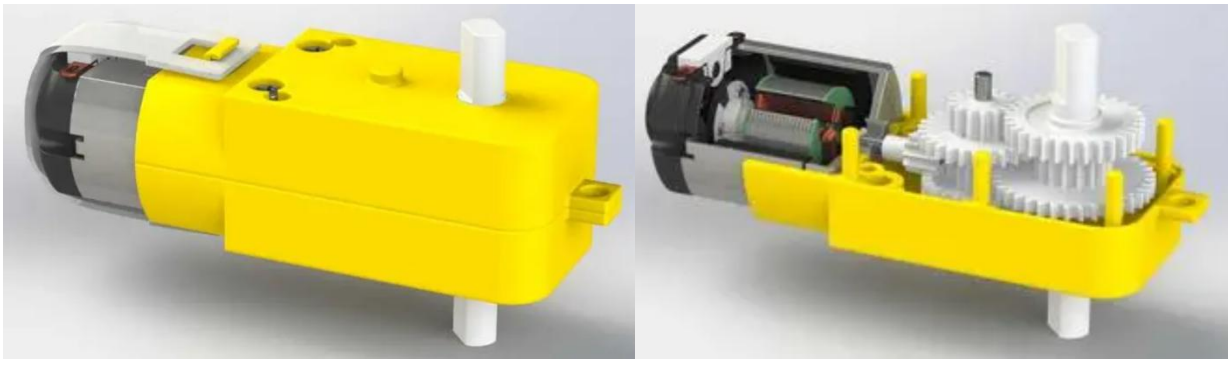
Lesson 2-Testing TT Motor

1. Knowledge of the TT Motor

As shown in the figure below, the TT motor consists of a DC motor and related gears, with a yellow outer shell fastened.



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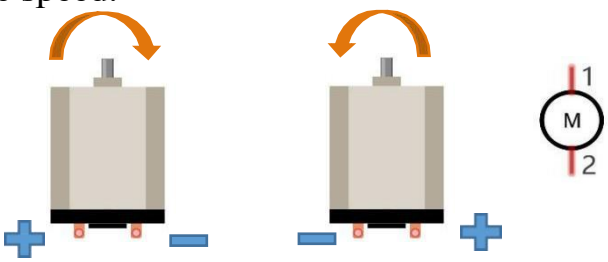
DC Motor

When motor is connected to the power supply, it will rotate in one direction. Reverse the polarity of power supply, the motor will rotate in the opposite direction.

And the speed of motor depends on the voltage between two ends. The larger the voltage, the lager the speed.



PWM

PWM, Pulse Width Modulation, uses digital pins to send certain frequencies of square waves, that is, the output of high levels and low levels, which alternately last for a while. The total time for each set of high levels and low levels is generally fixed, which is called the period (the reciprocal of the period is frequency). The time of high level outputs are generally called “pulse width”, and the duty cycle is the percentage of the ratio of pulse duration, or pulse width (PW) to the total period (T) of the waveform.

The longer the output of high levels last, the larger the duty cycle and the higher the corresponding voltage in analog signal will be. The following figures show how the analogs signal voltage vary between 0V-5V (high level is 5V) corresponding to the pulse width 0%-100%:

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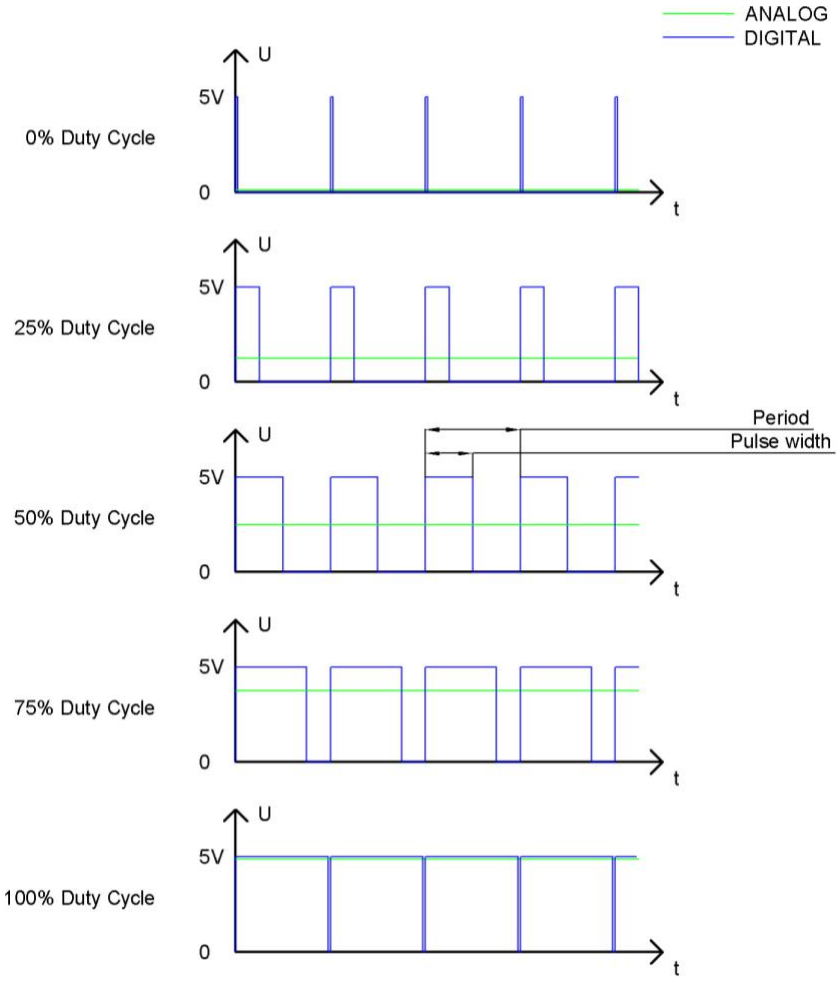

The longer the PWM duty cycle is, the higher the output power will be. Now that we understand this relationship, we can use PWM to control the brightness of an LED or the speed of DC motor and so on.

