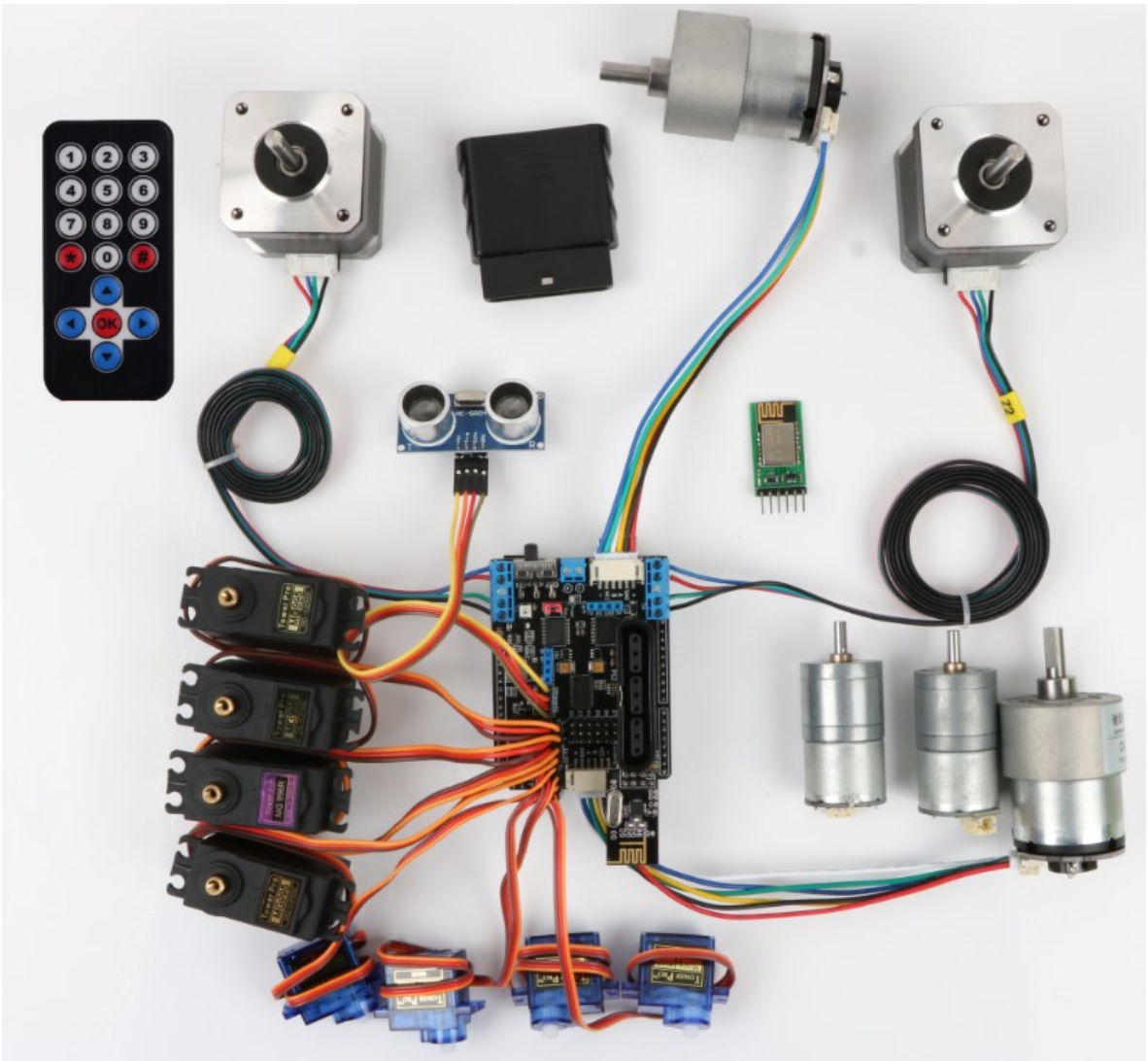
PS2X&Motor Drive Board Instruction Manual V.1.4



Revision

Date	Version	Description	Author
2018/11/27	V.1.0	Create	Abbott.Chen
2019/1/2	V.1.1	Rearrange the document frame and fix the error	Ken.chen
2019/1/11	V.1.2	Optimize and supplement documentation	Abbott.Chen
2019/1/14	V.1.3	Modify the image, the loading code is partially highlighted	Ken.Chen
2019/9/20	V.1.4	Modify the picture, modify the code path, increase the 6-way servo to 8	Carl.Du

Catalog

Overview

The PS2X&Motor Driver Board driver can drive 4 DC motors, 2 encoder motors, 2 stepper motors, 8 servos (external power supply), and drive current up to 2A. Designed specifically for the Arduino uno R3 and Arduino mega 2560 motherboards, the driver board can be directly plugged into the Arduino Uno and Arduino mega 2560. The motherboard integrates a passive buzzer, 2 RGB LED lights, and 1 IR receiver. head. Also reserved for PS2 socket, Uart interface, I2C interface, ultrasonic obstacle avoidance module socket and other sensor interfaces, it is very convenient to externally connect various sensor modules.

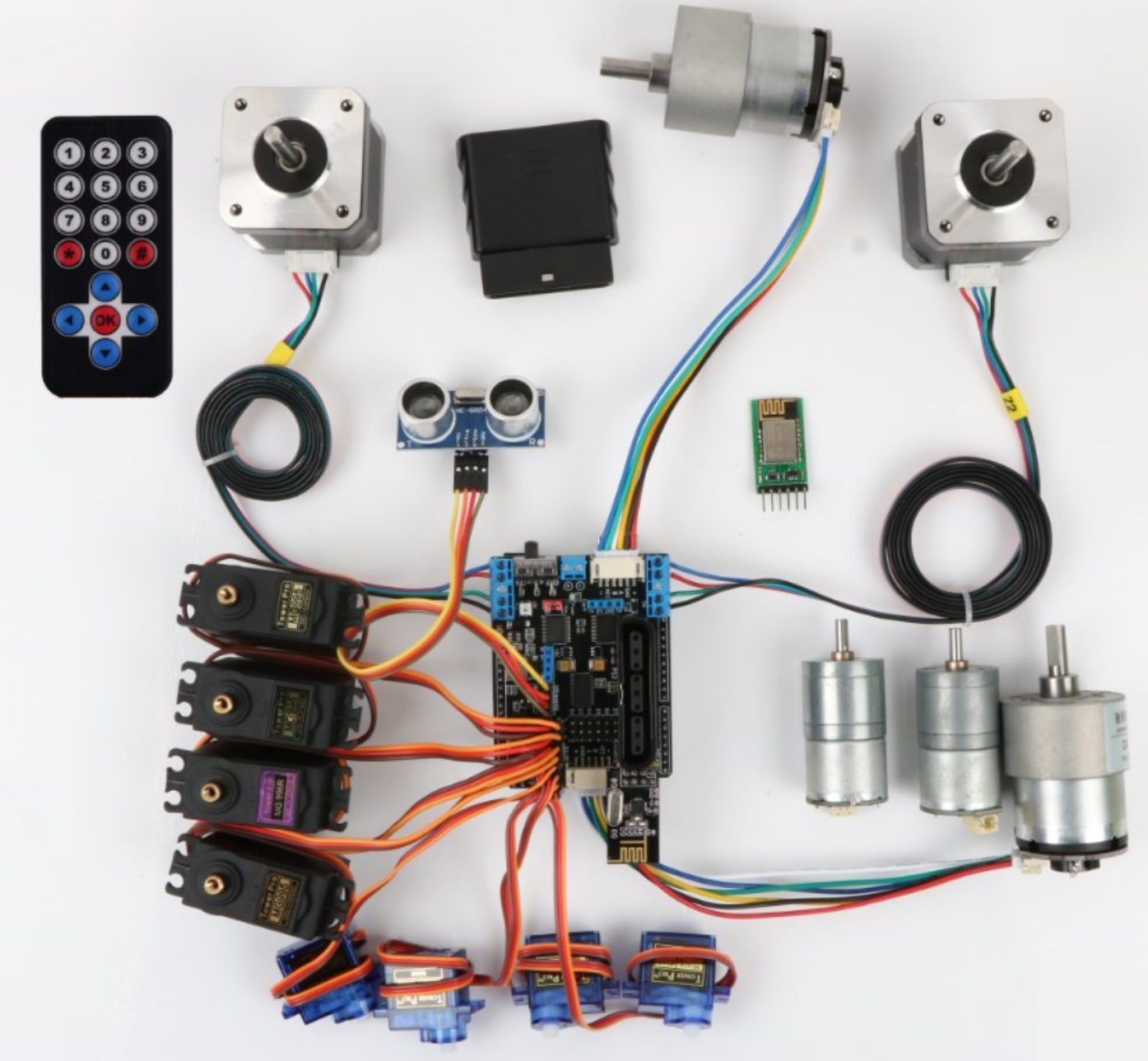
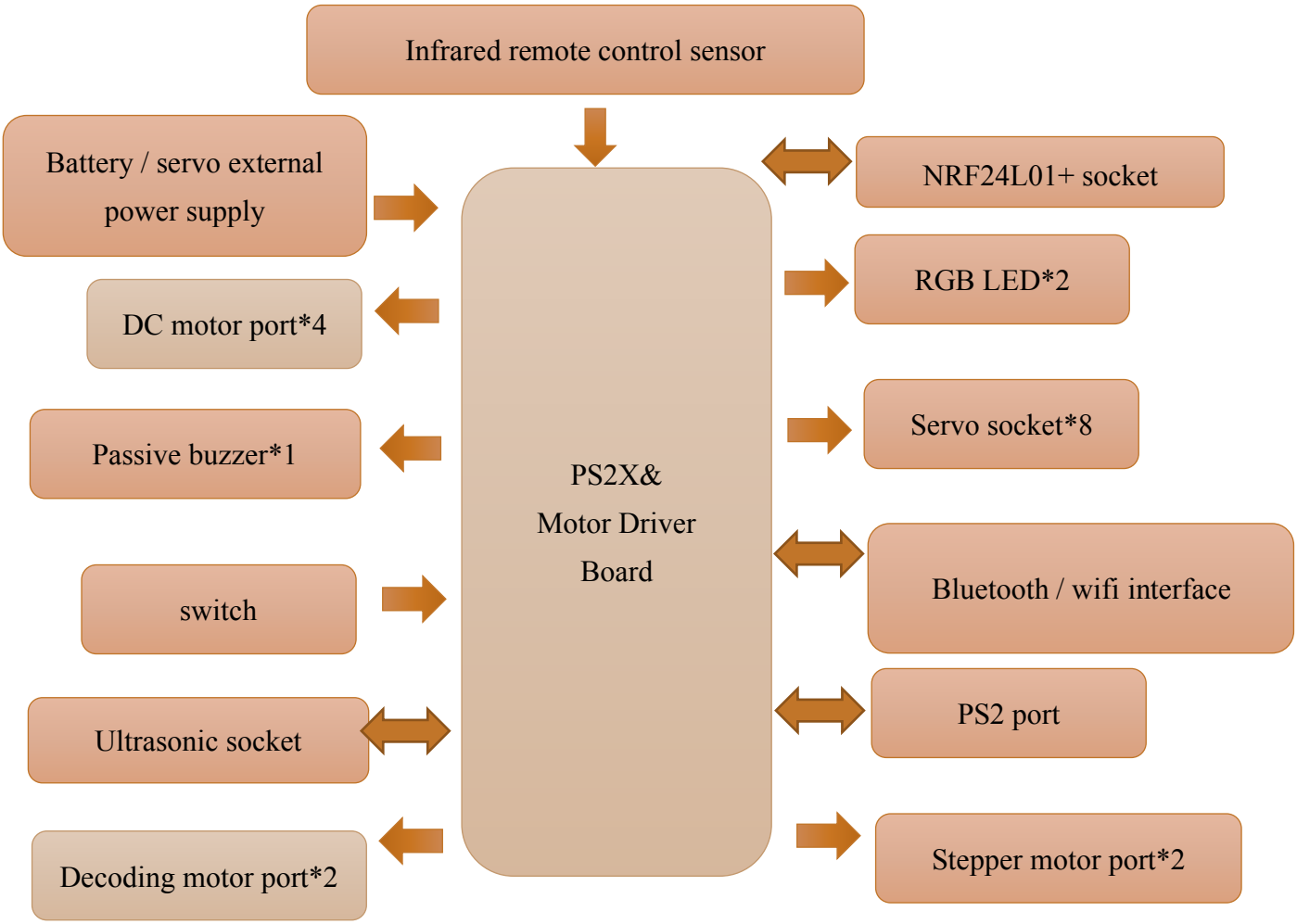


Figure 1-1 Function Display

PS2X&Motor Driver Board Composition frame



Driver Board Introduction

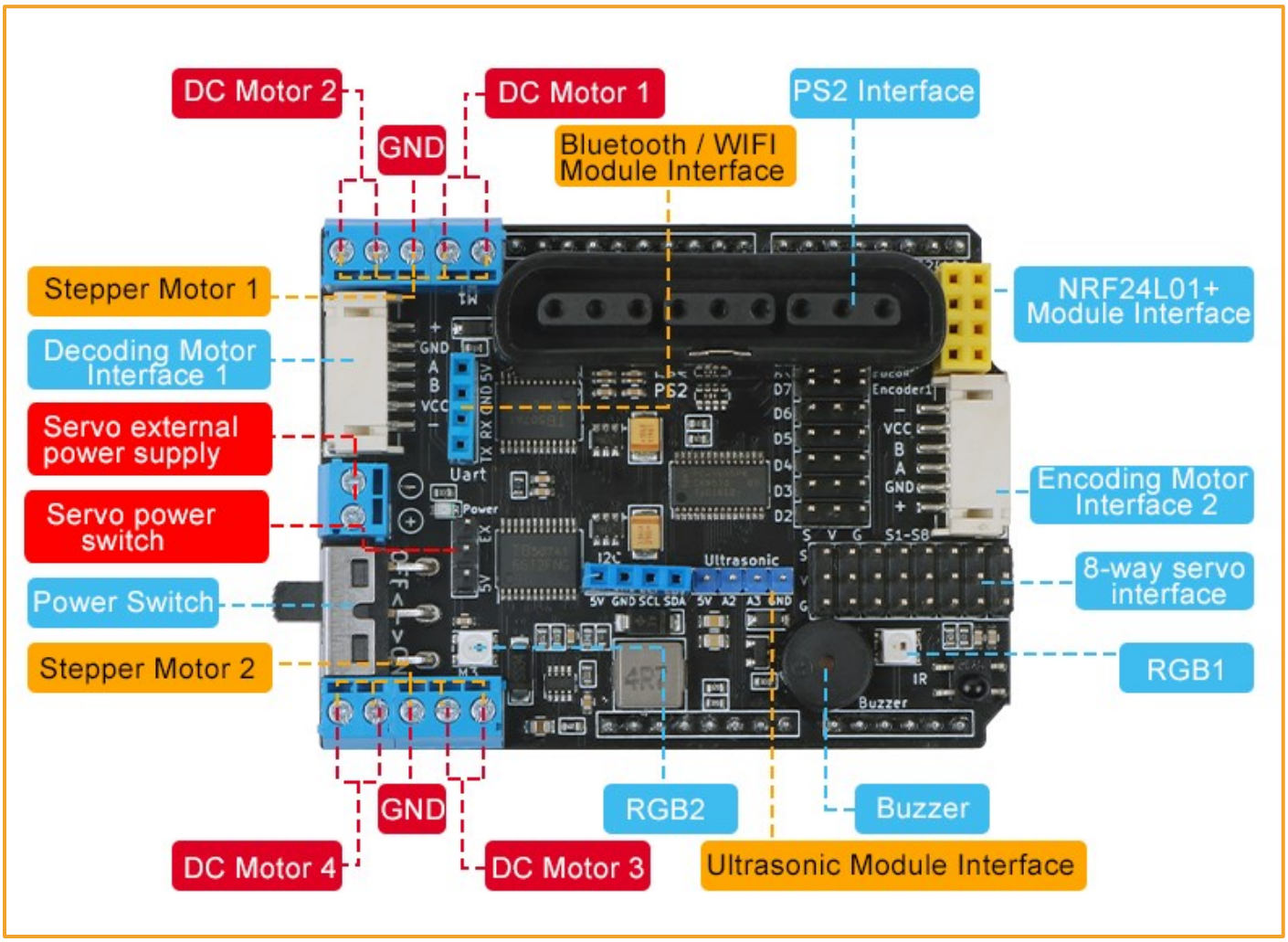


Figure 3-1 PS2X&Motor Driver Board Introduction

Common problems

Q：How to power the PS2X&Motor Driver Board?

A：It can be directly powered by the DC port of Arduino UNO, with a voltage range of 6~12V.

Q：How many motors does the PS2X&Motor Driver Board can drive?

A：The PS2X&Motor Driver Board can drive 4 DC motors ,2 stepper motors or 2 encoder motors.

Q：How does PS2X&Motor Driver Board connect power drive servo?

A：PS2X&Motor Driver Board 8 servos support external power supply steering gear. The external power supply interface of the servo is connected to the power supply. The jumper cap is connected to EX, and the power supply of the external power supply is just fine.

Q：I want to upload the sample program to the Arduino board, suggesting that the upload failed. What is the reason?

A：Before uploading the sample program to the Arduino board, you need to check if the board and the computer are properly connected, then install the driver and try again.

Q：I want to upload the sample program to the Arduino board, and then the motor does not work after turning on the power. What is the reason?

