|---|
| 22 | Dupont Line | 30 |  |
| 23 | M3*6MM Round Head Screw | 60 |  |
| 24 | M3*8MM Flat Head Screw | 2 |  |
| 25 | M3*30MM Round Head Screw | 8 |  |
| 26 | 3MM Nut | 16 |  |

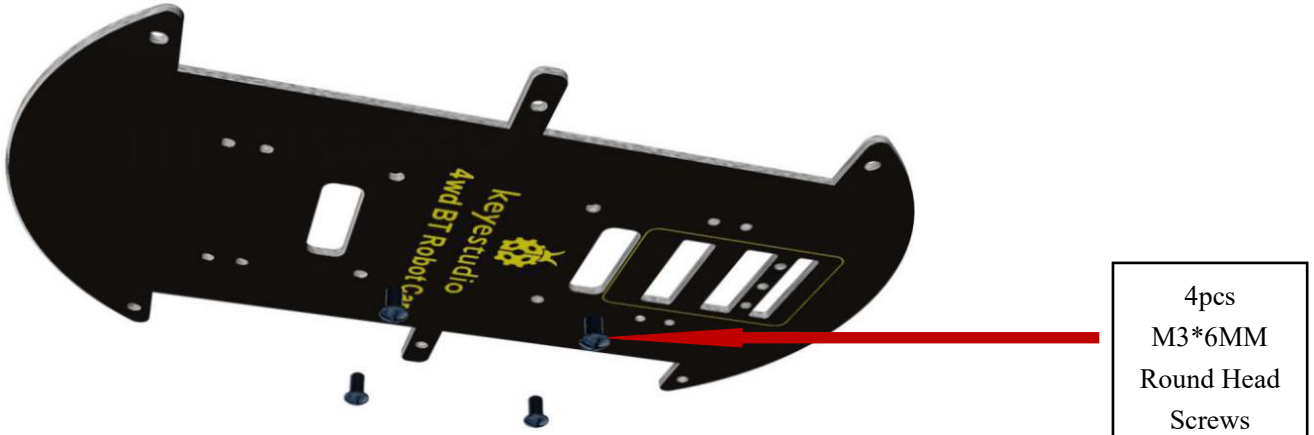
| | | | |
|---|---|---|---|
| 27 | Connector Wire (150mm, Black) | 6 |  |
| 28 | Connector Wire (150mm, Red) | 6 |  |
| 29 | Winding Wire (12CM) | 1 |  |

## 5. Installation Method

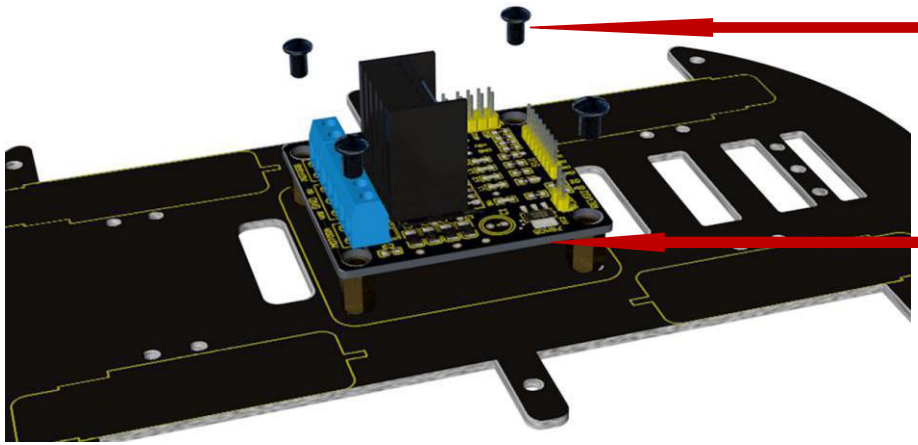
1. Plug 4 copper pillars (10MM) into bottom PCB.




2. 4 M3*6MM round head screws are slotted into the pillars.



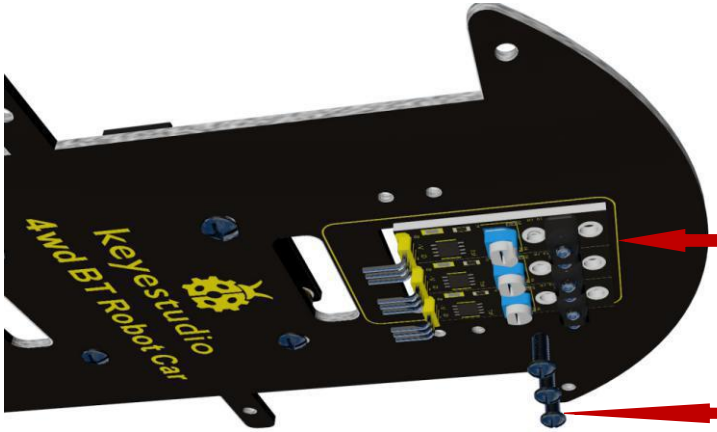

3. keyestudio L298N motor shield is bolted to the 4 pillars with 4 screws



4pcs
M3*6MM
Round Head
Screws

keyestudio
L298N Motor
Shield

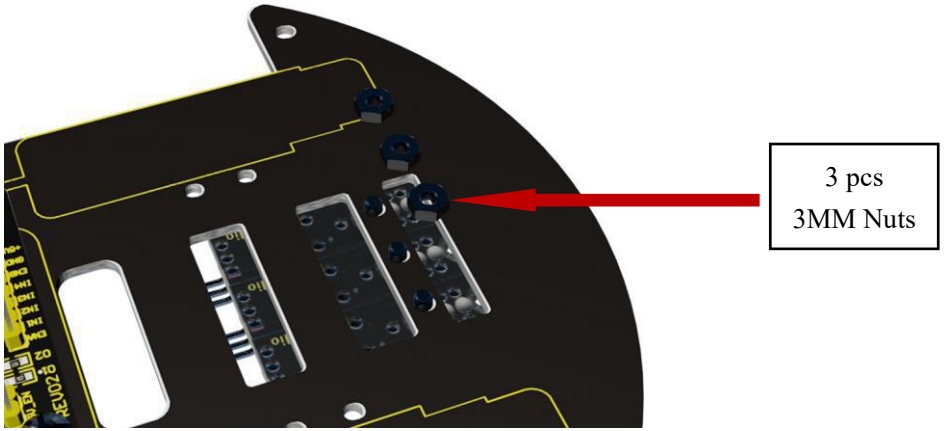
4. Attach 3 line tracking sensor to bottom PCB using 3 screws.



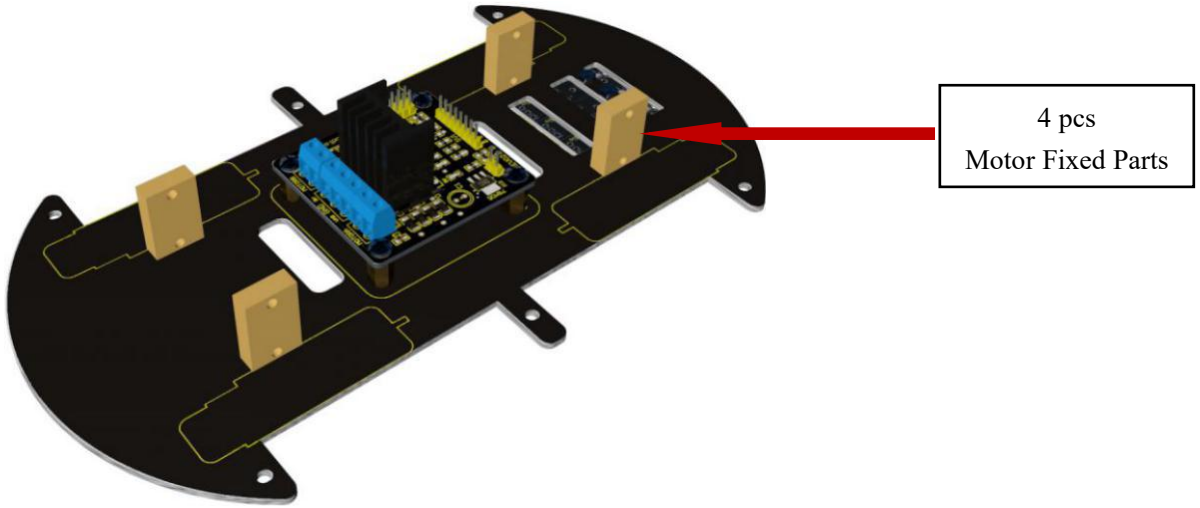

3 pcs
keyestudio
Line Tracking
Sensor

3pcs
M3*6MM
Round Head
Screws

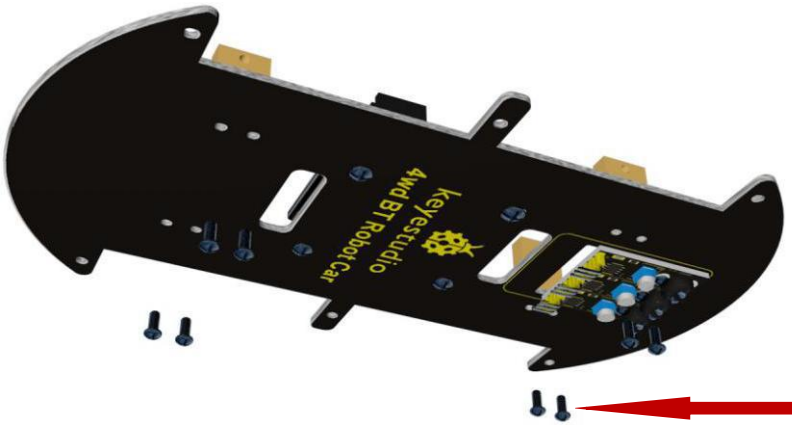
5. Fix the line tracking sensors with 3 nuts on the back.




6.Put 4 motor fixed parts to the holes on bottom PCB.

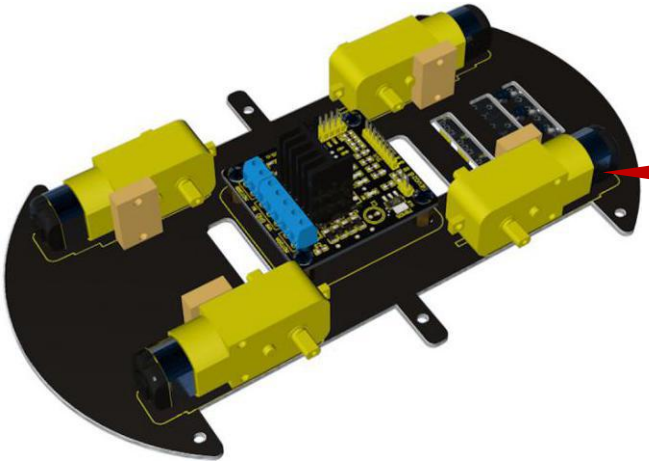


7. Bolt the motor fixed parts to bottom PCB with 8 screws.



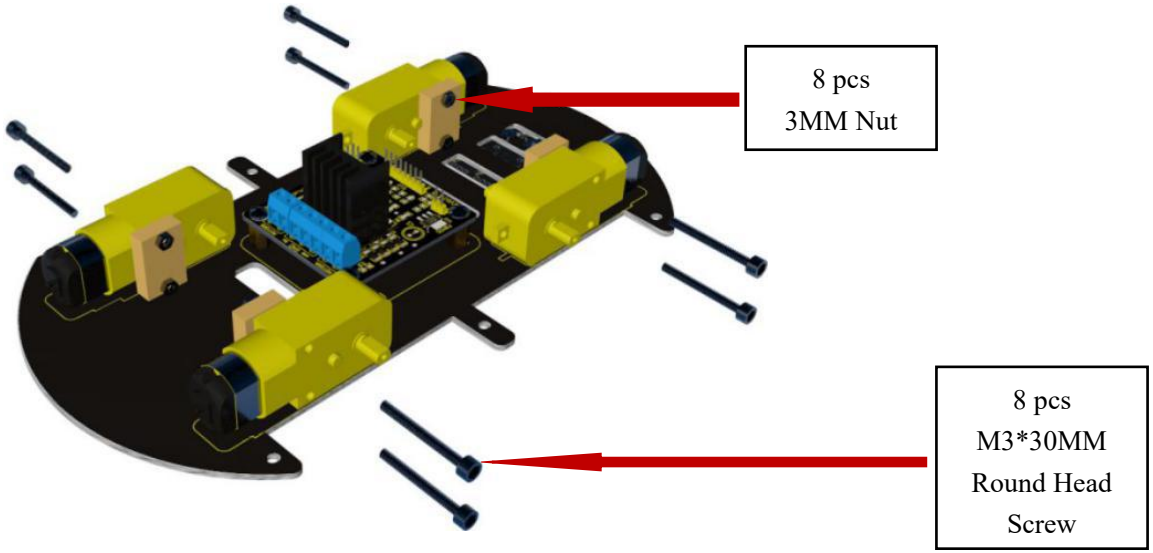

8 pcs
M3*6MM
Round Head
Screws

8. Place 4 metal motors on PCB near the motor fixed parts.

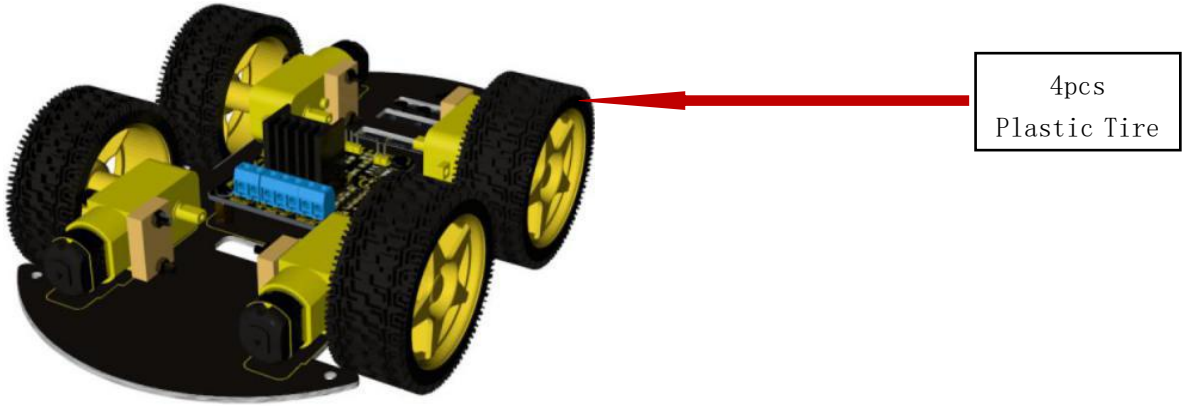


4pcs
Metal Motors

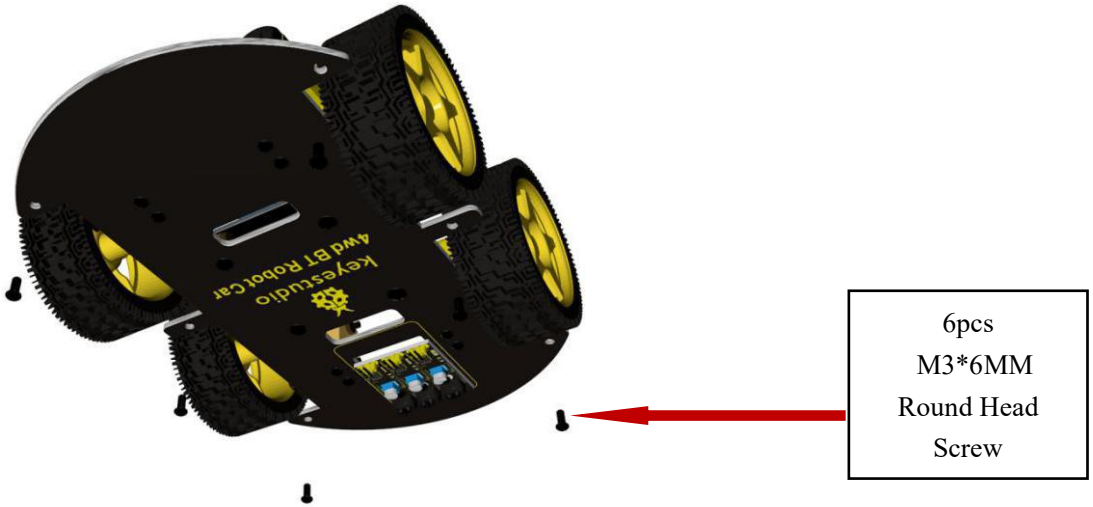
9. Attach 4 motors to bottom PCB using 8 screws and 8 nuts.



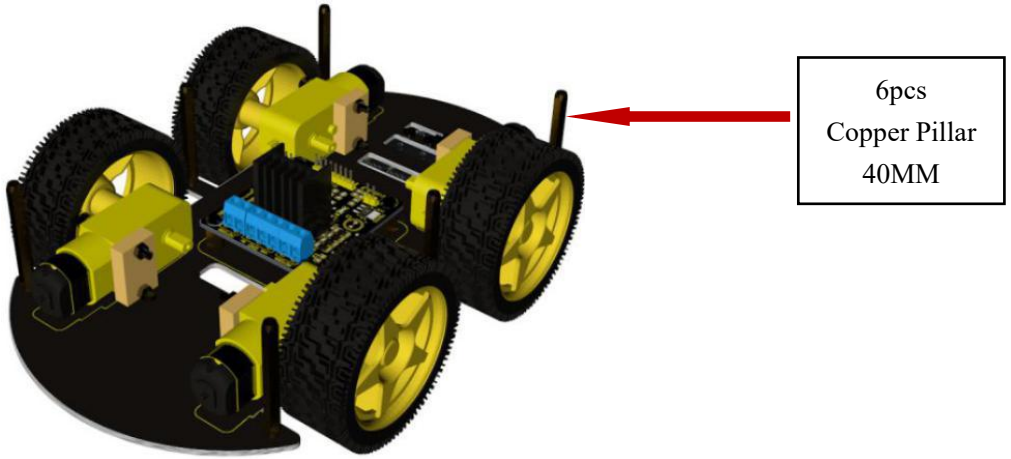

10. Plug 4 tires into the motors.



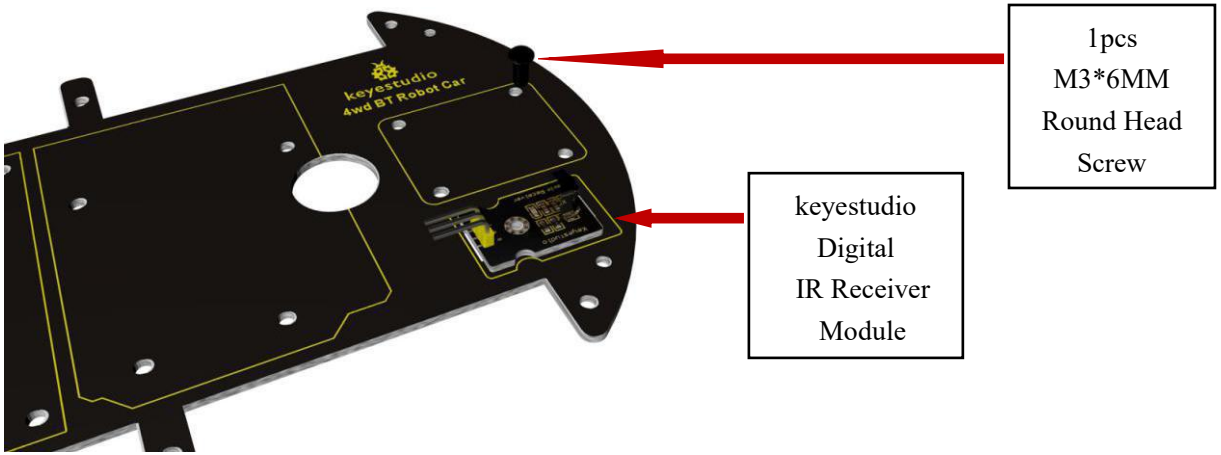

11. Insert 6 screws into 6 holes around bottom PCB.



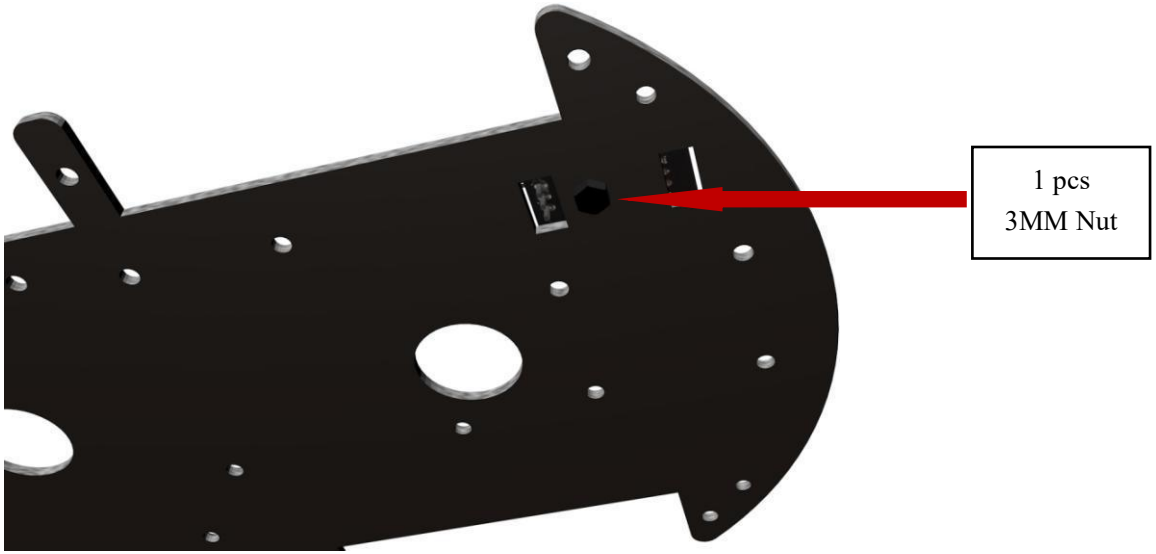

12. Slot 6 pillars into the screws.



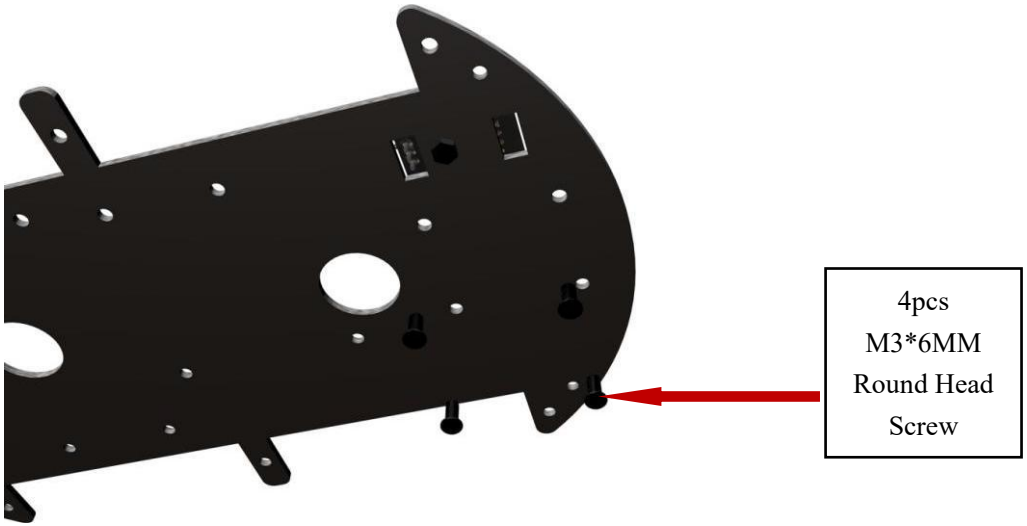
13. Attach IR receiver module to top PCB using a screw.



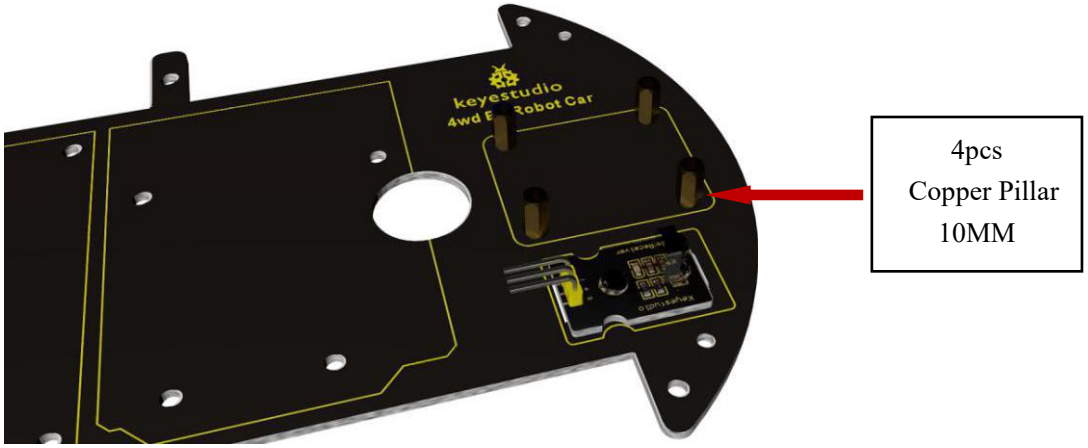

14. Twist a nut to the screw to fix IR receiver module.



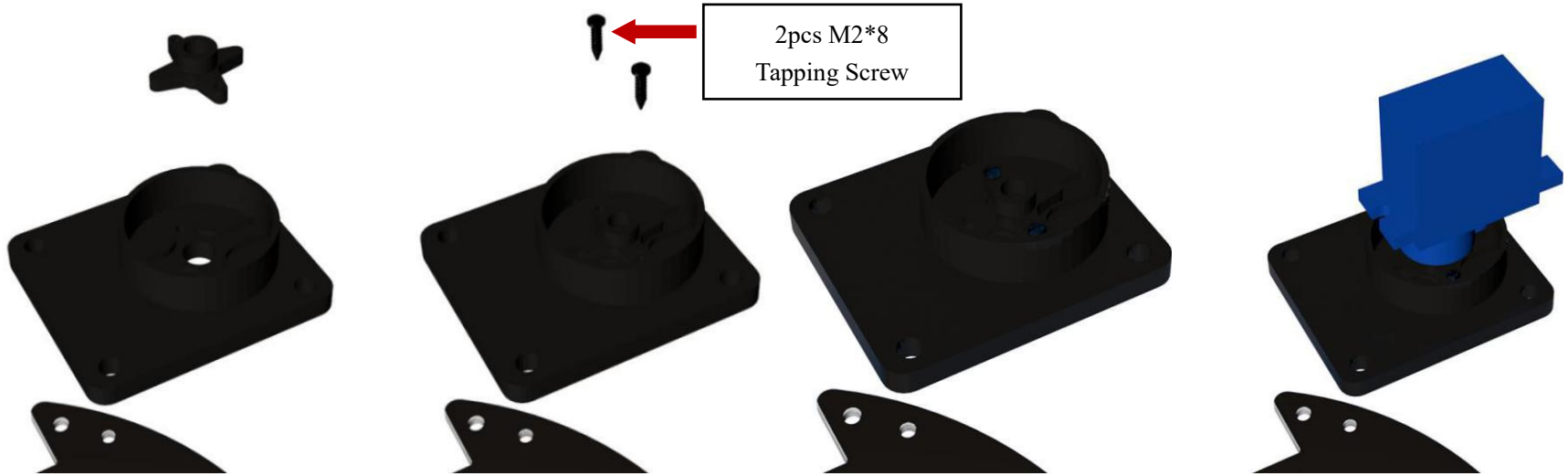

15. Insert 4 screws into the holes of top PCB.

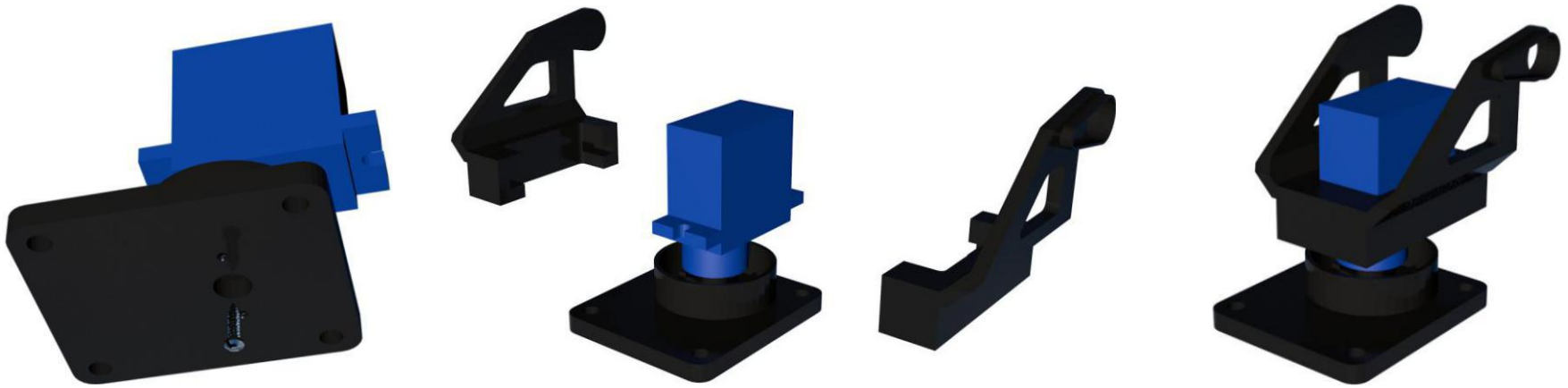



16. 4 pillars are slotted into the screws.

