

ZeroPi Programming Introductions

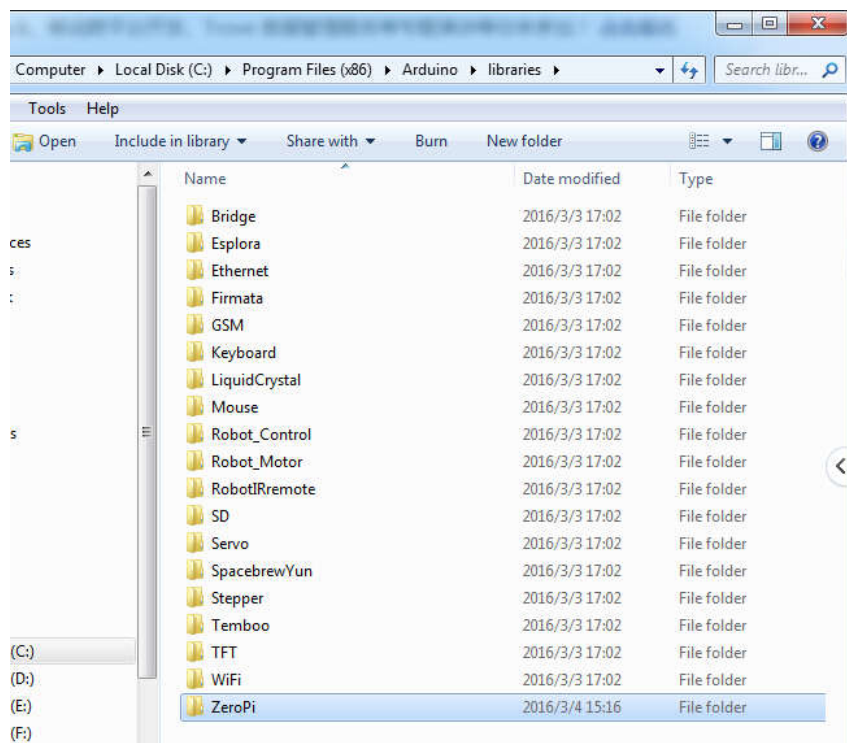
ZeroPi is a new powerful main control board developed for robotic motion structure system. It is capable of driving servos, DC motors and stepper motors. We have included six examples below showing you how to program ZeroPi with Arduino IDE.

Before getting started, please make sure you have read *Introduction to ZeroPi and Driver Installation* and configured Arduino IDE (this step ensures your ZeroPi can upload program successfully). If you already finished Arduino IDE configuration, please skip this step.

I. Before writing codes for ZeroPi, please visit GitHub to download ZeroPi library functions. Here is the URL:

https://github.com/ZeroPiProject/ZeroPi_lib

Please decompress ZeroPi library functions file before using them. Then place the decompressed file under the “libraries” folder of the Arduino install directory. In the picture below, the install directory of Arduino IDE is “C:\Program Files (x86)\Arduino\libraries”.



II. Examples:

1. Control DC Motors with ZeroPi
2. Control Servo Rotation with ZeroPi
3. Control Stepper Motor with ZeroPi
4. Read Temperature Data with ZeroPi
5. ZeroPi and Large-Current Devices
6. Measure Distance with ZeroPi and Ultrasonic Sensor Module

1. Control DC Motors with ZeroPi

This example will show you how to make two DC motors switching between clockwise rotation and counter-clockwise rotation at 1-second interval.

(1) Do the wiring

<1> Prepare materials:



DC motor driver

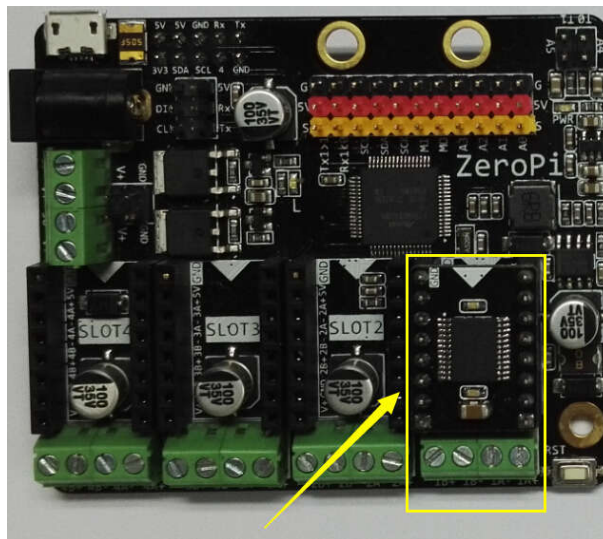


2 DC motors

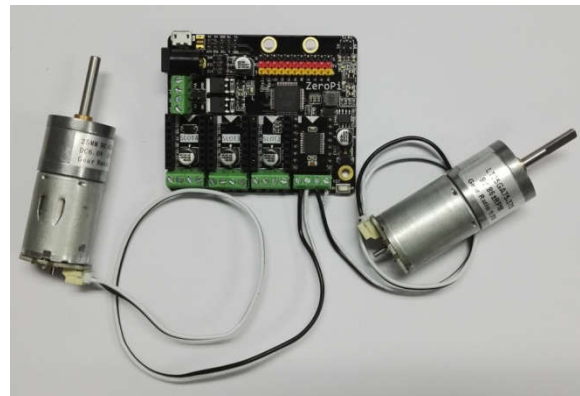


12V/5A Power Supply Adapter

<2> Plug the DC motor driver into the ZeroPi “SLOT1” interface. Please make sure that the small white tri-angle on DC motor driver is in the same direction with the tri-angle on ZeroPi.