A：Firstly, check if the green indicator on the Arduino UNO board is on. If it is not on, it means the power supply is not normal. Check whether the battery voltage is above 6v. Then check whether the motor's wiring port is consistent with the port set in the program. Turn it on again.

Q：How to install graphical programming library?

A：Download the relevant tutorial under this link: https://github.com/keywish/motor-drive-board

Q：Where can we download the program examples?

A：**Dow**nload the relevant tutorial under this link: https://github.com/keywish/motor-drive-board

Q：My Arduino will crash when the motor is running. Is the drive broken?

A：When the motor is running, the power consumption is large. You need to ensure that the battery has sufficient power. You can try to charge the battery before turning it on.

Software Installation

Install IDE software

Unzip the Arduino software installation package (path: MotorDriverBoard\ArduinoIDE) under the MotorDriverBoard folder, or download it from the Arduino website, download the address : https://www.arduino.cc/en/Main/OldSoftwareReleases#previous

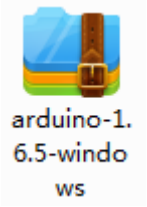


Figure 4-1 Arduino IDESoftware installation package

Unzip the zip file and double-click the arduino.exe installation file to install it. Because the installation of “arduino.exe” is very simple, it will not be explained here. It is recommended to quit the anti-virus software during the installation process, otherwise it may affect the IDE installation. After the installation is complete, click "arduino.exe" again to enter the IDE programming interface.

After the IDE installation, we connect the Arduino motherboard, right click on "My Computer"→ “Properties”→ “Device Manager”→View “Port（COM 和 LT）”.If you see the interface below, the

driver has the installation is successful. At this time, we open the IDE and select the corresponding development board model and port in the toolbar to use it normally.

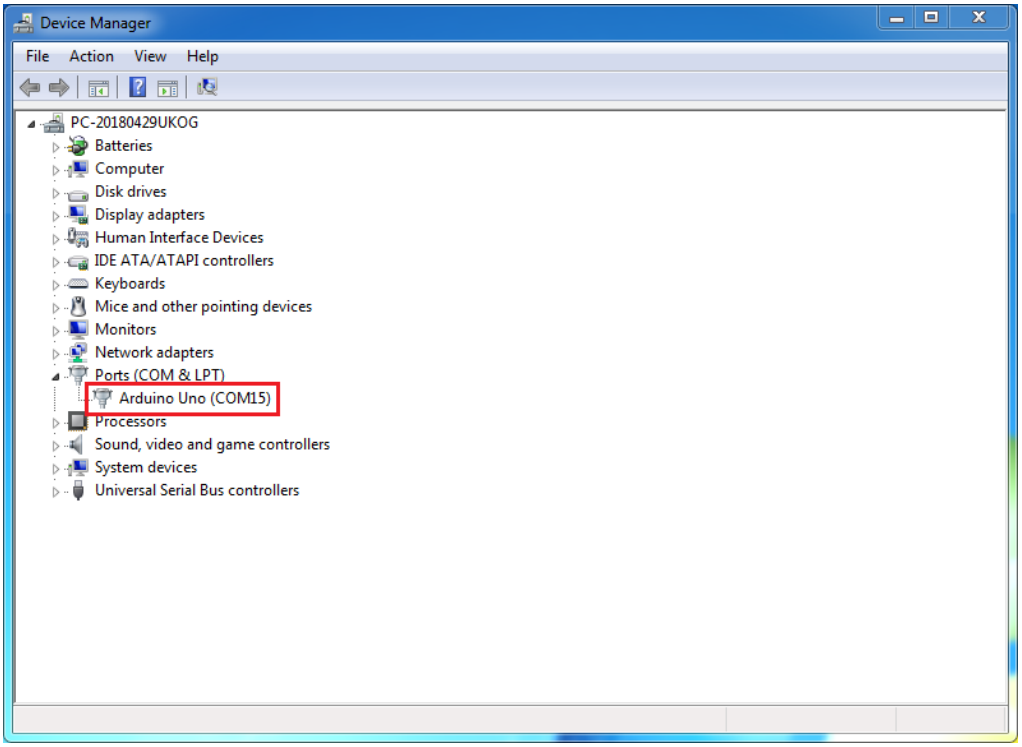


Figure 4-2 Driver installation successful interface

Notice:

1）If you connect the controller board to your computer, the computer does not respond. Right click on "My Computer" and select Open Device Manager to view the port (com&lpt). If there is no com or lpt, or if there is only an unknown device, there is a problem with the controller board or USB cable.

2）Right click on "My Computer" and select Device Manager to view the ports (COM and LPT). If there is a yellow Arduino UNO exclamation point, this means you need to install the driver yourself, the drive path: MotorDriverBoard\ArduinoIDE.

3）If the driver is always installed but eventually fail. Please uninstall the driver and reinstall > automatically install the driver > restart the computer.

Install driver

1、If your computer is a Windows 7 system:

1）Firstly, right click on "My Computer" and open the Device Manager to view the ports (COM and LPT). At this point you will see a "USB Serial Port", right click on "USB Serial Port" and select the "Update Driver Software" option.

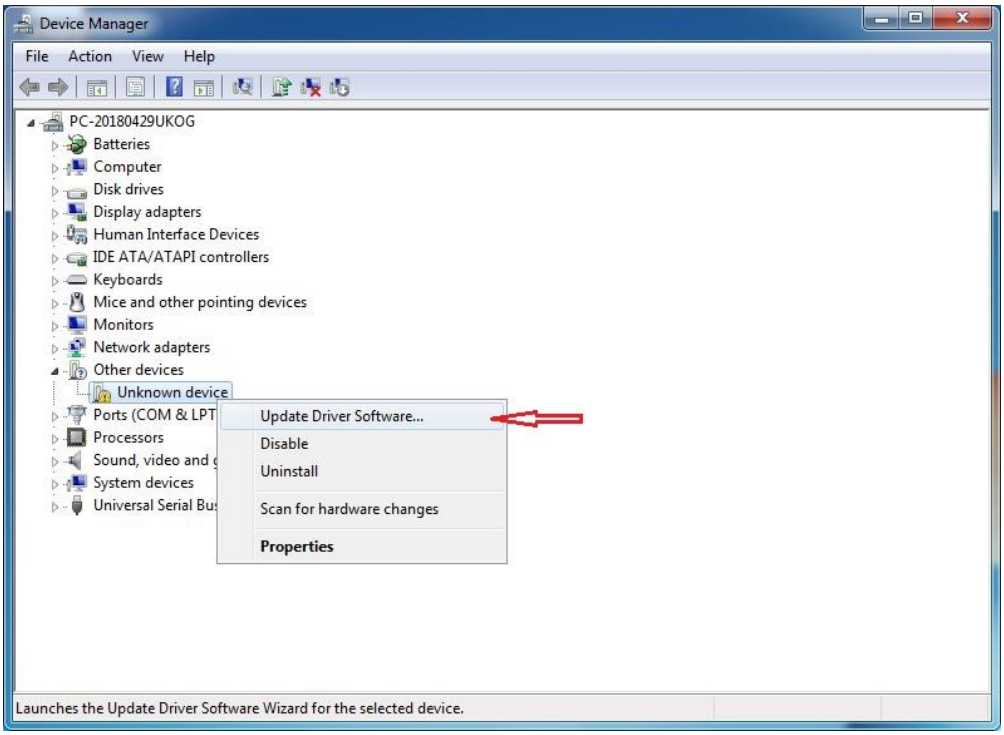


Figure 4-3 Update Driver

2）Nextly, next select the "Browse my computer for driver software" option.

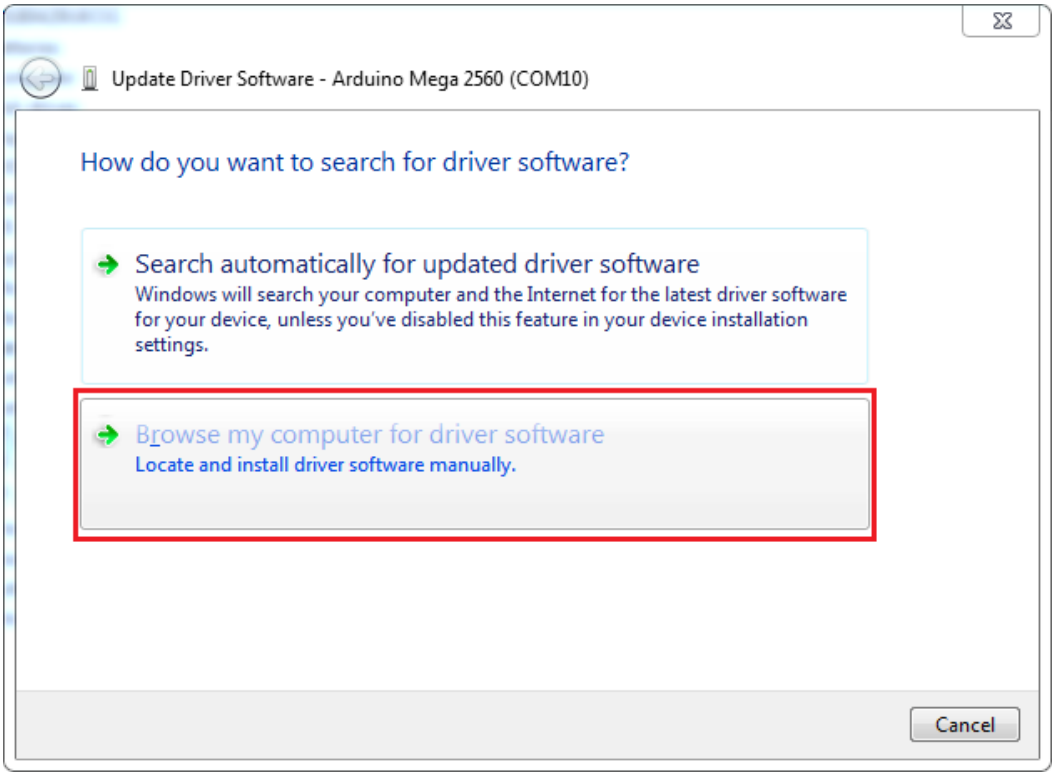


Figure 4-4 Driver update selection interface

3）Finally select the driver file named "FTDI USB Drivers" located in the "Drivers" folder of the Arduino software download.

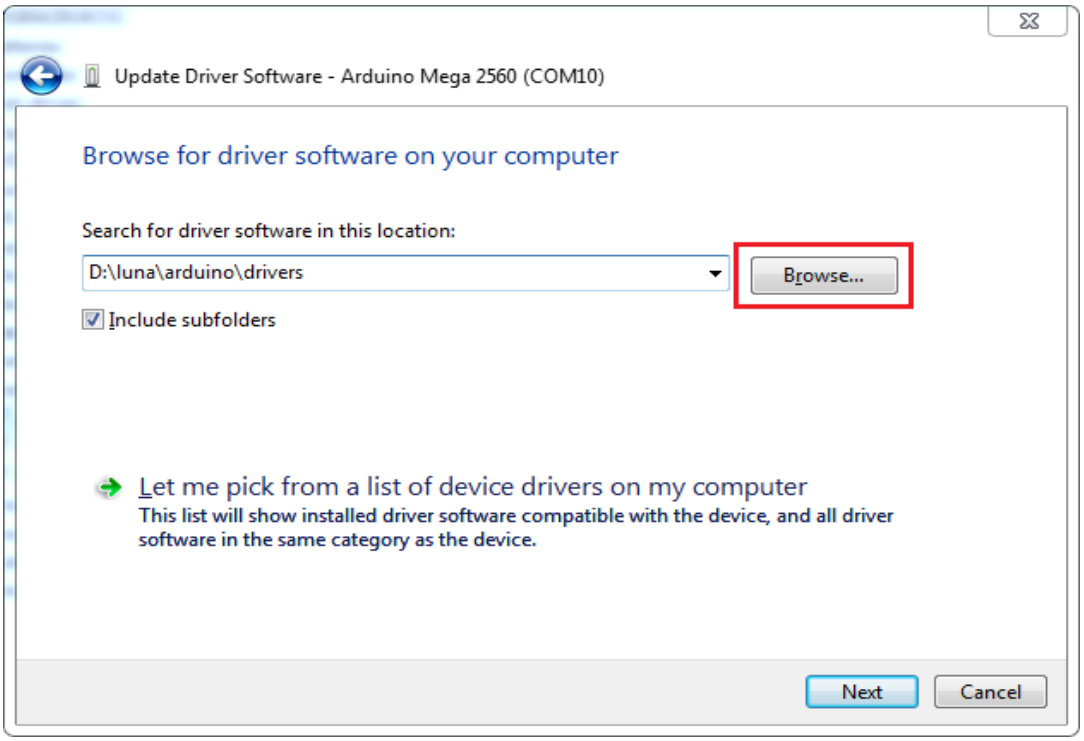


Figure 4-5 Select drive path

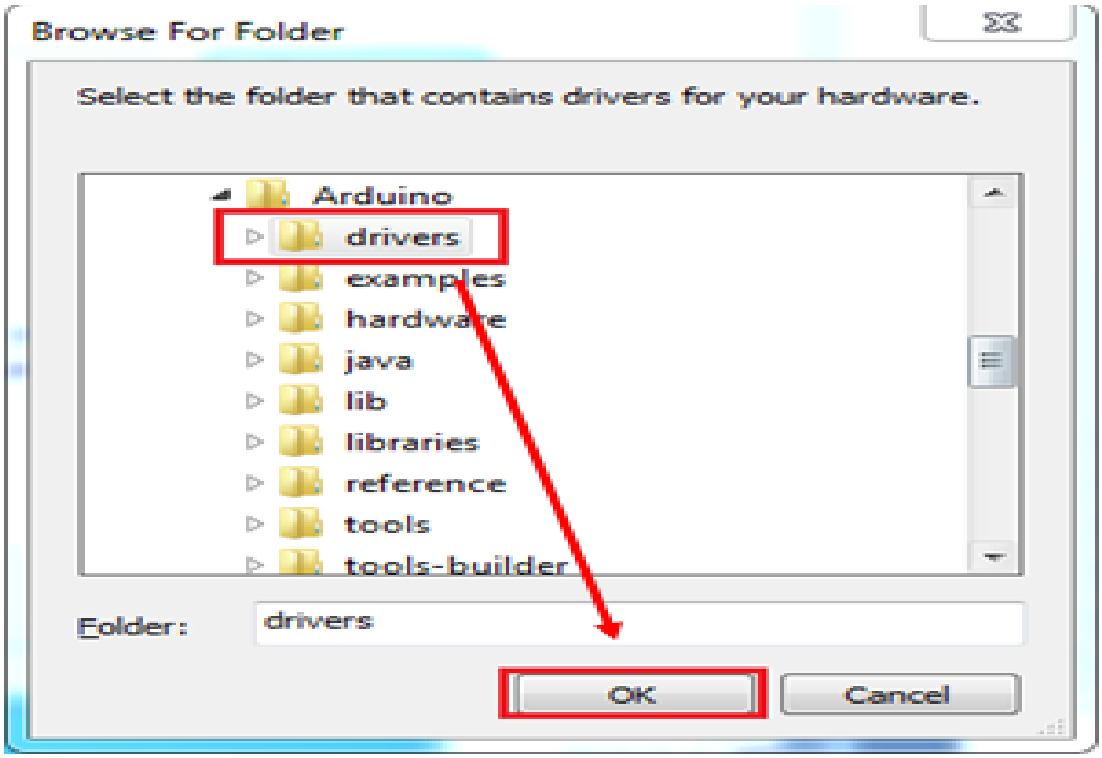


Figure 4-6 install driver

4）If you have already installed it, the interface shown in Figure 4-7 below will appear, automatically notifying you that the drive is successful.

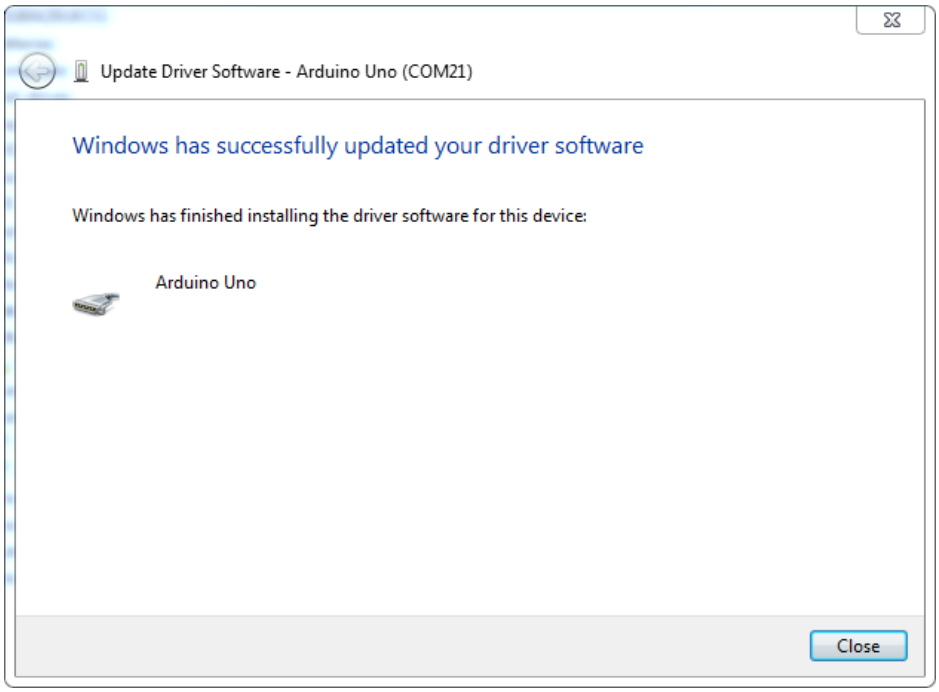


Figure4-7 Driver installation completed

At this time, we return to the "Device Manager" interface, the computer has successfully identified the Arduino, as shown in Figure 4-8, then open the Arduino compiler environment, you can open the Arduino journey.