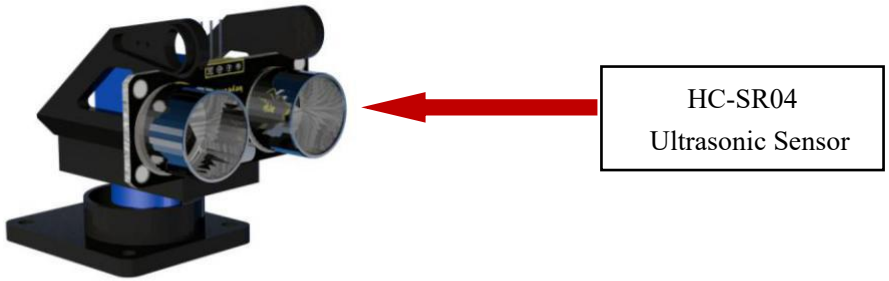


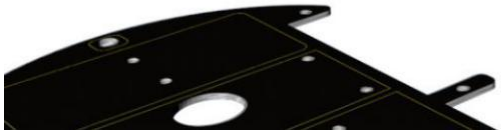
17. First cut the plastic object into a cross to put into the part completely, and then install platform and motor step by step according to the following figures.



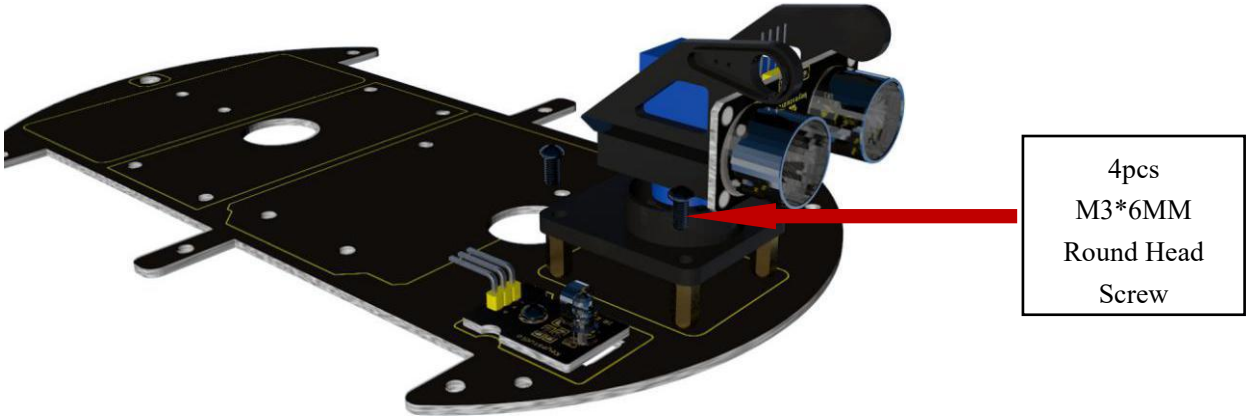


18. Attach ultrasonic sensor to the platform using wingding wire.

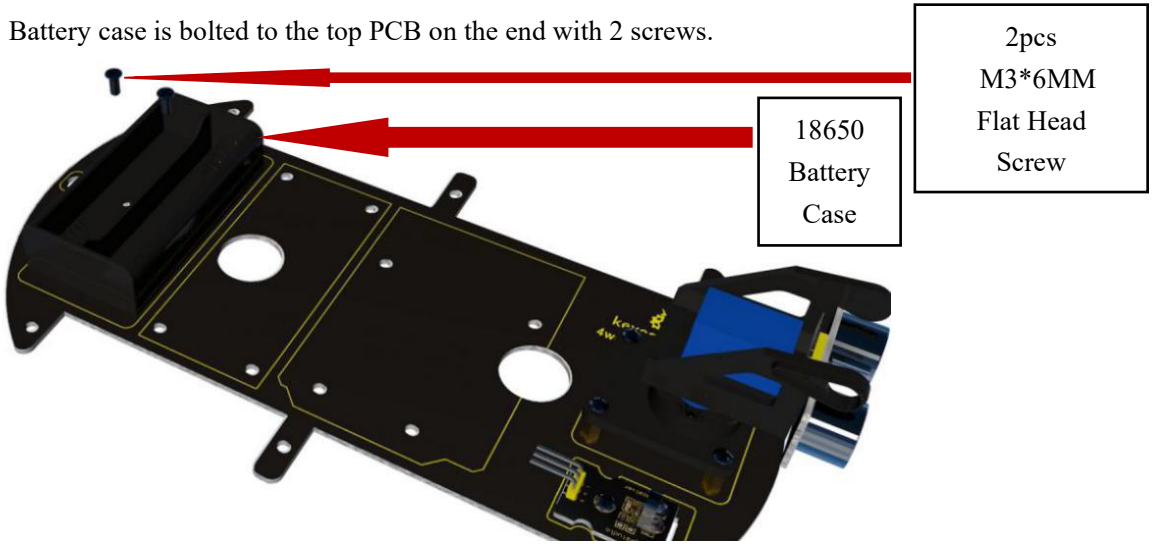


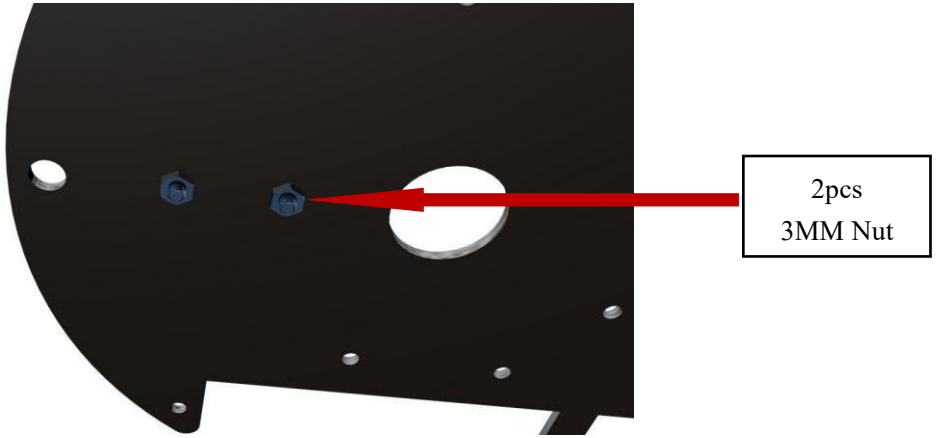
19. Bolt the whole platform to 4 pillars on top PCB with 4 screws.



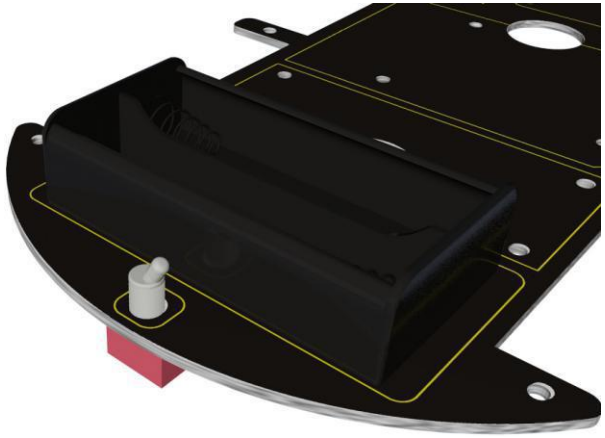

20. Battery case is bolted to the top PCB on the end with 2 screws.

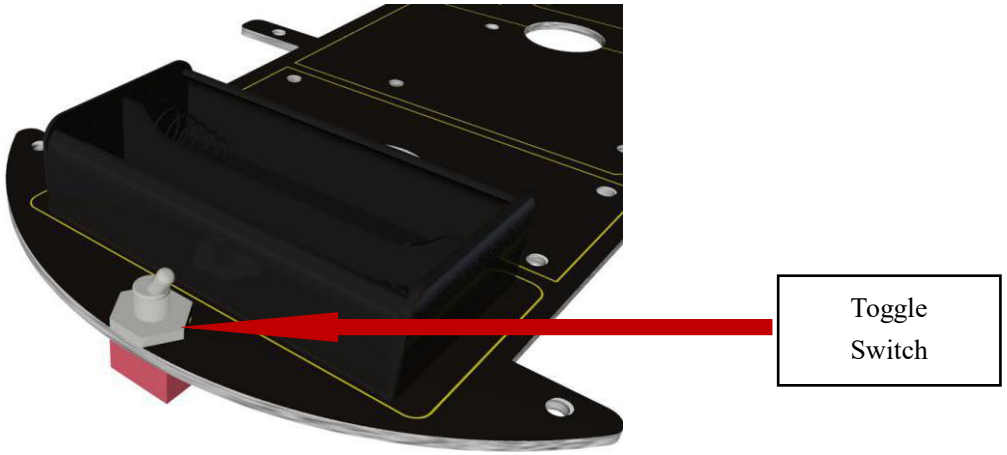


21. Twist 2 nuts to fix the battery case.

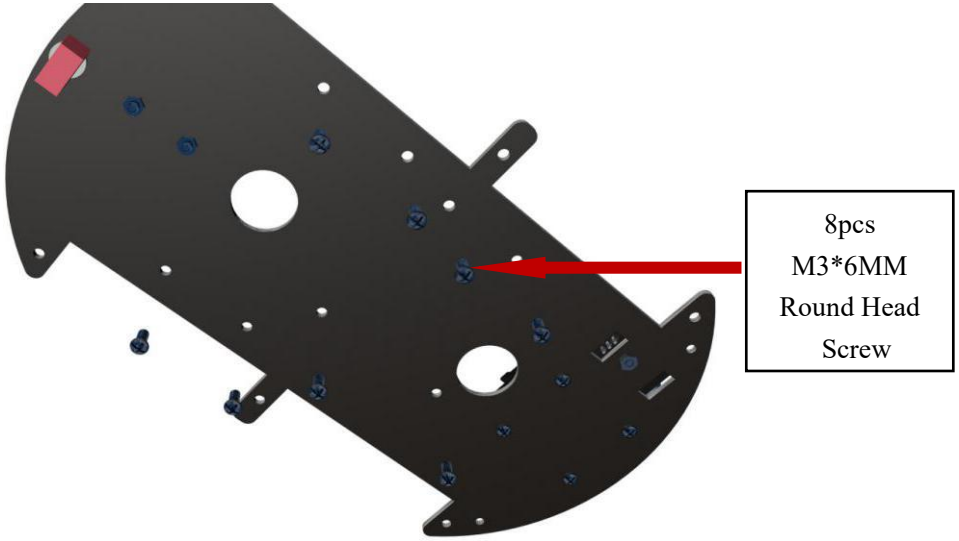



22. Install toggle switch on top PCB.

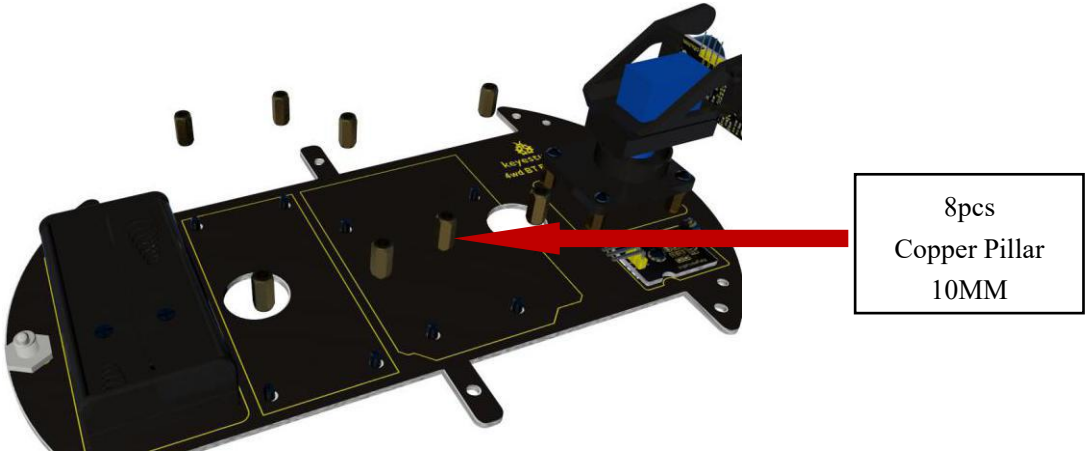




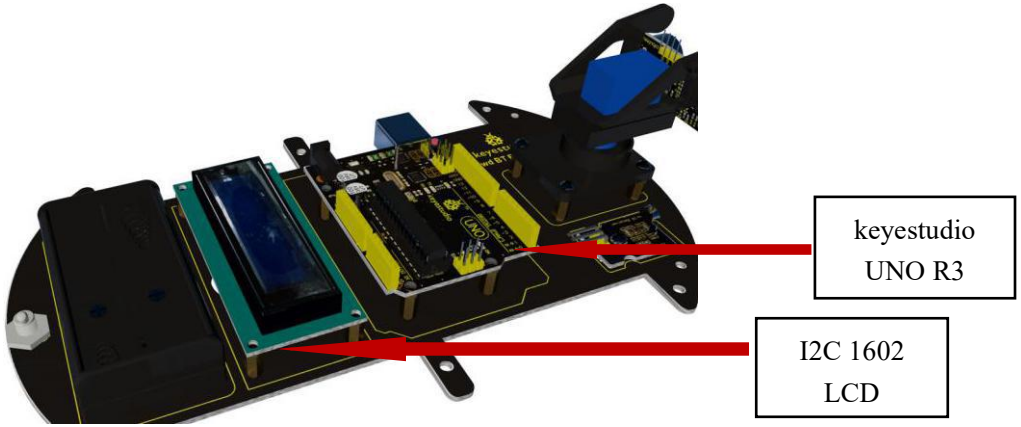

23. Insert 8 screws into the holes of the middle part on top PCB.



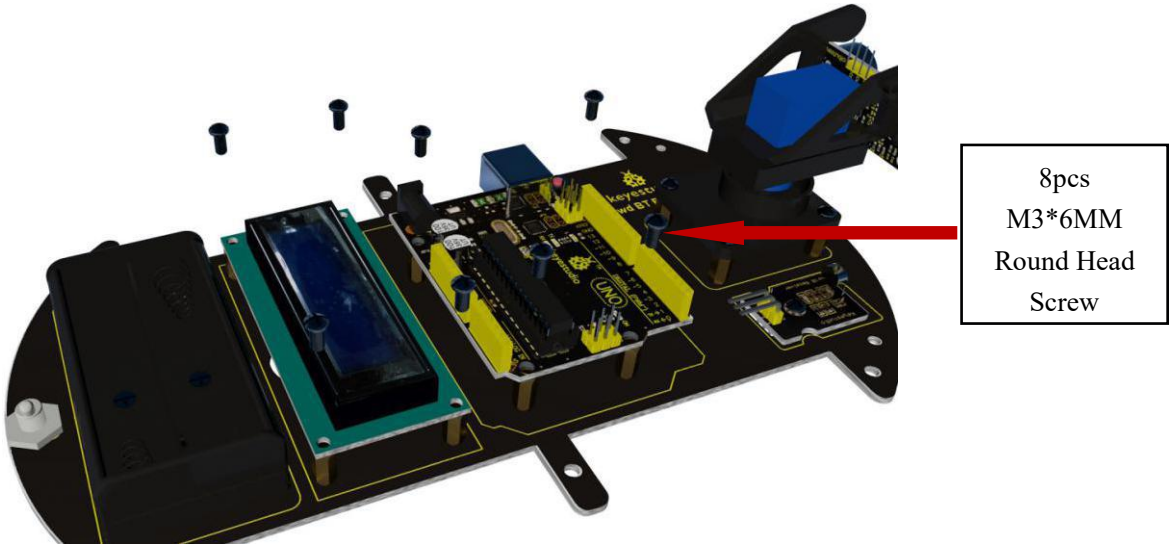
24. Slot 8 pillars into 8 screws.



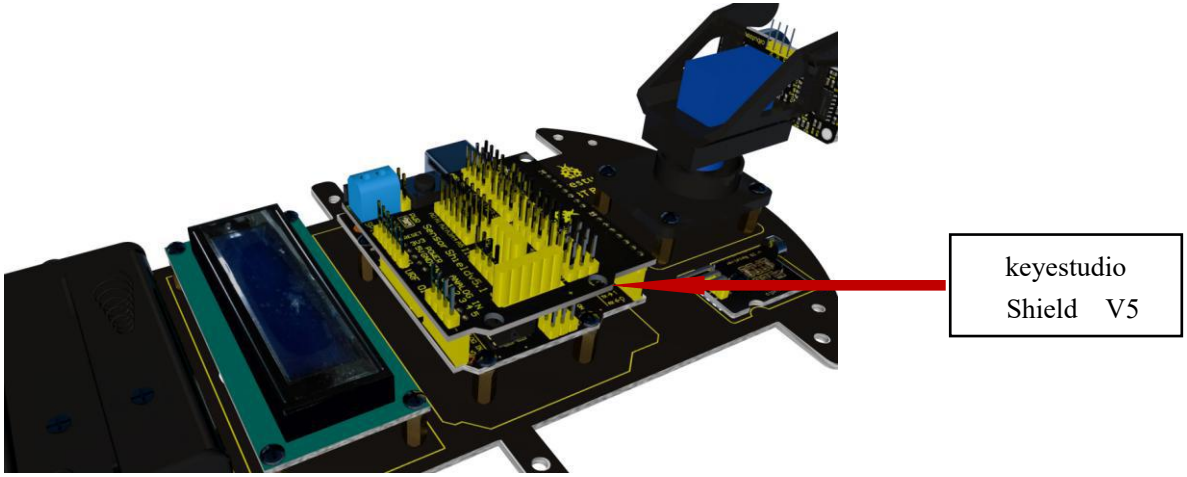

25.Plug LCD and UNO R3 into the 8 pillars.



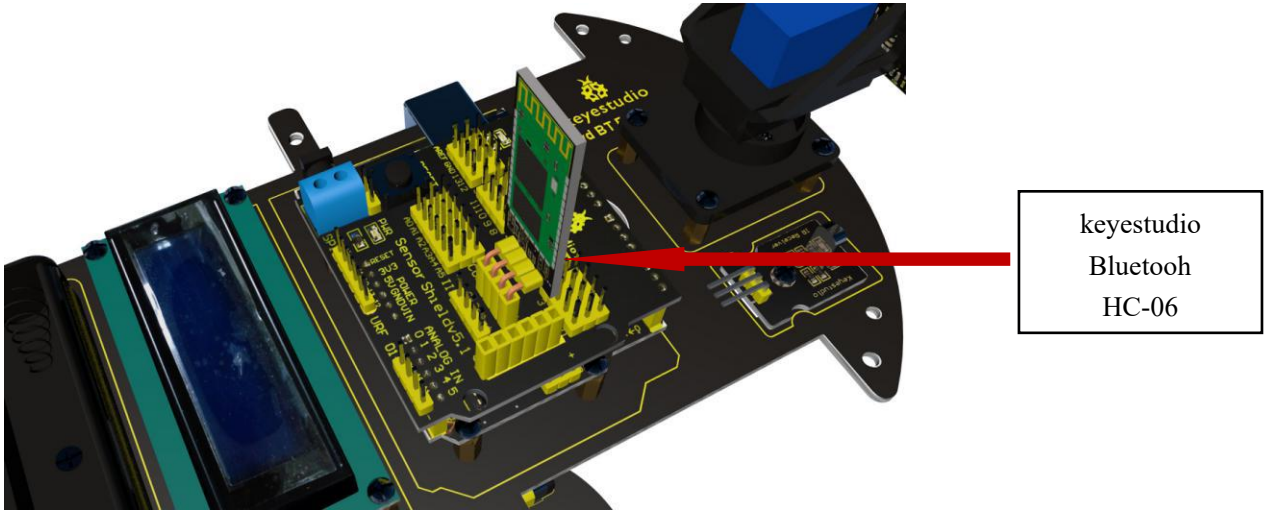
26. Attach LCD and UNO R3 to the pillars using screws.



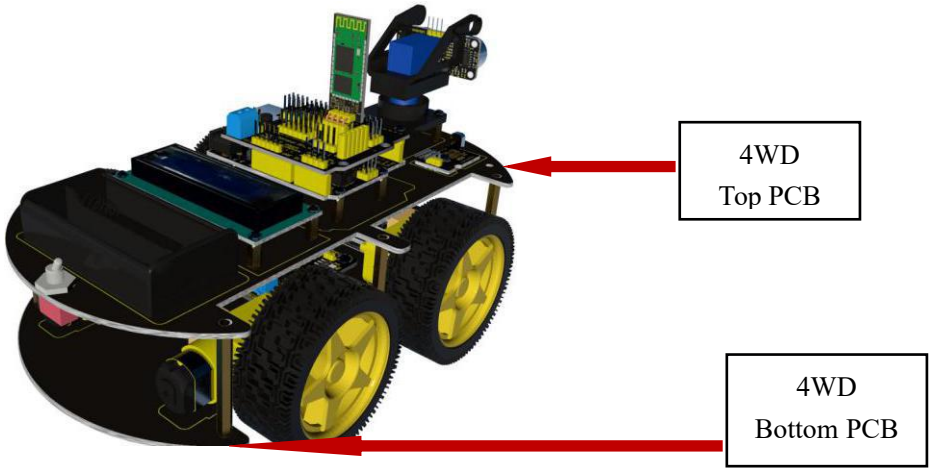

27. Plug shield V5 into UNO R3.



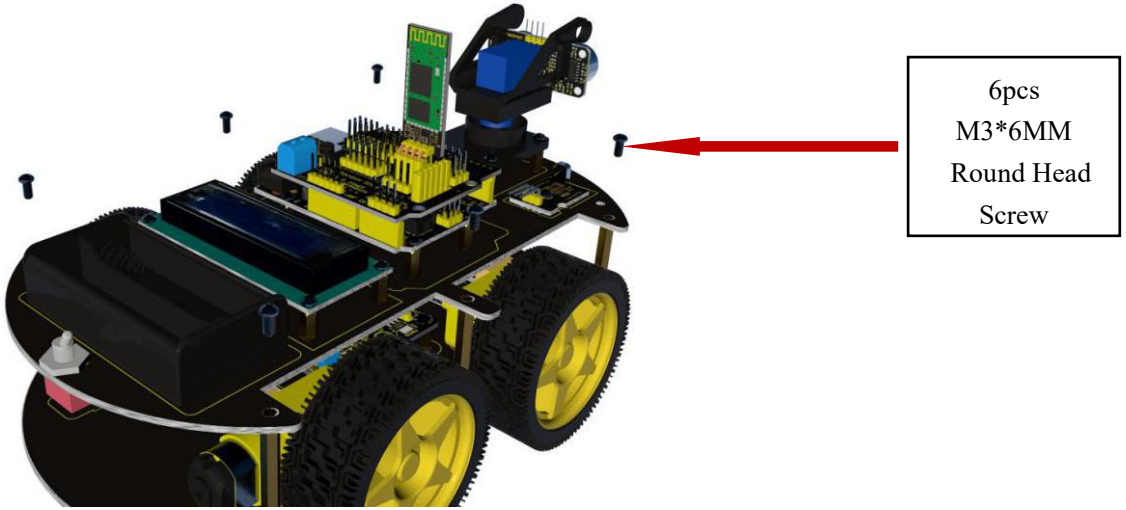

28. Plug Bluetooh HC-06 into shield V5.



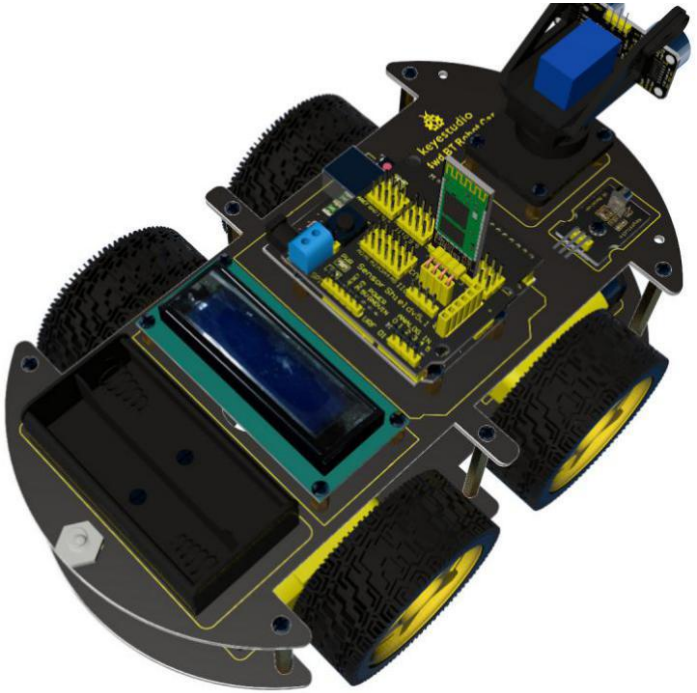
29. Plug top board into bottom board.




30. Fix top and bottom board using 6 screws.



31. Installation is complete,shown as the following figure.



**6. Address of Assembly Video**

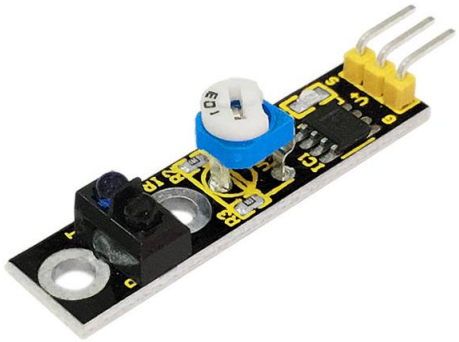
http://www.keyestudio.com/wp/2016/09/ks0192

**7. Address of Demonstration Video**

http://www.keyestudio.com/wp/2016/09/ks0192-keyestudio-4wd-bluetooth-Multi-purpose-car-demonstration-video/

# 8. Project Details

## Project 1: Line Tracking Sensor



**Introduction:**

This Line Tracking Sensor can detect white lines in black and black lines in white. The single line-tracking signal provides a stable output signal TTL for a more accurate and more stable line. Multi-channel option can be easily achieved by installing required line-tracking robot sensors.