In this course, a L293D motor control shield will be used with UNO board, which can control the rotation of 4 DC motors at the same time.

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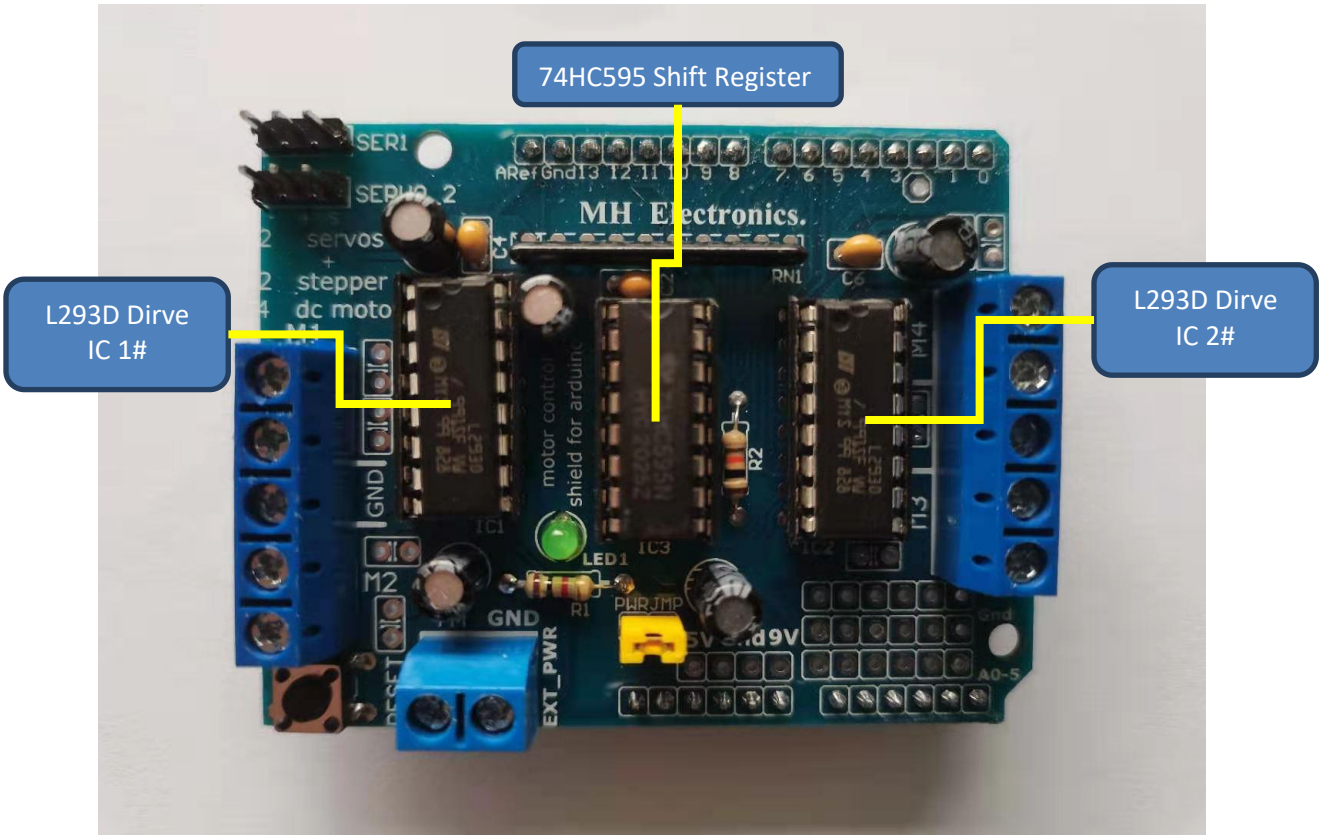
2. L293D motor control shield introduce

2.1 Structure

The L293D motor control shield is mainly composed of 2 L293D motor driver chips and a 74HC595 shift register. Its structure is as follows



2.2 Functions of L293D motor control shield

- L293D is a dual-channel H-bridge motor driver that can drive a pair of DC motors or a single stepper motor.
- Since the shield has two L293D motor driver chipsets, which means it can drive up to four DC motors individually, it is ideal for building a four-wheeled robotic platform.
- The shield provides a total of 4 H-bridges, each of which can supply up to 0.6A to the motor.
- The shield also comes with a 74HC595 shift register that extends the 4 digital pins of the UNO board to the 8 direction control pins of the two L293D chips.
- The shield has an array of pull-down resistors to keep the motors off during power up.
- Onboard LEDs indicate that motor power is OK. If it is not lit, the motor will not run.
- The RESET button is the reset button of the UNO board (when the L293D shield is installed on the UNO board).