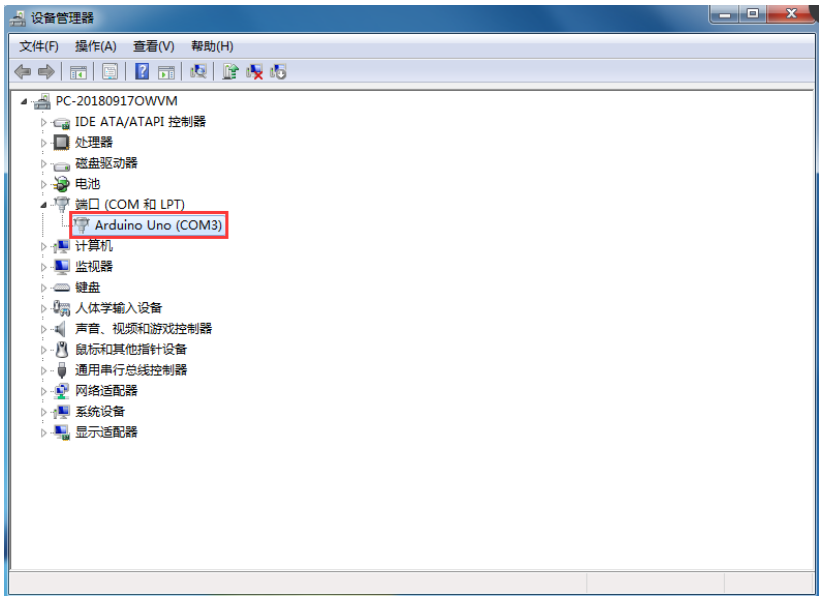


Figure 4-8 Drive successful identification interface

Note: In the Win10 system, after some Arduino is connected to the computer (non-genuine chips are difficult to be recognized), the system will automatically download the corresponding driver, you don't need to install the driver by yourself, but in Win7 system, you need to follow the above steps. Install the driver manually.

As shown in the figure above, we can see that the USB serial port is recognized as COM15, but different computers may be different. You may be COM4, COM5, etc., but the Arduino Uno must be the same. If you do not find the USB serial port, it may be that you installed it incorrectly or the system is not compatible.

IDE interface introduction

Then we introduce the IDE interface of Arduino. Firstly, enter the software directory. Then you can see the arduino.exe file and double click to open the IDE. As shown in Figure 4-9.

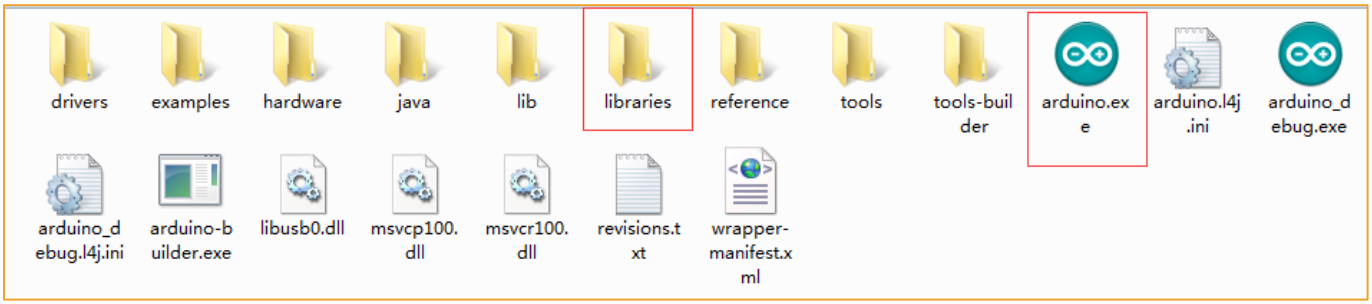


Figure 4-9 Software catalog

1、The first thing that catches your eye is the interface below. The toolbar button functions are "Compile" - "Upload" - "New Program" - "Open Program" - "Save Program" - "Serial Monitor", as shown in Figure 4-10.

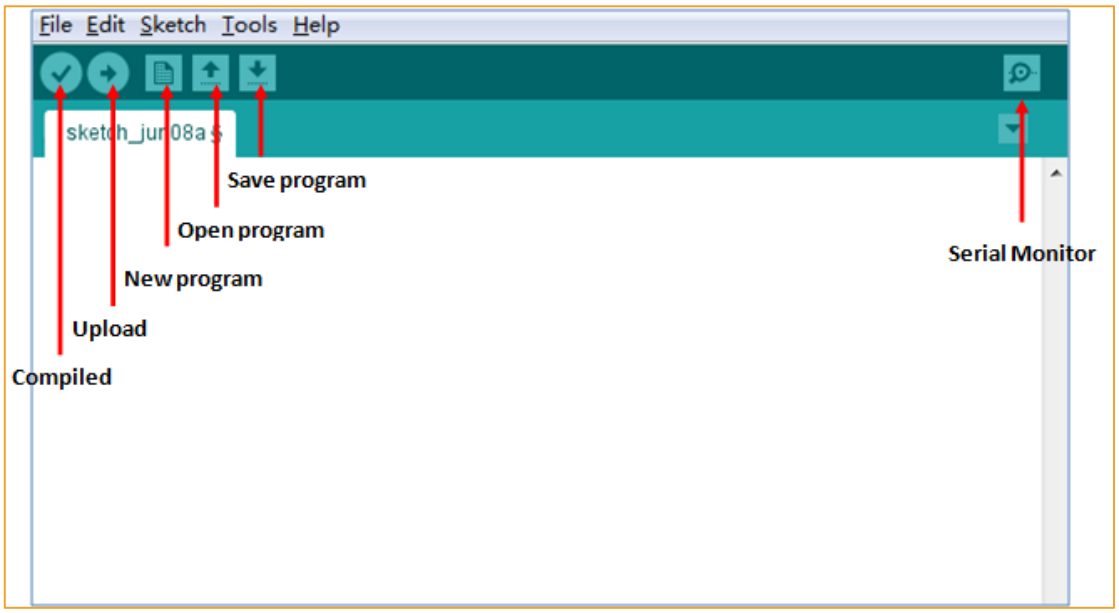


Figure 4-10 Arduino IDE interface

2、There are 5 menus on the menu bar, but we mainly introduce File and Tools. Click File, the interface shown in Figure 4-11, you can see the Examples and Preference options.Examples are some of the Arduino's own programs, these are compiled and can be used normally, which is very helpful for beginners. The Preference option is mainly the setting of parameters, such as language, font, etc.

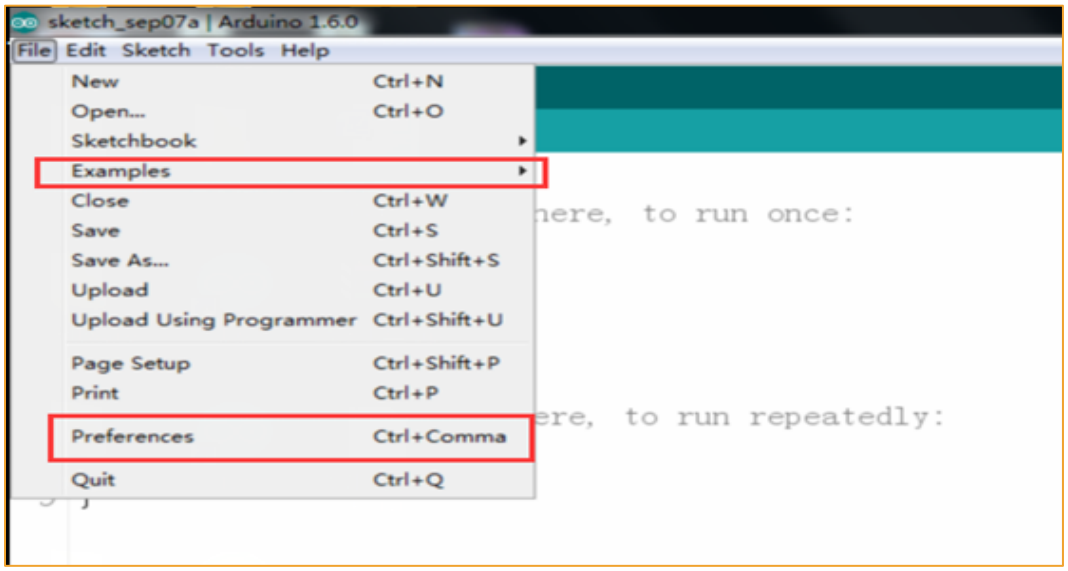


Figure 4-11 File menu bar options

3、Click Tools, the interface shown in Figure 4-12 pops up. Here we can see the two options of Board and Port. In the Board option, we can see the commonly used Arduino development board models, you only need to choose according to the development board in your hand. In the Port option, the USB serial port is mainly selected, as shown in Figure 4-13. If you are not sure, you can view it in the Device Manager and select the corresponding COM port.

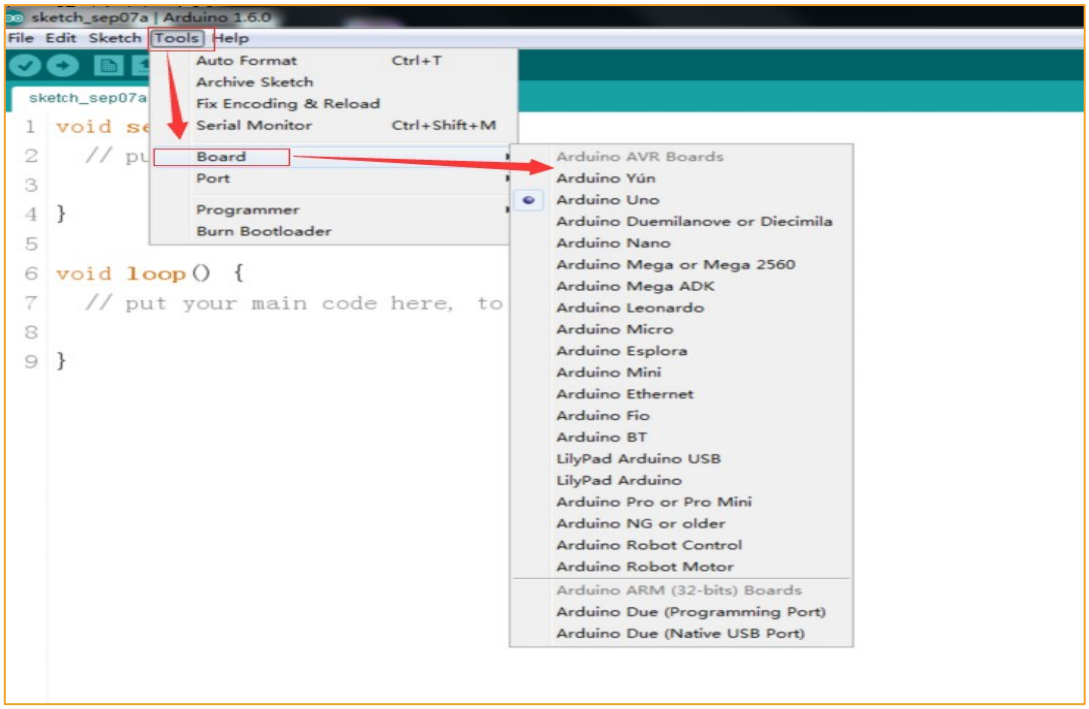
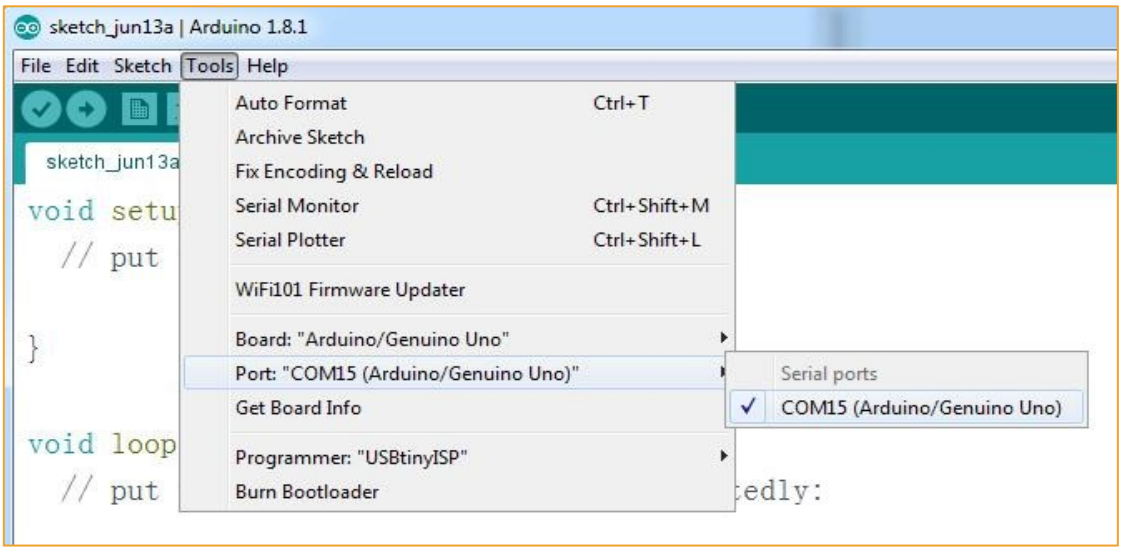


Figure 4-12 Tools interface



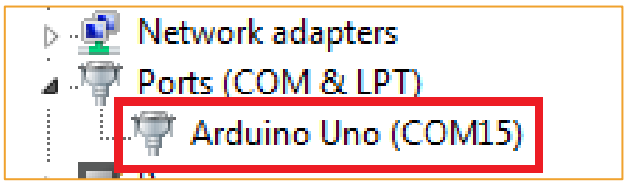


Figure 4-13 USB Serial port selection

So far, we have basically completed all the work, the next step is to combat, open any of the programs in Examples. First compile the program, if compiled correctly, you can directly download to the development board, then connect the corresponding device and the wire, you can see the corresponding phenomenon.

Connect to the Arduino UNO R3 development board

The pin header on the PS2X&Motor Driver Board can be plugged directly into the Arduino UNO R3 development board. No other flying lines are required. The pins are fully compatible and easy to install.

Run the sample code steps

1) Connect the Arduino UNO R3 development board connected to the PS2X&Motor Driver Board to the computer via a USB cable;
2) Click "Connect→ Serial port→COM4(the number of this COM port is different for different computers)";
3) Burning sample program (taking DC motor as an example)
4) In the IDE, choose "file → turn on", Open the DC motor test sample code in the code base (sample program file path: **Lesson\Module_Test\Encoder_DC_Test\Encoder_DC_Test.ino**);
5) Click the Upload button to burn the motor test sample program into the Arduino UNO R3 development board connected to the PS2X&Motor Driver Board.

Driver Board Power Supply

The power supply on the driver board can be directly powered by the DC port of the Arduino UNO. The voltage range is 6~12V and the current is 500mA~2A. Or PH2.0 wiring port power supply, the voltage range is 6~12V, there is a power supply jumper cap on the drive board, you need to short circuit the IN and 5V.