**Specification:**

Power Supply: +5V

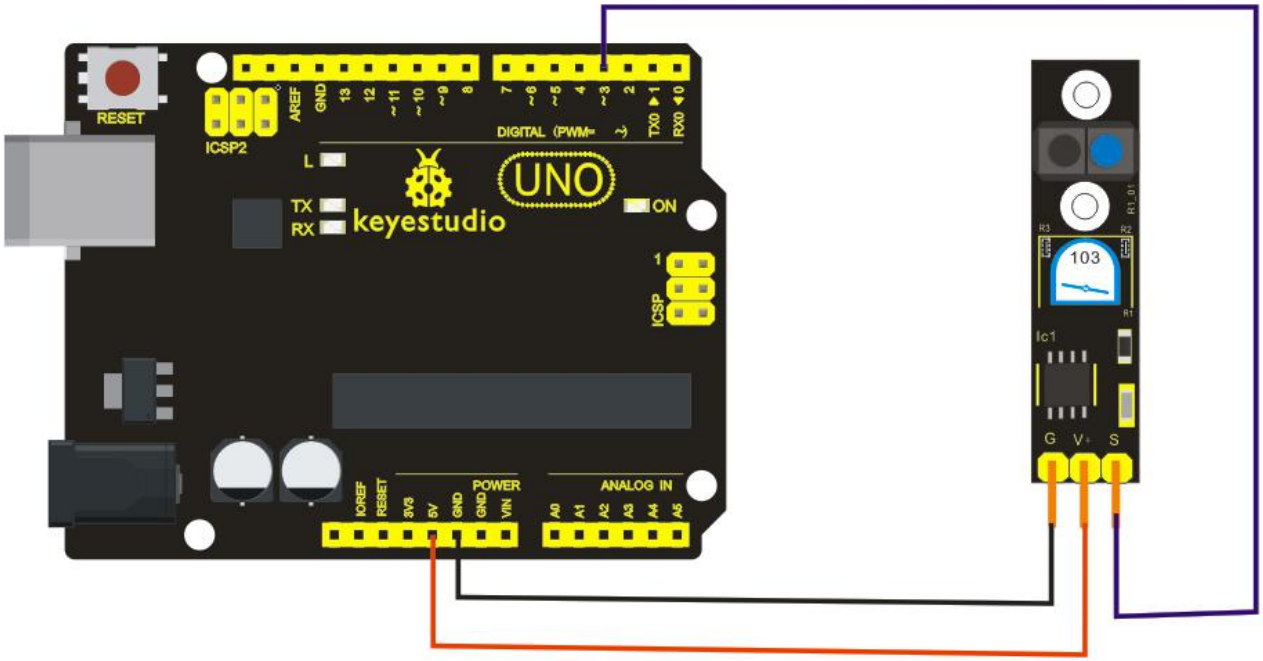
Operating Current: <10mA

Operating Temperature Range: 0°C ~ + 50°C

Output Interface: 3-wire interface (1 - signal, 2 - power, 3 - power supply negative)

Output Level: TTL level

**Connection Diagram:**




**Sample Code:**

```
/*********************************************************************************
const int sensorPin = 3;          // the number of the sensor pin
const int ledPin =    13;         // the number of the LED pin
int sensorState = 0;              // variable for reading the sensor status
```

```
void setup() {
   pinMode(ledPin, OUTPUT);
   pinMode(sensorPin, INPUT); }
void loop(){
   // read the state of the sensor value:
   sensorState = digitalRead(sensorPin);
   // if the sensorState is HIGH:
   if (sensorState == HIGH) {
        digitalWrite(ledPin, HIGH);
   }
   else {digitalWrite(ledPin, LOW);
   }}
*********************************************************************************
```

**Result**

After power-on, power indicator D1 is on. When you block the sensing part of line tracking sensor with black paper, LED on the sensor is off as shown in **Figure 1**. When you block it with white paper, LED is on as shown in **Figure 2**.

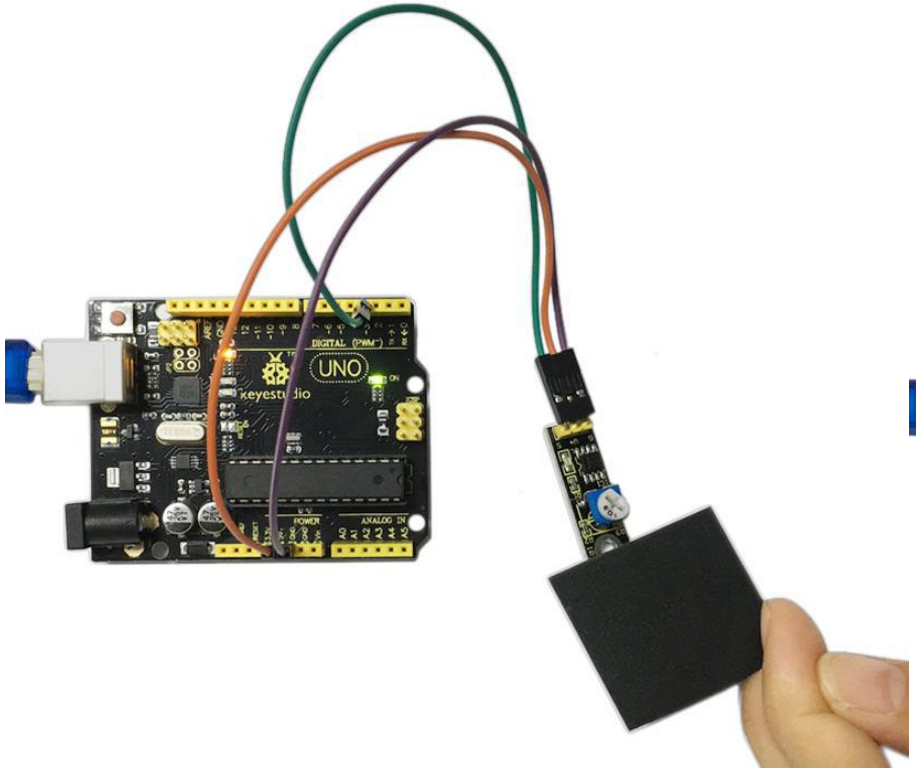


Figure 1

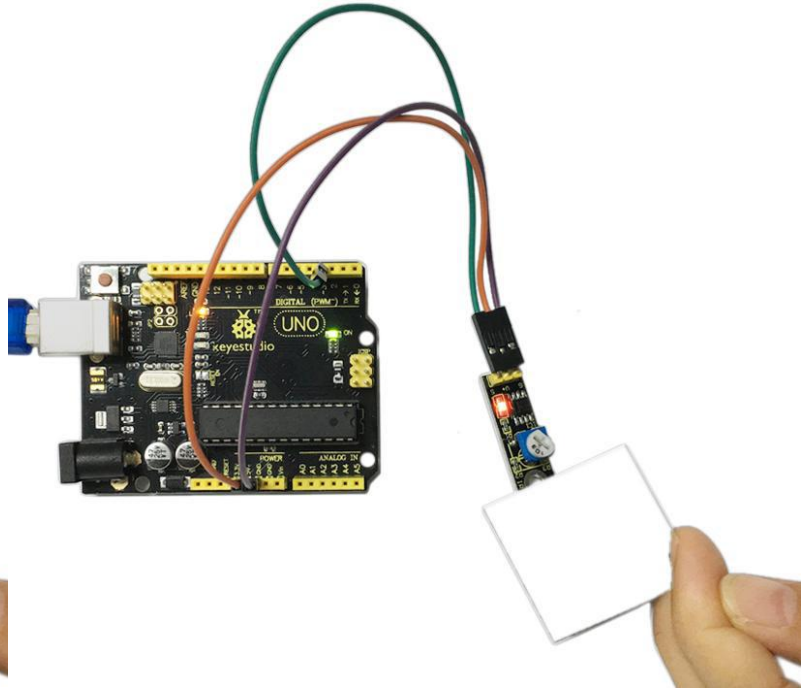


Figure 2

## Project 2: Ultrasonic Sensor


**Introduction:**

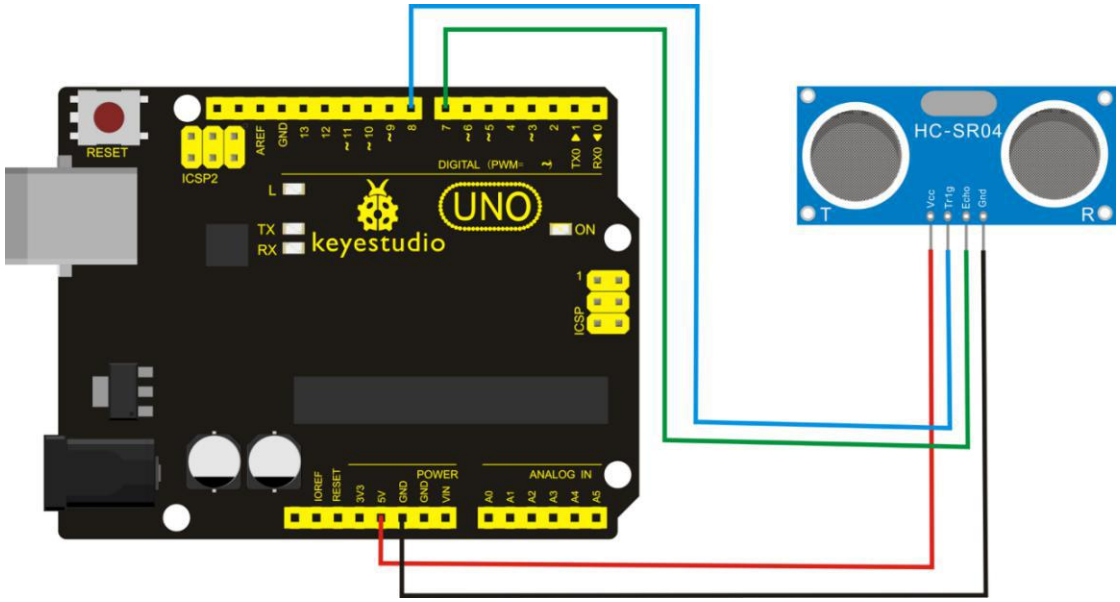
The HC-SR04 Ultrasonic Sensor is a very affordable proximity/distance sensor that has been used mainly for object avoidance in various robotics projects. It essentially gives your Arduino eyes / spacial awareness and can prevent your robot from crashing or falling off a table. It has also been used in turret applications, water level sensing, and even as a parking sensor. This simple project will use the HC-SR04 sensor with an Arduino and a Processing sketch to provide a neat little interactive display on your computer screen.

**Specification:**

Working Voltage: DC 5V
Working Current: 15mA
Working Frequency: 40KHz
Max Range: 4m

Min Range: 2cm
Measuring Angle: 15 degree
Trigger Input Signal: 10μS TTL pulse
Echo Output Signal Input TTL lever signal and the range in proportion
Size: 46*20.4mm
Weight: 9g

**Connection Diagram:**




**Sample Code:**

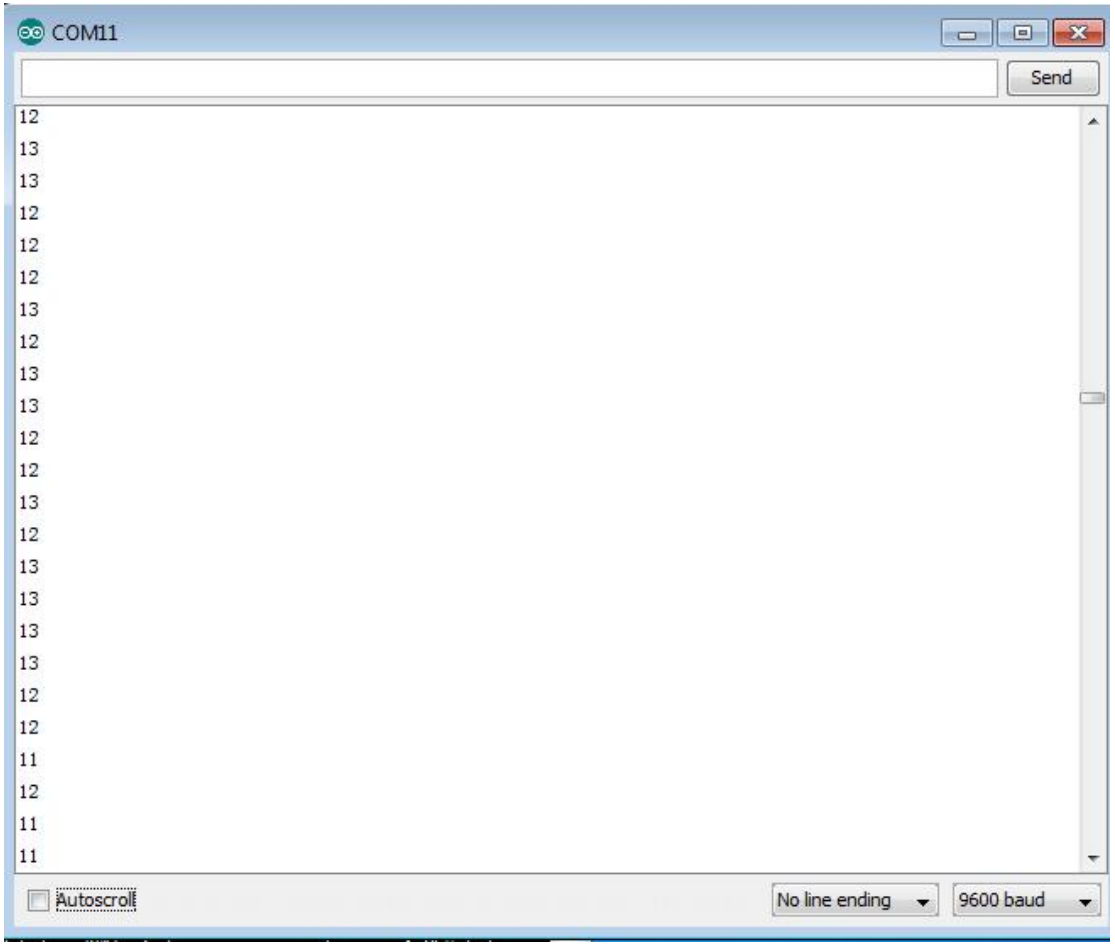
VCC to arduino 5v
GND to arduino GND
Echo to Arduino pin 7
Trig to Arduino pin 8

```
*****************************************************************************
#define echoPin 7 // Echo Pin
#define trigPin 8 // Trigger Pin
#define LEDPin 13 // Onboard LED

int maximumRange = 200; // Maximum range needed
int minimumRange = 0; // Minimum range needed
long duration, distance; // Duration used to calculate distance

void setup() {
  Serial.begin (9600);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(LEDPin, OUTPUT); // Use LED indicator (if required)
}

void loop() {
/* The following trigPin/echoPin cycle is used to determine the
  distance of the nearest object by bouncing soundwaves off of it. */
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
```

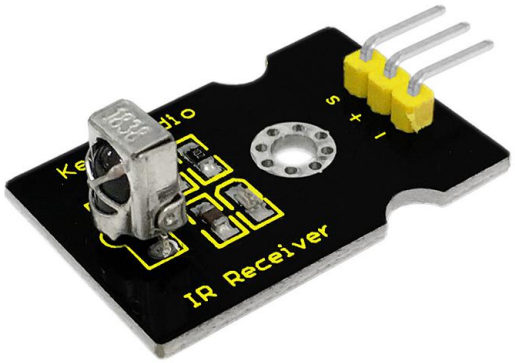
```
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);

  //Calculate the distance (in cm) based on the speed of sound.
  distance = duration/58.2;

  if (distance >= maximumRange || distance <= minimumRange){
  /* Send a negative number to computer and Turn LED ON
  to indicate "out of range" */
  Serial.println("-1");
  digitalWrite(LEDPin, HIGH);
  }
  else {
  /* Send the distance to the computer using Serial protocol, and
  turn LED OFF to indicate successful reading. */
  Serial.println(distance);
  digitalWrite(LEDPin, LOW);
  }
  //Delay 50ms before next reading.
  delay(50);
}
**********************************************************************************
```

**Result**

After wiring and uploading the code, when ultrasonic sensor senses obstacle within sensing area, it can measure the distance between itself and obstacle, and the value of distance is displayed on serial monitor, as shown in below figure.



## Project 3: Digital IR Receiver Module




**Introduction:**

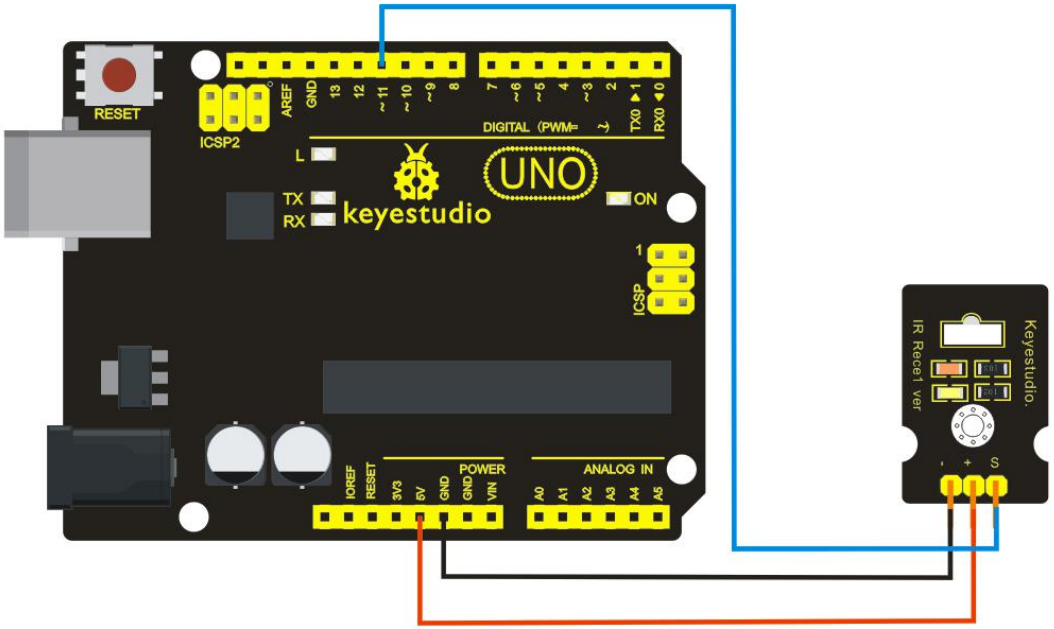
IR is widely used in remote control. With this IR receiver, Arduino project is able to receive command from any IR remoter controller if you have the right decoder. Well, it will be also easy to make your own IR controller using IR transmitter.

**Specification:**

Power Supply: 5V
Interface: Digital
Modulate Frequency: 38Khz
Module Interface Socket: JST PH2.0

**NOTE:** In the sample code below Digital pin 11 is in use, you may either change your wiring or change the sample code to match.

**Connection Diagram：**




**Sample Code:**

```
**********************************************************************************
```

Get library from: https://github.com/shirriff/Arduino-IRremote

```
#include <IRremote.h>
```

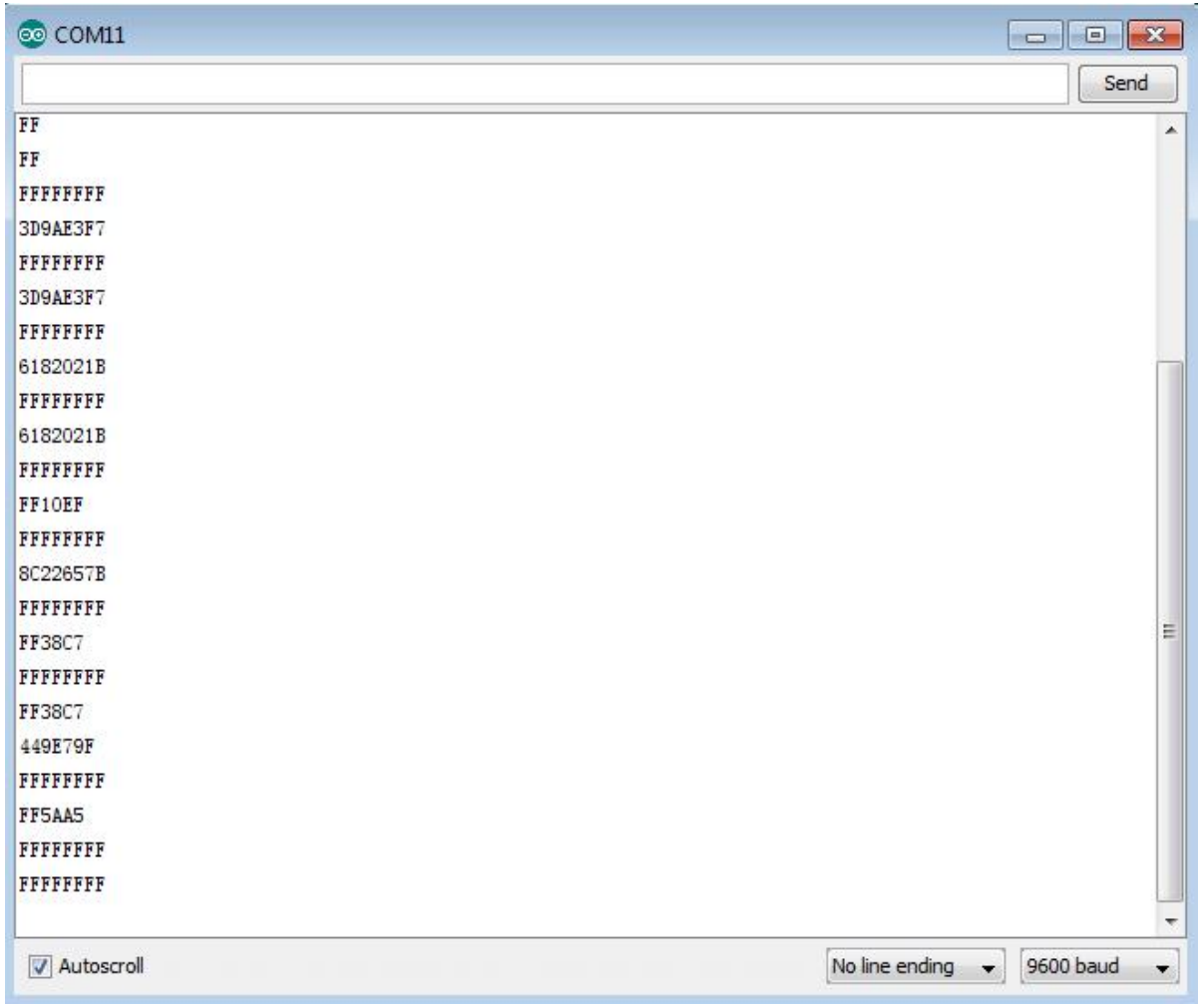
```
int RECV_PIN = 11;
IRrecv irrecv(RECV_PIN);
decode_results results;
void setup()
{
 Serial.begin(9600);
 irrecv.enableIRIn(); // Start the receiver
}
void loop() {
 if (irrecv.decode(&results)) {
   Serial.println(results.value, HEX);
   irrecv.resume(); // Receive the next value
  }
}
```

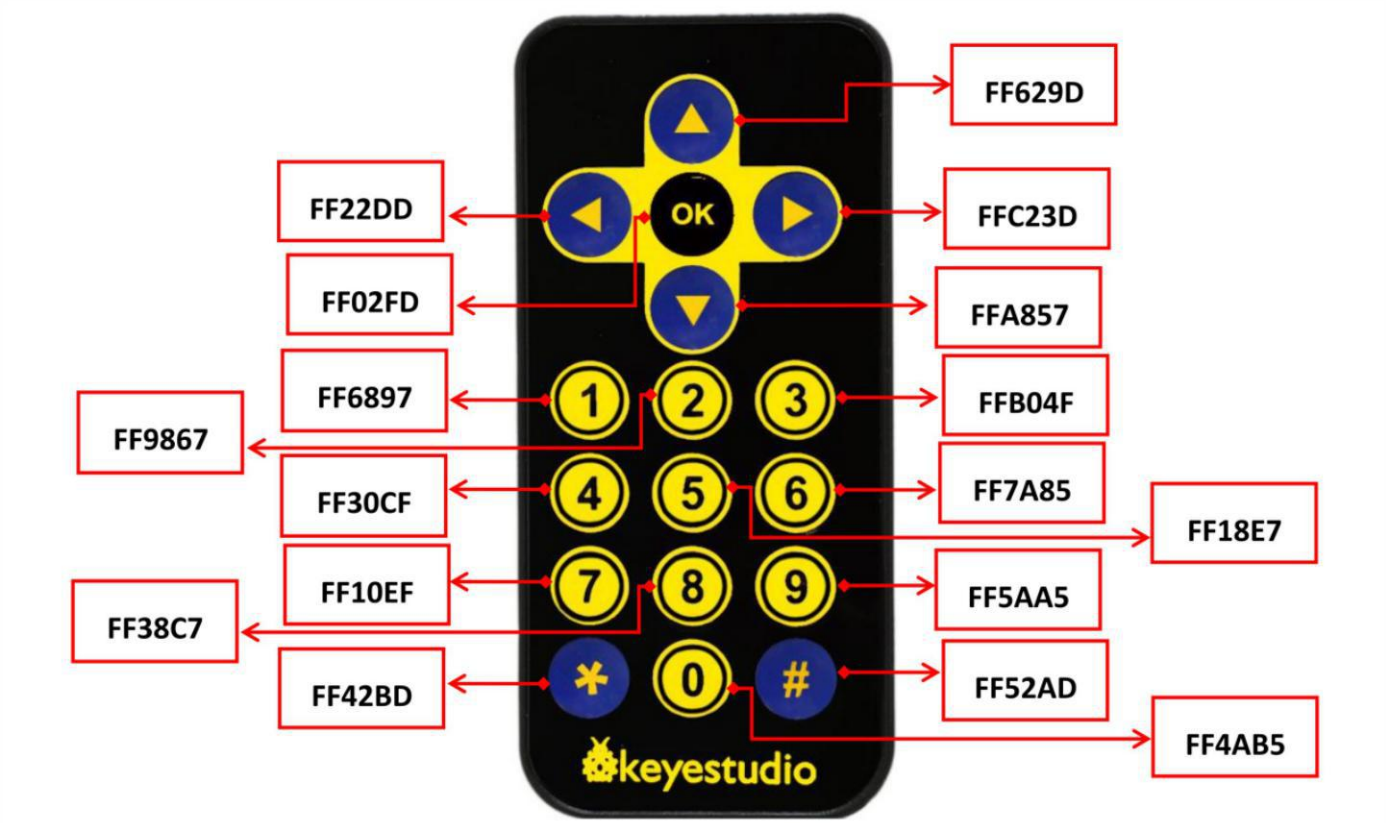
**********

**Result**

In this project, we need to use a IR remote control which has 17 functional keys and its launching distance is 8 meters at most, proper to control various devices indoors. This project is actually to decode remote control signal. After connection and uploading codes, aim at IR receiving module and press the key, finally you can see corresponding codes. If you press the key too long, it will show messy codes easily as shown in below figure.

# keyestudio


COM11
Send
FF
FF
FFFFFFFF
3D9AE3F7
FFFFFFFF
3D9AE3F7
FFFFFFFF
6182021B
FFFFFFFF
6182021B
FFFFFFFF
FF10EF
FFFFFFFF
8C22657B
FFFFFFFF
FF38C7
FFFFFFFF
FF38C7
449E79F
FFFFFFFF
FF5AA5
FFFFFFFF
FFFFFFFF
Autoscroll
No line ending
9600 baud


FF629D
FF22DD
OK
FFC23D
FF02FD
FFA857
FF6897
1
2
3
FFB04F
FF9867
FF30CF
4
5
6
FF7A85
FF18E7
FF10EF
7
8
9
FF5AA5
FF38C7
FF42BD
*
0
#
FF52AD
FF4AB5
keyestudio

**Project 4: Servo Motor**

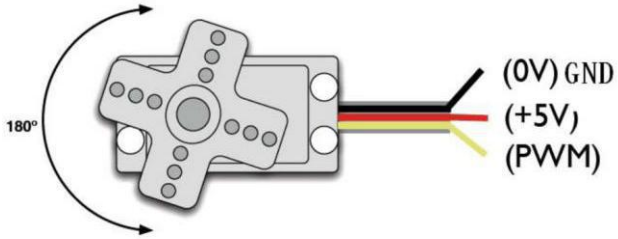
**Introduction**

Servomotor is a position control rotary actuator. It mainly consists of housing, circuit board, core-less motor, gear and position sensor.