2.3 L293D motor control shield principle

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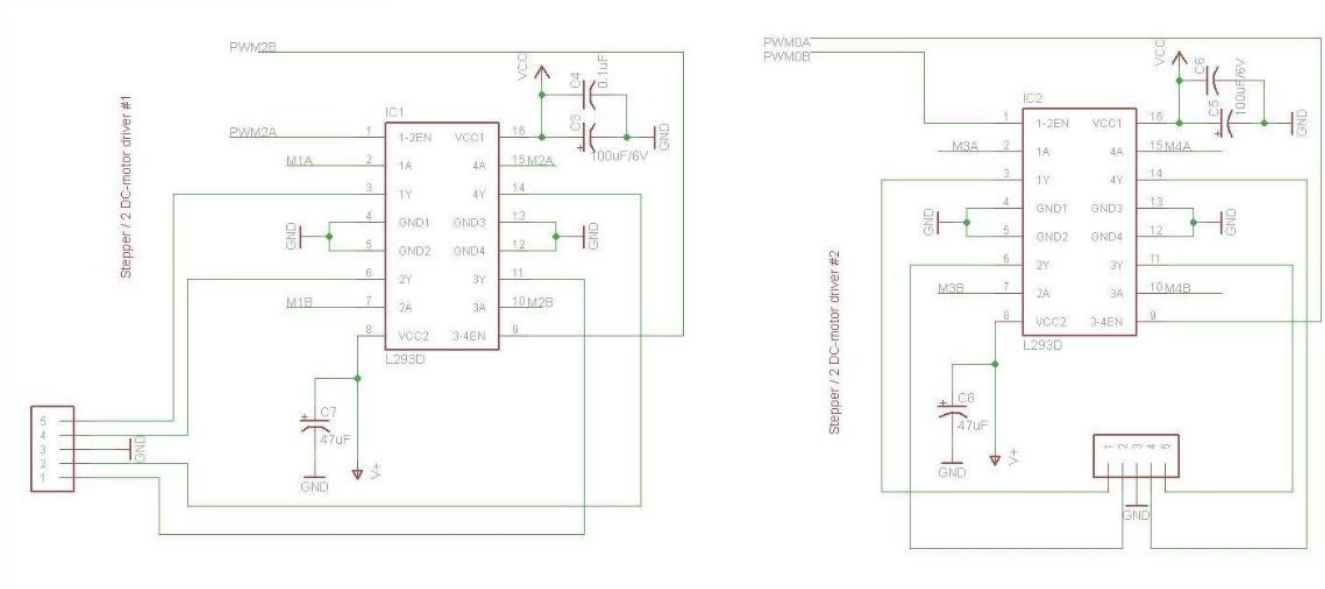
Using L293D to drive the motor, there is a 74HC595 chip in the middle that converts serial signals into parallel signals. This module is designed for Arduino, which has fewer I/O ports and requires 12 pins to control 4 DC motors. Using 74HC595 can reduce the use of 4 pins

74HC595

74HC595 is an 8-bit serial input and parallel output displacement buffer: parallel output is a three state output. On the rising edge of SCK, serial data is input from SDL to the internal 8-bit displacement buffer and output from Q7 ', while parallel output stores the data from the 8-bit displacement buffer to the 8-bit parallel output buffer on the rising edge of LCK. When the control signal of the serial data input end OE is low enabled, the output value of the parallel output end is equal to the value stored in the parallel output buffer. Simply put, first set pin 7 of the module to 0, and then pin 4 of the module (clock end for data input of 74HC595 chip) receives a rising edge. Move the 8-bit data in the chip to the left by one bit, leaving the low bit to write the 0 or 1 signal of pin 8 (serial data input of 74HC595 chip) to the low bit. After writing eight times, write the 8-bit signal that controls four motors to the 74HC595 chip (M3M4M3M2M1M2M4), Then, by giving a rising edge to pin 12, the data in the chip is output to the pins of the chip (Q0~Q7)