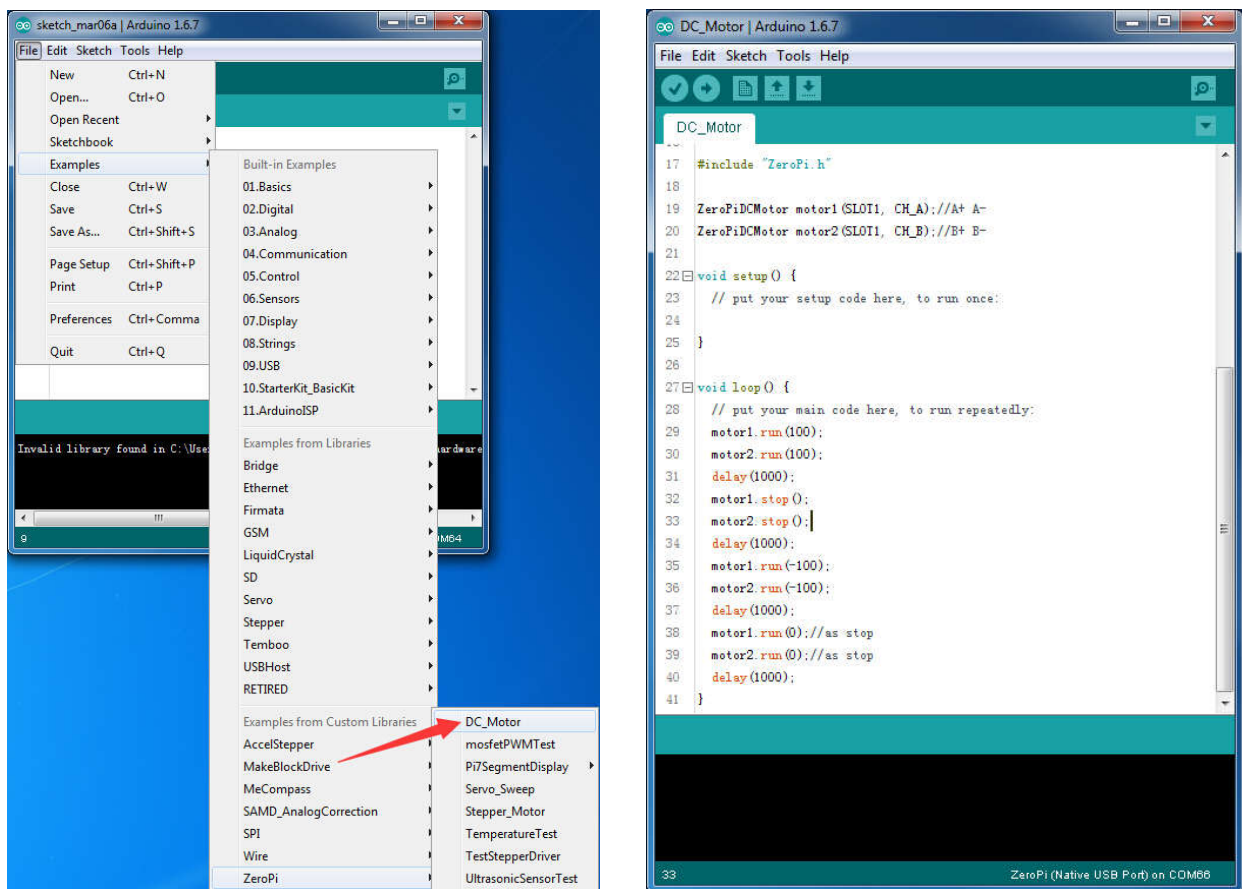


<3> Connect one DC motor to 1A-, 1A+ interface and the other DC motor to 1B-, 1B+ interface separately. Then plug the power supply adapter in ZeroPi.

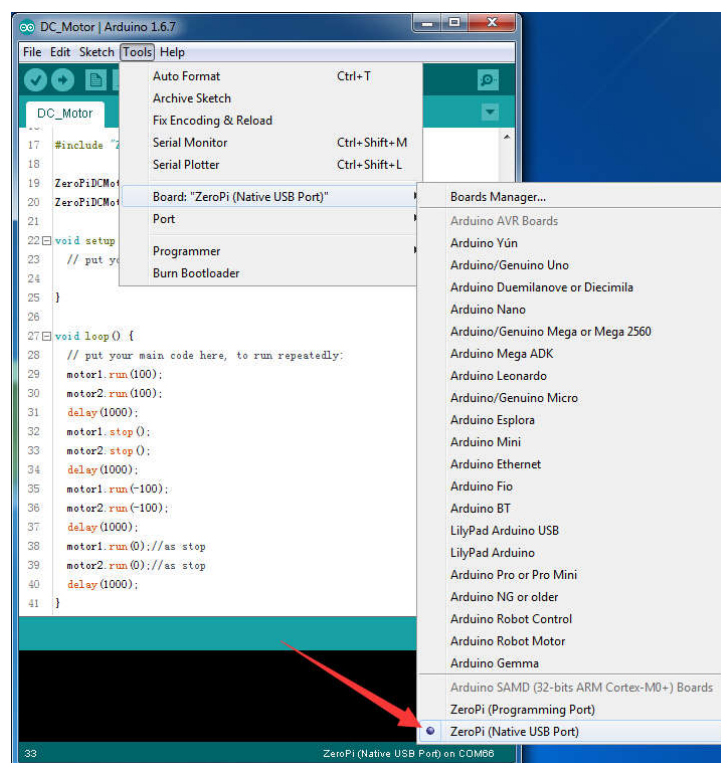


(2) Upload program

<1> Open up the Arduino IDE, click “File” -> “Examples” -> “ZeroPi” -> “DC_Motor” to open examples that ZeroPi used to control DC motors, as below:



<2> Click “Tools” -> “Board”, choose “ZeroPi (Native USB Port)”



<3> Go to “Tools” -> “Port”, choose “COM66 (ZeroPi (Native USB Port))”. Please note that different computer may show different port number.

<4> Click “Upload” to upload program.

(3) Function of Program

This program is to control rotations of two DC motors with the SLOT1 interface on ZeroPi. After uploading program to ZeroPi, these two DC motors will rotate clockwise for 1 second and rotate counter-clockwise for 1 second. Each SLOT interface on ZeroPi can control two DC motors, therefore, ZeroPi (with four SLOTS) is capable of driving up to 8 DC motors.