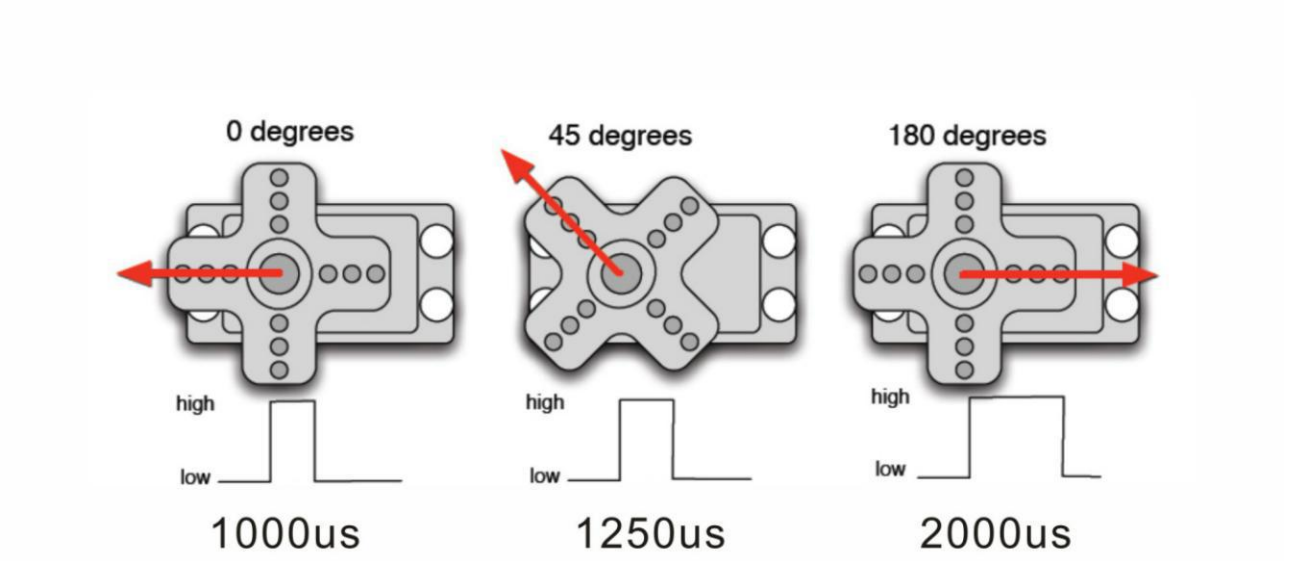
The receiver or MCU outputs a signal to the servomotor. The motor has a built-in reference circuit that gives out reference signal, cycle of 20ms and width of 1.5ms. The motor compares the acquired DC bias voltage to the voltage of the potentiometer and outputs a voltage difference. The IC on the circuit board will decide the rotate direction accordingly and drive the core-less motor. The gear then passes the force to the shaft. The sensor will determine if it has reached the commanded position according to the feedback signal.

Servomotors are used in control systems that require to have and maintain different angles. When the motor speed is definite, the gear will drive the potentiometer to rotate. When the voltage difference reduces to zero, the motor stops. Normally, the rotation angle range is among 0-180 degrees.

Servomotor comes with many specifications. But all of them have three connection wires, distinguished by brown, red, orange color(different brand may have different color). Brown one is for GND, red one for power positive, orange one for signal Line.




The rotate angle of the servo motor is controlled by regulating the duty cycle of the PWM(Pulse-Width Modulation) signal. The standard cycle of the PWM signal is 20ms（50Hz）. Theoretically, the width is distributed between 1ms-2ms, but in fact, it's between 0.5ms-2.5ms. The width corresponds the rotate angle from 0° to 180°. But note that for different brand motor, the same signal may have different rotating angle.

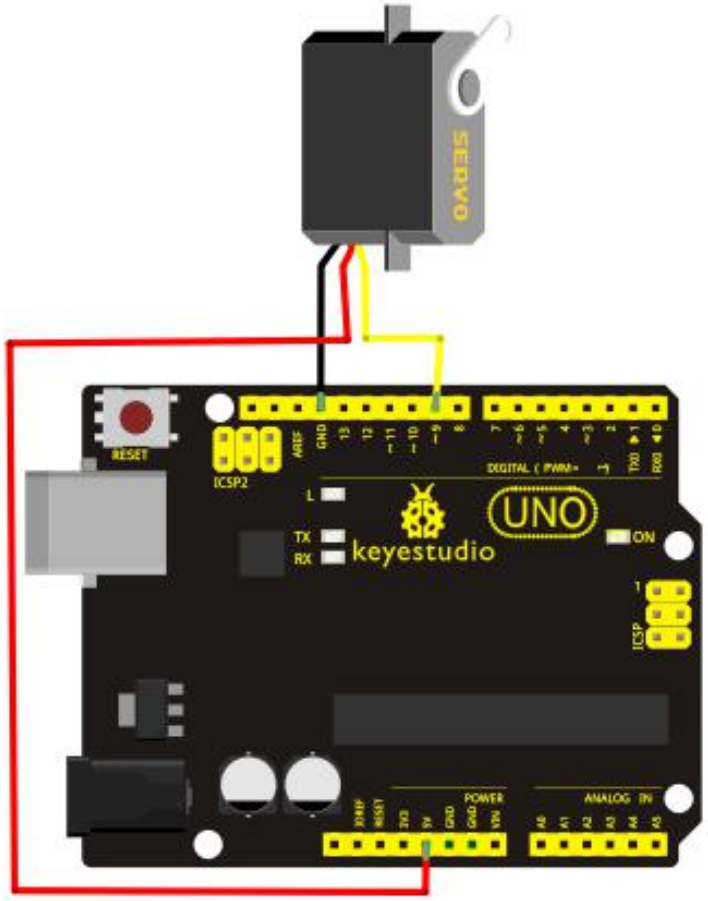



Mastering some basic knowledge, let's learn how to control a servomotor. In this experiment, you only need a servomotor and several jumper wires.

**Connection & Sample Program**

There are two ways to control a servomotor with Arduino. One is to use a common digital sensor port of Arduino to produce square wave with different duty cycle to simulate PWM signal and then use that signal to control the positioning of the motor. Another way is to directly use the Servo function of the Arduino to control the motor. In this way, the program will be more easier but it can only control two-contact motor for the servo function, only digital pin 9 and 10 can be used. The Arduino drive capacity is limited. So if you need to control more than one motor, you will need external power.

**Connection Diagram：**



**Sample Code：**

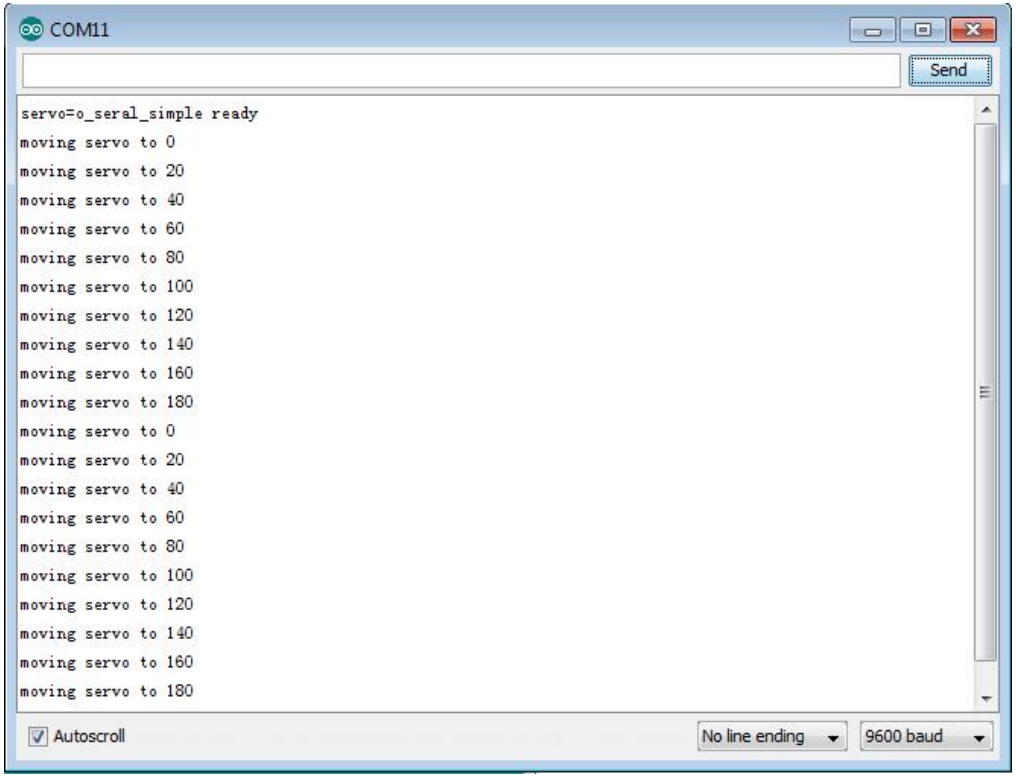
```
**********************************************************************************
int servopin=9;// select digital pin 9 for servomotor signal line
int myangle;// initialize angle variable
int pulsewidth;// initialize width variable
int val;
void servopulse(int servopin,int myangle)// define a servo pulse function
{
pulsewidth=(myangle*11)+500;// convert angle to 500-2480 pulse width
digitalWrite(servopin,HIGH);// set the level of servo pin as “high”
delayMicroseconds(pulsewidth);// delay microsecond of pulse width
digitalWrite(servopin,LOW);// set the level of servo pin as “low”
delay(20-pulsewidth/1000);
}
void setup()
{
pinMode(servopin,OUTPUT);// set servo pin as “output”
Serial.begin(9600);// connect to serial port, set baud rate at “9600”
Serial.println("servo=o_seral_simple ready" ) ;
}
void loop()// convert number 0 to 9 to corresponding 0-180 degree angle, LED blinks corresponding number of time
{
val=Serial.read();// read serial port value
if(val>='0'&&val<='9')
{
```

```
val=val-'0';// convert characteristic quantity to numerical variable
val=val*(180/9);// convert number to angle
Serial.print("moving servo to ");
Serial.print(val,DEC);
Serial.println();
for(int i=0;i<=50;i++) // giving the servo time to rotate to commanded position
{
servopulse(servopin,val);// use the pulse function
}
}
}
```

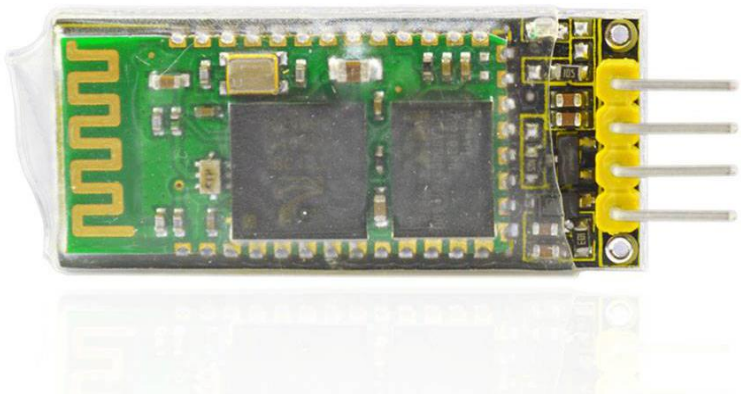
**********

**Result**

When you input a number on serial monitor, the motor rotates to an angle which is equal to the number input, and the angle value will be displayed on screen, as shown in below figure.


COM11
Send
servo=o_seral_simple ready
moving servo to 0
moving servo to 20
moving servo to 40
moving servo to 60
moving servo to 80
moving servo to 100
moving servo to 120
moving servo to 140
moving servo to 160
moving servo to 180
moving servo to 0
moving servo to 20
moving servo to 40
moving servo to 60
moving servo to 80
moving servo to 100
moving servo to 120
moving servo to 140
moving servo to 160
moving servo to 180
Autoscroll
No line ending
9600 baud

## Project 5: Bluetooth Module



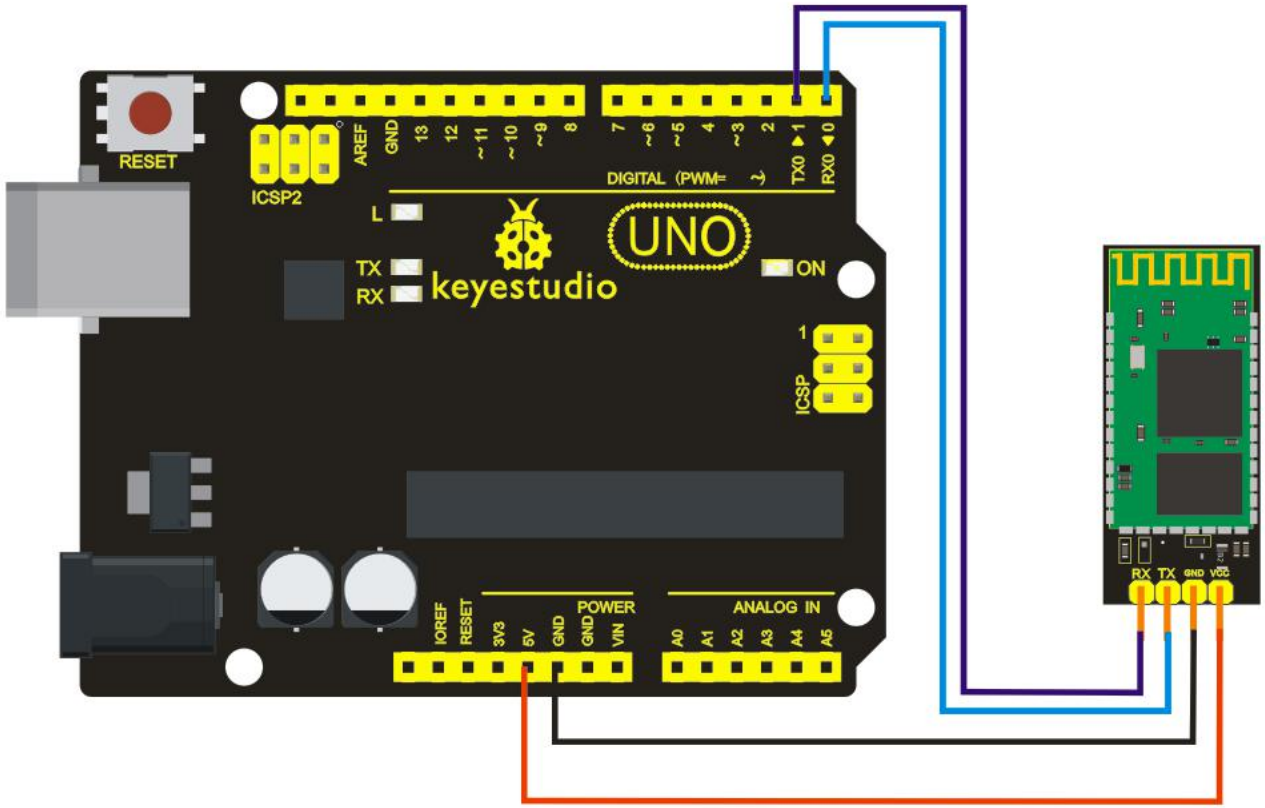
**Introduction:**

This Bluetooth module can easily achieve serial wireless data transmission. Its operating frequency is among the most popular 2.4GHz ISM frequency band (i.e. Industrial, scientific and medical). It adopts Bluetooth 2.1+EDR standard. In Bluetooth 2.1, signal transmit time of different devices stands at a 0.5 seconds interval so that the workload of bluetooth chip can be reduced substantially and more sleeping time can be saved for bluetooth. This module is set with serial interface, which is easy-to-use and simplifying overall design/development cycle.

**Specification：**

Bluetooth Protocol: Bluetooth 2.1+ EDR Standard
USB Protocol: USB v1.1/2.0
Operating Frequency: 2.4GHz ISM Frequency Band
Modulation Mode: Gauss Frequency Shift Keying
Transmit Power: ≤ 4dBm, Second Stage
Sensitivity: ≤-84dBm at 0.1% Bit Error Rate
Transmission Speed: 2.1Mbps(Max)/160 kbps(Asynchronous)； 1Mbps/1Mbps(Synchronous)
Safety Feature: Authentication and Encryption
Supported Configuration: Bluetooth Serial Port (major and minor)
Supply Voltage: 5 V DC 50mA
Operating Temperature: -20 to 55℃

**Connection Diagram:**



**Sample Code：**

```
**********************************************************************************
int val;
int ledpin=13;
void setup()
{
Serial.begin(9600);
  pinMode(ledpin,OUTPUT);
}
  void loop()
{ val=Serial.read();
if(val=='a')
  {
digitalWrite(ledpin,HIGH);
delay(250);
digitalWrite(ledpin,LOW);
delay(250);
  Serial.println("keyestudio");
}
}
**********************************************************************************
```

**Result**

After power-on, power indicator D1 is on, and LED on Bluetooth module is blinking; open Bluetooth on mobile phone, pair them, input 1234, and finish pairing as shown in **Figure 1** ; open APP — Bluetooth serial communication assistant, connect it to Bluetooth, select normal mode, complete connection, and LED on Bluetooth module is on as shown in **Figure 2**; input an "a" in the assistant, and display "keyestudio" as shown in **Figure 3**.

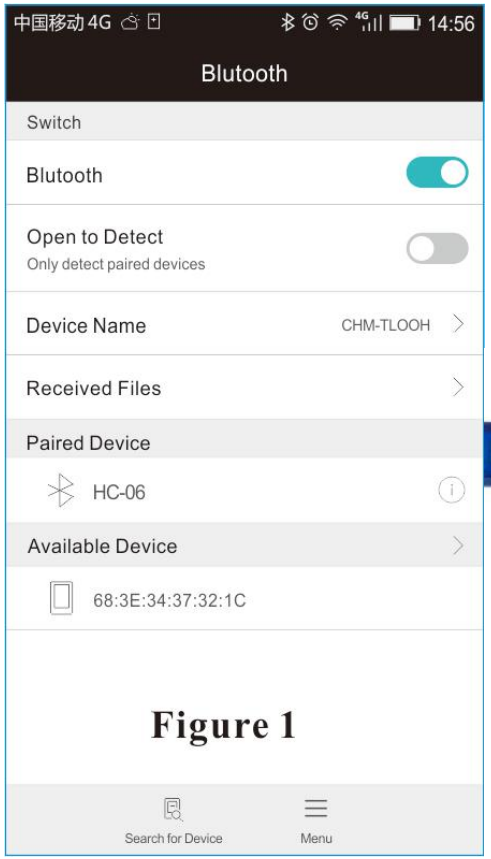



**Figure 1**

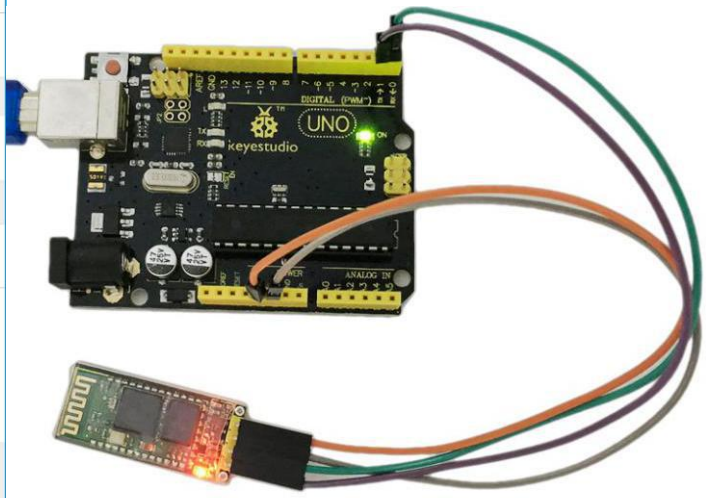



**Figure 2**


**Figure 3**

## Project 6: L298N Motor Driver


**Introduction:**

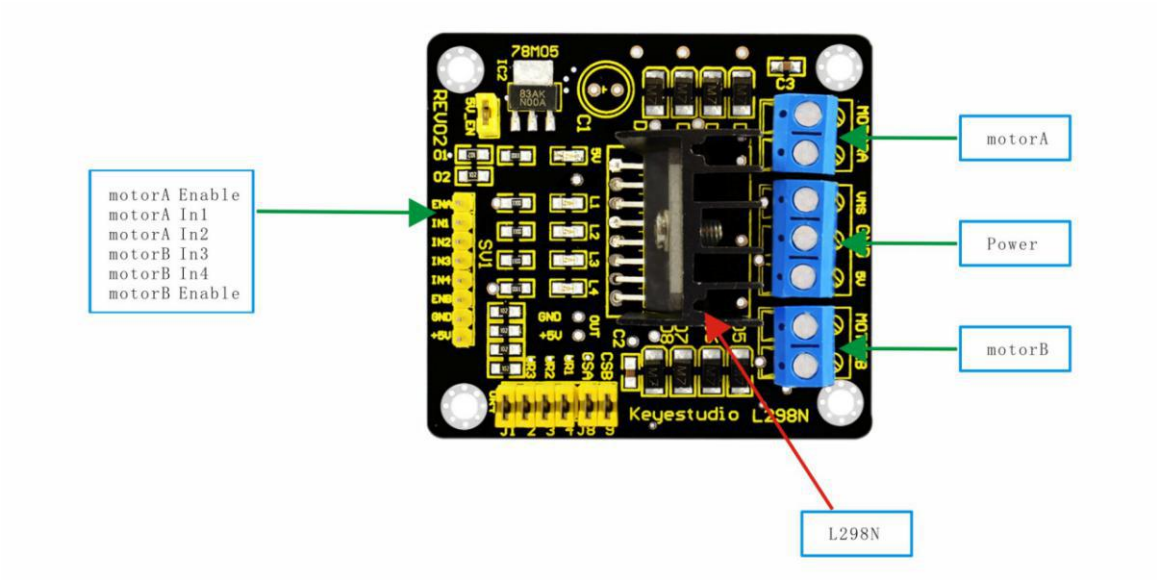
Using L298N made by ST Company as the control chip, the module has characteristics of strong driving ability, low calorific value and strong anti-interference ability.

This module can use built-in 78M05 for electric work via a driving power supply part. But to avoid the damage of the voltage stabilizing chip, please use an external 5V logic supply when using more than 12V driving voltage.

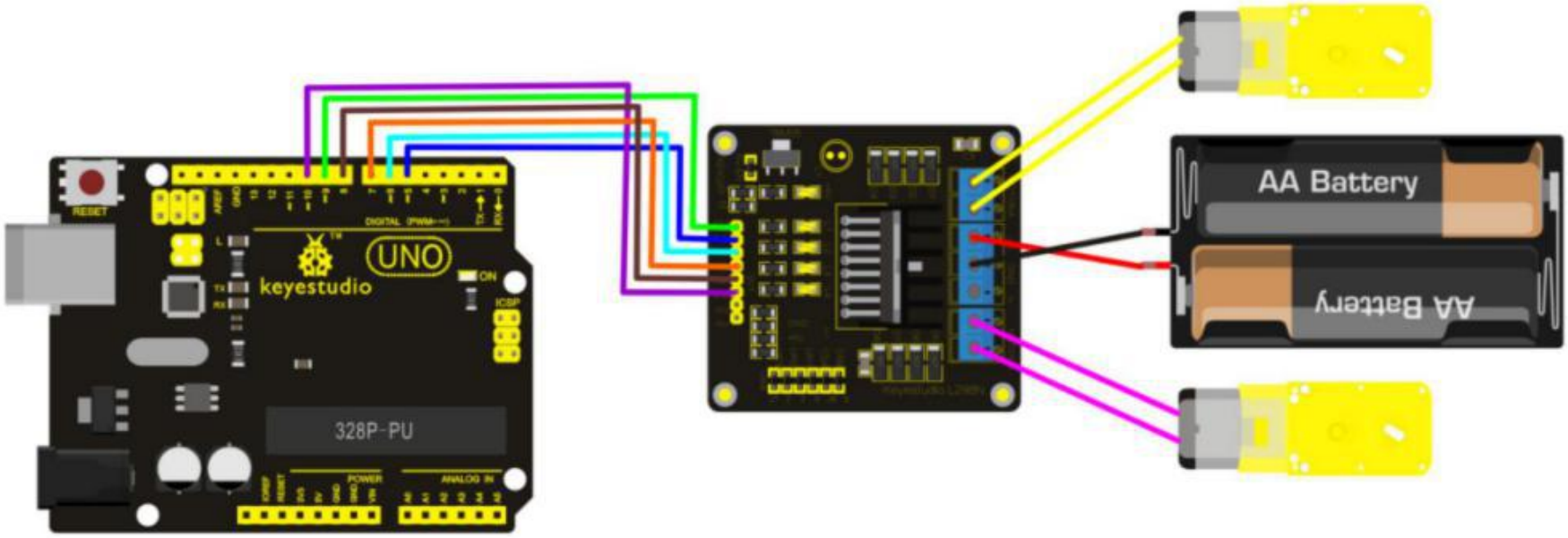
Using large capacity filter capacitor, this module can follow current to protect diodes and improve reliability.

**Specification:**

Working Mode: H bridge (double lines)
Control Chip: L298N (ST)
Logical Voltage: 5V
Driving Voltage: 5V-35V
Logical Current: 0mA-36mA
Driving Current: 2A (MAX single bridge)
Storage Temperature: -20 °C to +135 °C
Maximum Power: 25W
Weight: 30g
Periphery Dimension: 43 x 43 x 27 mm(L x W x H)




**Circuit Connection:**




**Sample Code:**

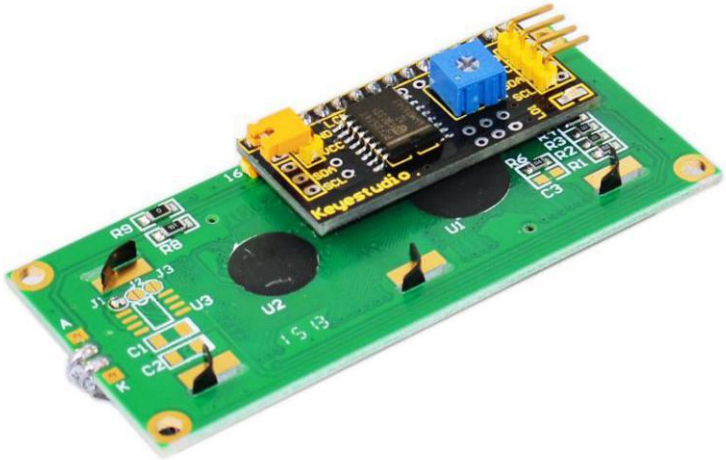
```
*********************************************************************************
int IN1=5;
int IN2=6;
int IN3=7;
int IN4=8;
int ENA=9;
int ENB=10;
void setup()
{
for (int i = 5; i <11; i ++)
  {
    pinMode(i, OUTPUT);
  }
}
void loop()
{
  // rotate CW
 digitalWrite(IN1,LOW);
 digitalWrite(IN2,HIGH);
analogWrite(ENA,200);
 digitalWrite(IN3,LOW);
 digitalWrite(IN4,HIGH);
analogWrite(ENB,200);
 delay(1000);
 // pause for 1S
 analogWrite(ENA,0);
```

```
analogWrite(ENB,0);
 delay(1000);
 // rotate CCW
 digitalWrite(IN1,HIGH);
 digitalWrite(IN2,LOW);
 analogWrite(ENA,100);
 digitalWrite(IN3,HIGH);
 digitalWrite(IN4,LOW);
analogWrite(ENB,100);
 delay(1000);
 // pause for 1S
 analogWrite(ENA,0);
analogWrite(ENB,0);
 delay(1000);
}
**************************************************************************
```

**Result**

After connection and power-on, two motors rotate clockwise for 1 second at a speed of 200 (PWM value is 200) and then stop for 1 second; two motors rotate anticlockwise for 1 second at a speed of 100 (PWM value is 100) and then stop for 1 second.

## Project 7: keyestudio 1602 I2C Module




**Introduction:**

This is a great LCD display compatible with arduino. With limited pin resources, your project will quickly run out of resources using normal LCDs. With this I2C interface LCD module, you only need 2 lines (I2C)to display the information. If you already have I2C devices in your project, this LCD module actually cost no more resources at all. The address can be set 0x27.