2.4 L293D motor control shield schematic diagram



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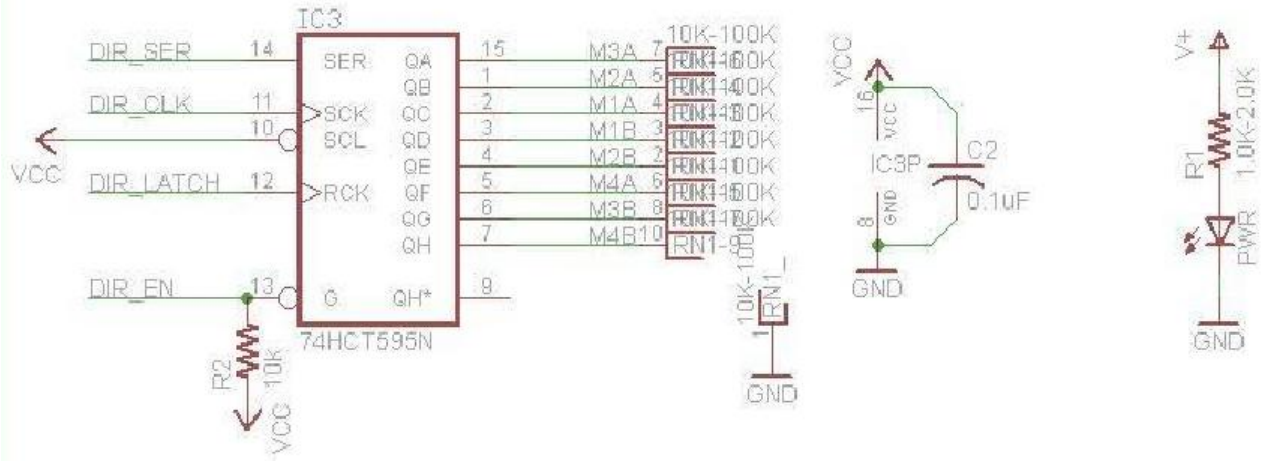
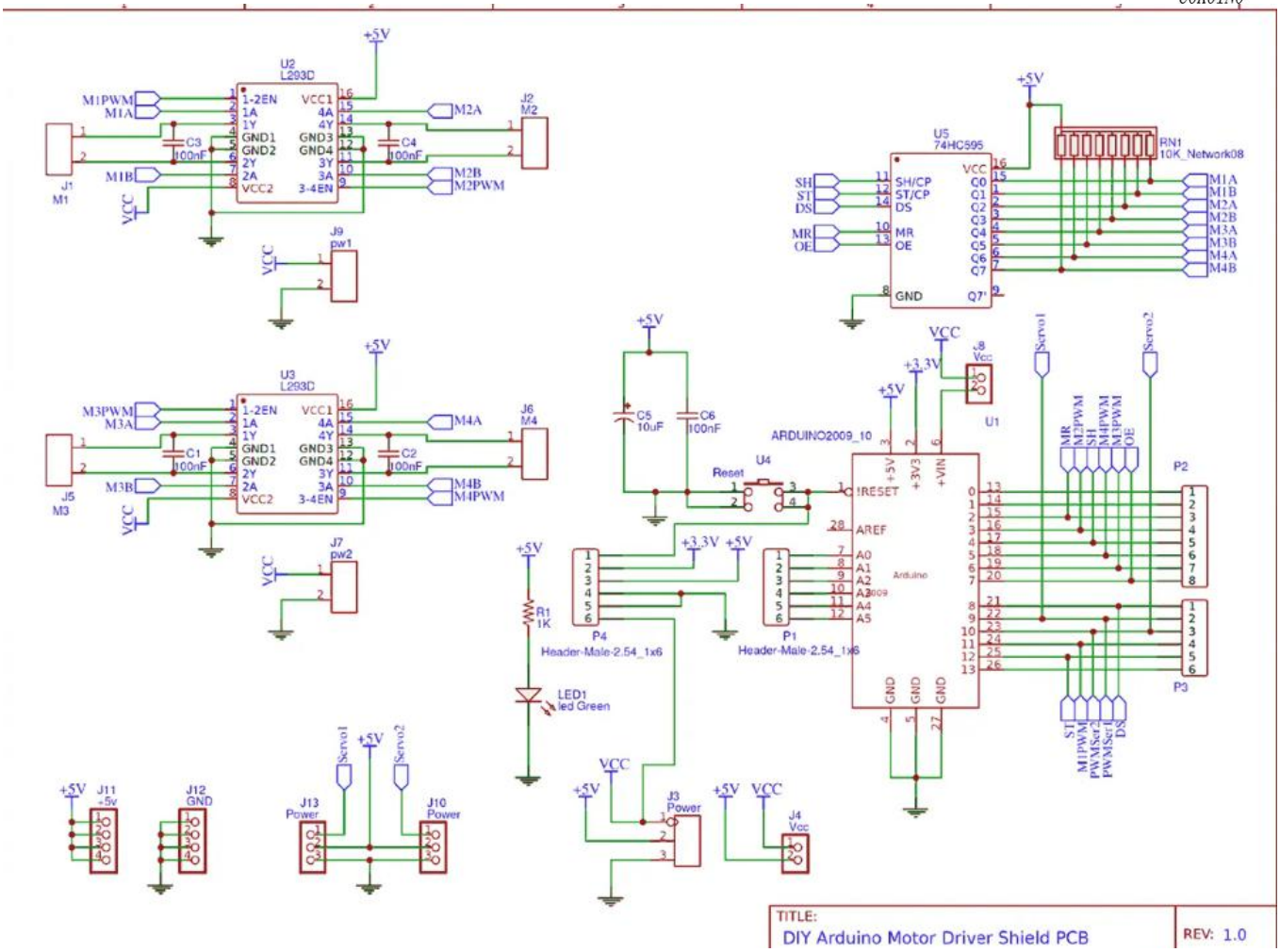

IC3
DIR_SER
DIR_CLK
DIR_LATCH
DIR_EN
VCC
SER
SCK
SCL
RCK
G
QA
QB
QC
QD
QE
QF
QG
QH
QH*
74HCT595N
M3A
M2A
M1A
M1B
M2B
M4A
M3B
M4B
10K-100K
RN1
R2
10K
C2
104
0.1uF
R1
1.0K-2.0K
PWR
GND


JP2
JP1
GND
DIR_LATCH
PWM2A
PWM1B
PWM1A
DIR_SER
DIR_EN
PWM0A
PWM0B
DIR_CLK
PWM2B
AREF
GND
D13
D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1
D0
ARDUINO
Duemilanove Diecimila
/RESET
3V
5V
GND2
GND1
VIN
A0
A1
A2
A3
A4
A5
JP3
JP5
VCC
GND
RESET
PWRJMP
V+
RESET
Reset
GND