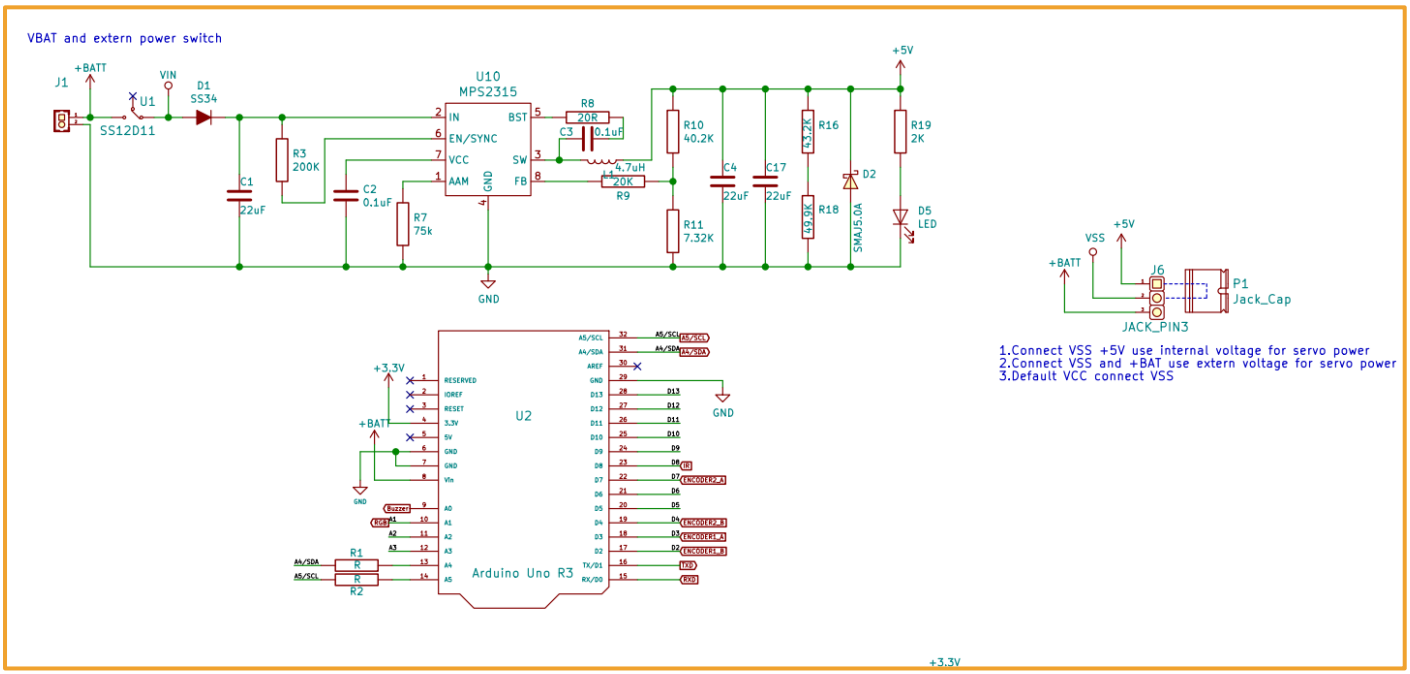


Figure 5-1 Power schematic

External power interface

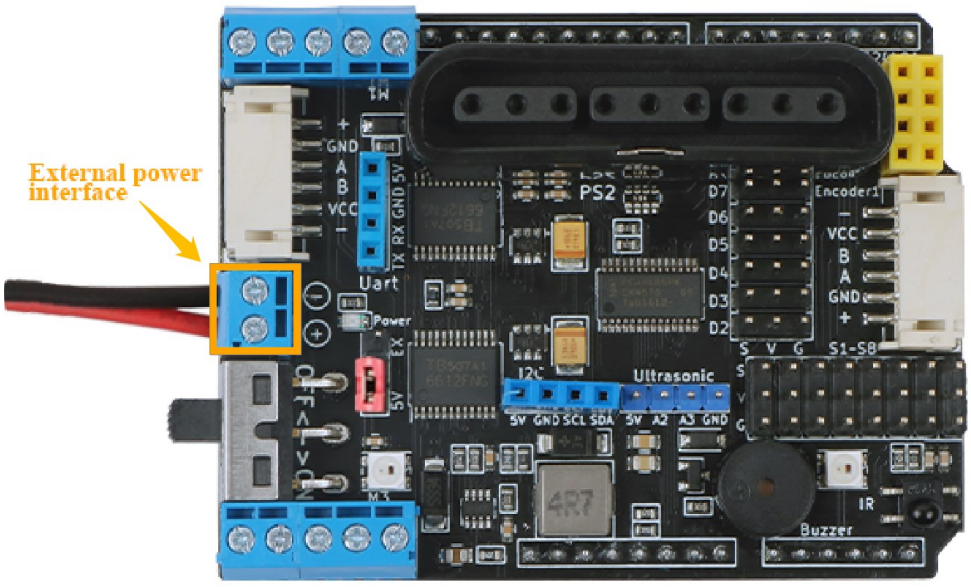


Figure 5-2 External power interface

The MotorDriverBoard can be powered in two ways. One is to power the MotorDrvierBoard through the UNO motherboard, and the other is to supply power through the external power supply. The external power supply can also supply power to the UNO board. But no matter what kind of power supply mode, the power switch is still the same.

Servo power supply:

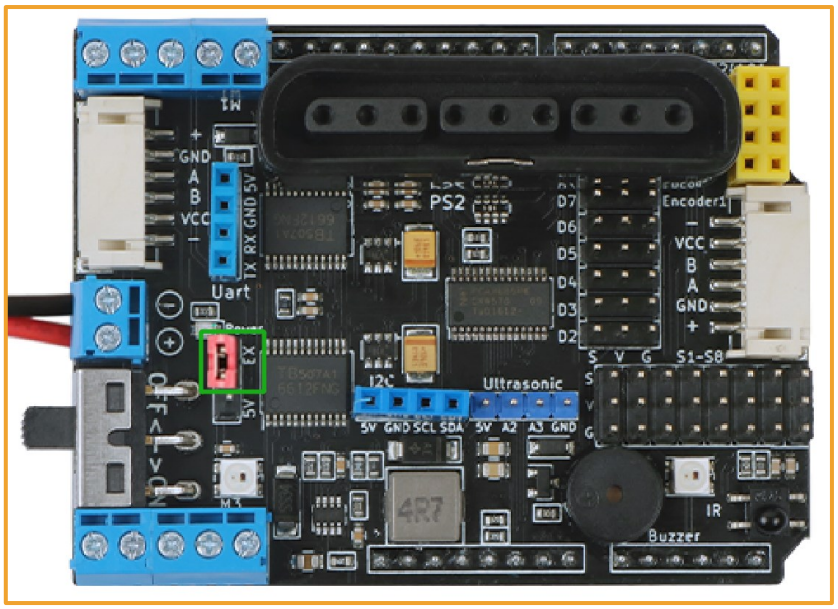
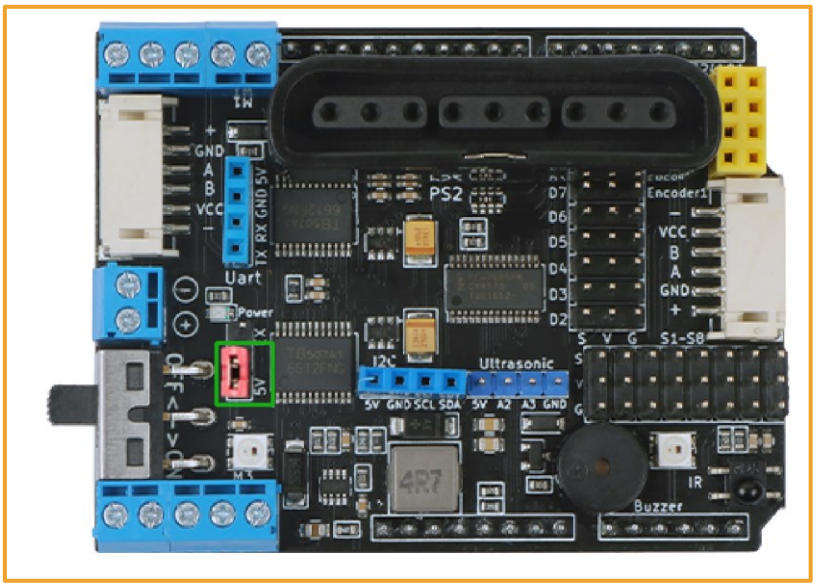


Figure 5-3 Power supply of the expansion board Figure



5-4 Power supply of the external power supply

When the shorting cap is inserted at 5V, the servo is powered by the step-down chip of the expansion board. The maximum current of 5V can reach 3A.

When the shorting cap is inserted into the EX, the servos use external power supply. This external power supply has two power supply modes, one is through the UNO motherboard, and the other is through the external power interface. Both external power supplies are directly used externally. The power of the power supply.

DC Motor

Motor control principle

The PS2X&Motor Driver Board uses the PCA9685 to output the PWM control motor driver chip TB6612FNG. Now we'll briefly introduce the two chips.

The main parameters of PCA9685 are as follows:

- I2C interface control can control 16-channel PWM and support up to 16 servos or PWM output, 12-bit resolution for per channel (4096 levels)
- Built-in 25MHz crystal oscillator, can be connected to external crystal oscillator or can also not be connected to external crystal oscillator, up to 50MHz.
- Supporting 2.3V-5.5V voltage, maximum withstand voltage is 5.5V

  With power-on reset, software reset and other functions

The device address of the PCA9685 is determined by the pins A0, A1, A2, A3, A4, and A5, and the pin cannot be left floating. Since there are six pins that together determine the device address, there are 64 device addresses. Since the IC keeps the LED All Call address (E0h, 1110 000) and Software Reset address (06h, 0000 0110) after power-on, there are only 62 available device addresses. Therefore, theoretically one I2C interface can control the way 16* 62=992 PWM, the pin control device address is shown in the figure below:

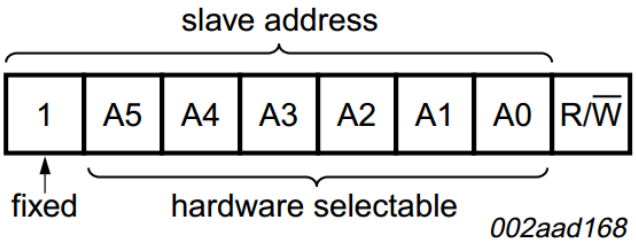


Fig 4. Slave address

Figure 6-1 Device address schematic

For detailed use of the chip, please refer to《MotorDriverBoard\Datasheet\PCA9685.pdf》

TB6612FNG Introduction

The PS2X&Motor Driver Board uses TB6612FNG to drive the motor. The TB6612FNG has a high-current MOSFET-H bridge structure, dual-channel circuit output, and a continuous drive current of up to 1.2 A per channel. The peak current is 2A/3.2 A (continuous pulse/single pulse). 4 kinds of motor control

modes: forward/reverse/brake/stop; standby state; PWM supports frequency up to 100 kHz; on-chip low-voltage detection circuit and thermal shutdown protection circuit, main pin function of TB6612FNG: AINl/AIN2 BIN1/BIN2, PWMA/PWMB are control signal input terminals; AO1/A02, B01/B02 are 2 motor control output terminals; STBY is normal working/standby state control pin; VM (4.5~15 V) and VCC (2.7 to 5.5 V) are the motor drive voltage input and the logic level input, respectively.

In the Arduino, the analog voltage cannot be output, and only the digital voltage value of 0 or 5V can be output. We use the high-resolution counter to modulate the square wave's duty cycle to the level of a specific analog signal to encode. The PWM signal is still digital because at any given time, the full-scale DC supply is either 5V (ON) or 0V (OFF). The voltage or current source is applied to the analog load in a repeating pulse sequence of ON or OFF. When the DC power is applied to the load, the power is disconnected when the power is turned off. Any analog value can be encoded using PWM as long as the bandwidth is sufficient. The output voltage value is calculated by the on and off times. Output voltage = (on time / pulse time) * maximum voltage value, Figure 6-2 is the voltage corresponding to the pulse change.

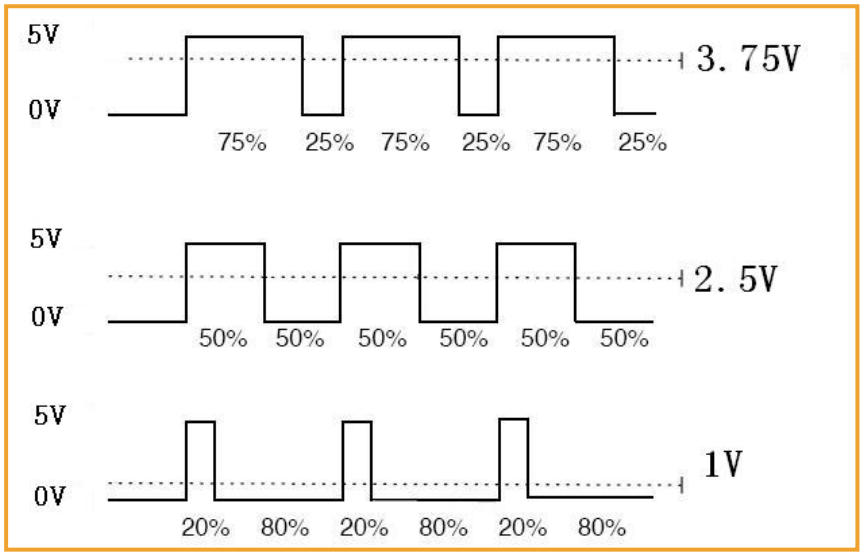


Figure 6-2 Diagram of pulse and voltage

For detailed use of the chip, please refer to《MotorDriverBoard\Datasheet\TB6612FNG.pdf》

Driving DC motor

The PS2X&Motor Driver Board has four DC motor interfaces, namely DC motor interface 1, DC motor interface 2, DC motor interface 3 and DC motor interface 4, which can be directly connected to the drive via the terminals. Connect 4 DC motors to DC motor interface 1, 2, 3, 4 (as shown in Figure 6-3). After connecting the motor, connect the battery to the development board, turn on the power switch, and the program starts running. We will see the motor will turn up, and the drive schematic of the DC motor is shown in Figure 6-4.

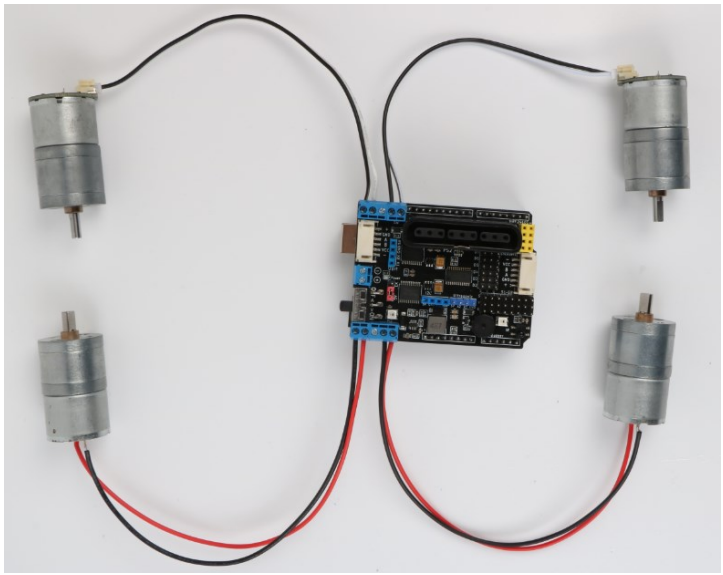


Figure 6-3 DC Motor connection diagram

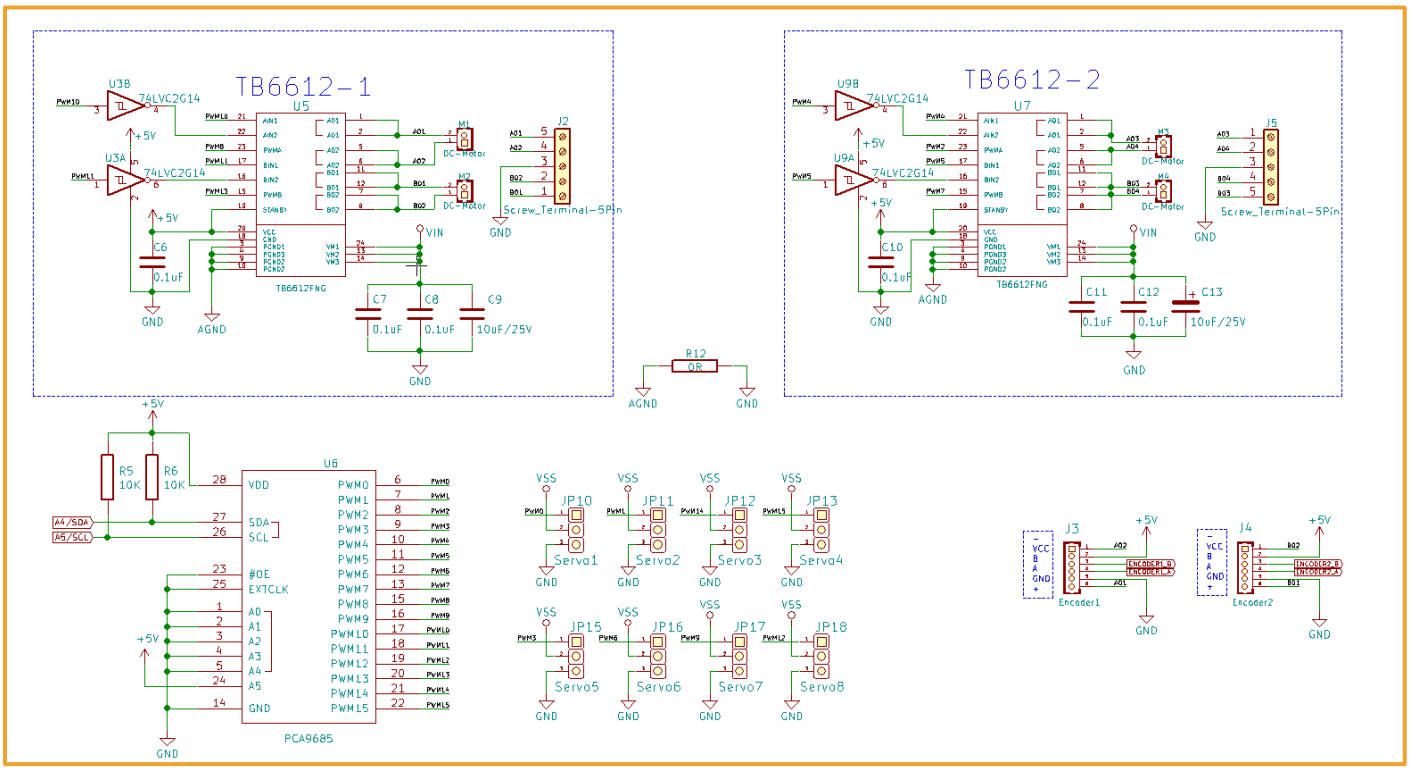


Figure 6-4 Motor drive schematic

Experimental procedure

Open the IDE, load the file -> **Lesson\Module_Test\Encoder_DC_Test\Encoder_DC_Test.ino**

We can see that motor 1 and motor 2 keep turning forward and reverse.