**Specification：**

I2C Address: 0x27

Back Lit (Blue with white char color)

Supply Voltage: 5V

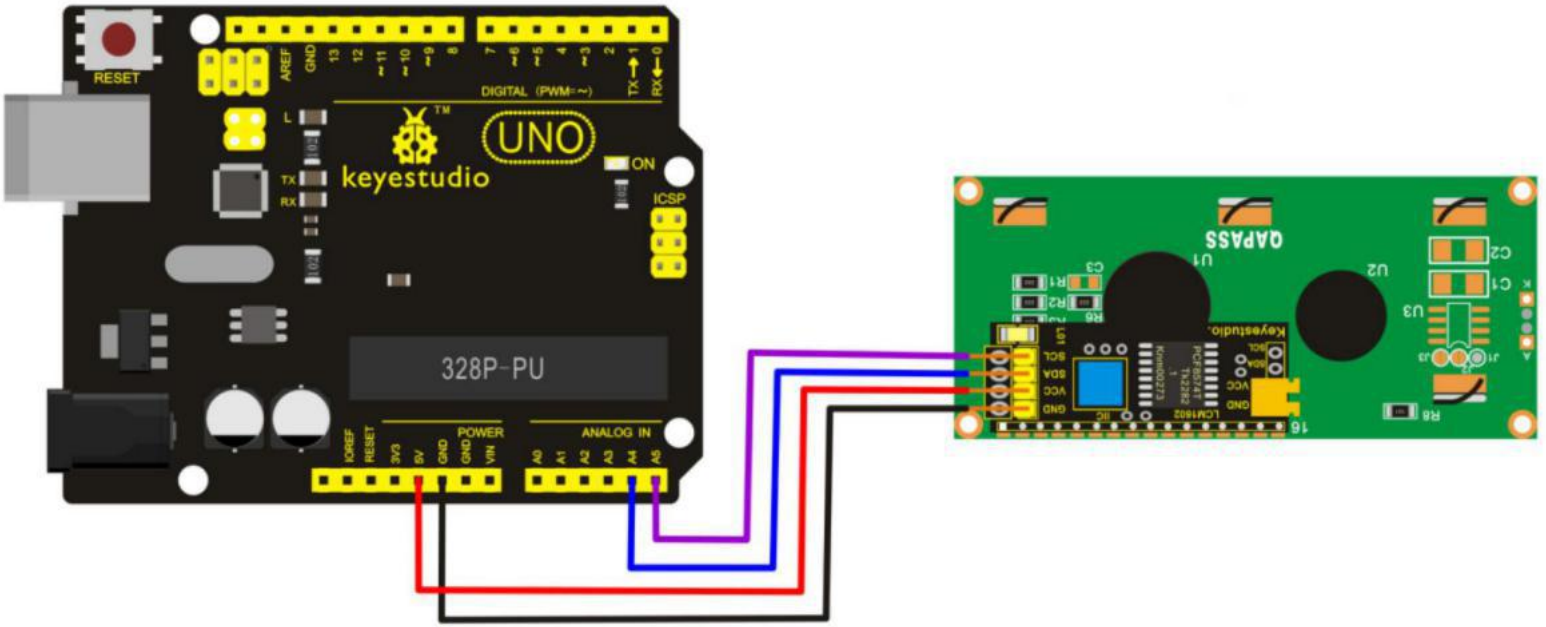
Interface: I2C/TWI x1, Gadgeteer interface x2

Adjustable Contrast

Size: 82x35x18 mm

**Connection Diagram：**

I602 is equipped with 4 pins in total. SCL should be connected to analog 5, SDA to analog 4, VCC to +5V and GND to ground.



**Sample Code：**

**Get libraries of Wire and LiquidCrystal_I2C from :**

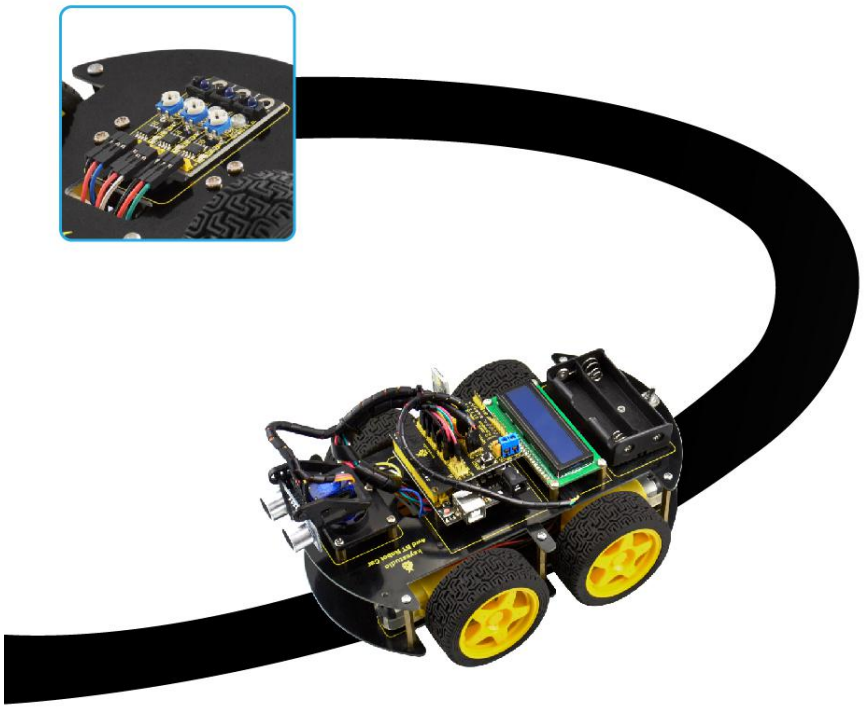
http://7326097.s21d-7.faiusrd.com/0/ABUIABAAGAAg7uTNvgUojdGEywY?f=LiquidCrystal_I2C++Wire.zip&v=1473475182

```
**********************************************************************************
//Compatible with the Arduino IDE 1.0
//Library version:1.1
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,16,2); // set the LCD address to 0x27 for a 16 chars and 2 line display
void setup()
{
lcd.init(); // initialize the lcd
lcd.init();
// Print a message to the LCD.
lcd.backlight();
lcd.setCursor(3,0);
lcd.print("Hello, world!");
lcd.setCursor(2,1);
lcd.print("keyestudio!");
}
void loop()
{}
**********************************************************************************
```

**Result**

After connection and uploading codes, keyestudio 1602 I2C module will display as the figure shown below.

## Project 8: Line Tracking of Smart Car



**Introduction:**

This project introduces a simple and automatic line tracking system of a car based on Arduino microcontroller.This car, regarding UNO as main control, detects black line by IR photoelectric sensor and sends the feedback to Arduino. Arduino will analyze the feedback signal and then control the driver motor to adjust the

car diversion. Finally the car is able to go around the black line automatically. In addition, you can observe the state of the car through keyestudio 1602 I2C module.

**Principle:**

1.Black absorbs most light. When the panel isn't black, most IR emitted by the sensor is reflected back. So the sensor output low level at 0.

2.When there is a sensor above black line, since the reflectivity of black is small, little IR is reflected back under demand that the sensor works. Therefore, the sensor output 1.

3.We just need to know the output of the sensor is 1 or 0 with Arduino to detect black line.

4. Arduino controls the motion of the car according to received signal. The system scheme is showed by following picture 1-1.

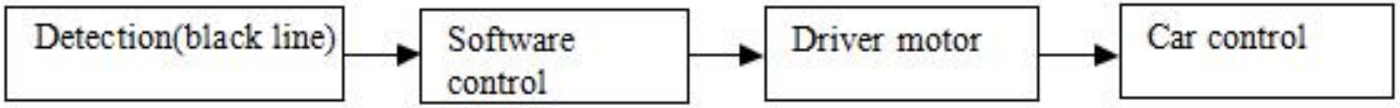



Figure 1-1

5.The system is composed of main control circuit, power supply, IR detecting module, motor and driver module. The structure chart of the system is showed by picture 2-1.

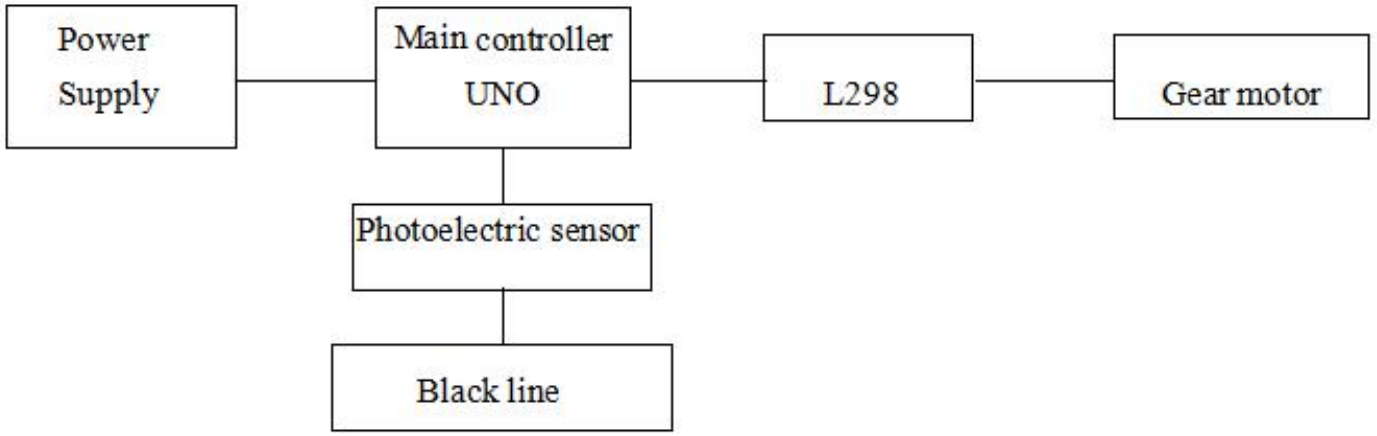
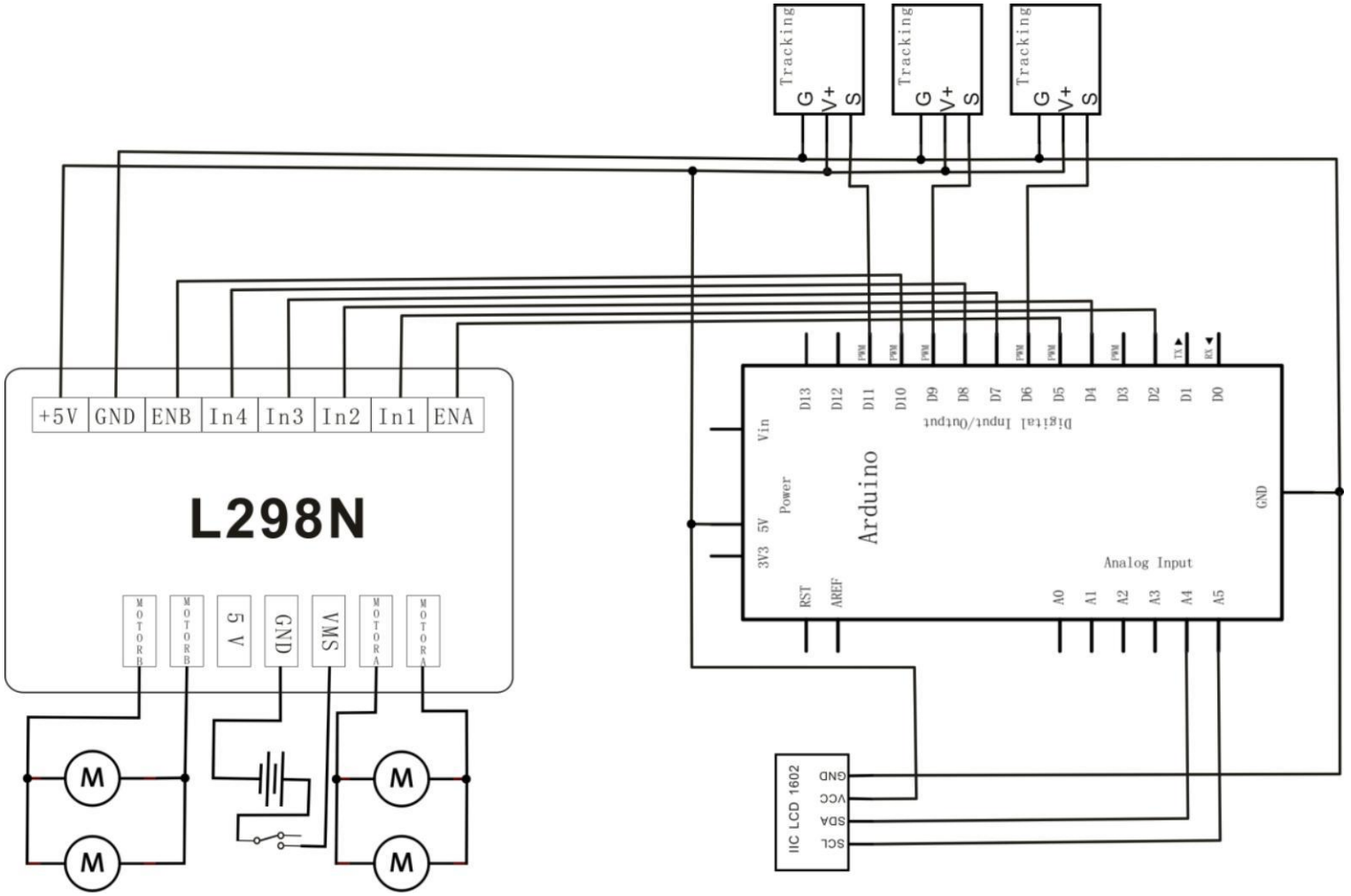
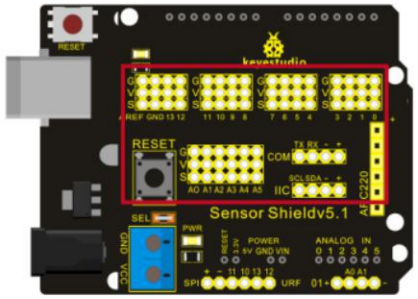

Power Supply
Main controller UNO
L298
Gear motor
Photoelectric sensor
Black line

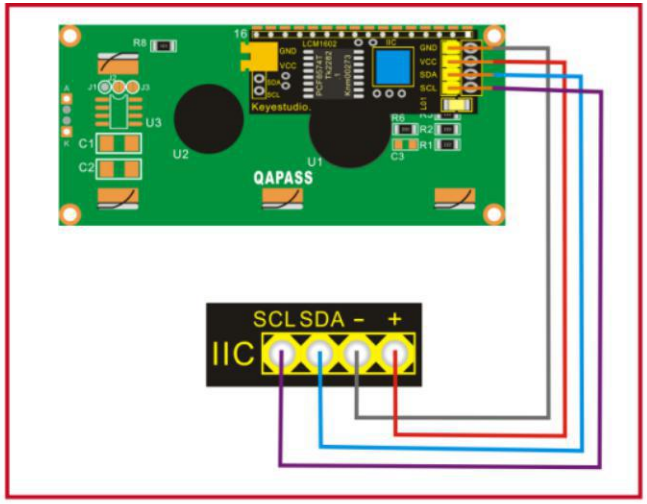
Figure2-1

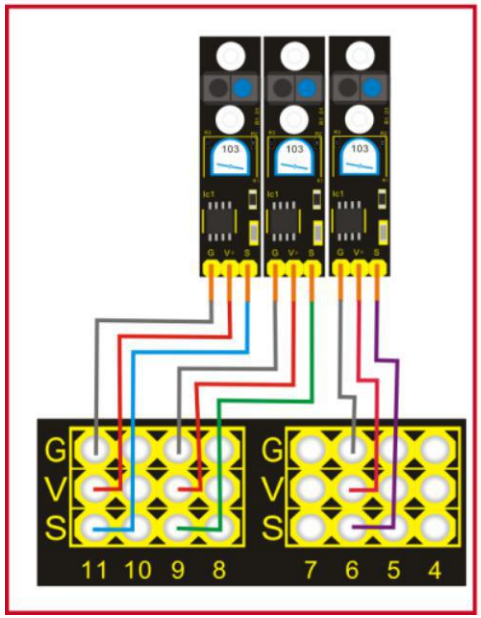
**Schematic Diagram:**

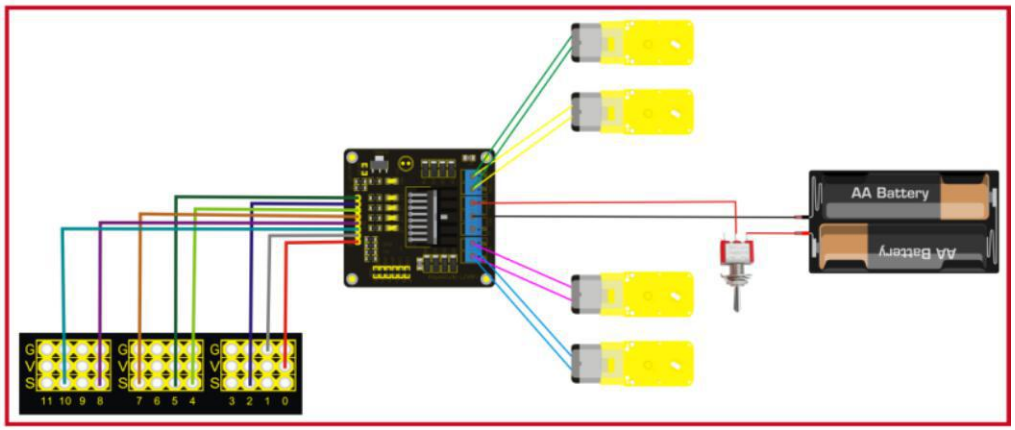


**Connection Diagram:**



**Sample Code:**

```
**********************************************************************************
#include <LiquidCrystal_I2C.h>
#include <Wire.h>
#define SensorLeft       6     //input pin of left sensor
#define SensorMiddle    9      //input pin of middle sensor
#define SensorRight     11     //input pin of right sensor
unsigned char SL;              //state of left sensor
unsigned char SM;              //state of middle sensor
unsigned char SR;              //state of right sensor
#define Lpwm_pin    5          //pin of controlling speed---- ENA of motor driver board
#define Rpwm_pin    10         //pin of controlling speed---- ENA of motor driver board
int pinLB=2;                   //pin of controlling diversion----IN1 of motor driver board
int pinLF=4;                   //pin of controlling diversion----IN2 of motor driver board
int pinRB=7;                   //pin of controlling diversion----IN3 of motor driver board
int pinRF=8;                   //pin of controlling diversion----IN4 of motor driver board
unsigned char Lpwm_val =180;//the speed of left wheel at 180 in initialization
unsigned char Rpwm_val = 180;//the speed of right wheel at 180 in initialization
int Car_state=0;                    //state of car moving
LiquidCrystal_I2C lcd(0x27,16,2);    // set the LCD address to 0x27 for a 16 chars and 2
void LCD1602_init(void)
{
   lcd.init();
   lcd.backlight();
   lcd.clear();
```

```
}
void Sensor_IO_Config()
{
  pinMode(SensorLeft,INPUT);
  pinMode(SensorMiddle,INPUT);
  pinMode(SensorRight,INPUT);
}
void Sensor_Scan(void)
{
  SL = digitalRead(SensorLeft);
  SM = digitalRead(SensorMiddle);
  SR = digitalRead(SensorRight);
}
void M_Control_IO_config(void)//initialized function of IO of motor driver
{
  pinMode(pinLB,OUTPUT); // pin 2--IN1 of motor driver board
  pinMode(pinLF,OUTPUT); // pin 4--IN2 of motor driver board
  pinMode(pinRB,OUTPUT); // pin 7--IN3 of motor driver board
  pinMode(pinRF,OUTPUT); // pin 8--IN4 of motor driver board
  pinMode(Lpwm_pin,OUTPUT); // pin 5    (PWM) --ENA of motor driver board
  pinMode(Rpwm_pin,OUTPUT); // pin 10 (PWM) --ENB of motor driver board
}
void Set_Speed(unsigned char Left,unsigned char Right)//setting function of speed
{
  analogWrite(Lpwm_pin,Left);
  analogWrite(Rpwm_pin,Right);
```

```
}
void advance()      // going forwards
    {
     digitalWrite(pinRB,LOW);    // making motor move towards right rear
     digitalWrite(pinRF,HIGH);
     digitalWrite(pinLB,LOW);    //    making motor move towards left rear
     digitalWrite(pinLF,HIGH);
     Car_state = 1;
     show_state();
    }
void turnR()          //turning on the right(dual wheels)
    {
     digitalWrite(pinRB,LOW);    //making motor move towards right rear
     digitalWrite(pinRF,HIGH);
     digitalWrite(pinLB,HIGH);
     digitalWrite(pinLF,LOW);    //making motor move towards left front
     Car_state = 4;
     show_state();
    }
void turnL()          //turning on the left(dual wheels)
    {
     digitalWrite(pinRB,HIGH);
     digitalWrite(pinRF,LOW );      //making motor move towards right front
     digitalWrite(pinLB,LOW);      //making motor move towards left rear
     digitalWrite(pinLF,HIGH);
     Car_state = 3;
```

```
        show_state();
      }
void stopp()                //stop
      {
        digitalWrite(pinRB,HIGH);
        digitalWrite(pinRF,HIGH);
        digitalWrite(pinLB,HIGH);
        digitalWrite(pinLF,HIGH);
        Car_state = 5;
        show_state();
      }
void back()                 //back
      {
        digitalWrite(pinRB,HIGH);   //making motor move towards right rear
        digitalWrite(pinRF,LOW);
        digitalWrite(pinLB,HIGH);   //making motor move towards left rear
        digitalWrite(pinLF,LOW);
        Car_state = 2;
        show_state() ;
      }
void show_state(void)   //showing current state of the car
{
   lcd.setCursor(0, 1); //showing from second row
     switch(Car_state)
     {
        case 1:lcd.print(" Go    ");Serial.print("\n GO");
```

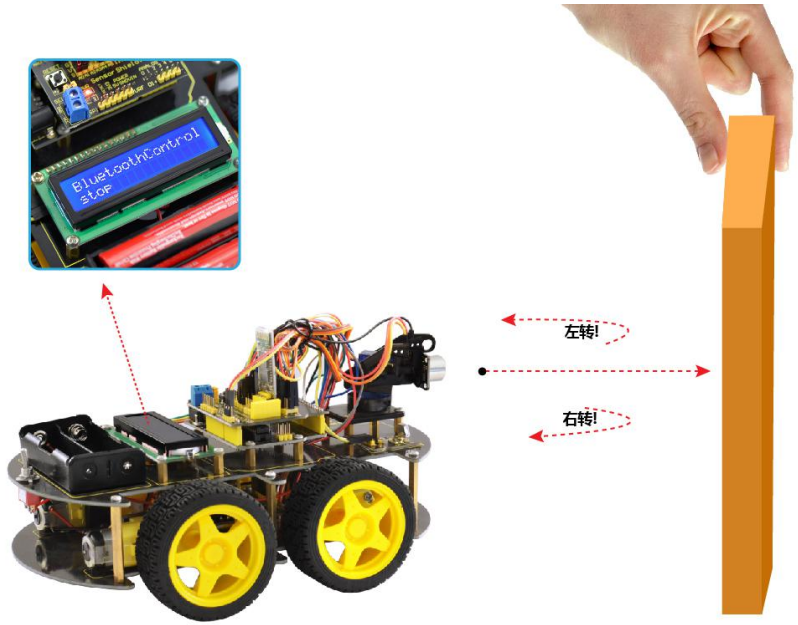
```
        break;
        case 2:lcd.print("Back ");Serial.print("\n Back");
        break;
        case 3:lcd.print("Left ");Serial.print("\n Left");
        break;
        case 4:lcd.print("Right");Serial.print("\n Right");
        break;
        case 5:lcd.print("Stop ");Serial.print("\n Stop");
        break;
        default:
        break;
    }
}
void setup()
{
    LCD1602_init();
    Sensor_IO_Config();
    M_Control_IO_config();              //motor controlling the initialization of IO
    Set_Speed(Lpwm_val,Rpwm_val); //setting initialization of speed
    lcd.clear();
    lcd.setCursor(0, 0);    //cursor set in first row and first column，
    lcd.print("    Wait    Signal    ");
    stopp();
}
unsigned char old_SL,old_SM,old_SR;
void loop()
```

```
{
   Sensor_Scan();
  if (SM == HIGH)// middle sensor in black area
{
if (SL == LOW & SR == HIGH) // black on left, white on right, turn left
{
turnR();
}
else if (SR == LOW & SL == HIGH) // white on left, black on right, turn right
{
turnL();
}
else // white on both sides, going forward
{
advance();
}
}
else // middle sensor on white area
{
if (SL== LOW & SR == HIGH)// black on left, white on right, turn left
{
turnR();
}
else if (SR == LOW & SL == HIGH) // white on left, black on right, turn right
{
turnL();
```

```
}
else // all white, stop
{
back();
delay(100);
stopp() ;
}
}
}
```

**********

## Project 9: Ultrasonic Obstacle Avoidance of Smart Car




**Introduction:**

This project, regarding Arduino UNO as main control, is to detect front obstacle by ultrasonic sensor and platform motor, and then send the feedback to Arduino. Arduino will analyze the feedback signal and then control the driver motor to adjust the car diversion. Finally, the car is able to avoid obstacle automatically and to keep going.

**Principle:**

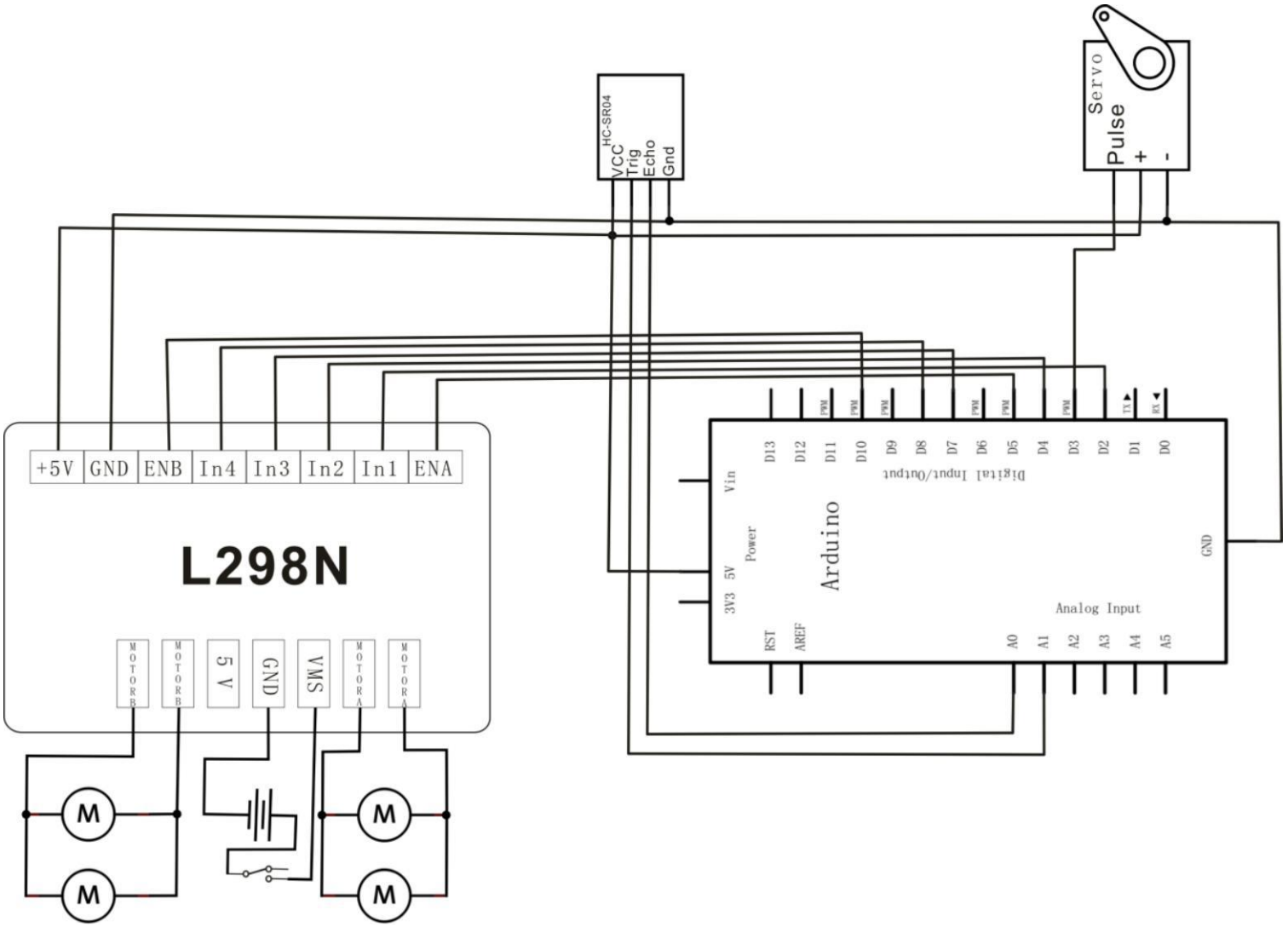
1.Ultrasonic detecting distance: one port emits high level more than 10 US. Once outputting level, open potentiometer to time. When the port becomes low level, read out current value. Use the time of detecting distance to calculate distance.