L293D motor control shield occupies Arduino pin corresponding table

L293D motor control shield	Arduino UNOR3(for example)
L293D Driver IC1#1-2EN	**D11**
L293D Driver IC1#3-4EN	**D3**
L293D Driver IC2#1-2EN	**D5**
L293D Driver IC2#3-4EN	**D6**
74HC595 DIR-SER	**D8**
74HC595 DIR-CLK	**D4**
74HC595 DIR-LATCH	**D12**
74HC595 DIR-EN	**D7**
SER1	**D10**
SERVO_2	**D9**
N/A	**D2**
N/A	**D13**
N/A	**A0**
N/A	**A1**
N/A	**A2**
N/A	**A3**
N/A	**A4**
N/A	**A5**

2.5 Power the motors through the control shield

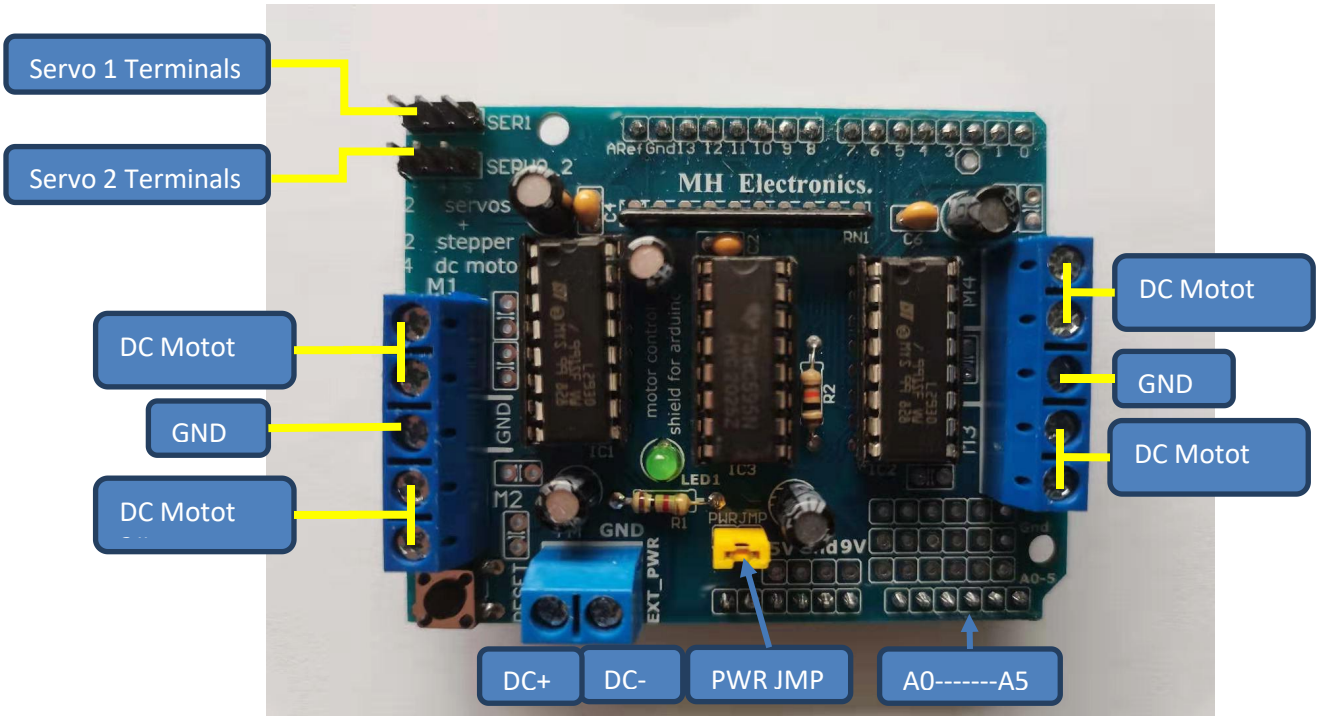
Use a single DC power supply to power both the UNO board and the control shield board, just plug the DC power supply into the DC jack of the UNO board or the 2 pin EXT_PWR on the control shield board.

Please keep the power jumper of the control shield on the board, it can only be used when the working voltage of the motor is less than 9V.

Note：

Do not supply more than 9V at the EXT_PWR input when the jumper is in place, or you may damage the Arduino UNO Board!

2.6 Output/input terminal of the L293D motor control shield



The output channels of the two L293D chips output M1, M2, M3 and M4 through two 5-pin screw terminals. These terminals support DC motors with operating voltages between 4.5 and 25V.

Each channel on the module can supply up to 600mA to the DC motor. However, the amount of current supplied to the motor depends on the power supply to the system.

You can also connect two stepper motors to the output terminals. One stepper motor is connected to motor ports M1-M2 and the other is connected to M3-M4.

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If it is a unipolar stepper motor, connect the center tap of the unipolar stepper motor to the GND terminal.