(4) About Library functions

Library functions that ZeroPi used to control DC motors are as below:

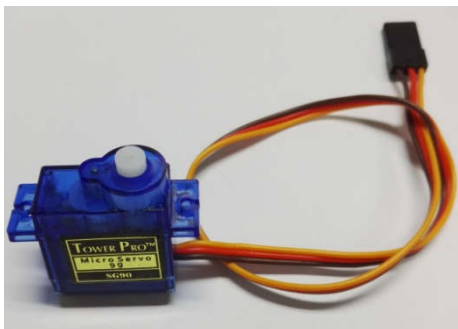
Function	Purpose
<code>ZeroPiDCMotor(SLOT_NUM_t slot, CHANNEL_t channel)</code>	Define interface of DC motor
<code>void run(int pwm)</code>	Control the rotating speed of motors PWM Range: -255~255
<code>void stop(void)</code>	Stop rotation of the motor

2. Control Rotation of Servo with ZeroPi

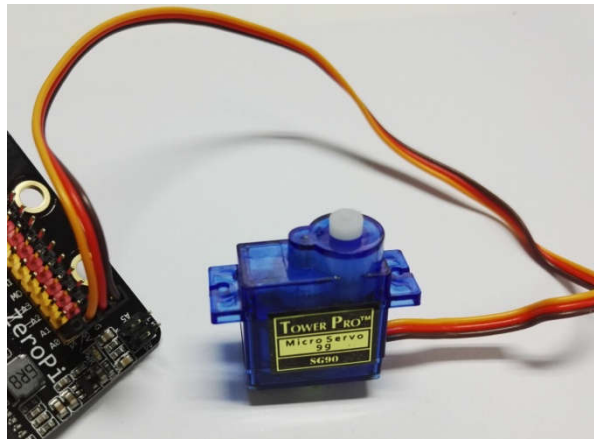
The output voltage of on-board servo interface is 5V, therefore ZeroPi can be used to control digital servo (operating voltage: 5V). The way that ZeroPi controls servo is the same as Arduino board.

(1) Do the wiring

<1> Prepare a digital servo (operating voltage of the servo: 5V)