2.Use ultrasonic sensor to detect the distance between obstacle and car, so that control the motion of the car according to the data.

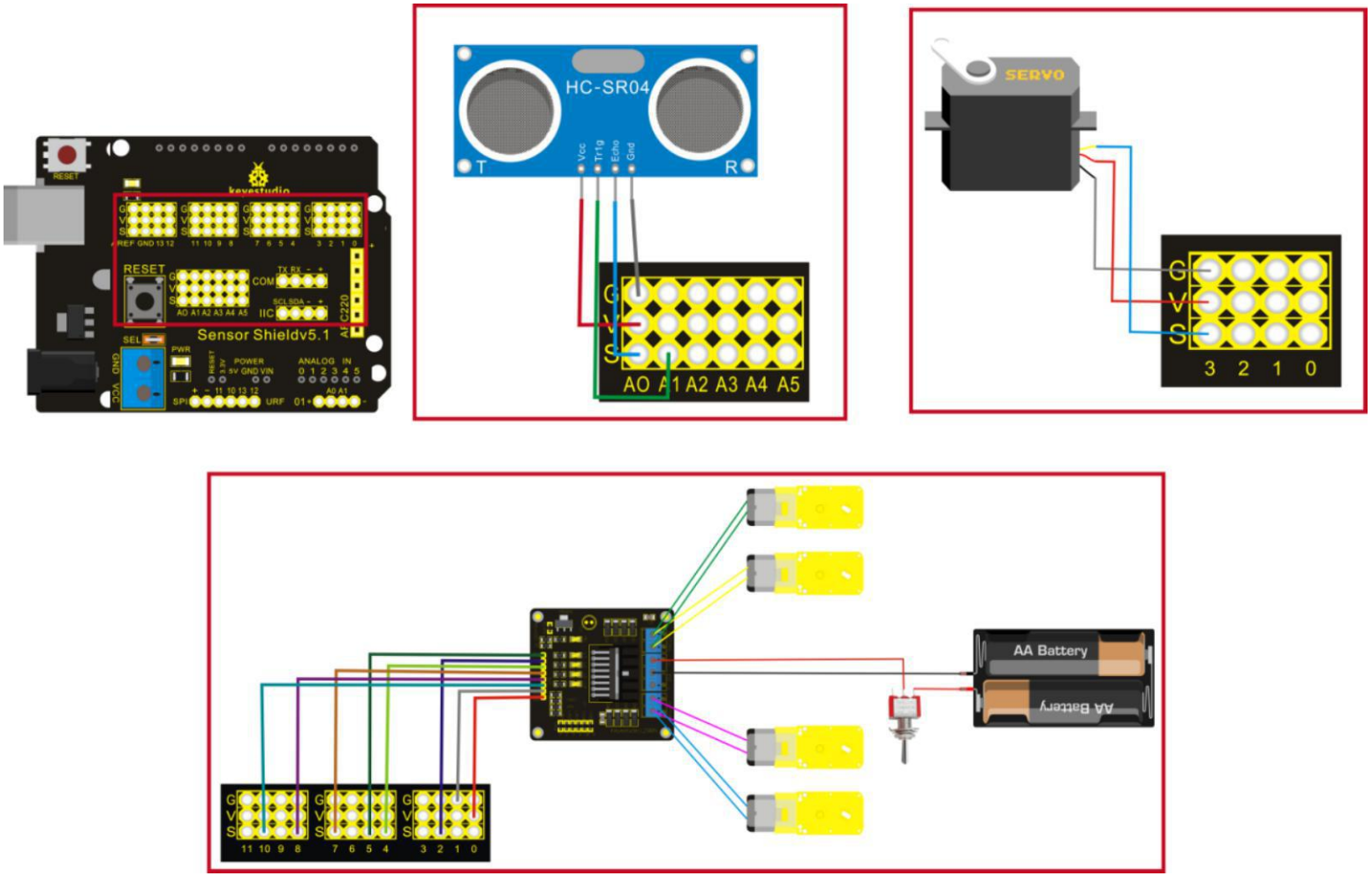
3. If the distance between the car and obstacle is less than 20 cm, the car goes backward; if the distance is no less than 40 cm, the car goes forwards; if the distance is less than 40cm, the motor turns to detect the distance between car and left obstacle or right obstacle; if the distance between car and left obstacle, the distance between car and right obstacle are less than 15 cm, the car goes backward; if the distance between car and left obstacle is larger , the car turns left; if the distance between car and left obstacle is less than or equal to the distance between car and right obstacle, the car turns right.

**Schematic Diagram:**

# keyestudio


HC-SR04
VCC
Trig
Echo
Gnd
Servo
Pulse
+
-
+5V
GND
ENB
In4
In3
In2
In1
ENA
L298N
MOTOR B
MOTOR B
5 V
GND
VMS
MOTOR A
MOTOR A
M
M
M
M
Arduino
Digital Input/Output
Analog Input
Vin
Power
5V
3V3
RST
AREF
GND
D13
D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1
D0
A0
A1
A2
A3
A4
A5
PWM
TX
RX

**Connection Diagram:**



**Sample Code:**

```
**********************************************************************************
#include <Servo.h>
int pinLB = 2;          // defining pin 12
int pinLF = 4;          // defining pin 3
int pinRB = 7;        // defining pin 13
int pinRF = 8;        // defining pin 11
int Lpwm_pin = 5;    //adjusting speed
int Rpwm_pin = 10;      //adjusting speed //
unsigned char Lpwm_val = 200;
unsigned char Rpwm_val = 200;
////////////////////////////////
int inputPin = A0;        // defining receiving pin of ultrasonic signal
int outputPin =A1;        // defining emitting pin of ultrasonic signal

int Fspeedd = 0;           // forward speed
int Rspeedd = 0;           // right speed
int Lspeedd = 0;           // left speed
int directionn = 0;      // front=8 back=2 left=4 right=6
Servo myservo;               // setting my servo
int delay_time = 250; // time for servo motor turning backward

int Fgo = 8;               // going forward
int Rgo = 6;               // turning right
int Lgo = 4;               // turning left
int Bgo = 2;               // turning backward
```

```
void setup()
  {
    Serial.begin(9600);          // defining output pin of motor
    pinMode(pinLB,OUTPUT); // pin 12
    pinMode(pinLF,OUTPUT); // pin 3 (PWM)
    pinMode(pinRB,OUTPUT); // pin 13
    pinMode(pinRF,OUTPUT); // pin 11 (PWM)
    pinMode(inputPin, INPUT);        // defining input pin of ultrasonic
    pinMode(outputPin, OUTPUT);    // defining output pin of ultrasonic
    myservo.attach(3);        // defining output pin9 of motor
  }
void advance()          // going forward
       {
       digitalWrite(pinLB,LOW);        // right wheel going forward
       digitalWrite(pinRB, LOW);    // left wheel going forward
       digitalWrite(pinLF,HIGH);
       digitalWrite(pinRF,HIGH);
       }
void stopp()                 //stop
       {
         digitalWrite(pinRB,HIGH);
         digitalWrite(pinRF,HIGH);
         digitalWrite(pinLB,HIGH);
         digitalWrite(pinLF,HIGH);
       }
```

```
void right()              //turning right(single wheel)
      {

       digitalWrite(pinRB,LOW);    //making motor move towards right rear
       digitalWrite(pinRF,HIGH);
       digitalWrite(pinLB,HIGH);
       digitalWrite(pinLF,LOW);    //making motor move towards left front
      }
void left()               //turning left(single wheel)
      {
       digitalWrite(pinRB,HIGH);
       digitalWrite(pinRF,LOW );      //making motor move towards right front
       digitalWrite(pinLB,LOW);      //making motor move towards left rear
       digitalWrite(pinLF,HIGH);
      }

void back()               //going backward
      {
       digitalWrite(pinRB,HIGH);    //making motor move towards right rear
       digitalWrite(pinRF,LOW);
       digitalWrite(pinLB,HIGH);    //making motor move towards left rear
       digitalWrite(pinLF,LOW);
      }
void detection()          //measuring 3 angles(0.90.179)
      {
        int delay_time = 250;      // time for servo motor turning backward
```

```
 ask_pin_F();                  // reading out the front distance
if(Fspeedd < 20)              // assuming the front distance less than 10cm
 {
 stopp();                     // clear output material
 delay(100);
 back();                      // going backward for 0.2 second
 delay(200);
 }

 if(Fspeedd < 40)             // assuming the front distance less than 25cm
 {
    stopp();
    delay(100);                 // clear output material
    ask_pin_L();                // reading out the left distance
    delay(delay_time);          // waiting servo motor to be stable
    ask_pin_R();                // reading out the right distance
    delay(delay_time);          // waiting servo motor to be stable

    if(Lspeedd > Rspeedd)     //assuming left distance more than    right distance
    {
       directionn = Lgo;          //turning left
    }

    if(Lspeedd <= Rspeedd)     //assuming left distance less than or equal to right distance
    {
      directionn = Rgo;          //turning right
```

```
            }

            if (Lspeedd < 15 && Rspeedd < 15)      //assuming both left distance and right distance less than    10cm
            {
              directionn = Bgo;            //going backward
            }
          }
          else                                  //assuming the front distance more than 25 cm
          {
            directionn = Fgo;               //going forward
          }

      }
void ask_pin_F()      // measuring the front distance
      {
        myservo.write(90);
        digitalWrite(outputPin, LOW);      // ultrasonic launching low voltage at 2μs
        delayMicroseconds(2);
        digitalWrite(outputPin, HIGH);    // ultrasonic launching high voltage at 10μs，at least at10μs
        delayMicroseconds(10);
        digitalWrite(outputPin, LOW);        // keeping ultrasonic launching low voltage
        float Fdistance = pulseIn(inputPin, HIGH);    // time of error reading
        Fdistance= Fdistance/5.8/10;              // converting time into distance（unit：cm）
        Fspeedd = Fdistance;                        // reading-in Fspeedd(fore speed) with distance
      }
 void ask_pin_L()      // measuring left distance
```

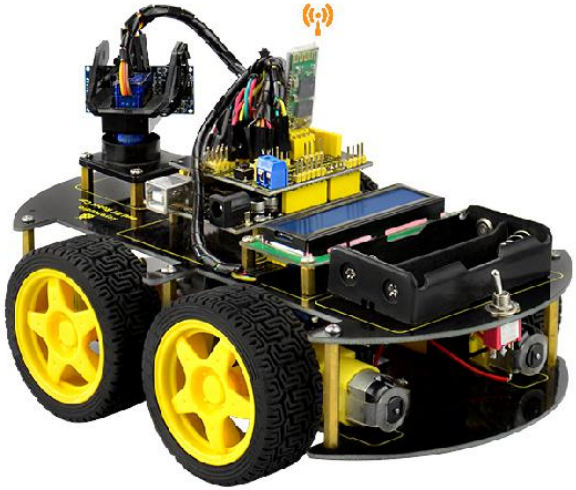
```
    {
      myservo.write(5);
      delay(delay_time);
      digitalWrite(outputPin, LOW);      // ultrasonic launching low voltage at 2μs
      delayMicroseconds(2);
      digitalWrite(outputPin, HIGH);    // ultrasonic launching high voltage at 10μs，at least at10μs
      delayMicroseconds(10);
      digitalWrite(outputPin, LOW);       // keeping ultrasonic launching low voltage
      float Ldistance = pulseIn(inputPin, HIGH);    // time of error reading
      Ldistance= Ldistance/5.8/10;             // converting time into distance（unit：cm）
      Lspeedd = Ldistance;                        //reading-in Lspeedd(left speed) with distance
    }
void ask_pin_R()      // measuring right distance
    {
      myservo.write(177);
      delay(delay_time);
      digitalWrite(outputPin, LOW);      // ultrasonic launching low voltage at 2μs
      delayMicroseconds(2);
      digitalWrite(outputPin, HIGH);    // ultrasonic launching high voltage at 10μs，at least at10μs
      delayMicroseconds(10);
      digitalWrite(outputPin, LOW);       // keeping ultrasonic launching low voltage
      float Rdistance = pulseIn(inputPin, HIGH);    // time of error reading
      Rdistance= Rdistance/5.8/10;             // converting time into distance（unit：cm）
      Rspeedd = Rdistance;                        // reading-in Rspeedd(right speed) with distance
    }
```

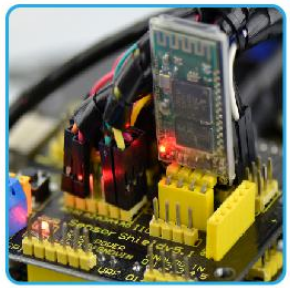
```
void loop()
  {
    myservo.write(90);    //making motor regression, being ready for next measurement
    detection();          //measuring angle and deciding which direction it moves towards
   if(directionn == 2)    //supposing direction = 2(back up)
   {
     back();
     delay(800);                    //    back up
     left() ;
     delay(200);                    //moving slightly towards left(avoiding locked)
   }
   if(directionn == 6)              //supposing direction = 6(turning right)
   {
     back();
     delay(100);
     right();
     delay(600);                    // turning right
   }
   if(directionn == 4)              //supposing direction = 4(turning left)
   {
     back();
     delay(600);
     left();
     delay(600);                    // turning left
   }
   if(directionn == 8)              //supposing direction =    = 8(going forwards)
```

```
    {
     advance();                    // going forwards normally
     delay(100);
    }
    }
**********************************************************************************
```

**Project 10: IR Remote Control of Smart Car**

# keyestudio





APP manipulation mode

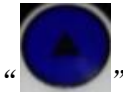
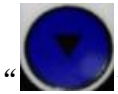
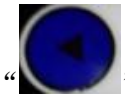
Connecting bluetooth on phone APP to control car's drive and direction.

**Introduction:**

This project, regarding Arduino microcontroller as main control, uses IR module to receive IR remote signal and sends the signal to Arduino. Arduino will analyze the signal and then control the driver motor and the motion of the car with IR remote control. In addition, you can observe the state of the car through keyestudio 1602 I2C Module.

**Principle:**

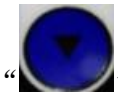
1. Connecting Arduino to IR receiving module, Bluetooth module and IR receiving module communicating with IR remote control.

2. IR remote control will send these button message “  ” “  ” “  ” “  ” “ 

” “ 

” to IR receiving module.

3. IR receiving module will send signal to Arduino , and it will control the motion of the car.

4. When Arduino receiving this message “  ” , the car goes forwards； when receiving this “  ” , the car goes backward；

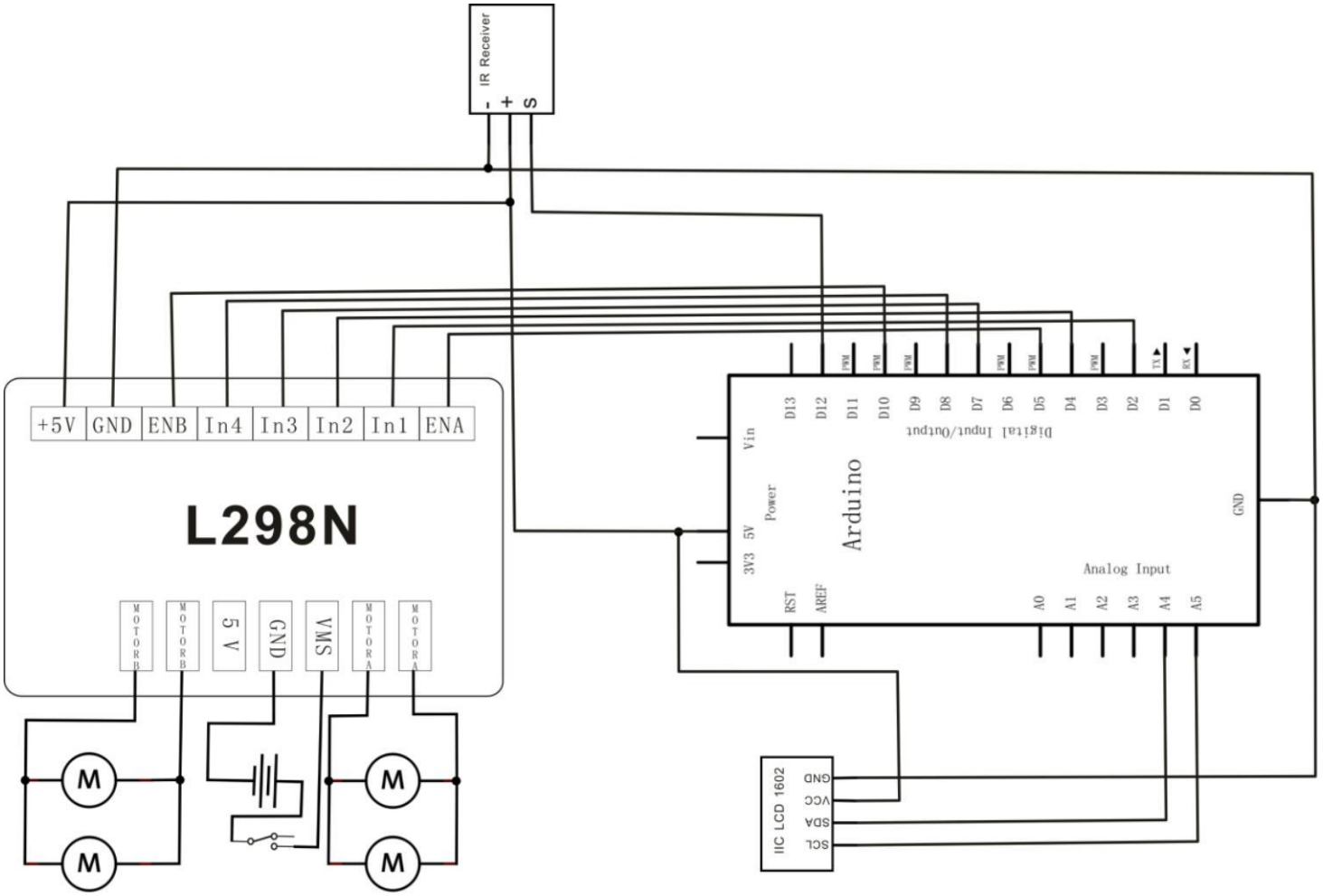
when receiving “  ” , the car turns left； when receiving “  ” , the car turns right； when receiving “ 

” , the car stops；

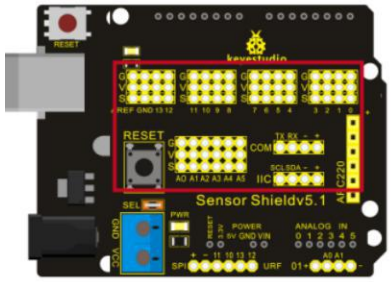
when receiving “ 

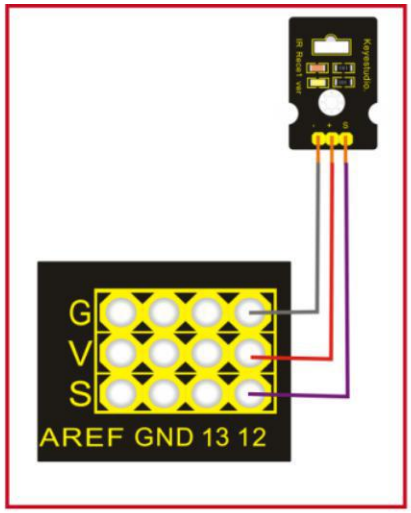
” , the car quits.

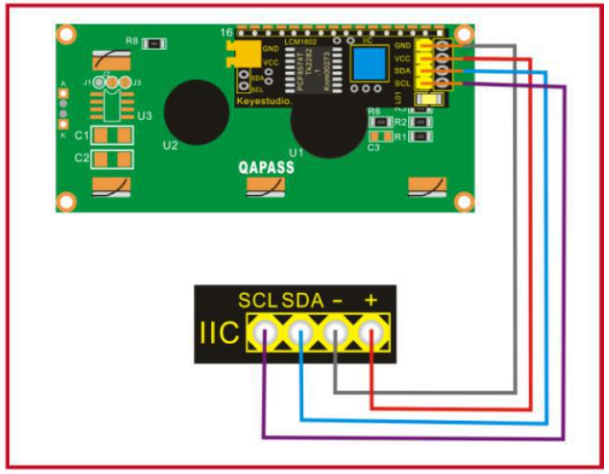
**Schematic Diagram:**

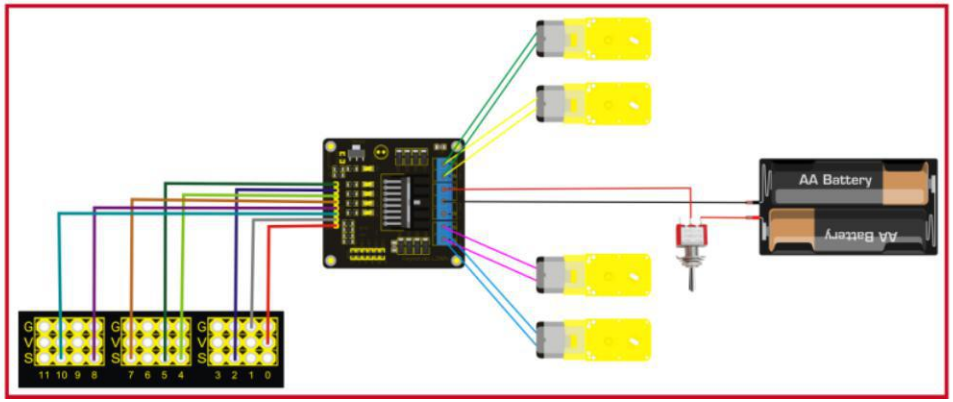



**Connection Diagram:**


RESET
Sensor Shieldv5.1


G
V
S
AREF GND 13 12


QAPASS
SCL SDA - +
IIC


AA Battery
11 10 9 8
7 6 5 4
3 2 1 0

**Sample Code:**

```
*****************************************************************************
#include <LiquidCrystal_I2C.h>      //including libraries of I2C-LCD1602 liquid crystal
#include <Wire.h>                        //including libraries of I2C
#include <IRremote.h>
int RECV_PIN = 12;
IRrecv irrecv(RECV_PIN);
decode_results results;
#define IR_Go          0x00ff629d
#define IR_Back       0x00ffa857
#define IR_Left       0x00ff22dd
#define IR_Right     0x00ffc23d
#define IR_Stop       0x00ff02fd
#define IR_ESC         0x00ff52ad
LiquidCrystal_I2C lcd(0x27,16,2);    //defining liquid crystal
#define Lpwm_pin    5          //adjusting speed
#define Rpwm_pin    10         //adjusting speed //
int pinLB=2;                    // defining pin2 left rear
int pinLF=4;                    // defining pin4 left front
int pinRB=7;                    // defining pin7 right rear
int pinRF=8;                    // defining pin8 right front
unsigned char Lpwm_val = 200;
unsigned char Rpwm_val = 200;
int Car_state=0;
void M_Control_IO_config(void)
{
  pinMode(pinLB,OUTPUT); // pin2
```

```
    pinMode(pinLF,OUTPUT); // pin4
    pinMode(pinRB,OUTPUT); // pin7
    pinMode(pinRF,OUTPUT); // pin8
    pinMode(Lpwm_pin,OUTPUT); // pin11 (PWM)
    pinMode(Rpwm_pin,OUTPUT); // pin10 (PWM)
}
void Set_Speed(unsigned char Left,unsigned char Right)
{
    analogWrite(Lpwm_pin,Left);
    analogWrite(Rpwm_pin,Right);
}
void advance()          // going forward
      {
       digitalWrite(pinRB,LOW);    // making motor move towards right rear
       digitalWrite(pinRF,HIGH);
       digitalWrite(pinLB,LOW);    // making motor move towards left rear
       digitalWrite(pinLF,HIGH);
       Car_state = 1;
       show_state();
      }
void turnR()              //turning right(dual wheel)
      {
       digitalWrite(pinRB,LOW);    //making motor move towards right rear
       digitalWrite(pinRF,HIGH);
       digitalWrite(pinLB,HIGH);
       digitalWrite(pinLF,LOW);    //making motor move towards left front
```

```
    Car_state = 4;
    show_state();
  }
void turnL()            //turning left(dual wheel)
  {
    digitalWrite(pinRB,HIGH);
    digitalWrite(pinRF,LOW );    //making motor move towards right front
    digitalWrite(pinLB,LOW);     //making motor move towards left rear
    digitalWrite(pinLF,HIGH);
    Car_state = 3;
    show_state();
  }
void stopp()              //stop
  {
    digitalWrite(pinRB,HIGH);
    digitalWrite(pinRF,HIGH);
    digitalWrite(pinLB,HIGH);
    digitalWrite(pinLF,HIGH);
    Car_state = 5;
    show_state();
  }
void back()               //back up
  {
    digitalWrite(pinRB,HIGH);   //making motor move towards right rear
    digitalWrite(pinRF,LOW);
    digitalWrite(pinLB,HIGH);   //making motor move towards left rear
```

```
        digitalWrite(pinLF,LOW);
        Car_state = 2;
        show_state() ;
       }
void show_state(void)
{
   lcd.setCursor(0, 1);
     switch(Car_state)
     {
        case 1:lcd.print(" Go    ");Serial.print("\n GO");
        break;
        case 2:lcd.print("Back ");Serial.print("\n Back");
        break;
        case 3:lcd.print("Left ");Serial.print("\n Left");
        break;
        case 4:lcd.print("Right");Serial.print("\n Right");
        break;
        case 5:lcd.print("Stop ");Serial.print("\n Stop");
        break;
        default:
        break;
     }
}
void LCD1602_init(void)                    //function of initialization of liquid crystal
{
   lcd.init();    //invoking initialized function in LiquidCrystal_I2C.h
```

```
   delay(10);      //delaying for10 millisecond
   lcd.backlight(); //open backlight of LCD1602
   lcd.clear();         //clear screen
}
void IR_Control(void)
{
     unsigned long Key;
     lcd.setCursor(0,0);    //setting cursor in the first row and column
     lcd.print("IR_Ctr                  ");
   while(Key!=IR_ESC)
    {
     if(irrecv.decode(&results)) //judging if serial port receives data
  {
        Key = results.value;
      switch(Key)
        {
          case IR_Go:advance();      //UP
          break;
          case IR_Back: back();      //back
          break;
          case IR_Left:turnL();      //Left
          break;
          case IR_Right:turnR(); //Righ
          break;
          case IR_Stop:stopp();      //stop
          break;
```

```
            default:
            break;
          }
          irrecv.resume(); // Receive the next value
        }
    }
    lcd.clear();
    lcd.setCursor(0, 0);    //setting cursor in the first row and column，
    lcd.print("    Wait    Signal    ");
    stopp();
}
void setup()
{
    LCD1602_init();
    M_Control_IO_config();
    Set_Speed(Lpwm_val,Rpwm_val);
    irrecv.enableIRIn(); // Start the receiver
    Serial.begin(9600);      //initializing serial port, Bluetooth used as serial port, setting baud ratio at 9600
    lcd.setCursor(0, 0);    //setting cursor at the first row and column
    lcd.print("    Wait    Signal    ");
    stopp();
}
void loop()
{
    if (irrecv.decode(&results)) {
        if(results.value == IR_Stop )IR_Control();
```

```
        irrecv.resume(); // Receive the next value
    }
}
```

**********

## Project 11: Distance Detecting of Smart Car


**Introduction:**

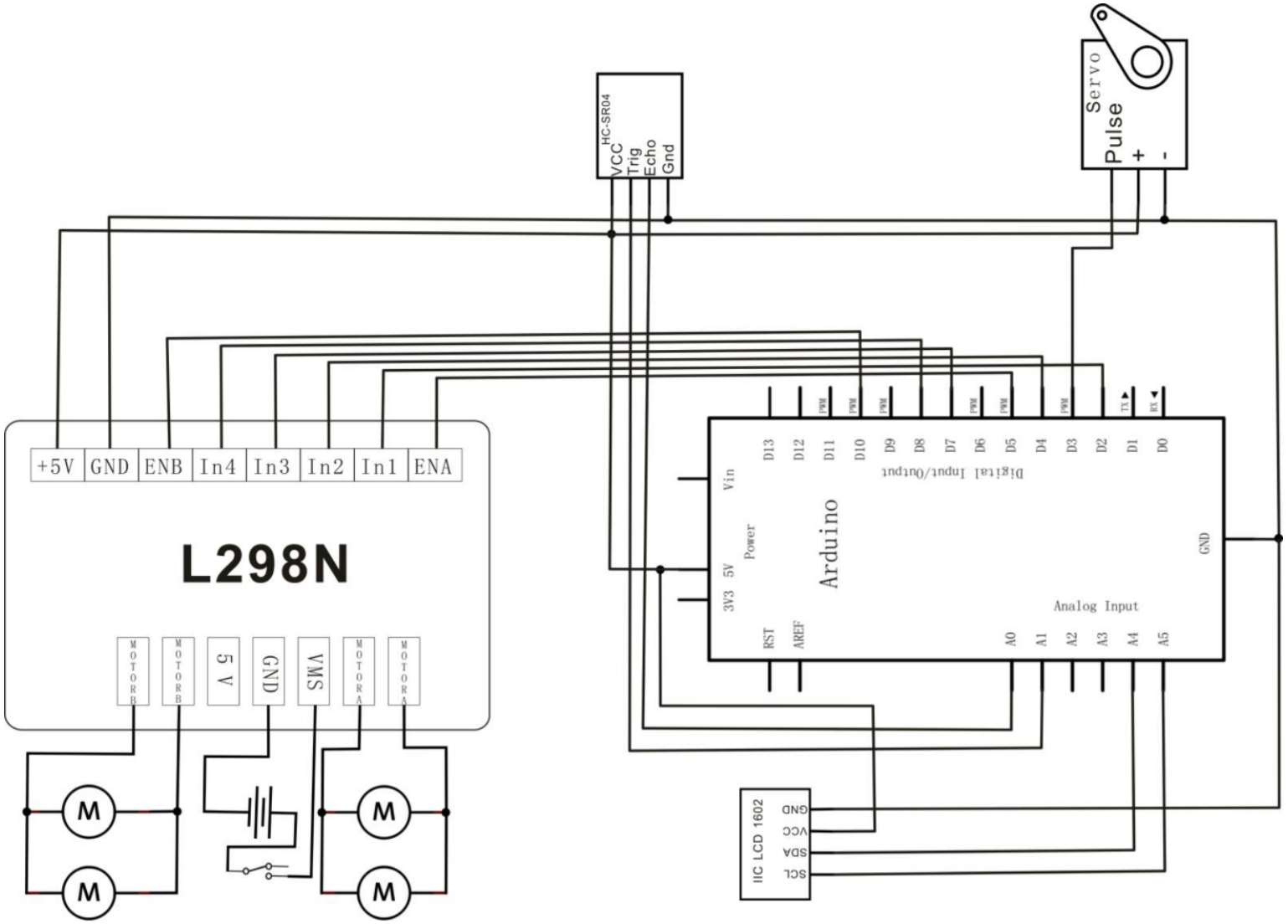
This project, regarding Arduino as main control, is to detect front obstacle by ultrasonic sensor and platform motor, and then send the feedback to Arduino. Arduino will analyze the feedback signal and then control the driver motor to adjust the car diversion. Finally, the car is able to avoid obstacle automatically and to keep going.
In addition, you can observe the state and speed of the car, the angle of motor and the distance between car and obstacle through keyestudio 1602 I2C Module.