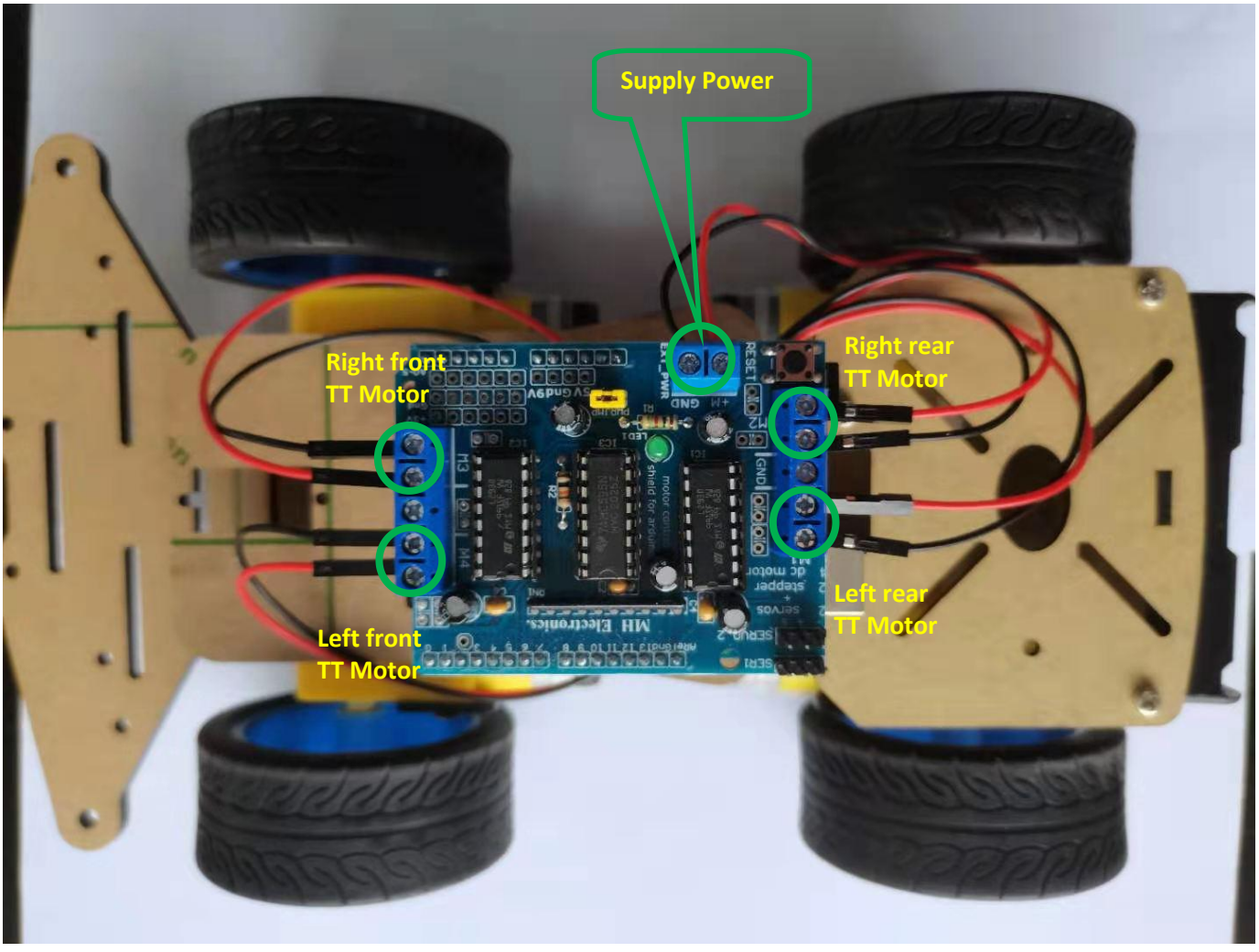
Two servos can be connected by pulling the 16-bit PWM output lines out to two 3 pin connectors.

2.7 Unused pins on L293D motor control shield

Mount the shield on the UNO board, it does not occupy the digital pins #2, #13 and analog pins A0-A5 of the UNO board. If you want to use these pins, you can connect some headers to the corresponding places.

3. Circuit connection

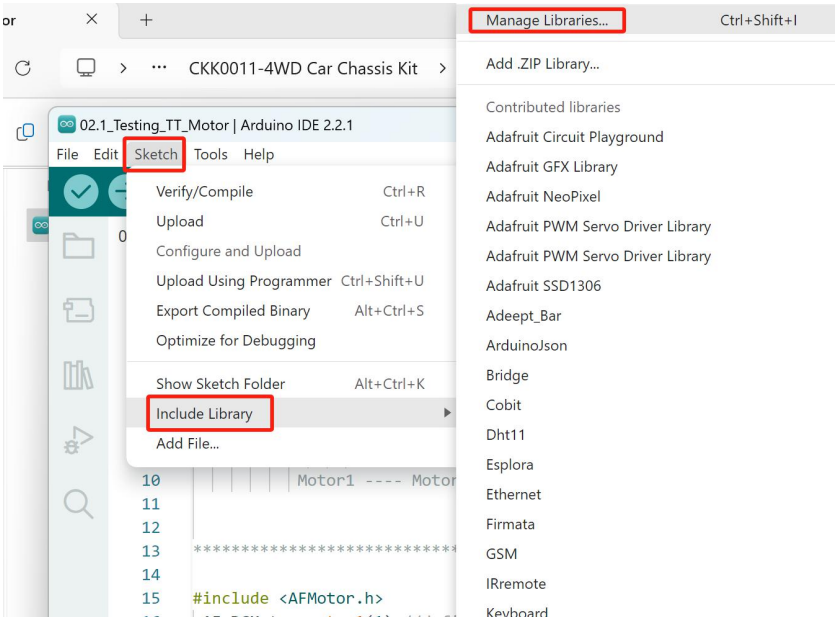
First fix the UNO board on the 4WD car body, install the L293D motor control shield on the UNO board, and then connect the 4 TT motors to the L293D expansion board as shown in the figure below, and connect the power wire of the 18650 battery box to the EXT_PWR terminal of the control shield, note that the positive and negative poles cannot be connected wrongly.