Stepper Motor

Principle of stepper motor

Stepper motor is an open-loop control motor that converts electrical pulse signals into angular displacement or line displacement. It is the main actuator in modern digital program control systems and widely used. In the case of non-overloading, the speed and stop position of the motor only depends on the frequency of the pulse signal and the number of pulses.

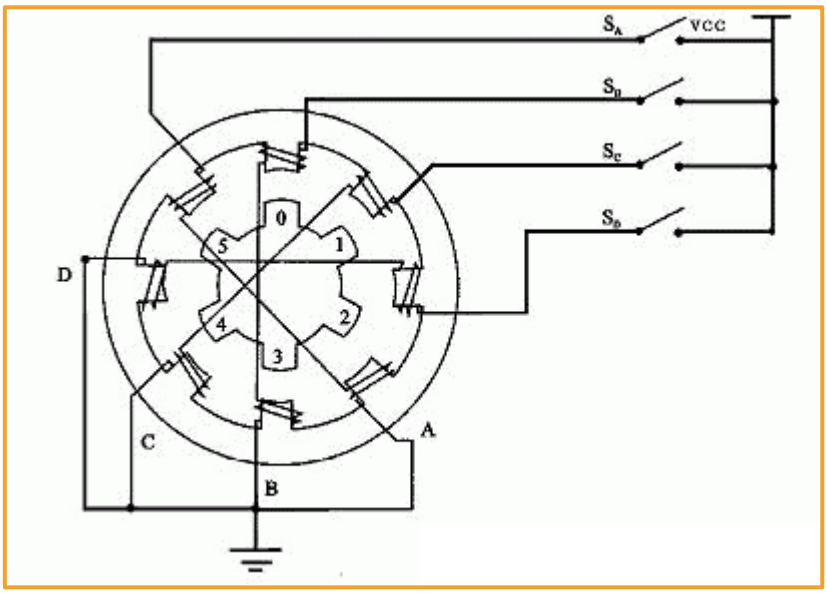


Figure 7-1 stepper motor schematic

As shown in Figure 7-1 above, there are multiple pairs of magnetic poles inside the stepping motor.If the power-on state remains unchanged, the stepper motor will remain in a fixed state. Only by changing the energization state of each pair of poles can the stepper motor continue to rotate. Therefore, the stepper motor cannot be directly connected to the DC or AC power supply, and a dedicated driving power supply (stepper motor driver) must be used. The controller (pulse signal generator) can control the angular displacement by controlling the number of pulses to achieve the purpose of accurate positioning. At the same time, the speed and acceleration of the motor rotation can be controlled by controlling the pulse frequency, thereby achieving the purpose of speed regulation.

Driving stepper motor

Connect a stepper motor to port 1 and port 2 of the stepper motor as shown in Figure 6-5. The working voltage of the stepper motor is between 5~12V. If the working voltage of the stepper motor is too low or too high, there is a phenomenon that the burned motor or the drive board collapses, and the battery should be fully charged when driving the motor. After connecting the motor to the line (as shown in Figure 7-2), find

the stepper motor test sample program in the sample program (sample program file path: load file -> Lesson\Module_Test\Stepper_Test\Stepper_Test.ino). Burning the program into the development board, then turn on the power of the driver board, you will find the stepper motor rotates. The schematic diagram of the stepper motor is shown in Figure 6-4.

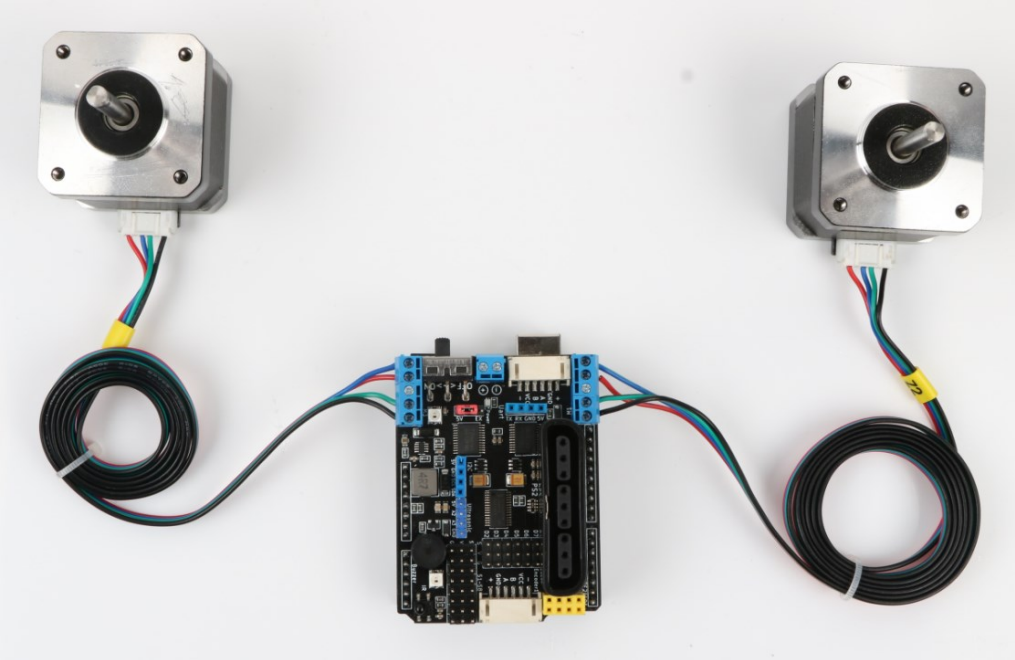


Figure 7-2 Stepper motor connection diagram

Encode Motor

Encoder Introduction

An encoder is a rotary sensor that converts angular or angular velocity into a series of electrical digital pulses. We can measure the displacement or velocity information through the encoder. The encoder is divided into output data types and can be divided into incremental encoders and absolute encoders. From the principle of encoder detection, it can also be divided into optical, magnetic, inductive and capacitive. Commonly used are photoelectric encoders (optical) and Hall encoders (magnetic) and our balanced car trials are Hall encoders.

Encoder Principle

A Hall encoder is a sensor that converts the amount of mechanical geometric displacement on an output shaft into a pulse or digital quantity by magnetoelectric conversion. The Hall encoder consists of a Hall code disc and a Hall element. The Hall code disc is equidistantly arranged with different magnetic poles on a circular plate of a certain diameter. The Hall code disc is coaxial with the motor. When the motor rotates, the

Hall element detects and outputs several pulse signals. In order to judge the steering, two groups of square wave signals having a certain phase difference are generally output. It can be seen that the encoders of both principles aim to obtain the square wave signal of the AB phase output, and the method of use is the same. The following is a simple schematic diagram.

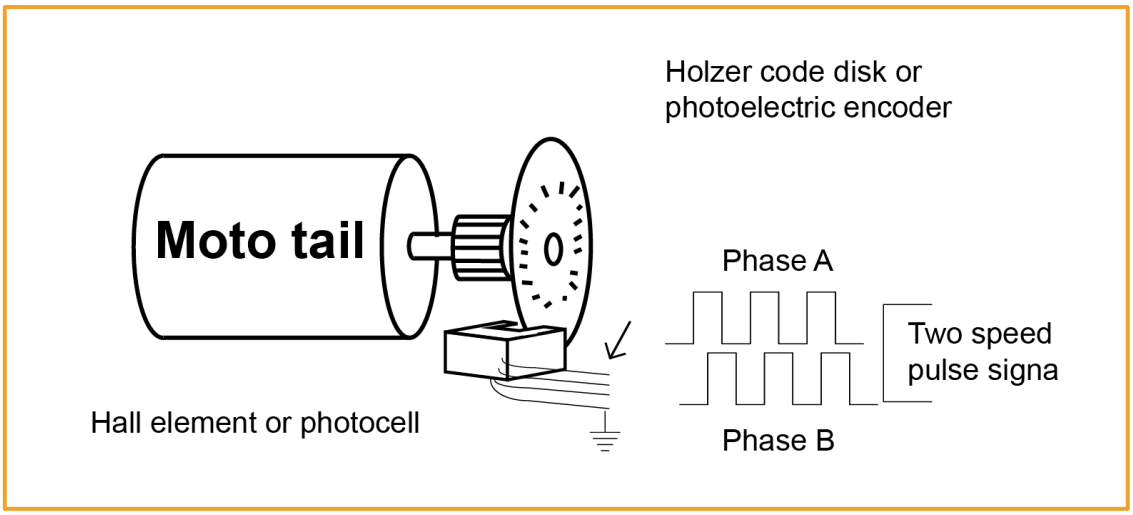


Figure 8-1 Schematic diagram of the Coded Motor

Encoder wiring instructions

Specific to our encoder motor, we can look at the actual motor encoder. This is an incremental output Hall encoder. The encoder AB phase output, so not only the speed can be measured, but also the steering can be discerned. According to the wiring instructions in Figure 6-2-4, we only need to supply 5V power to the encoder, and the square wave signal can be output through the AB phase when the motor rotates. The encoder comes with a pull-up resistor, so no external pull-up is required and can be directly connected to the microcontroller IO for reading.

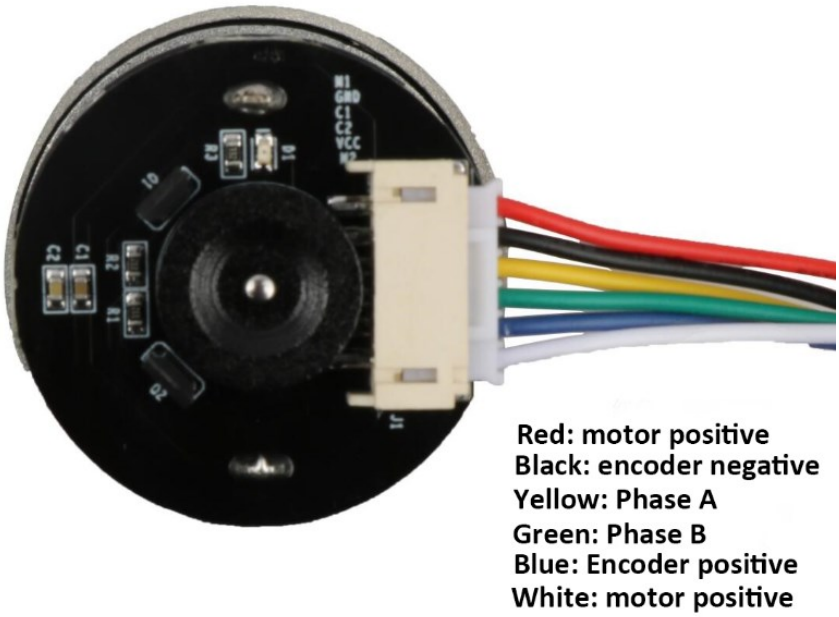


Figure 8-2 Encoder wiring diagram

Drive Encode Motor

Connect a coding motor to port 1 and port 2 of the encoder motor as shown in Figure 8-3. The working voltage of the encoder motor is between 5 and 12V. After connecting the motor to the line, find the encoded motor test sample program in the sample program (sample program file path: load file -> **Lesson\Module_Test\Encoder_Test\Encoder_Test.ino**), burn the program to the development board, and then turn on the driver. The power of the board will find that the two encoder motors will rotate synchronously. The schematic diagram of the encoder motor is shown in Figure 8-1.

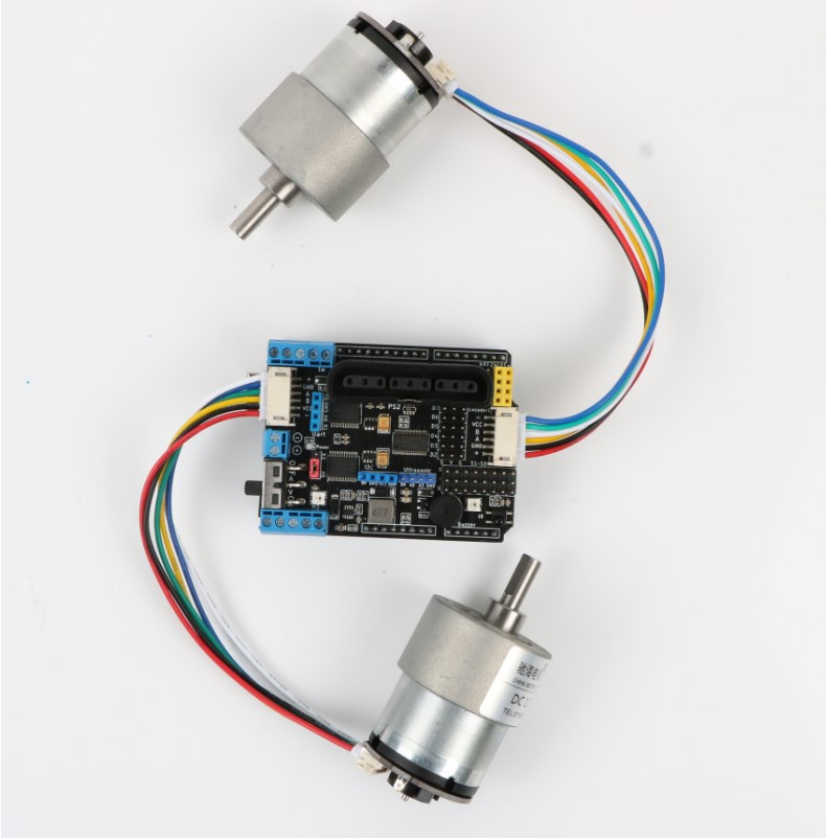


Figure 8-3 Coded motor connection diagram

RGB LED light

RGB WS2812 Introduction

The WS2812 RGB LED lamp is a three-channel drive control. It contains an intelligent digital interface data latch signal shaping and amplifying driver circuit. It also includes a high-precision internal oscillator and a 15V high-voltage programmable constant current output driver. At the same time, in order to reduce the power supply ripple, the three channels have a certain delay turn-on function, which can reduce the circuit ripple installation more easily during frame refresh.

Unlike the traditional RGB LED lamps, the WS2812 RGB LED lamps integrate a dedicated driver control chip to control one LED bead or multiple LED modules with a single signal line. Its main features are as follows:

- Output port withstand voltage 15V
- Built-in voltage regulator tube, only 24V power supply terminal only needs string resistor to IC VDD pin, no need to add regulator tube
- Grayscale adjustment circuit (256 levels of grayscale adjustable)

- Built-in signal shaping circuit, after any IC receives the signal, the waveforms of other various LED lighting products are shaped and re-output to ensure that the waveform distortion of the line will not be accumulated.
- Built-in power-on reset and power-down reset circuit
- The PWM control terminal can achieve 256 levels of adjustment, and the scanning frequency is not less than 400Hz/s.
- Serial interface level connection port, which can receive and decode data through one signal line
- Any two points transmission distance is more than 10 meters without adding any circuit
- When the refresh rate is 30 frames/second, the cascading number of the low-speed mode is not less than 512 points, and the high-speed mode is not less than 1024 points.
- Data transmission speed is 800Kbps mode

Working principle of WS2812 RGB LED Light

WS2812 RGB LED light data protocol adopts single-line return-to-zero code communication mode. After the power-on reset, the DIN terminal accepts the data transmitted from the controller. The first 24 bits of data sent by the first pixel are extracted and sent. The data latch inside the pixel, the remaining data is shaped and amplified by the internal shaping processing circuit, and then the output is forwarded to the next cascaded pixel through the DO port, and the signal is reduced by 24 bits after each pixel transmission. The pixel adopts automatic shaping and forwarding technology, so that the number of cascaded pixels is not limited by signal transmission, and only the signal transmission speed is limited.

The data latch inside the chip generates different duty cycle control signals at the OUTR, OUTG, and OUTB control terminals according to the received 24bit data. When the DIN terminal inputs the RESET signal, all the chips synchronously send the received data to each section. The chip will re-accept the new data after the end of the signal. After receiving the first 24bit data, the data port is forwarded through the DO port. Before the chip receives the RESET code, the original output of the OUTR, OUTG, and OUTB pins remains unchanged. After receiving a low level RESET code of 50μs or more, the chip outputs the pulse width of the 24bit PWM data just received to the OUTR, OUTG, and OUTB pins. The pin and function of the chip are shown in Figure 9-1 and Table 1.

No	Symbol	Pin name	Function description
1	VDD	Logic power	IC Power Supply
2	OUT	LED Drive output	Display data cascade output
3	IN	LED Drive input	Display data input
4	VSS	Ground	Ground, finally cascaded

Table 1 WS2812 chip pin function table

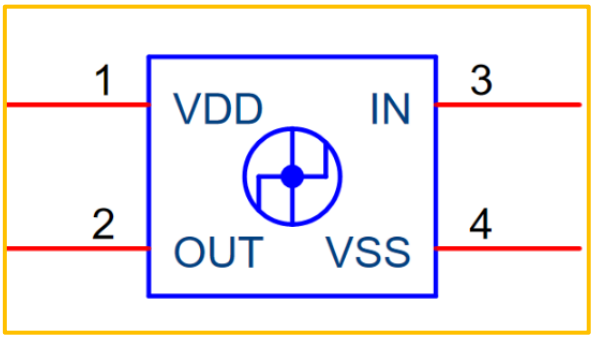


Figure 9-1 Schematic diagram of the pin function of the WS2812 chip

WS2812 RGB LED Light Driving principle

The WS2812 RGB LED low level is represented by T0, which is 0.5μs high level 2μs low level. T1 consists of a low level of 2μs and a low level of 0.5μs. Low level time above 50μs during reset.