**Principle:**

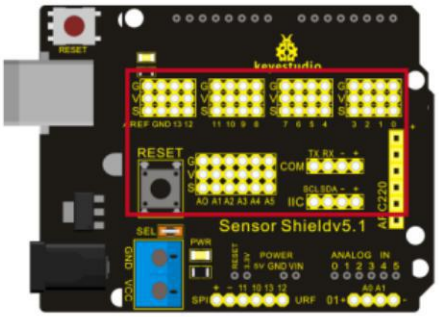
1.Ultrasonic detecting distance: one port emits high level more than 10 US. Once outputting level, open potentiometer to time. When the port becomes low level, read out current value. Use the time of detecting distance to calculate distance.
2.Use ultrasonic to detect the distance between obstacle and car, so that control the motion of the car according to the data.
3.If the distance between the car and obstacle is less than 35 cm, the car goes backward; if the distance is no less than 10 cm, the car goes forwards; if the distance is less than 60 cm , the motor turns to detect the distance between car and left obstacle or right obstacle; if the distance between car and left obstacle, the distance between car and right obstacle are less than 35 cm, the car goes backward; if the distance between car and left obstacle is larger, the car turns left; if the distance between car and left obstacle is less than or equal to the distance between car and right obstacle, the car turns right.

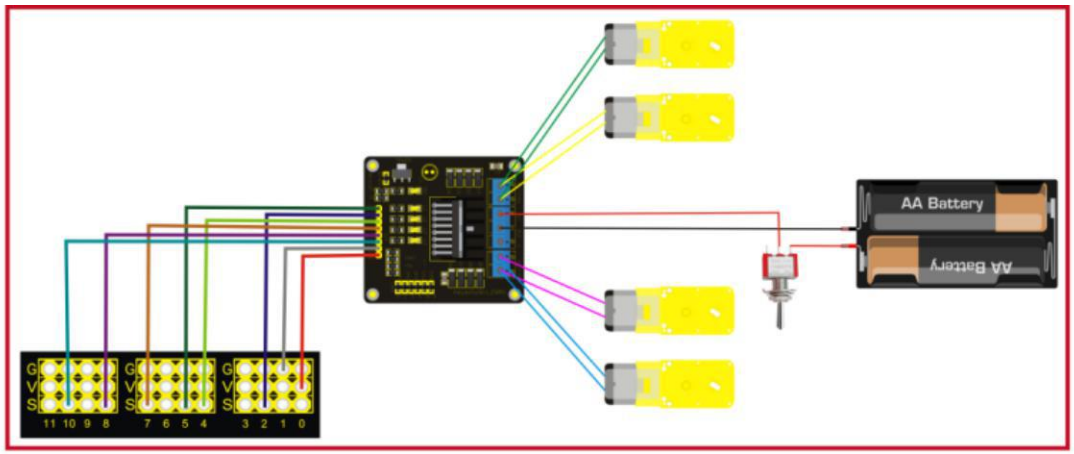
**Schematic Diagram：**

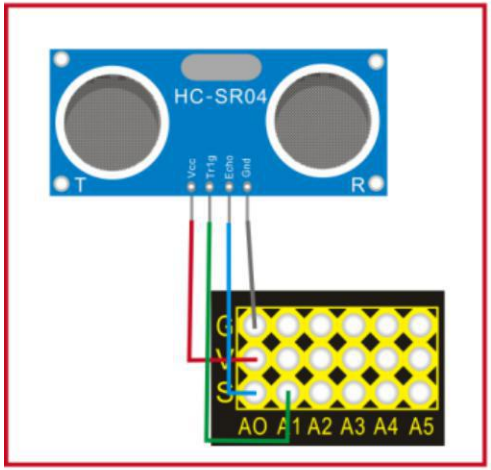
# keyestudio

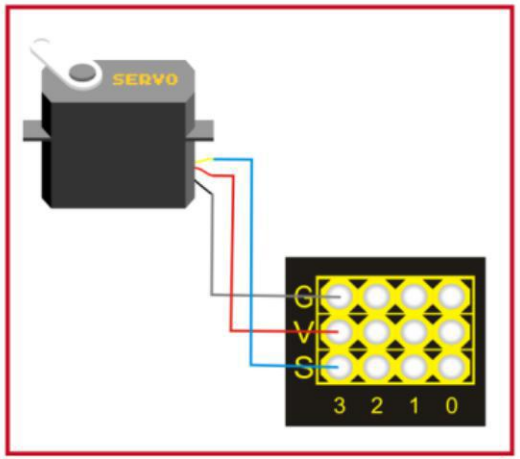

HC-SR04
VCC
Trig
Echo
Gnd
Servo
Pulse
+
-
+5V
GND
ENB
In4
In3
In2
In1
ENA
L298N
MOTOR B
MOTOR B
5 V
GND
VMS
MOTOR A
MOTOR A
M
M
M
M
Arduino
Digital Input/Output
Analog Input
Power
Vin
5V
3V3
RST
AREF
GND
D13
D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1
D0
A0
A1
A2
A3
A4
A5
IIC LCD 1602
GND
VCC
SDA
SCL

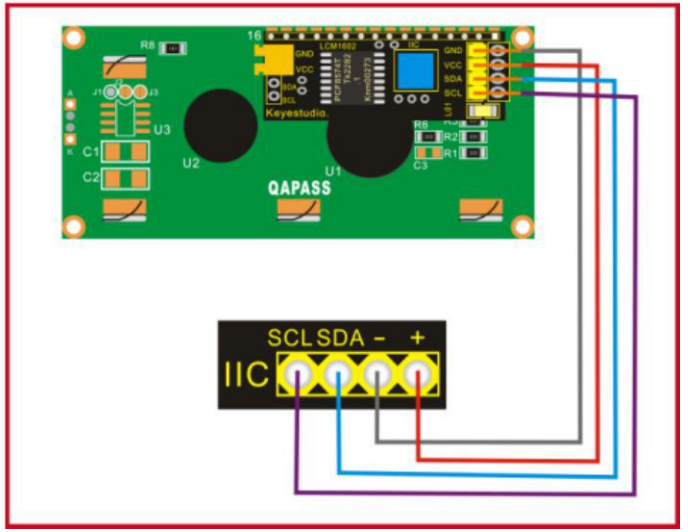
**Connection Diagram：**



**Sample Code：**

```
*****************************************************************************************
#include <LiquidCrystal_I2C.h>      //including libraries of I2C-LCD1602 liquid crystal
#include <Wire.h>                   //including libraries of I2C
//////////////////////////////////////////////////
int inputPin=A0;    // ultrasonic module      ECHO to A0
int outputPin=A1;    // ultrasonic module    TRIG to A1
LiquidCrystal_I2C lcd(0x27,16,2);      //defining liquid crystal
#define Lpwm_pin    5         //pin of controlling speed---- ENA of motor driver board
#define Rpwm_pin    10        //pin of controlling speed---- ENB of motor driver board
int pinLB=2;                  //pin of controlling turning---- IN1 of motor driver board
int pinLF=4;                  //pin of controlling turning---- IN2 of motor driver board
int pinRB=7;                  //pin of controlling turning---- IN3 of motor driver board
int pinRF=8;                  //pin of controlling turning---- IN4 of motor driver board
unsigned char Lpwm_val = 250; //initialized left wheel speed at 250
unsigned char Rpwm_val = 250; //initialized right wheel speed at 250
int Car_state=0;              //the working state of car
int servopin=3;               //defining digital port pin 3, connecting to signal line of servo motor
int myangle;                  //defining variable of angle
int pulsewidth;               //defining variable of pulse width
unsigned char DuoJiao=60;     //initialized angle of motor at 60°

void servopulse(int servopin,int myangle) //defining a function of pulse
{
pulsewidth=(myangle*11)+500; //converting angle into pulse width value at 500-2480
digitalWrite(servopin,HIGH); //increasing the level of motor interface to upmost
```

```
delayMicroseconds(pulsewidth); //delaying microsecond of pulse width value
digitalWrite(servopin,LOW); //decreasing the level of motor interface to the least
delay(20-pulsewidth/1000);
}
void Set_servopulse(int set_val)
{
  for(int i=0;i<=10;i++)    //giving motor enough time to turn to assigning point
      servopulse(servopin,set_val); //invokimg pulse function
}
void M_Control_IO_config(void)
{
   pinMode(pinLB,OUTPUT); // /pin 2
   pinMode(pinLF,OUTPUT); // pin 4
   pinMode(pinRB,OUTPUT); // pin 7
   pinMode(pinRF,OUTPUT);    // pin 8
   pinMode(Lpwm_pin,OUTPUT);    // pin 11 (PWM)
   pinMode(Rpwm_pin,OUTPUT);    // pin10(PWM)
}
void Set_Speed(unsigned char Left,unsigned char Right) //function of setting speed
{
   analogWrite(Lpwm_pin,Left);
   analogWrite(Rpwm_pin,Right);
}
void advance()       //    going forward
      {
        digitalWrite(pinRB,LOW);    // making motor move towards right rear
```

```
    digitalWrite(pinRF,HIGH);
    digitalWrite(pinLB,LOW);    // making motor move towards left rear
    digitalWrite(pinLF,HIGH);
    Car_state = 1;
    show_state();
  }
void turnR()              //turning right(dual wheel)
  {
    digitalWrite(pinRB,LOW);    //making motor move towards right rear
    digitalWrite(pinRF,HIGH);
    digitalWrite(pinLB,HIGH);
    digitalWrite(pinLF,LOW);    //making motor move towards left front
    Car_state = 4;
    show_state();
  }
void turnL()               //turning left(dual wheel)
  {
    digitalWrite(pinRB,HIGH);
    digitalWrite(pinRF,LOW );      //making motor move towards right front
    digitalWrite(pinLB,LOW);      //making motor move towards left rear
    digitalWrite(pinLF,HIGH);
    Car_state = 3;
    show_state();
  }
void stopp()              //stop
  {
```

```
        digitalWrite(pinRB,HIGH);
        digitalWrite(pinRF,HIGH);
        digitalWrite(pinLB,HIGH);
        digitalWrite(pinLF,HIGH);
        Car_state = 5;
        show_state();
      }
void back()                //back up
      {
        digitalWrite(pinRB,HIGH);    //making motor move towards right rear
        digitalWrite(pinRF,LOW);
        digitalWrite(pinLB,HIGH);    //making motor move towards left rear
        digitalWrite(pinLF,LOW);
        Car_state = 2;
        show_state() ;
      }
void show_state(void)
{
   lcd.setCursor(0, 1);
     switch(Car_state)
     {
        case 1:lcd.print(" Go    ");Serial.print(" \r\n GO");
        break;
        case 2:lcd.print("Back ");Serial.print(" \r\n Back");
        break;
        case 3:lcd.print("Left ");Serial.print(" \r\n Left");
```

```
        break;
        case 4:lcd.print("Right");Serial.print(" \r\n Right");
        break;
        case 5:lcd.print("Stop ");Serial.print(" \r\n Stop");
        break;
        default:
        break;
    }
}
void LCD1602_init(void)                    //including initialized function of liquid crystal
{
  lcd.init();    //invoking initialized function of LCD in LiquidCrystal_I2C.h
  delay(10);    //delaying for 10 millisecond
  lcd.backlight(); //open backlight of LCD1602
  lcd.clear();       //clear screen
}
void Show_V(unsigned char V)
{
        lcd.setCursor(11, 0);
        lcd.print("V=       ");
        lcd.setCursor(13, 0);
        lcd.print(V,DEC);
        Serial.print("\n Speed = ");
        Serial.print(V,DEC);
}
void Show_DuoJiao(unsigned char Jiao)
```

```
{
        lcd.setCursor(6,1);
        lcd.print("C=       ");
        lcd.setCursor(8, 1);
        lcd.print(Jiao,DEC);
        Serial.print("\n JiaoDu = ");
        Serial.print(Jiao,DEC);
}
void Self_Control(void)//self-going, ultrasonic obstacle avoidance
{
    int H;
    lcd.setCursor(0, 0);    //setting cursor in the first row and column
    lcd.print("Self_Ctr              ");
    Show_V(Lpwm_val);
    Set_servopulse(DuoJiao);
    Show_DuoJiao(DuoJiao);
    H = Ultrasonic_Ranging(1);
    delay(300);
    if(Ultrasonic_Ranging(1) < 35)
    {
          stopp();
          delay(100);
          back();
          delay(50);
     }
```

```
if(Ultrasonic_Ranging(1) < 60)
      {
        stopp();
        delay(100);
        Set_servopulse(5);
        Show_DuoJiao(5);
        int L = ask_pin_L(2);
        delay(300);
          Set_servopulse(177);
          Show_DuoJiao(177);
        int R = ask_pin_R(3);
        delay(300);

        if(ask_pin_L(2) > ask_pin_R(3))
        {
          back();
        delay(100);
        turnL();
       delay(400);
       stopp();
       delay(50);
       Set_servopulse(DuoJiao);
       Show_DuoJiao(DuoJiao);
       H = Ultrasonic_Ranging(1);
       delay(500);
        }
```

```
if(ask_pin_L(2)    <= ask_pin_R(3))
{
 back();
 delay(100);
 turnR();
 delay(400);
 stopp();
 delay(50);
 Set_servopulse(DuoJiao);
 Show_DuoJiao(DuoJiao);
 H = Ultrasonic_Ranging(1);
 delay(300);
   }
   if (ask_pin_L(2)    < 35 && ask_pin_R(3)< 35)
   {
 stopp();
 delay(50);
 back();
 delay(50);
   }
}
else
{
advance();
}
```

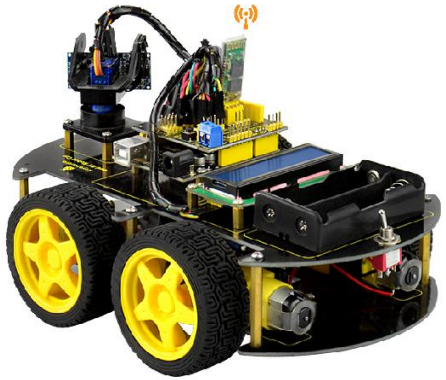
```
}
int Ultrasonic_Ranging(unsigned char Mode)//function of ultrasonic distance detecting ， MODE=1，displaying，no displaying under other situation

{
   int old_distance;
   digitalWrite(outputPin, LOW);
   delayMicroseconds(2);
   digitalWrite(outputPin, HIGH);
   delayMicroseconds(10);
   digitalWrite(outputPin, LOW);
   int distance = pulseIn(inputPin, HIGH);    // reading the duration of high level
   distance= distance/58;      // Transform pulse time to distance
   if(Mode==1){
              lcd.setCursor(11, 1);
              lcd.print("H=       ");
              lcd.setCursor(13, 1);
              lcd.print(distance,DEC);
              Serial.print("\n H = ");
              Serial.print(distance,DEC);
              return distance;
   }
     else    return distance;
}
int ask_pin_L(unsigned char Mode)
   {
   int old_Ldistance;
```

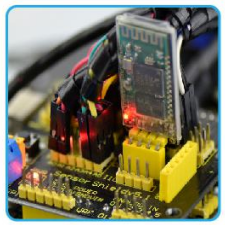
```
    digitalWrite(outputPin, LOW);
    delayMicroseconds(2);
    digitalWrite(outputPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(outputPin, LOW);
    int Ldistance = pulseIn(inputPin, HIGH);
    Ldistance= Ldistance/58;      // Transform pulse time to distance
    if(Mode==2){
                lcd.setCursor(11, 1);
                lcd.print("L=       ");
                lcd.setCursor(13, 1);
                lcd.print(Ldistance,DEC);
                Serial.print("\n L = ");
                Serial.print(Ldistance,DEC);
                return Ldistance;
    }
      else    return Ldistance;
}
int ask_pin_R(unsigned char Mode)
      {
    int old_Rdistance;
    digitalWrite(outputPin, LOW);
    delayMicroseconds(2);
    digitalWrite(outputPin, HIGH); //
    delayMicroseconds(10);
    digitalWrite(outputPin, LOW);
```

```
    int Rdistance = pulseIn(inputPin, HIGH);
    Rdistance= Rdistance/58;      // Transform pulse time to distance
    if(Mode==3){
                lcd.setCursor(11, 1);
                lcd.print("R=       ");
                lcd.setCursor(13, 1);
                lcd.print(Rdistance,DEC);
                Serial.print("\n R = ");
                Serial.print(Rdistance,DEC);
                return Rdistance;
    }
     else    return Rdistance;
}

void setup()
{
    pinMode(servopin,OUTPUT);    //setting motor interface as output
    LCD1602_init();                    //initializing 1602
    M_Control_IO_config();         //motor controlling the initialization of IO
    Set_Speed(Lpwm_val,Rpwm_val);    //setting initialized speed
    Set_servopulse(DuoJiao);             //setting initialized motor angle
    pinMode(inputPin, INPUT);           //starting receiving IR remote control signal
    pinMode(outputPin, OUTPUT);       //IO of ultrasonic module
    Serial.begin(9600);                   //initialized serial port , using Bluetooth as serial port, setting baud
    lcd.setCursor(0, 0);                  //setting cursor at 0.0
    lcd.print("    Wait    Signal    ");    //LCD printing character string
```

```
    stopp();                              //stop
}
void loop()
{

        Self_Control();
}
**********************************************************************************
```

## Project 12: Bluetooth Remote Control of Smart Car





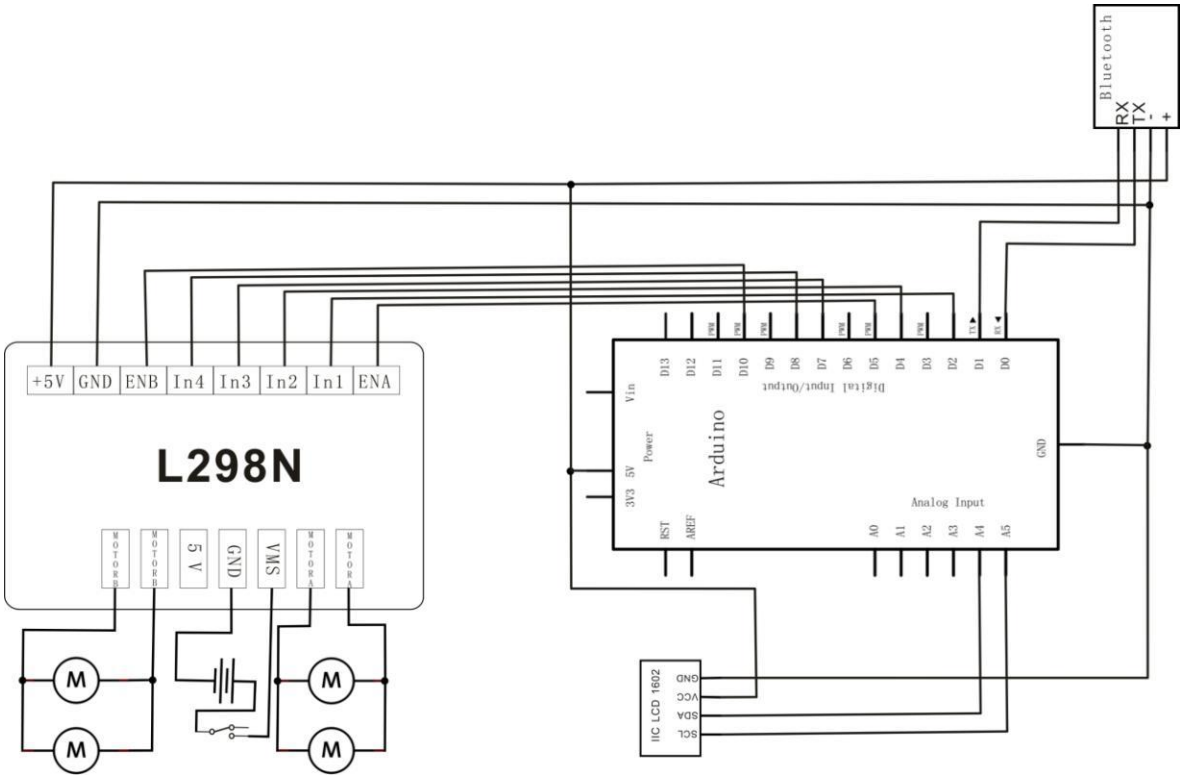
**Introduction：**

This project, regarding Arduino as main control, uses Bluetooth module to receive signal from mobile phone, and sends the signal to Arduino. Arduino will analyze the signal and then control the driver motor to control the motion of the car. In addition, you can observe the state and speed of the car, the angle of motor , and the distance between car and obstacle through keyestudio 1602 I2C Module.

**Principle：**

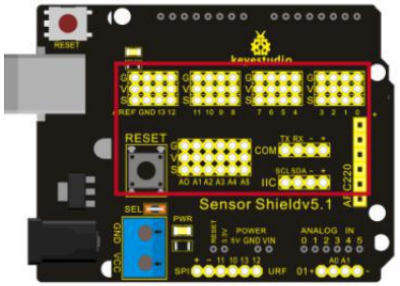
1. Connecting Aduino to Bluetooth module, this module can communicate with APP on the mobile phone
2. APP sending “U”“D”“L”“R”“S” to Bluetooth module
3. Bluetooth module will send the received massage to Arduino, thus Arduino can control the car correspondingly.
4. When Arduino receiving “U”, the car goes forward; when receiving “D”, it goes backward; when receiving “R”, it turns right; when receiving “S”, it stops moving.