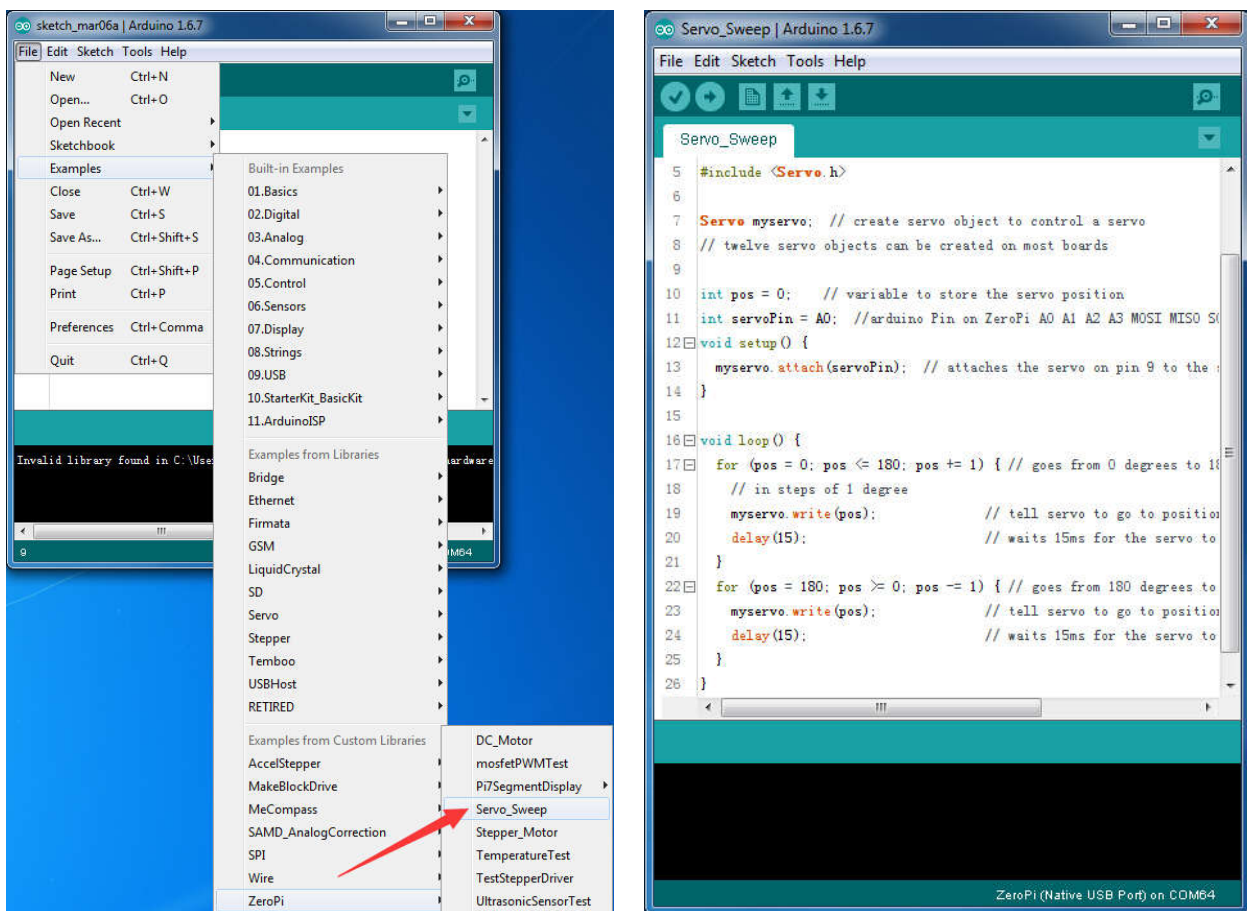


<2> There are three (black, red, yellow) extension pins on the ZeroPi. The black extension pin is the negative terminal of the power supply, the red one is 5V power supply, and the yellow one is control signal. Connect the servo to the A0 pin of ZeroPi, as below:



(2) Upload program

<1> Open up the Arduino IDE, click “File” -> “Examples” -> “ZeroPi” -> “Servo_Sweep” to open the examples that ZeroPi used to control servos:



<2>Go to “Tools” -> “Board”, choose “ZeroPi (Native USB Port)”

<3>Click “Tools” -> “Port”, find “COM66 (ZeroPi (Native USB Port))”. Please note that different computer may show different port number. Afterwards, click “Upload” to upload programs.

(3) Function of Program

The function of this program is to control a digital servo and let it rotate from 0 to 180 degrees. The extension pins includes 11 I/O pins (TX1, RX1, SCL, SDA, SCK, MISO, MOSI, A3, A2, A1, A0), which gives ZeroPi the ability of controlling up to 11 servos.

Note: the DC current of each I/O pin is 7mA, hence we suggest that you do not use the I/O pins to drive large-current modules.

(4) About Library functions

Library functions that ZeroPi used to control servo are the same with Arduino' s. Each function is as below:

Function	Purpose
<code>void attach()</code>	Select the control pin of servo
<code>void write(int16_t angle)</code>	Rotate the servo to certain angle. Angle range: 0~180 degrees

3. Control Stepper Motor with ZeroPi

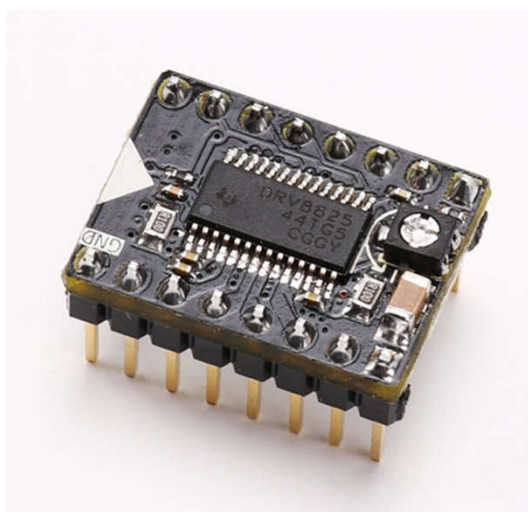
Stepper motor is the most common motor used in motion control structure. ZeroPi, as a powerful main control board for motion structure system, obviously it is also capable of driving stepper motors. ZeroPi can drive up to 4 stepper motors at the same time. Next is an example to showing you how to control stepper motor with ZeroPi.

(1) Wiring Up

<1> The mode of the stepper motor in this example is 42BYGHW609D4P1(1.7A 1.8°). There are 4 wires (blue, red, green, black) on this motor. To wire it up, we still need to prepare a DRV8825 stepper motor driver and a 12V/2A power supply adapter.