T0H	0 yards, high voltage time	0. 5μs
T1H	1 yard, high voltage time	2μs
T0L	0 yards, low voltage time	2μs
T1L	1 yard, low voltage time	0. 5μs
RES	Reset code, low voltage time	>50μs

时序波形图如下

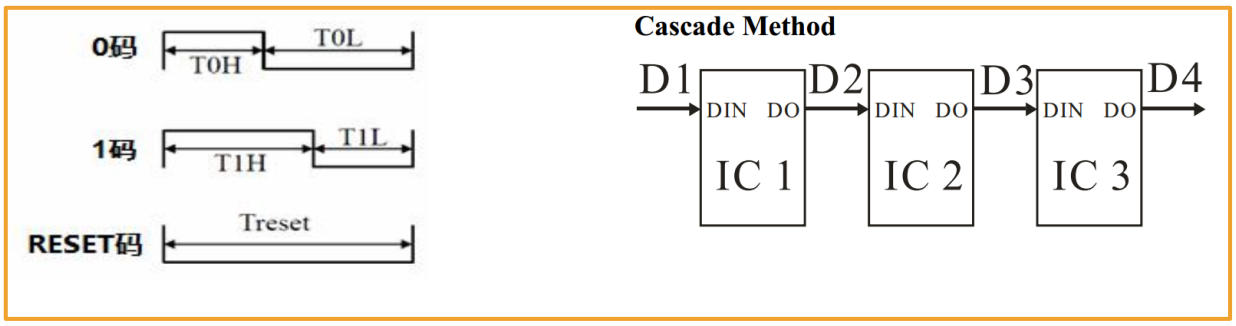


Figure 9-2 Waveform timing diagram and connection method

24bit data structure

R7	R6	R5	R4		R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0

Drive RGB LED light

There are two RGB LED lights RGB1 and RGB2 on the PS2X&Motor Driver Board. You can control the RGB light-off timing by programming. You can also set the color of the RGB light (example program file path: load file -> **Lesson\Module_Test\RGB_Test\RGB_test1\RGB_test1.ino**) After burning the sample

program, turn on the power switch and you will see the RGB light flashing. The schematic diagram of the RGB LED light is shown in Figure 9-3.

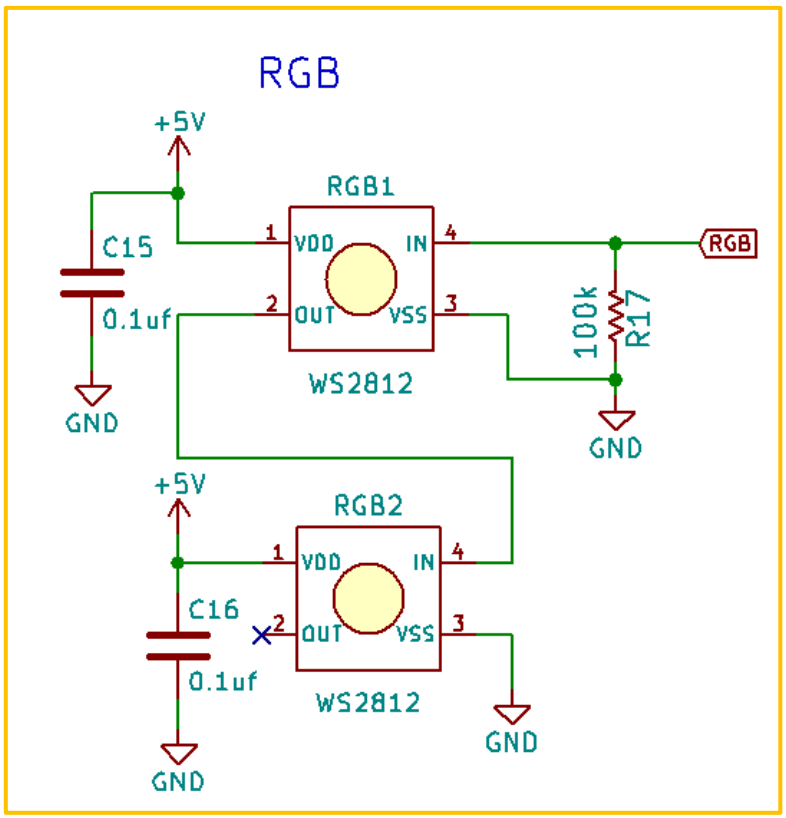


Figure 9-3 RGB LED schematic

Buzzer

Buzzer Introduction

The buzzer is an integrated structure electronic sounder that is powered by a DC voltage and is used in electronic products as a sounding device. The buzzer is mainly divided into two types: active buzzer and passive buzzer. The main difference between the two is as follows:

The ideal signal for active buzzer operation is direct current, usually labeled VDC, VDD, and so on. Because the buzzer has a simple oscillating circuit inside, it can drive the molybdenum sheet to vibrate as long as it is energized. However, some active buzzers can work under certain AC signals, but the voltage and frequency of the AC signal are very high. This kind of scene is rare.

There is no oscillation circuit inside the passive buzzer, and the working signal is a pulse signal of a certain frequency. If the passive buzzer for the DC signal is not responsive, the molybdenum sheet cannot vibrate because the magnetic path is constant.

Active buzzer Passive buzzer

Figure 10-1 Physical diagram of active buzzer and passive buzzer

Working principle of buzzer

The passive buzzer generates music mainly by controlling the buzzer sound by outputting high and low pulse signals from the I/O port of the single chip microcomputer. To generate an audio pulse signal, it is necessary to calculate the period (1/frequency) of an audio, and then Dividing this period by 2 is the half-cycle time. The time of this half cycle is counted by the single-chip timer, and the I/O port of the output pulse is inverted every time the timer is counted, so that the frequency of the pulse is obtained on the I/O port.

For example, if the Arduino uses a 12MHzs crystal, the sound of the mid-tone Re is required to output an audio pulse frequency of 587Hzs. The pulse period of the audio signal is T=1/587=1703.5775us, and the half-cycle time is 852us. The device count = 852us / 1us = 852, the I / O port is inverted at 852 every count, the middle adjustment Re of C major is obtained.

In addition, the passive buzzer sounds the principle that the current passes through the electromagnetic coil, causing the electromagnetic coil to generate a magnetic field to drive the diaphragm to sound. Therefore, a certain current is required to drive it, and the voltage output from the Arduino I/O pin is small. The level of the Arduino output basically does not drive the buzzer, because an amplifier circuit needs to be added. Here, the transistor SS8050 is used as an amplifying circuit.

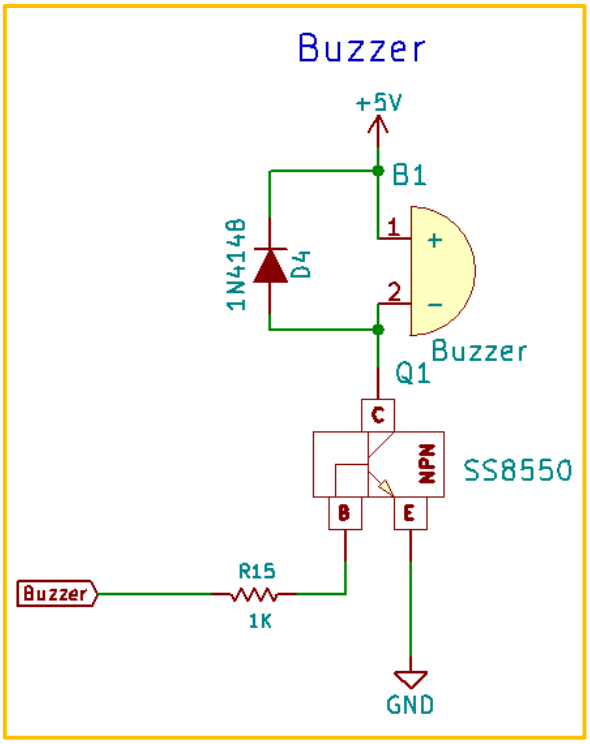


Figure 10-2 Buzzer schematic

Drive buzzer

The PS2X&Motor Driver Board has a passive buzzer on it that can be programmed to control the buzzer to play a tone or play music (example program file path:
Load File-> **Lesson\Module_Test\Buzzer_Test\Happy_Birthday\Happy_Birthday.ino**) After burning the sample program, turn on the power switch and the buzzer plays music. The schematic diagram of the buzzer is shown in Figure 10-2. Show.

Servo

Servo Introduction

The steering gear is also called servo motor. It was first used to realize its steering function on the ship. Because it can continuously control its rotation angle through the program, it is widely used to realize the steering and the various joint movements of the robot. The steering gear is the control of the steering of the trolley. The mechanism has the characteristics of small size, large torque, simple external mechanical design and high stability. Whether in hardware design or software design, the steering gear design is an important part of the car control. Generally speaking, the steering gear is mainly composed of the following The components are composed of steering wheel, reduction gear set, position feedback potentiometer, DC motor,

control circuit, etc., as shown in Figure 11-1 and Figure 11-2. Motor Driver Board uses 180 degree SG90 (180 degrees) 9g servo.

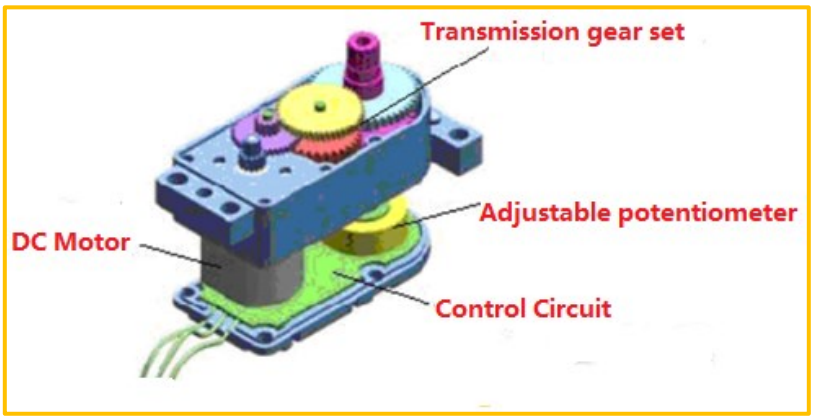


Figure11-1 Diagram of Servo

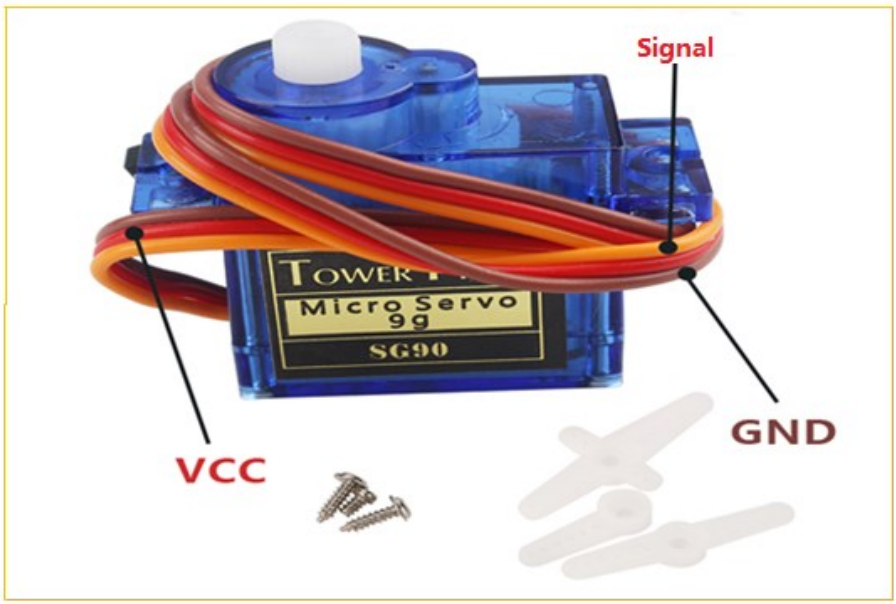


Figure 11-2 Physical diagram of the servo

Working principle of servo

The servo control signal enters the signal modulation chip from the channel of the receiver to obtain a DC bias voltage. It has a reference circuit inside, which generates a reference signal with a period of 20ms and a width of 1.5ms, and compares the obtained DC bias voltage with the voltage of the potentiometer to obtain a voltage difference output. Finally, the positive and negative voltage output of the voltage difference to the motor drive chip determines the forward and reverse of the motor. When the motor speed is constant,

the potentiometer is rotated by the cascade reduction gear, so that the voltage difference is 0, and the motor stops rotating.

When the control circuit board receives the control signal from the signal line, the motor is controlled to rotate, the motor drives a series of gear sets, and after deceleration, the drive is transmitted to the output steering wheel. The output shaft of the steering gear and the position feedback potentiometer are connected. When the steering wheel rotates, the position feedback potentiometer is driven. The potentiometer will output a voltage signal to the control circuit board for feedback, and then the control circuit board determines the motor according to the position. The direction and speed of rotation to achieve the target stop. The workflow is: control signal → control circuit board → motor rotation → gear set deceleration → steering wheel rotation → position feedback potentiometer → control circuit board feedback.

The control signal period of the servo is 20MS pulse width modulation (PWM) signal, the pulse width is from 0.5-2.5MS, and the corresponding steering wheel position is 0-180 degrees, which varies linearly. That is to say, give him a certain pulse width, its output shaft will maintain a certain corresponding angle, no matter how the external torque changes, until it is given a pulse signal of another width, it will change the output angle to the new corresponding position is shown in Figure 11-3. There is a reference circuit inside the steering gear to generate a reference signal with a period of 20MS and a width of 1.5MS. There is a comparator that compares the applied signal with the reference signal to determine the direction and size to produce the motor's rotation signal.

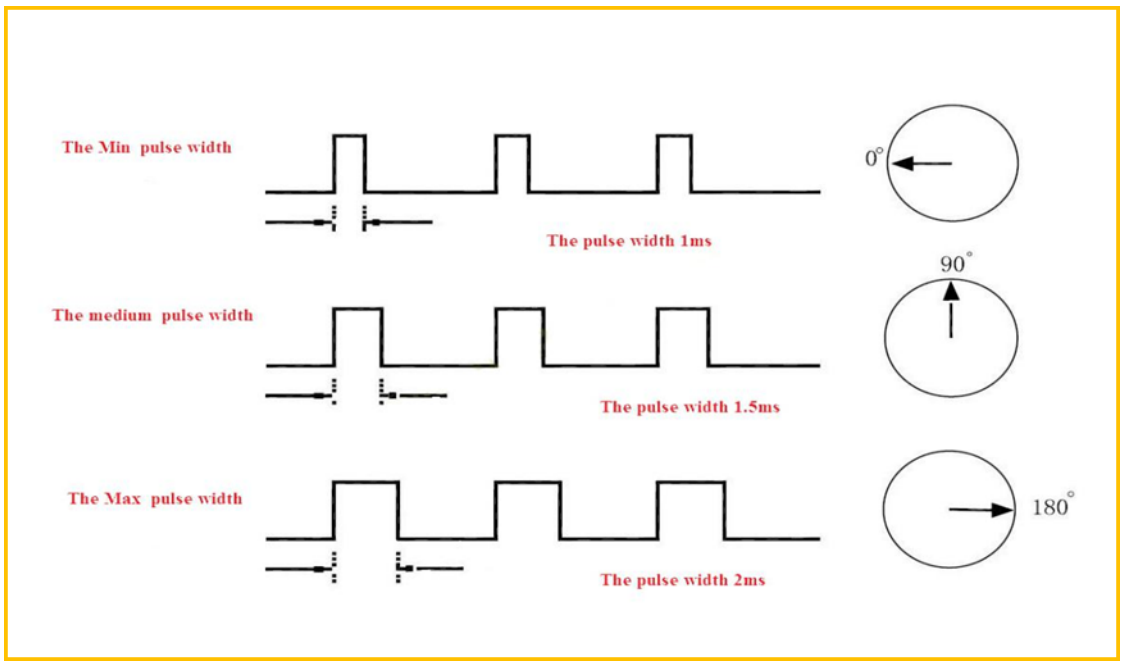


Figure 11-3 Relationship between servo output angle and input pulse

Drive Servo

The PS2X&Motor Driver Board driver board can drive 8-way servos, the servo pin position on the driver board (pins above the IR receiver), ground pins (G), power pins (V) and signal pins (S), the three pins respectively correspond to the corresponding pins of the servo (Fig. 11-4), and can also control the servo through I2C communication, as shown in Figure 11-5, (Example program file path: Load file -> **Lesson\Module_Test\Servo_Test\I2C_Servo\I2C_Servo.ino**) After burning the sample program, turn on the power of the expansion board, and you can find that the eight servos rotate to 0°, 90°, and 180° at the same time. We can realize the steering of the robot by driving the rotation of the steering gear, or install the sensor probe on the steering gear, so as to adjust the detection direction of the sensor through the steering gear. The schematic diagram of the servo interface is shown in Figure 11-6.