4. Upload code and test

Install AFMotor Library

In order to establish communication with the L293D motor control shield, we need to install the **AFMotor.h** library first so that it can issue commands to control DC, stepper and servo motors. Click to open Arduino IDE，then click "Sketch">"Include library">"Manage Libraries..."



Open the libraries manage interface like below

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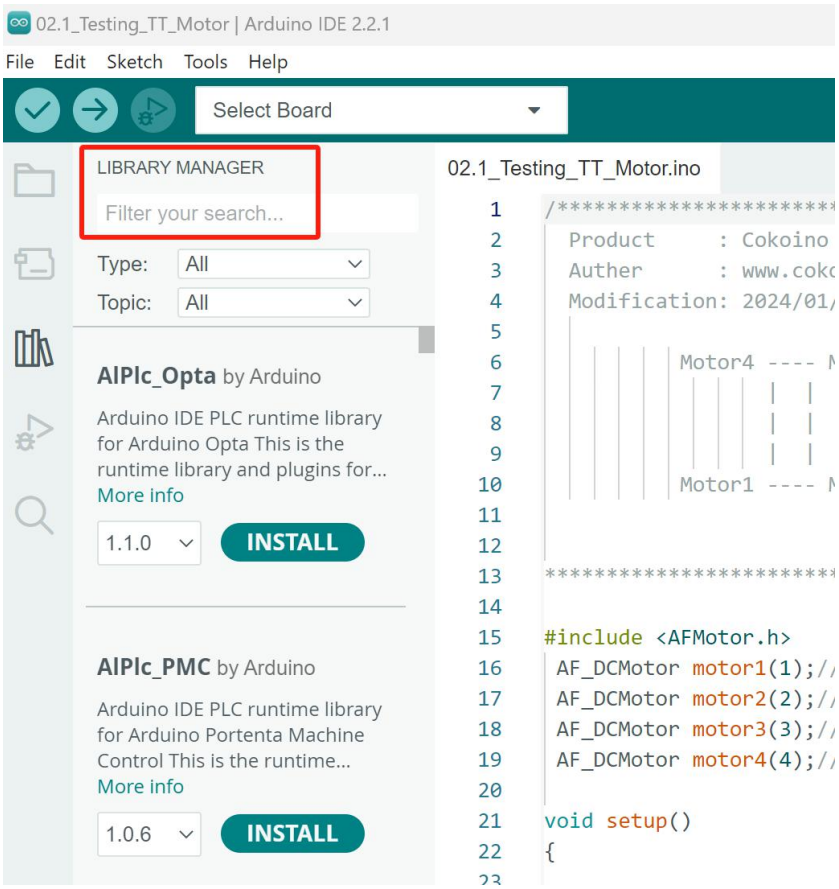
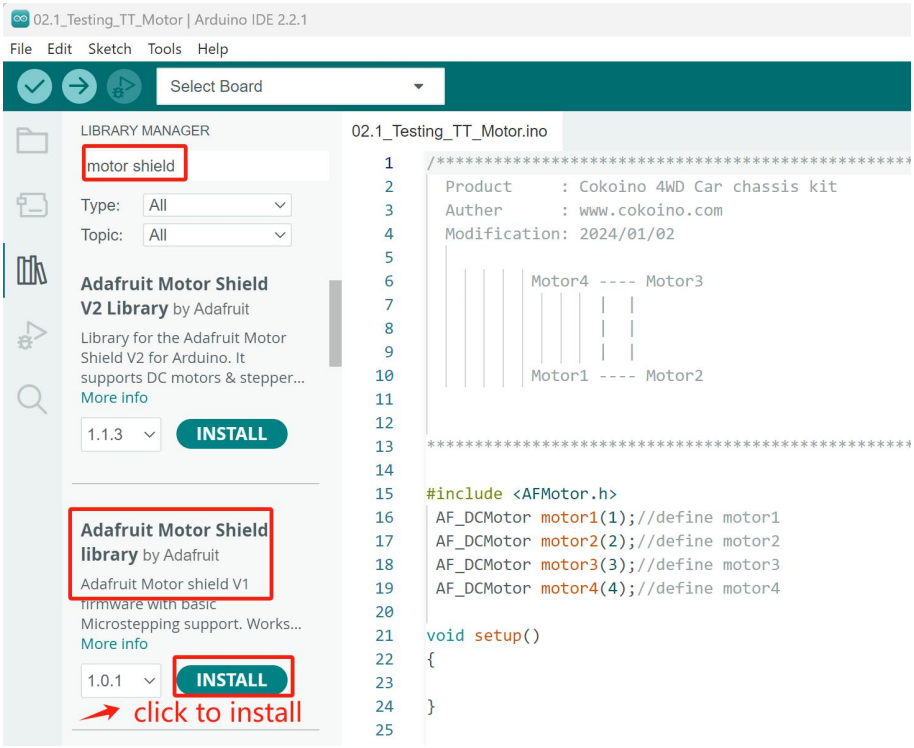