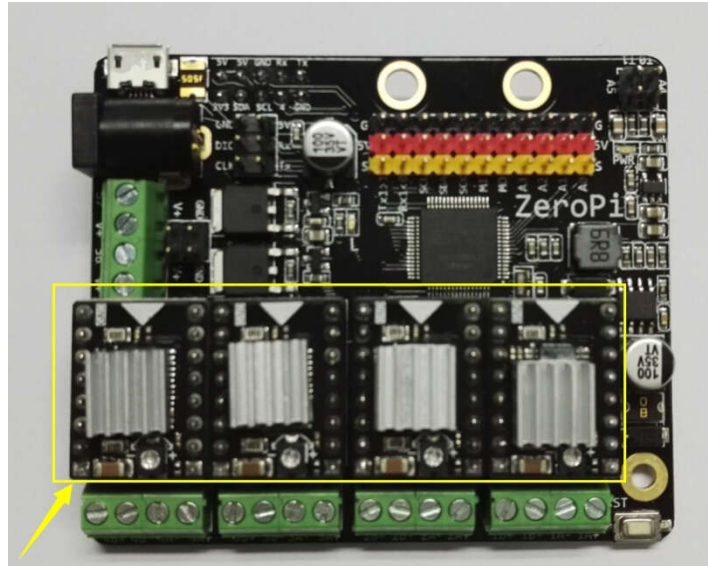
Stepper Motor



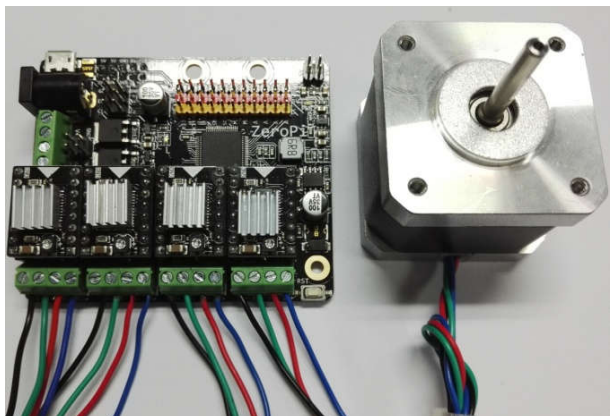
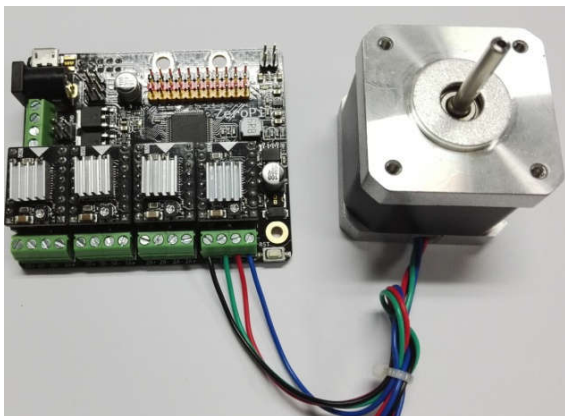
Stepper Motor Driver

<2> Connect four DRV8825 stepper motor drivers with SLOT1, SLOT2, SLOT3, and SLOT4 interface separately.

Note: Please make sure the small white triangle on the stepper motor driver is in the same direction with the triangle on ZeroPi.