Figure 11-4 MG90 Servo machine physical map

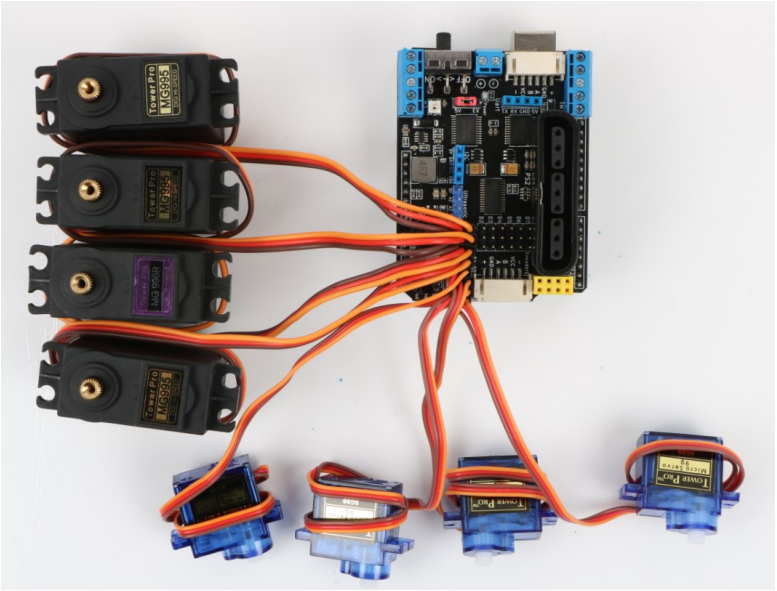


Figure 11-5 Drive Servo connection diagram

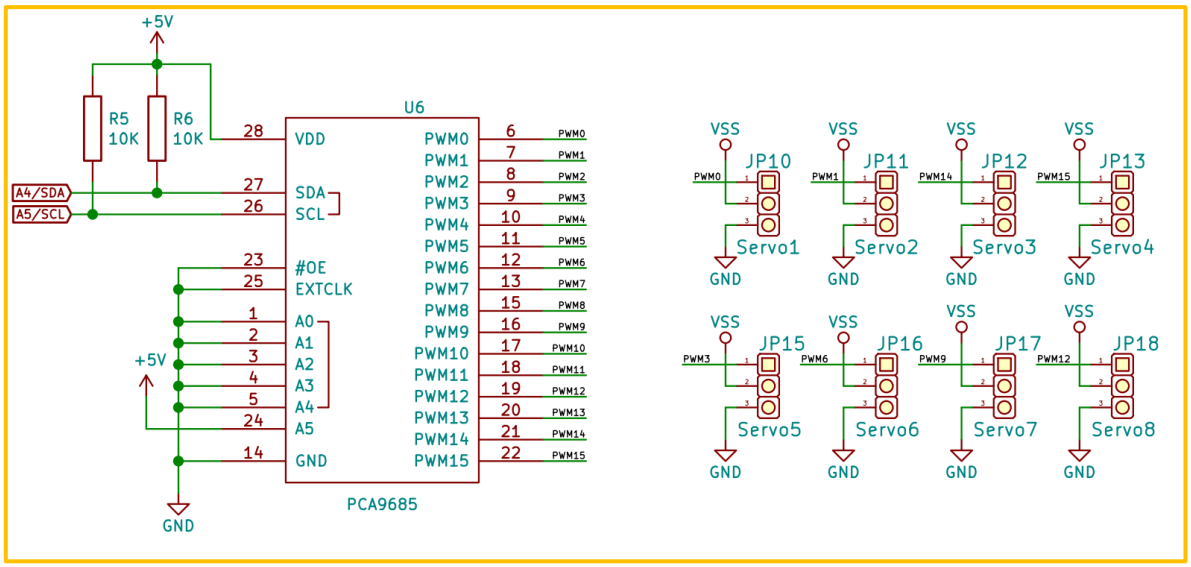


Figure 11-6

How to use an external power supply to drive the servo

The PS2X&Motor Driver Board can not only power the steering gear through the power supply chip to drive the steering gear, but also power the steering gear through an external power supply to drive the steering gear. The voltage of the main control chip of PS2X&Motor Driver Board is generally 5V. When driving the servo, although it can also be driven, some servos will have a rated voltage higher than 5V. If the voltage is supplied with 5V, the steering wheel will rotate. If the force is too small, the accuracy will be affected. If the external voltage is greater than 5V (5.2-7.2V), then the steering gear will be driven, obviously the speed of the steering gear will be much faster, and the force during rotation will be very high. Strong and accurate.

The specific steps are as follows:

1) Short the power supply pin EX pin on the PS2X&Motor Driver Board through the jumper cap;

2) Connect the external power supply to the power connector on the PS2X&Motor Driver Board;

3) Turn on the power switch.

Ultrasonic obstacle avoidance module

Working Principle of Ultrasonic module

The ultrasonic transmitter emits ultrasonic in a certain direction, and starts timing at the same time as the transmission time. When the ultrasonic travels in the air, it will return immediately when it hits an obstacle. And the ultrasonic receiver stops the timing immediately upon receiving the reflected waves. The propagation speed of the ultrasonic in the air is V, and according to the time difference Δt of the measured

transmitted and received echo recorded by the timer, the distance S of the emission point from the obstacle can be calculated, that is:

$$S = V \cdot \Delta t / 2$$

Drive Ultrasonic Module

The PS2X&Motor Driver Board has a four-wire ultrasonic module interface on the driver board. The four pins are the power supply pin (vcc), the ultrasonic signal transmission pin (A1), the ultrasonic signal receiving pin (A1), and the ground (GND). The four pins are connected to the corresponding pins of the ultrasonic module (as shown in Figure 12-1), as shown in Figure 12-2. (Example program file path: **Load file -> Lesson\Module_Test\Ultrasonic_Test\Ultrasonic_Test.ino**) After burning the sample program, turn on the power switch and turn on the serial monitor. You will see the distance of the ultrasonic probe continuously printed on the serial monitor. The schematic diagram of the ultrasonic obstacle avoidance module interface is shown in Figure 12-3.

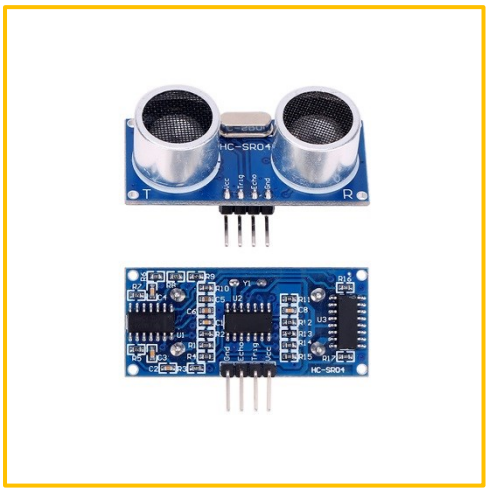


Figure 12-1 Physical diagram of the ultrasonic module

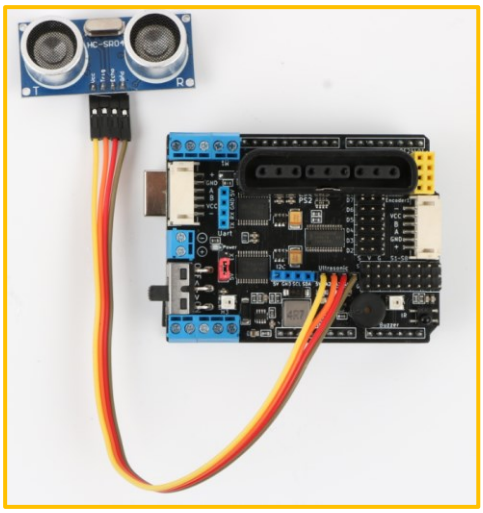


Figure 12-2 Ultrasonic module connection diagram

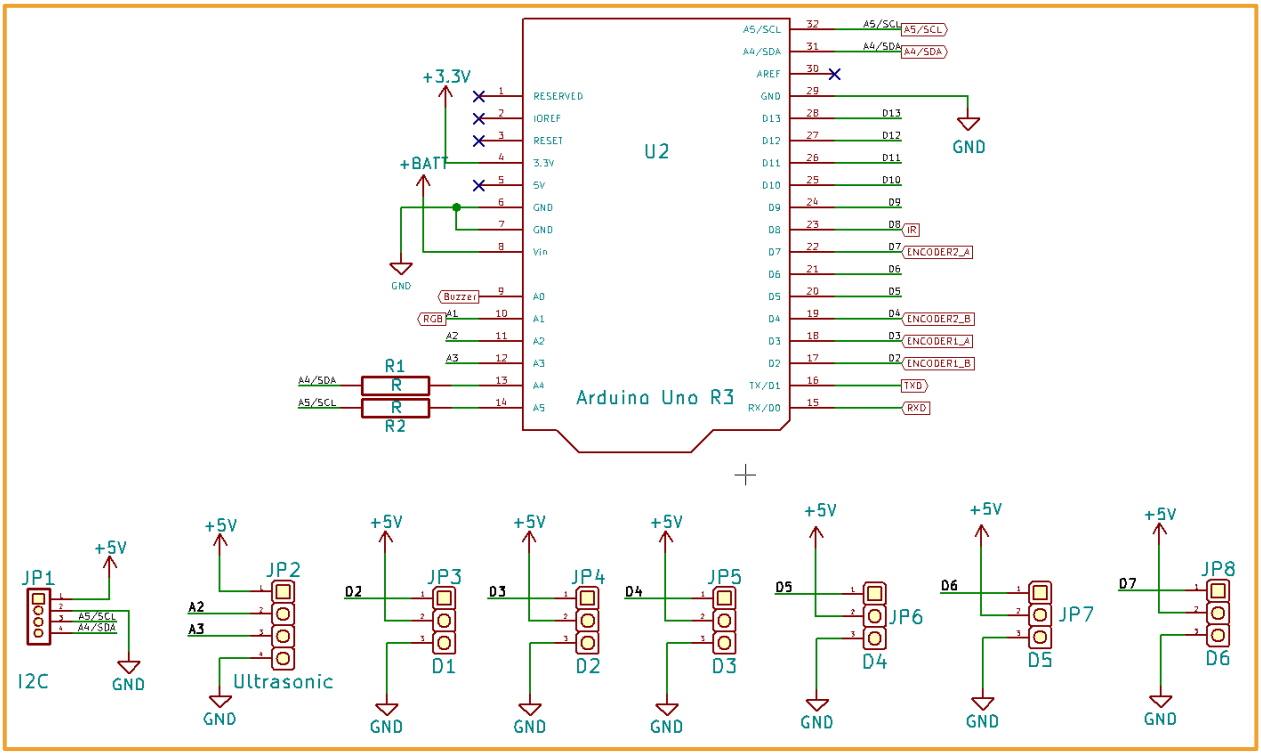


Figure 12-3 Schematic diagram of ultrasonic connection

Infrared Remote Control

Infrared wireless remote control consists of Mini ultra-thin infrared remote control (shown in Figure 13-1) and integrated 38KHz infrared receiving head. Mini ultra-thin infrared remote control has 17 function keys, the transmission distance can reach 8 meters, which is very suitable for Control a variety of equipment indoors.

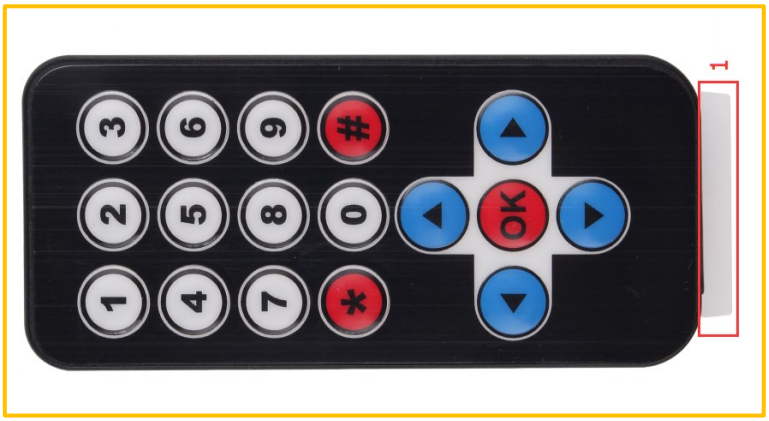


Figure 13-1 Infrared remote control physical map

In the Motor Driver Board of the racing car,the integrated infrared receiver has been added to the expansion board. When it is used, it only needs to be inserted into the Arduino. When there is an infrared coded signal transmission, after being processed by the infrared connector, the output is a square wave signal after the detection and shaping, and is directly supplied to the single chip microcomputer, and the corresponding operation is performed to achieve the purpose of controlling the motor.

Working Principle

The remote control system generally consists of a remote control (transmitter) and a receiver. When you press any button on the remote control, the remote control generates a corresponding code pulse to output various infrared-based control pulse signals. The pulse is a computer command code. The infrared monitor diode monitors the infrared signal and then sends the signal to the amplifier and the limiter. The limiter controls the pulse amplitude to a certain level regardless of the distance between the infrared transmitter and the receiver. The AC signal enters the bandpass filter. The bandpass filter can pass the load wave of 30KHZ to 60KHZ, enter the comparator through the demodulation circuit and the integration circuit, and the comparator outputs high and low levels to restore the signal waveform of the transmitter. As shown in the 13-2 system fram diagram.

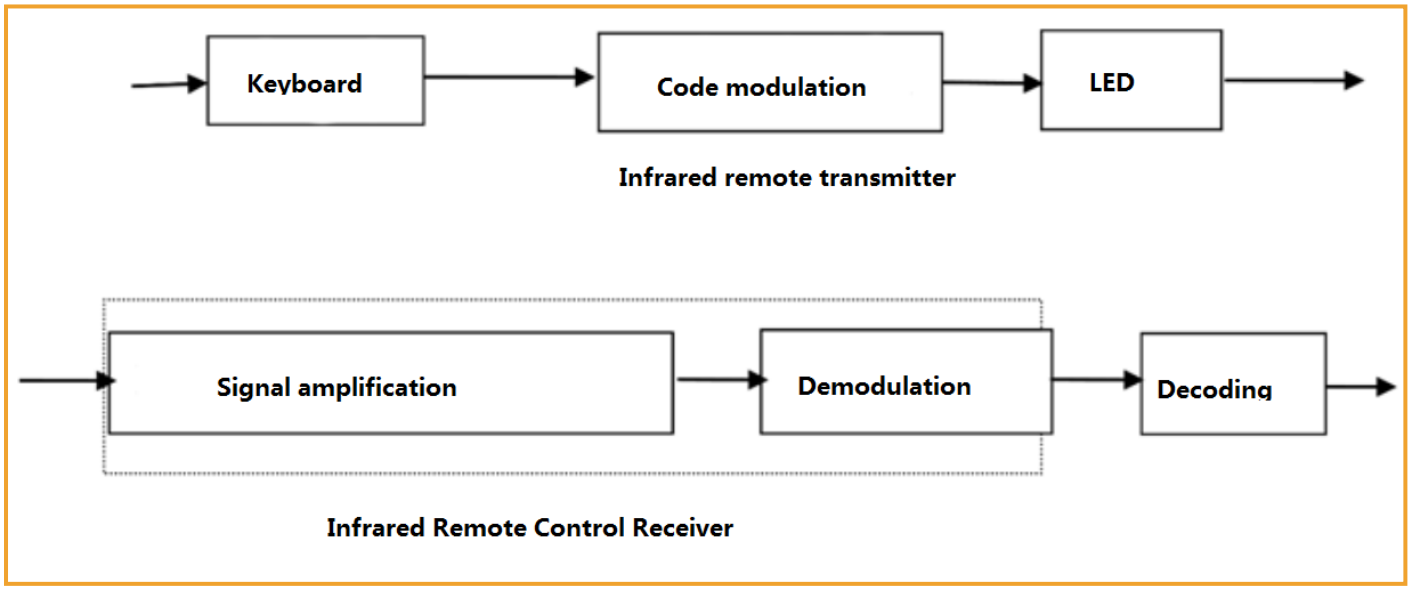


Figure 13-2 Block diagram of the infrared transmitting and receiving system

Driving infrared remote control

There is an infrared remote control receiving probe on the PS2X&Motor Driver Board (as shown in Figure 14-1). (Example program file path: Load file -> **Lesson\Module_Test\IrkeyPressed_Test\IrkeyPressed_Test.ino**) After burning the sample program, turn on the power. Switch, and open the serial monitor, use the remote control to press the different buttons on the infrared receiver on the driver board, you will see different numbers printed on the serial monitor, and the receiver will light red when receiving the infrared signal.Of course, you can also write a program that uses infrared remote control to control the rotation of the motor or the rotation of the servo. It is more intuitive to see the effect of the infrared remote control. The schematic diagram of the infrared remote control is shown in Figure 14-3.