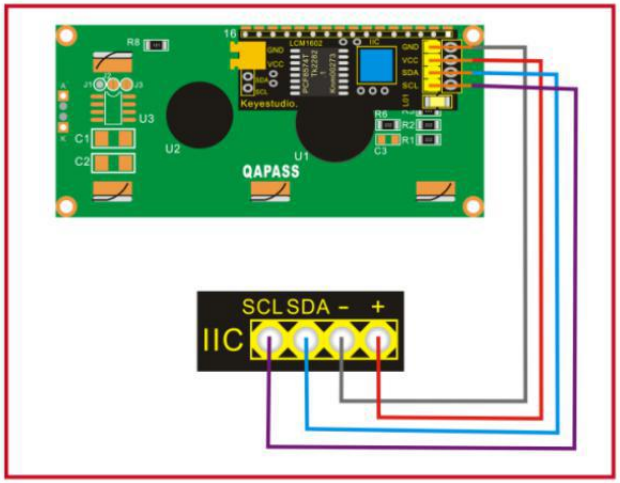
**Schematic Diagram：**

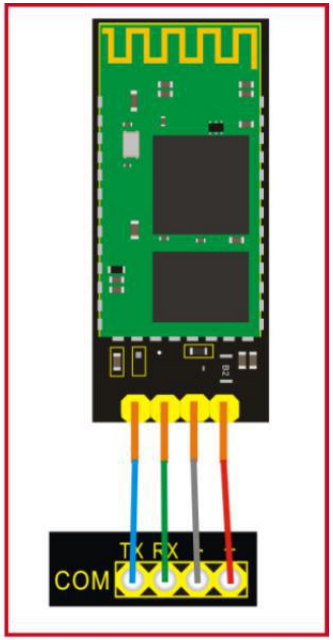


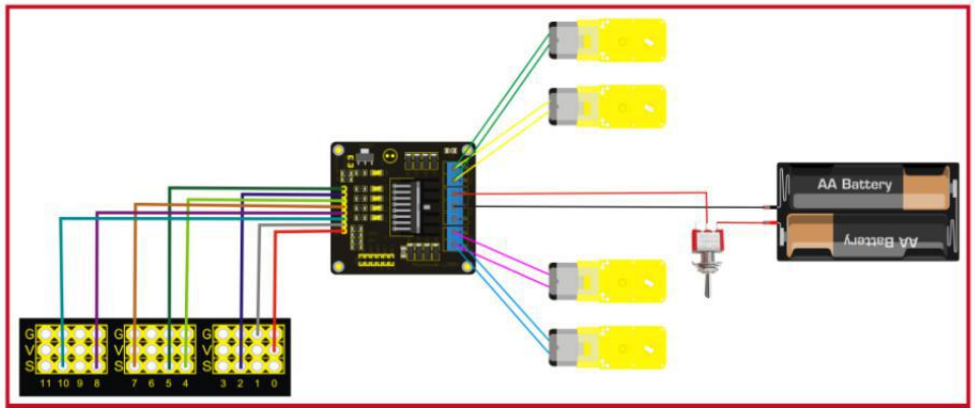

**Connection Diagram：**

# keyestudio


RESET
Sensor Shieldv5.1


QAPASS
SCL SDA - +
IIC


TX RX - +
COM


AA Battery

**Sample Code：**

```
**********************************************************************************
#include <LiquidCrystal_I2C.h>      //including the libraries of I2C-LCD1602 liquid crystal
#include <Wire.h>                    //including the libraries of I2C
unsigned char Bluetooth_val;          //defining variable val
LiquidCrystal_I2C lcd(0x27,16,2);    //defining liquid crystal
#define Lpwm_pin    5         //adjusting speed
#define Rpwm_pin    10        //adjusting speed    //
int pinLB=2;          // defining pin2 left rear
int pinLF=4;          // defining pin4 left front
int pinRB=7;        // defining pin7 right rear
int pinRF=8;        // defining pin8 right front
unsigned char Lpwm_val = 255;
unsigned char Rpwm_val = 255;
int Car_state=0;
void M_Control_IO_config(void)
{
  pinMode(pinLB,OUTPUT); // pin 2
  pinMode(pinLF,OUTPUT); // pin 4
  pinMode(pinRB,OUTPUT); // pin 7
  pinMode(pinRF,OUTPUT); // pin 8
  pinMode(Lpwm_pin,OUTPUT); // pin 11 (PWM)
  pinMode(Rpwm_pin,OUTPUT); // pin 10 (PWM)
}
void Set_Speed(unsigned char Left,unsigned char Right)
{
```

```
    analogWrite(Lpwm_pin,Left);
    analogWrite(Rpwm_pin,Right);
}
void advance()        //    going forward
      {
       digitalWrite(pinRB,LOW);    // making motor move towards right rear
       digitalWrite(pinRF,HIGH);
       digitalWrite(pinLB,LOW);    // making motor move towards left rear
       digitalWrite(pinLF,HIGH);
       Car_state = 1;
       show_state();
      }
void turnR()              //turning right(dual wheel)
      {
       digitalWrite(pinRB,LOW);    //making motor move towards right rear
       digitalWrite(pinRF,HIGH);
       digitalWrite(pinLB,HIGH);
       digitalWrite(pinLF,LOW);    //making motor move towards left front
       Car_state = 4;
       show_state();
      }
void turnL()              //turning left(dual wheel)
      {
       digitalWrite(pinRB,HIGH);
       digitalWrite(pinRF,LOW );      //making motor move towards right front
       digitalWrite(pinLB,LOW);      //making motor move towards left rear
```

```
        digitalWrite(pinLF,HIGH);
        Car_state = 3;
        show_state();
      }
void stopp()                //stop
      {
        digitalWrite(pinRB,HIGH);
        digitalWrite(pinRF,HIGH);
        digitalWrite(pinLB,HIGH);
        digitalWrite(pinLF,HIGH);
        Car_state = 5;
        show_state();
      }
void back()                 //back up
      {
        digitalWrite(pinRB,HIGH);   //making motor move towards right rear
        digitalWrite(pinRF,LOW);
        digitalWrite(pinLB,HIGH);   //making motor move towards left rear
        digitalWrite(pinLF,LOW);
        Car_state = 2;
        show_state() ;
      }
void show_state(void)
{
   lcd.setCursor(0, 1);
     switch(Car_state)
```

```
    {
      case 1:lcd.print(" Go    ");
      break;
      case 2:lcd.print("Back ");
      break;
      case 3:lcd.print("Left ");
      break;
      case 4:lcd.print("Right");
      break;
      case 5:lcd.print("stop ");
      break;
      default:
      break;
    }
}
void LCD1602_init(void)                    //including initialized function of liquid crystal
{
  lcd.init();    //invoking initialized function of LCD in LiquidCrystal_I2C.h
  delay(10);      //delaying for 10 millisecond
  lcd.backlight(); //open backlight of LCD1602
  lcd.clear();          //clear screen
}
void setup()
{
    LCD1602_init();
    M_Control_IO_config();
```

```
    Set_Speed(Lpwm_val,Rpwm_val);
    Serial.begin(9600);      //initialized serial port , using Bluetooth as serial port, setting baud at 9600
    lcd.setCursor(0, 0);    //setting cursor in the first row and column
    lcd.print("      Wait    Sigal");
    stopp();
}
void loop()
{
    lcd.setCursor(0, 0);    //setting cursor in the first row and column
    lcd.print("BluetoothControl");

    if(Serial.available()) //to judge whether the serial port receives the data.
     {
      Bluetooth_val=Serial.read();    //reading (Bluetooth) data of serial port,giving the value of val;
     switch(Bluetooth_val)
      {
        case 'U':advance(); //UP
        break;
        case 'D': back();      //back
        break;
        case 'L':turnL();      //Left
        break;
        case 'R':turnR();    //Right
        break;
        case 'S':stopp();       //stop
        break;
```

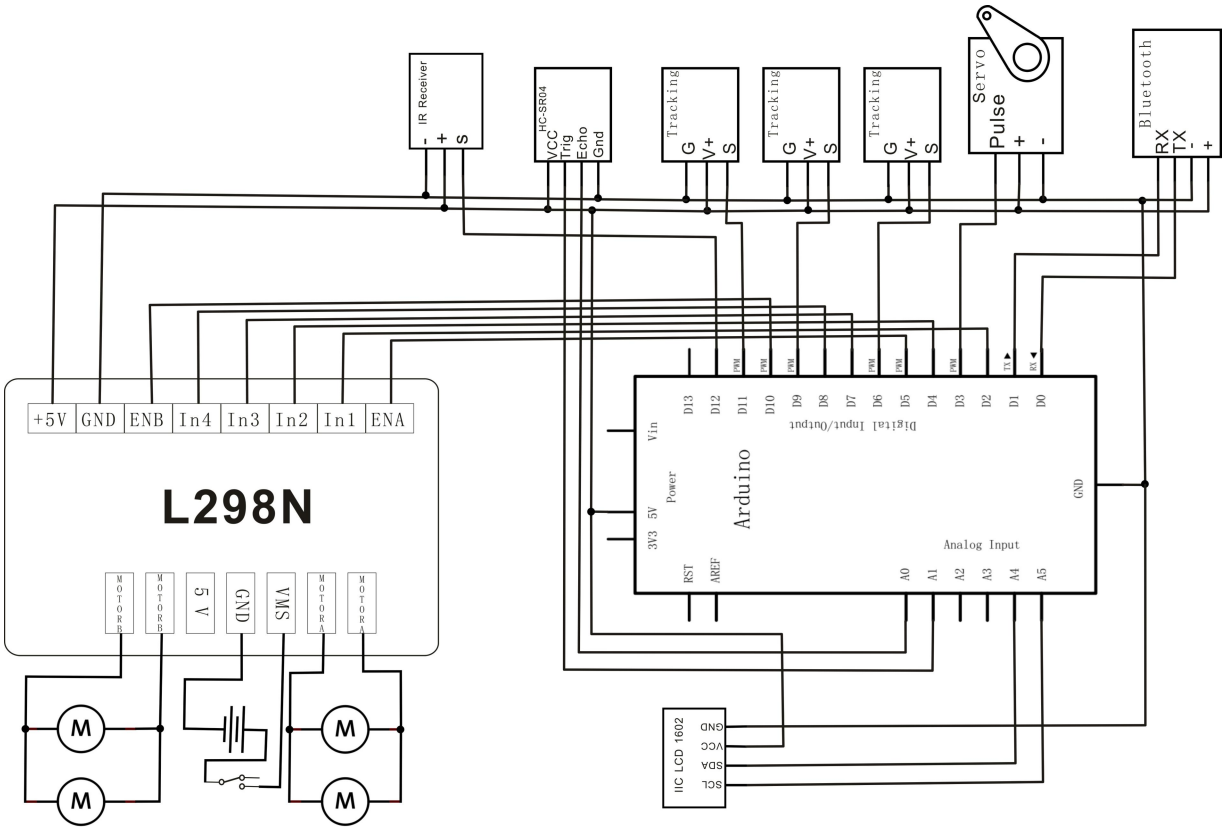
```
        }
      }
}
**********************************************************************************
```

**Project 13: 5 in 1 Multi-purpose Car (Line Tracking, Obstacle Avoidance, Bluetooth and IR Remote Control, Distance Detection)**

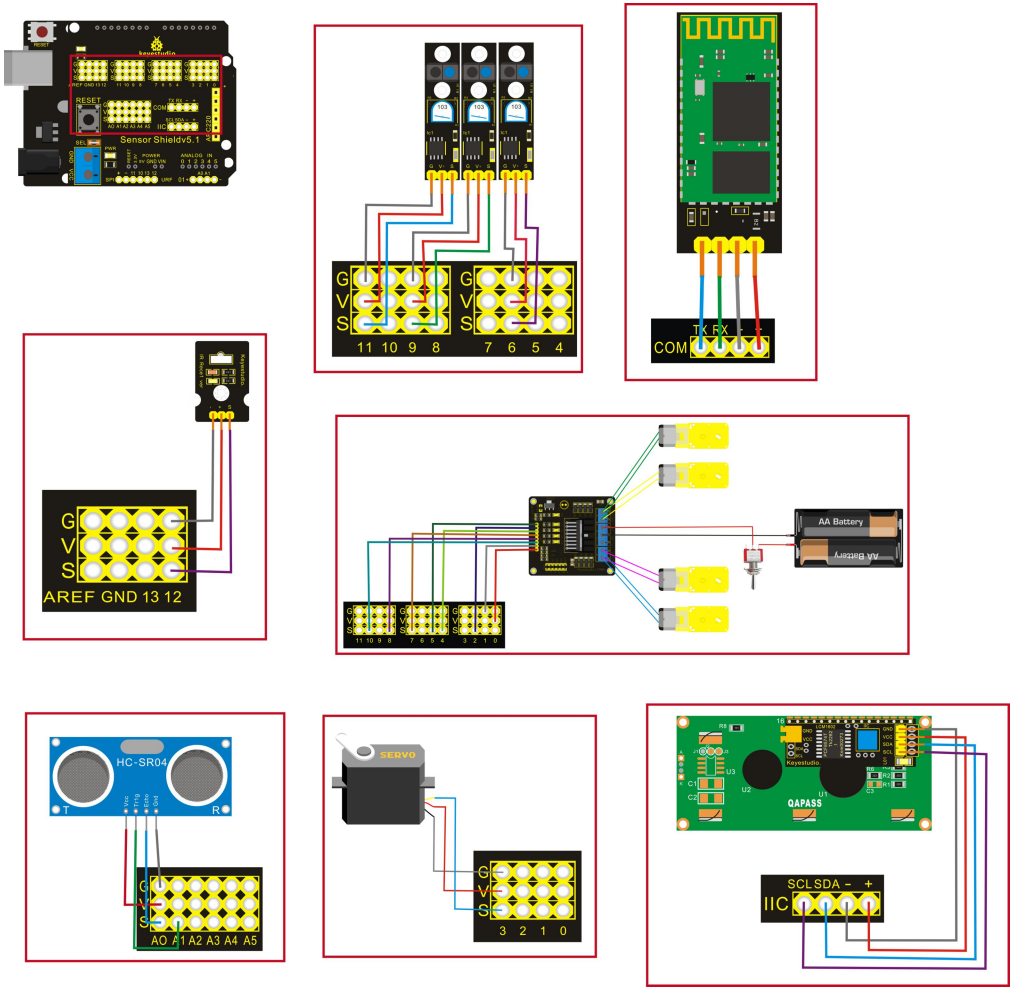
**Introduction：**

In this project, we will put five functions (namely line tracking, obstacle avoidance, Bluetooth and IR remote control, distance detection) together into one to realize the working mode of the car. Press the button “5” of IR remote control to start line tracking; button “6” to start ultrasonic obstacle avoidance and distance detecting; button “7” to start IR remote control, button “8”to start Bluetooth remote control, and press reset button to enter initialized mode.

**Schematic Diagram：**



**Connection Diagram：**



**Sample Code：**

```
**********************************************************************************
#include <LiquidCrystal_I2C.h>      //including libraries of I2C-LCD1602 liquid crystal
#include <Wire.h>                   //including libraries of I2C
#include <IRremote.h>               //including libraries of remote control
#define RECV_PIN    12              //pin 12 of IR remoter control receiver
IRrecv irrecv(RECV_PIN);            //defining pin 12 of IR remoter control
decode_results results;             //cache of decode of IR remoter control
#define IR_Go             0x00ff629d //going forward
#define IR_Back           0x00ffa857    //going backward
#define IR_Left           0x00ff22dd    //turning left
#define IR_Right          0x00ffc23d    //turning right
#define IR_Stop           0x00ff02fd    //stop
#define IR_Servo_L    0x00ff6897    //motor turning left
#define IR_Servo_R    0x00ff9867    //motor turning right
#define IR_Speed_UP         0x00ffb04f //increasing speed
#define IR_Speed_DOWN       0x00ff30cf //decreasing speed
#define IR_XunJi_Mode       0x00ff18e7
#define IR_Self_Control    0x00ff7a85    //ultrasonic distance detecting
#define IR_IR_Control    0x00ff10ef
#define IR_Bluetooth_Control    0x00ff38c7
#define IR_ESC            0x00ff52ad    //quitting from remote control
////////////////////////////////////////////////
#define SensorLeft        6      //sensor left pin of line tracking module
#define SensorMiddle    9      //sensor middle pin of line tracking module
#define SensorRight       11    //sensor right pin of line tracking module
```

```
unsigned char SL;              //state of left sensor of line tracking module
unsigned char SM;               //state of middle sensor of line tracking module
unsigned char SR;              //state of right sensor of line tracking module
int inputPin=A0;    // ultrasonic module      ECHO to A0
int outputPin=A1;    // ultrasonic module    TRIG to A1
unsigned char Bluetooth_val;            // ultrasonic module    TRIG to A1
LiquidCrystal_I2C lcd(0x27,16,2);      //defining liquid crystal
#define Lpwm_pin    5         //pin of controlling speed---- ENA of motor driver board
#define Rpwm_pin    10        //pin of controlling speed---- ENB of motor driver board
int pinLB=2;                   //pin of controlling turning---- IN1 of motor driver board
int pinLF=4;                   //pin of controlling turning---- IN2 of motor driver board
int pinRB=7;                   //pin of controlling turning---- IN3 of motor driver board
int pinRF=8;                   //pin of controlling turning---- IN4 of motor driver board
unsigned char Lpwm_val = 250; //initialized left wheel speed at 250
unsigned char Rpwm_val = 250; //initialized right wheel speed at 250
int Car_state=0;                    //the working state of car
int servopin=3;                     //defining digital port pin 3, connecting to signal line of servo motor
int myangle;                        //defining variable of angle
int pulsewidth;                     //defining variable of pulse width
unsigned char DuoJiao=60;       //initialized angle of motor at 60°
void Sensor_IO_Config()         //IO initialized function of three line tracking , all setting at input
{
   pinMode(SensorLeft,INPUT);
   pinMode(SensorMiddle,INPUT);
   pinMode(SensorRight,INPUT);
}
```

```
void Sensor_Scan(void) //function of reading-in signal of line tracking module
{
   SL = digitalRead(SensorLeft);
   SM = digitalRead(SensorMiddle);
   SR = digitalRead(SensorRight);
}
void servopulse(int servopin,int myangle) //defining a function of pulse
{
pulsewidth=(myangle*11)+500; //converting angle into pulse width value at 500-2480
digitalWrite(servopin,HIGH); //increasing the level of motor interface to upmost
delayMicroseconds(pulsewidth); //delaying microsecond of pulse width value
digitalWrite(servopin,LOW); //decreasing the level of motor interface to the least
delay(20-pulsewidth/1000);
}
void Set_servopulse(int set_val)
{
  for(int i=0;i<=10;i++)    //giving motor enough time to turn to assigning point
      servopulse(servopin,set_val); //invoking pulse function
}
void M_Control_IO_config(void)
{
   pinMode(pinLB,OUTPUT); // /pin 2
   pinMode(pinLF,OUTPUT); // pin 4
   pinMode(pinRB,OUTPUT); // pin 7
   pinMode(pinRF,OUTPUT);    // pin 8
   pinMode(Lpwm_pin,OUTPUT);    // pin 11 (PWM)
```

```
  pinMode(Rpwm_pin,OUTPUT);    // pin10(PWM)
}
void Set_Speed(unsigned char Left,unsigned char Right) //function of setting speed
{
  analogWrite(Lpwm_pin,Left);
  analogWrite(Rpwm_pin,Right);
}
void advance()       //    going forward
      {
       digitalWrite(pinRB,LOW);    // making motor move towards right rear
       digitalWrite(pinRF,HIGH);
       digitalWrite(pinLB,LOW);    // making motor move towards left rear
       digitalWrite(pinLF,HIGH);
       Car_state = 1;
       show_state();
      }
void turnR()              //turning right(dual wheel)
      {
       digitalWrite(pinRB,LOW);    //making motor move towards right rear
       digitalWrite(pinRF,HIGH);
       digitalWrite(pinLB,HIGH);
       digitalWrite(pinLF,LOW);    //making motor move towards left front
       Car_state = 4;
       show_state();
      }
void turnL()               //turning left(dual wheel)
```

```
    {
     digitalWrite(pinRB,HIGH);
     digitalWrite(pinRF,LOW );     //making motor move towards right front
     digitalWrite(pinLB,LOW);     //making motor move towards left rear
     digitalWrite(pinLF,HIGH);
     Car_state = 3;
     show_state();
    }
void stopp()              //stop
    {
     digitalWrite(pinRB,HIGH);
     digitalWrite(pinRF,HIGH);
     digitalWrite(pinLB,HIGH);
     digitalWrite(pinLF,HIGH);
     Car_state = 5;
     show_state();
    }
void back()               //back up
    {
     digitalWrite(pinRB,HIGH);    //making motor move towards right rear
     digitalWrite(pinRF,LOW);
     digitalWrite(pinLB,HIGH);    //making motor move towards left rear
     digitalWrite(pinLF,LOW);
     Car_state = 2;
     show_state() ;
    }
```

```
void show_state(void)
{
   lcd.setCursor(0, 1);
     switch(Car_state)
     {
        case 1:lcd.print(" Go    ");Serial.print(" \r\n GO");
        break;
        case 2:lcd.print("Back ");Serial.print(" \r\n Back");
        break;
        case 3:lcd.print("Left ");Serial.print(" \r\n Left");
        break;
        case 4:lcd.print("Right");Serial.print(" \r\n Right");
        break;
        case 5:lcd.print("Stop ");Serial.print(" \r\n Stop");
        break;
        default:
        break;
     }
}
void LCD1602_init(void)                    //including initialized function of liquid crystal
{
   lcd.init();    //invoking initialized function of LCD in LiquidCrystal_I2C.h
   delay(10);    //delaying for 10 millisecond
   lcd.backlight(); //open backlight of LCD1602
   lcd.clear();       //clear screen
}
```

```
void Show_V(unsigned char V)
{
        lcd.setCursor(11, 0);
        lcd.print("V=       ");
        lcd.setCursor(13, 0);
        lcd.print(V,DEC);
        Serial.print("\n Speed = ");
        Serial.print(V,DEC);
}
void Show_DuoJiao(unsigned char Jiao)
{
        lcd.setCursor(6,1);
        lcd.print("C=       ");
        lcd.setCursor(8, 1);
        lcd.print(Jiao,DEC);
        Serial.print("\n JiaoDu = ");
        Serial.print(Jiao,DEC);
}
void Xunji_Mode(void) //function of line tracking
{
  lcd.setCursor(0, 0);    //setting cursor in the first row and column
  lcd.print("Xunji_Mode                  ");
  Sensor_Scan();
  if (SM == HIGH)// middle sensor in black area
{
if (SL == LOW & SR == HIGH) // black on left, white on right, turn left
```

```
{
turnR();
}
else if (SR == LOW & SL == HIGH) // white on left, black on right, turn right
{
turnL();
}
else // white on both sides, going forward
{
advance();
}
}
else // middle sensor on white area
{
if (SL== LOW & SR == HIGH)// black on left, white on right, turn left
{
turnR();
}
else if (SR == LOW & SL == HIGH) // white on left, black on right, turn right
{
turnL();
}
else // all white, stop
{
back();
delay(100);
```

```
stopp() ;
}
}
}
void Self_Control(void)//self-going, ultrasonic obstacle avoidance
{
    int H;
    lcd.setCursor(0, 0);    //setting cursor in the first row and column
    lcd.print("Self_Ctr              ");
    Show_V(Lpwm_val);
    Set_servopulse(DuoJiao);
    Show_DuoJiao(DuoJiao);
    H = Ultrasonic_Ranging(1);
    delay(300);
    if(Ultrasonic_Ranging(1) < 35)
    {
          stopp();
          delay(100);
          back();
          delay(50);
      }

  if(Ultrasonic_Ranging(1) < 60)
        {
          stopp();
          delay(100);
```

```
  Set_servopulse(5);
  Show_DuoJiao(5);
  int L = ask_pin_L(2);
  delay(300);
    Set_servopulse(177);
    Show_DuoJiao(177);
  int R = ask_pin_R(3);
  delay(300);

  if(ask_pin_L(2) > ask_pin_R(3))
  {
    back();
  delay(100);
  turnL();
 delay(400);
 stopp();
 delay(50);
 Set_servopulse(DuoJiao);
 Show_DuoJiao(DuoJiao);
 H = Ultrasonic_Ranging(1);
 delay(500);
   }

if(ask_pin_L(2)    <= ask_pin_R(3))
{
 back();
```

```
          delay(100);
          turnR();
          delay(400);
          stopp();
          delay(50);
          Set_servopulse(DuoJiao);
          Show_DuoJiao(DuoJiao);
          H = Ultrasonic_Ranging(1);
          delay(300);
            }
            if (ask_pin_L(2)    < 35 && ask_pin_R(3)< 35)
            {
          stopp();
          delay(50);
          back();
          delay(50);
        }
        }
        else
        {
        advance();
        }
}
int Ultrasonic_Ranging(unsigned char Mode)//function of ultrasonic distance detecting，MODE=1，displaying，no displaying under other situations

{
```

```
    int old_distance;
    digitalWrite(outputPin, LOW);
    delayMicroseconds(2);
    digitalWrite(outputPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(outputPin, LOW);
    int distance = pulseIn(inputPin, HIGH);    // reading the duration of high level
    distance= distance/58;      // Transform pulse time to distance
    if(Mode==1){
                lcd.setCursor(11, 1);
                lcd.print("H=       ");
                lcd.setCursor(13, 1);
                lcd.print(distance,DEC);
                Serial.print("\n H = ");
                Serial.print(distance,DEC);
                return distance;
    }
      else    return distance;
}
int ask_pin_L(unsigned char Mode)
{
    int old_Ldistance;
    digitalWrite(outputPin, LOW);
    delayMicroseconds(2);
    digitalWrite(outputPin, HIGH);
    delayMicroseconds(10);
```

```
    digitalWrite(outputPin, LOW);
    int Ldistance = pulseIn(inputPin, HIGH);
    Ldistance= Ldistance/58;      // Transform pulse time to distance
    if(Mode==2){
                lcd.setCursor(11, 1);
                lcd.print("L=        ");
                lcd.setCursor(13, 1);
                lcd.print(Ldistance,DEC);
                Serial.print("\n L = ");
                Serial.print(Ldistance,DEC);
                return Ldistance;
    }
      else    return Ldistance;
}
int ask_pin_R(unsigned char Mode)
     {
    int old_Rdistance;
    digitalWrite(outputPin, LOW);
    delayMicroseconds(2);
    digitalWrite(outputPin, HIGH); //
    delayMicroseconds(10);
    digitalWrite(outputPin, LOW);
    int Rdistance = pulseIn(inputPin, HIGH);
    Rdistance= Rdistance/58;      // Transform pulse time to distance
    if(Mode==3){
                lcd.setCursor(11, 1);
```

```
            lcd.print("R=       ");
            lcd.setCursor(13, 1);
            lcd.print(Rdistance,DEC);
            Serial.print("\n R = ");
            Serial.print(Rdistance,DEC);
            return Rdistance;
   }
    else    return Rdistance;
}

void IR_Control(void)     //remote control，when pressing“#”， it quits from the mode
{
    unsigned long Key;
    lcd.setCursor(0,0);    //setting cursor in the first row and column
    lcd.print("IR_Ctr                ");
   while(Key!=IR_ESC)
   {
    if(irrecv.decode(&results))    //to judge whether serial port receive data
      {
       Key = results.value;
      switch(Key)
       {
          case IR_Go:advance();      //UP
          break;
          case IR_Back: back();      //back
          break;
```

```
 case IR_Left:turnL();      //Left
 break;
 case IR_Right:turnR(); //Righ
 break;
 case IR_Stop:stopp();      //stop
 break;
 case IR_Servo_L: if(DuoJiao<=180){    //motor turning left
                  DuoJiao+=10;
                  Set_servopulse(DuoJiao);
                  Show_DuoJiao(DuoJiao);}
 break;
case IR_Servo_R: if(DuoJiao-10>=0){    //motor turning right
                  DuoJiao-=10;
                  Set_servopulse(DuoJiao);
                  Show_DuoJiao(DuoJiao);}
 break;
case IR_Speed_UP:if(Rpwm_val+10<=250&&Rpwm_val+10<=250){    //increasing speed
                  Lpwm_val+=10; Rpwm_val+=10;
                  Set_Speed(Lpwm_val,Rpwm_val);
                  Show_V(Lpwm_val);
                  }
 break;
case IR_Speed_DOWN:if(Rpwm_val-10>=0&&Rpwm_val-10>=0){    //decreasing speed
                  Lpwm_val-=10; Rpwm_val-=10;
                  Set_Speed(Lpwm_val,Rpwm_val);
                  Show_V(Lpwm_val);
```

```
                        }
            break;
            default:
            break;
          }
          irrecv.resume(); // Receive the next value
        }
    }
    lcd.clear();
    lcd.setCursor(0, 0);    //setting cursor in the first row and column
    lcd.print("    Wait    Signal    ");
    stopp();
}
void Bluetooth_Control() //Bluetooth remote control
{
     lcd.setCursor(0, 0);    //setting cursor in the first row and column
     lcd.print("BluetoothControl");

     if(Serial.available()) //to judge whether serial port receive data
       {
         Bluetooth_val=Serial.read();    //reading value of Bluetooth serial port, giving the value to val
       switch(Bluetooth_val)
         {
            case 'U':advance(); //UP
            break;
            case 'D': back();      //back
```

```
            break;
            case 'L':turnL();      //Left
            break;
            case 'R':turnR();    //Right
            break;
            case 'S':stopp();       //stop
            break;
        }
       }
}

void setup()
{
    pinMode(servopin,OUTPUT);    //setting motor interface as output
    LCD1602_init();                    //initializing 1602
    M_Control_IO_config();         //motor controlling the initialization of IO
    Set_Speed(Lpwm_val,Rpwm_val);    //setting initialized speed
    Set_servopulse(DuoJiao);             //setting initialized motor angle
    Sensor_IO_Config();                   //initializing IO of line tracking module
    irrecv.enableIRIn();                  //starting receiving IR remote control signal
    pinMode(inputPin, INPUT);           //starting receiving IR remote control signal
    pinMode(outputPin, OUTPUT);       //IO of ultrasonic module
    Serial.begin(9600);                   //initialized serial port, using Bluetooth as serial port, setting baud
    lcd.setCursor(0, 0);                  //setting cursor at 0.0
    lcd.print("    Wait    Signal    ");    //LCD printing character string
    stopp();                                  //stop
```

```
}
void loop()
{

    if (irrecv.decode(&results))
    {//when receiving a button
        if(results.value == IR_XunJi_Mode)
        {
          while(IR_XunJi_Mode)
          {
            Xunji_Mode();
          }      //pressing“OK”on remote controller, and entering remote control mode
        }
        if(results.value == IR_Self_Control)
          {
            while(IR_Self_Control)
            {
            Self_Control();    //pressing“OK”on remote controller, and entering remote control mode
            }
          }
        if(results.value == IR_IR_Control)
          {
            while(IR_IR_Control)
            {
            IR_Control();    //pressing“OK”on remote controller, and entering remote control mode
            }
```

```
            }
          if(results.value == IR_Bluetooth_Control)
            {
              while(IR_Bluetooth_Control)
              {
              Bluetooth_Control();    //pressing “OK” on remote controller, and entering remote control mode
              }
            }
          irrecv.resume(); // Receive the next value
        }
    delay(10);
}
*********************************************************************************
```

**Result**

The car is controlled by IR remote control and mobile phone Bluetooth together.

After connection, press the key numbered 5 of IR remote control, the car will enter into line tracking mode to go along with black line.

When pressing the reset, and then pressing the number 6 key, the car will enter into ultrasonic obstacle avoidance mode and it goes with automatic obstacle avoidance, displaying current condition and distance between car and obstacle on LCD.

Press reset and then press the number 7 key, the car is in IR control, its motion is controlled by IR up, down, right and left key, “OK” means stop.

Number 1 and 2 key control the rotation of motor, while 3 and 4 key will control its moving speed. Reset again, the car goes into Bluetooth mode. If connecting to Bluetooth APP, you can control the motion of the car by APP.