Enter the **" motor shield "** in the Search bar to search the AF Motor library. Look for the Adafruit Motor Shield library (Version 1) provided by Adafruit. Select the 1.0.1 version and click “INSTALL”



Click "File---"Open" in the IDE interface, and select the code under the path of "CKK0011-main\Tutorial\ Arduino\Sketches\ 02.1_Testing_TT_Motor".
After the code is compiled successfully, connect the UNO board on the 4WD body to the computer with a USB cable, and upload the program.
After the upload is successful, you can power on and test the TT Motor.

Code:

```
/*************************************************************************
  Product     : Cokoino 4WD Car chassis kit
  Auther      : www.cokoino.com
  Modification: 2024/01/02

        Motor4 ---- Motor3
            | |
            | |
            | |
        Motor1 ---- Motor2


*************************************************************************/

#include <AFMotor.h>
 AF_DCMotor motor1(1);//define motor1
 AF_DCMotor motor2(2);//define motor2
 AF_DCMotor motor3(3);//define motor3
 AF_DCMotor motor4(4);//define motor4

void setup()
{

}

void loop()
{
  motor1.setSpeed(200);//setup the speed of motor1
  motor2.setSpeed(200);//setup the speed of motor2
  motor3.setSpeed(200);//setup the speed of motor3
  motor4.setSpeed(200);//setup the speed of motor4
  //car move forward
  motor1.run(BACKWARD);//motor1 run BACKWARD
  motor2.run(FORWARD); //motor2 run FORWARD
  motor3.run(BACKWARD);//motor3 run BACKWARD
  motor4.run(FORWARD); //motor4 run FORWARD
  delay(1600);
  motor1.run(RELEASE);// motor1 stop run
  motor2.run(RELEASE);// motor2 stop run
  motor3.run(RELEASE);// motor3 stop run
  motor4.run(RELEASE);// motor4 stop run
  delay(1000);
   //car move backward
  motor1.run(FORWARD);// motor1 run FORWARD
  motor2.run(BACKWARD);//motor2 run BACKWARD
  motor3.run(FORWARD);// motor3 run FORWARD
```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```
47.         motor4.run(BACKWARD);//motor4 run BACKWARD
48.         delay(1600);
49.         motor1.run(RELEASE);
50.         motor2.run(RELEASE);
51.         motor3.run(RELEASE);
52.         motor4.run(RELEASE);
53.         delay(1000);
54.         //car move forward and turn left
55.         motor1.setSpeed(100);//setup the speed of motor1
56.         motor2.setSpeed(200);//setup the speed of motor2
57.         motor3.setSpeed(200);//setup the speed of motor3
58.         motor4.setSpeed(100);//setup the speed of motor4
59.
60.         motor1.run(BACKWARD);//motor1 run BACKWARD
61.         motor2.run(FORWARD); //motor2 run FORWARD
62.         motor3.run(BACKWARD);//motor3 run BACKWARD
63.         motor4.run(FORWARD); //motor4 run FORWARD
64.         delay(2000);
65.         motor1.run(RELEASE);
66.         motor2.run(RELEASE);
67.         motor3.run(RELEASE);
68.         motor4.run(RELEASE);
69.         delay(1000);
70.          //car move forward and turn right
71.         motor1.setSpeed(200);//setup the speed of motor1
72.         motor2.setSpeed(100);//setup the speed of motor2
73.         motor3.setSpeed(100);//setup the speed of motor3
74.         motor4.setSpeed(200);//setup the speed of motor4
75.
76.         motor1.run(BACKWARD);//motor1 run BACKWARD
77.         motor2.run(FORWARD); //motor2 run FORWARD
78.         motor3.run(BACKWARD);//motor3 run BACKWARD
79.         motor4.run(FORWARD); //motor4 run FORWARD
80.         delay(2000);
81.         motor1.run(RELEASE);
82.         motor2.run(RELEASE);
83.         motor3.run(RELEASE);
84.         motor4.run(RELEASE);
85.         delay(1000);
86.          //car move rotation
87.         motor1.setSpeed(200);//setup the speed of motor1
88.         motor2.setSpeed(200);//setup the speed of motor2
89.         motor3.setSpeed(200);//setup the speed of motor3
90.         motor4.setSpeed(200);//setup the speed of motor4
91.
92.         motor1.run(BACKWARD); //motor1 run BACKWARD
93.         motor2.run(BACKWARD); //motor2 run BACKWARD
94.         motor3.run(FORWARD);  //motor3 run FORWARD
95.         motor4.run(FORWARD);  //motor4 run FORWARD
96.         delay(2000);
97.         motor1.run(RELEASE);
98.         motor2.run(RELEASE);
99.         motor3.run(RELEASE);
100.        motor4.run(RELEASE);
101.        delay(1000);
102.
103.    }
```


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5. Make your suggestion and get support

THANK YOU for participating in this learning experience!

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We will make every effort to make changes and correct errors as soon as feasibly possible and publish a revised version.

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