Figure 14-1 Infrared receiver head physical map

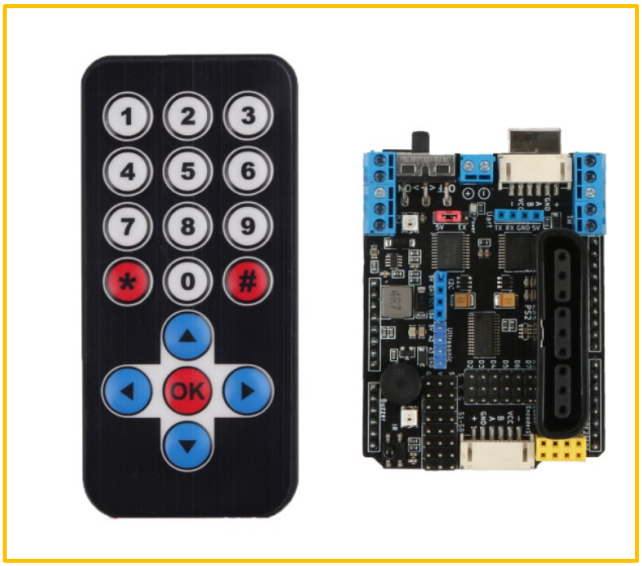


Figure 14-2 Infrared remote control

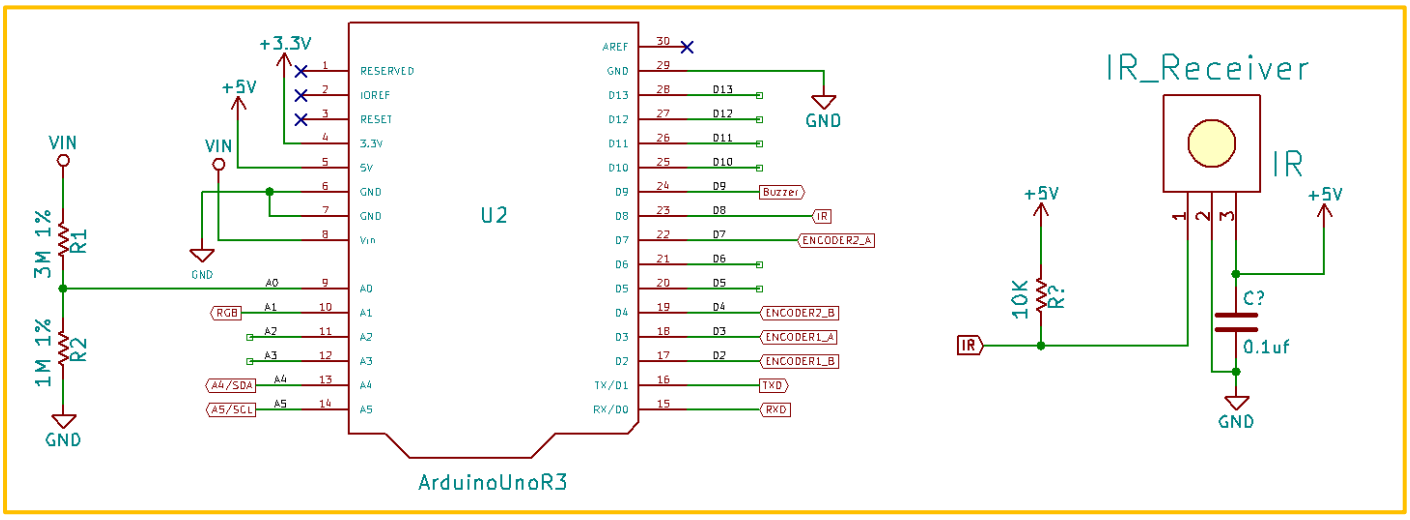


Figure 14-3 Schematic diagram of the infrared receiver connection

PS2 Remote Control

PS2 Introduction

The PS2 handle is the remote control handle of Sony game machine, Sony series game host is in the world very popular. The outstanding characteristic is that this kind of handle price is extremely high now. Key-rich, easy to extend to other applications, such as the picture 15-1 is a commonly used PS2 wireless handle.

Figure 15-1 PS2 Wireless Handle

PS2 handle is composed of two parts of the handle and receiver, the handle needs two section 7th 1.5V power supply, the receiver's power supply and controller use the same power supply, the power supply range is 3~5v, can not be reversed or exceed voltage. Overvoltage and reverse connection will cause the receiver to burn out. There is a power switch on the handle, on the open/off off, the handle switch to on.In the case of no search to the receiver, the lamp on the handle flashing constantly, in a certain period of time, has not been found in the receiver, the handle will enter Standby mode, the handle on the lights will be extinguished, at this time, press the "START" button, wake-up handle.

The receiver is connected to the Arduino, and is powered by Arduino. In an unpaired condition, with a green light flashing. The handle is open, the receiver is powered, the handle and receiver will automatically pair, when the lamp is always bright, the handle pair succeeds. The key "mode" (handle batch is different, the above identification may be "analog", but will not affect the use), you can choose "Red light Mode", "Green mode".

There are 9 interfaces at the end of the receiving head, each of which is shown in the following table:

1	2	3	4	5	6	7	8	9
DI/DAT	DO/CMD	NC	GND	VDD	CS/SEL	CLK	NC	ACK

Note: The batch is different, the appearance of the receiver will be a difference, one on the power light red light, a power supply lights, but the use of the same method, pin definition is the same.

Di/dat: Signal flow, from the handle to the host, this signal is a 8bit serial data, synchronous transmission in the clock down the edge. The reading of the signal is done in the process of changing the clock from high to low.

Do/CMD: Signal flow, from the host to the handle, this signal and DI relative, the signal is a 8bit serial data, synchronously transmitted to the clock down the edge.NC: Empty port; .

GND: Ground;

VDD: The 3~5V power supply;

CS/SEL: Providing trigger signals for handles, the level is low during communication;

CLK: The clock signal is sent by the host to maintain data synchronization;

NC: Empty port;

ACK: the response signal from the handle to the host. This signal changes to low in the last cycle of each 8-bit data sending, and the CS remains low. If the CS signal do not remain low, the PS host will try another device in about 60 microseconds. The ACK port is not used in programming.

Drive PS2 remote

There is a PS2 port on the PS2X&Motor Driver Board. The PS2 infrared receiver can be directly plugged into the PS2 port. After the PS2 receiver is properly inserted (as shown in Figure 11-1), the sample program starts to be burned. (Example program file Path: Load File -> **Lesson\Module_Test\PS2X_Test\PS2X_Test.ino**) After burning the sample program, turn on the power switch and turn the handle switch to ON. When the receiver is not searched, the light on the handle will flash continuously. The receiver has not been searched for a certain period of time. It will enter standby mode, the light on the handle will be extinguished, then press the "START" button to wake up the handle. The handle and the receiver are automatically paired. When the pairing is not successful, the green light of the receiver flashes, and the light on the handle will also flash. After the pairing is successful, the green light on the receiver is always on, and the light on the handle is always on. Press the button “MODE”. "(The handle batch is different, the above logo may be "ANALOG", but it will not affect the use), you can choose "red light mode", "green light mode". After the connection is successful, open the serial monitor, use the handle remote control to press the different buttons on the drive board, you will see the print content on the serial monitor. Of course, you can also write a program that uses PS2 to control the rotation of the motor or the rotation of the servo. It is more intuitive to see the effect of the PS2 remote control. The schematic diagram of the PS2 remote control is shown in Figure 15-3.。

Figure 15-2 PS2 Control

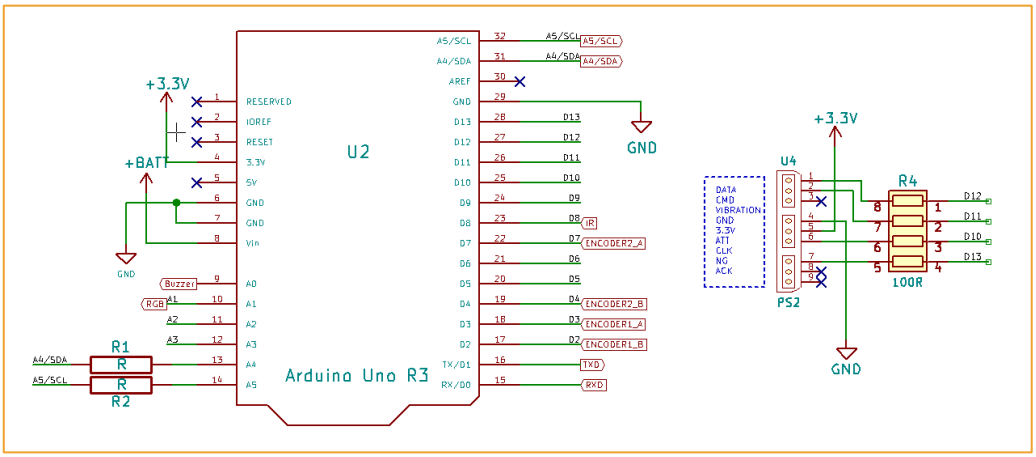


Figure 15-3 Schematic diagram of the PS2 receiver

NRF2401

NRF24L01+ module Introduction

The nRF24L01+ module(as shown in Figure 13-1) is a 2.4G wireless communication module developed by Nordic based on the nRF24L01 chip. Adopt FSK modulation and integrate Nordic's own Enhanced Short Burst protocol. Point-to-point or 1-to-6 wireless communication can be achieved. Wireless communication speed can reach up to 2M (bps). The NRF24L01 has four operating modes: transceiver mode, configuration mode, idle mode, and shutdown mode.

Drive NRF24L01+ module

Insert the nRF24L01+ module into the corresponding interface on the PS2X&Motor Driver Board driver board (as shown in Figure 16-2). For the stable reception of Nrf24L01 data, it is recommended to connect 10uf capacitor between VCC and GUD as shown in Figure 16-3. **(Sample program file path: Receive load file -> Lesson\Module_Test\Nrf24L01+_Test\Receive\Receive.ino Send load file -> Lesson\Module_Test\Nrf24L01+_Test\Emitter\Emitter.ino)**, which can send and receive data tests to each other through two devices.

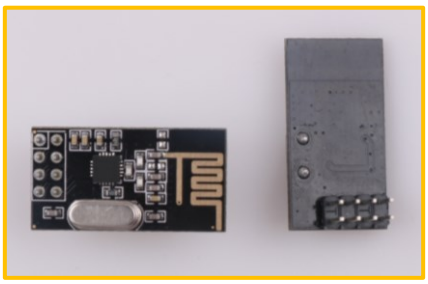


Figure 16-1: Nrf24l01+ physical map

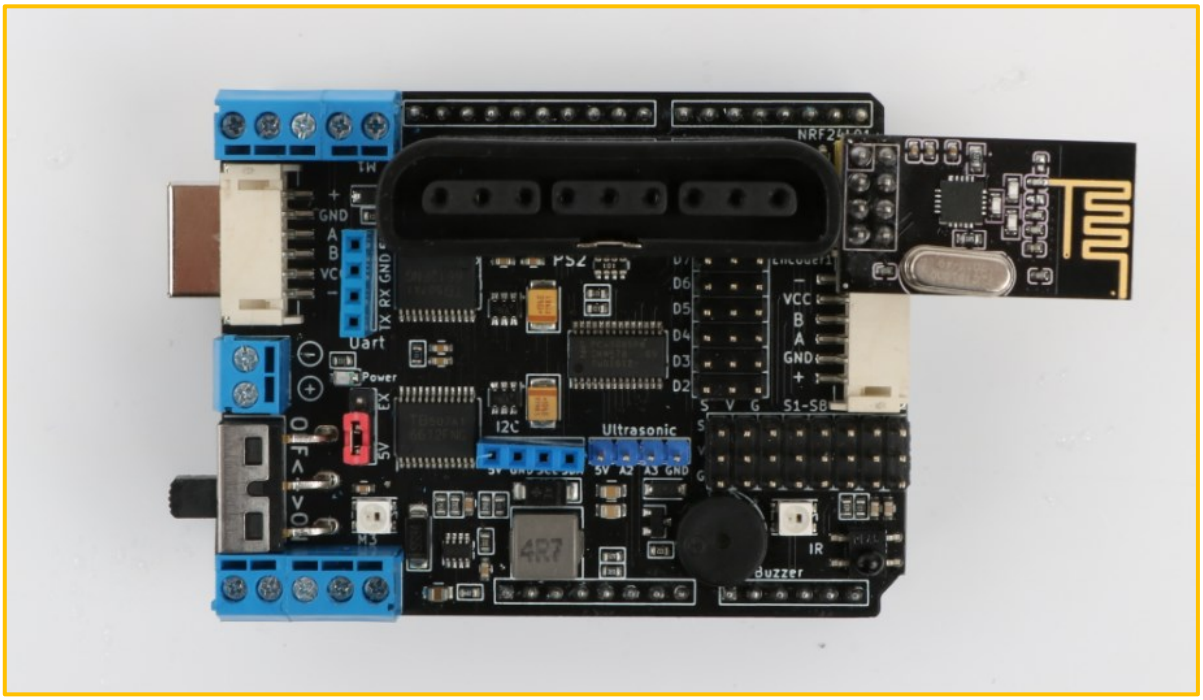


Figure 16-2 Connection diagram of Nrf24l01+

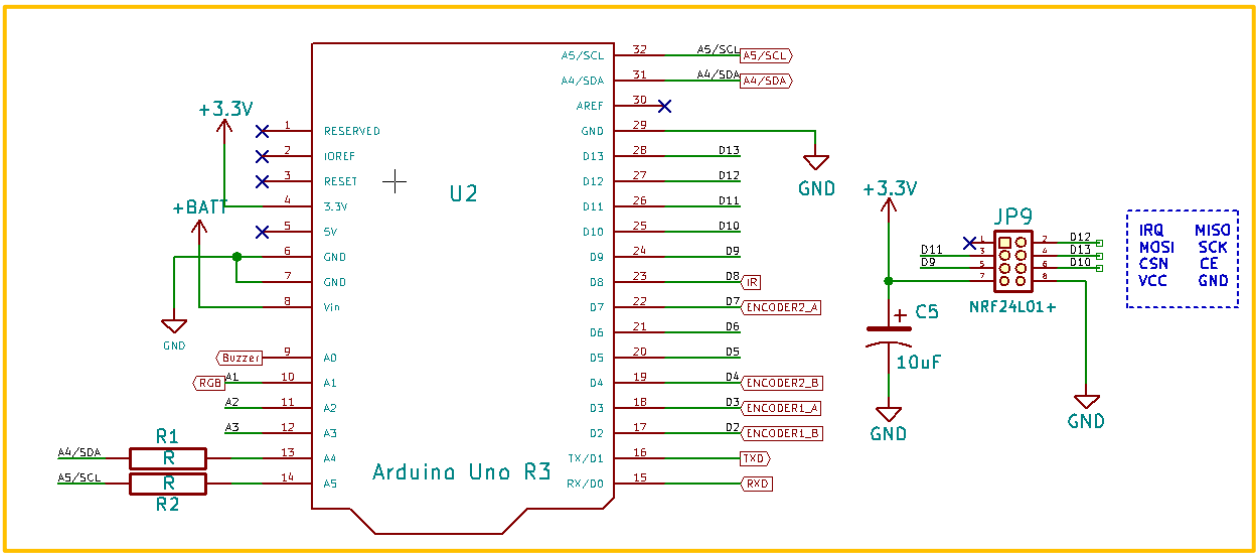


Figure 16-3 Schematic diagram of the Nrf24l01+ connection

Robotic arm

Robot arm wiring

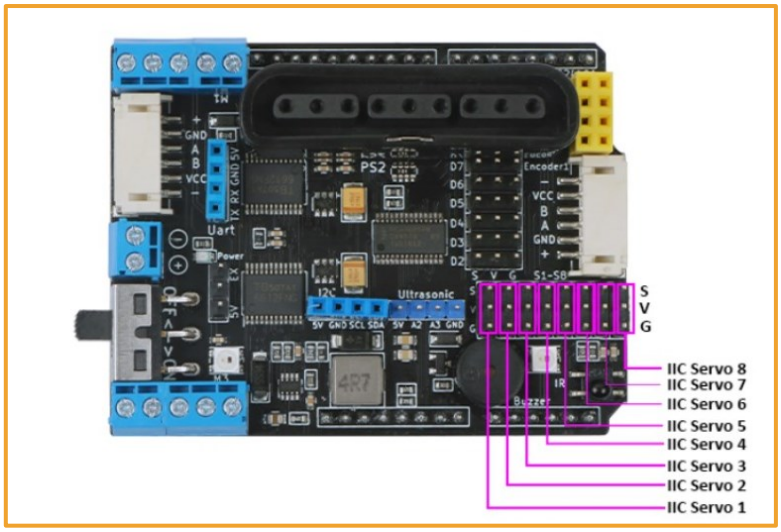


Figure 17-1

The arm of the arm is connected to the IIC servo 1, the left steering gear of the robot arm is connected to the IIC steering gear 2, the right steering gear is connected to the IIC steering gear 3, and the clip steering gear is connected to the IIC steering gear 4.

Robotic arm PS2 control

Figure 17-2

Left rocker 0 – 90°, 270 - 360° to control the IIC servo 1 The angle is slowly reduced, and 91–269° is used to control the IIC steering angle slowly.

Right rocker 0 – 44°, 315 - 360° for controlling IIC steering gear 2 angle slowly decreasing, 135 – 225 degrees for controlling IIC steering gear 2 angle slowly increasing, 45 – 134° for controlling IIC steering gear 3 angle Slowly increase, 225 – 314° control IIC servo 3 angle slowly decreases.

L1 is to increase the control IIC servo 4, and R1 is to control the IIC servo 4 to slowly decrease.

Note: Because of the mechanical arm structure problem, the left and right steering gears have a travel limit. If you are not using well, you can ask the technical support personnel how to adjust. If you understand, you can try it yourself.

Appendix

External sensor connection method

In addition to the ultrasonic module socket and the servo jack, the PS2X&Motor Driver Board also reserves 10 sets of expansion pin interfaces, of which 6 are general digital I/0 interfaces and 4 are I2C control interfaces. These expansion interfaces can be used for external connection of various sensor modules, such as infrared obstacle avoidance modules, infrared tracking modules and other common sensor modules that can make your products more powerful and functional.