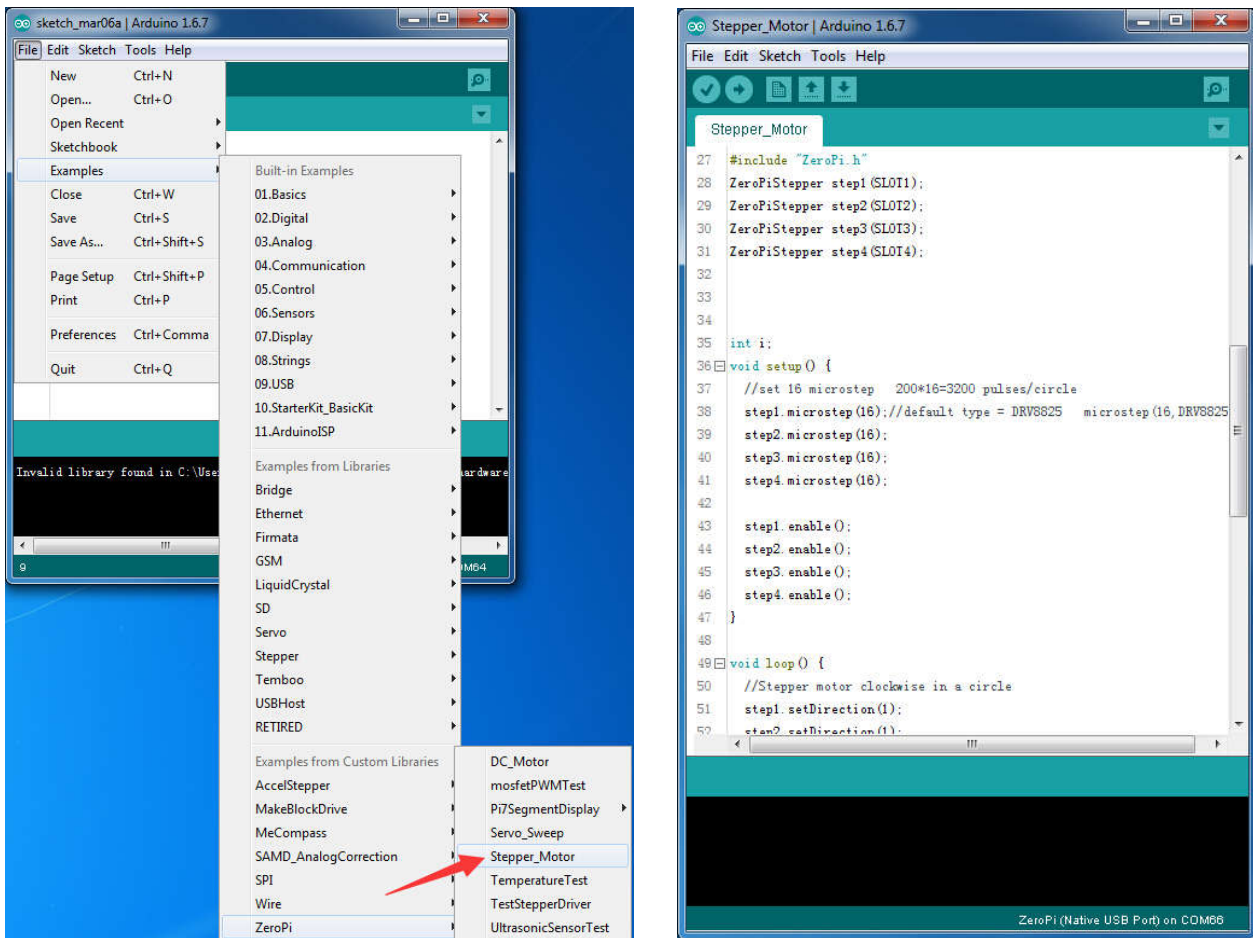


<3> Connect the blue, the red, the green, and the black wire on the stepper motor (needed to be in this order) to 1A+, 1A-, 1B-, 1B+ of SLOT1 interface. Connect the rest three stepper motor using the same method to SLOT2, SLOT3, and SLOT 4. And afterwards, connect the 12V/2A power supply adapter with ZeroPi.



(2) Upload Program

<1> Open up Arduino IDE, click “File” -> “Examples” -> “ZeroPi” -> “Stepper_Motor” to open the example that ZeroPi used to control stepper motors, as below:



<2> Go to “Tools” -> “Board”, and choose “ZeroPi (Native USB Port)”

<3> Click to “Tools” -> “Port”, find “COM66 (ZeroPi (Native USB Port))”. Then click “Upload” to upload program

(3) Function of Program

The function of program is to set the resolution of stepper motor to 1/16-step and rotate the stepper motor clockwise 3200 steps then rotate counter-clockwise 3200 steps. The specification of the stepper motor is 1.7A 1.8°, which means when the motor rotates 3200 steps, it rotates a circle. After uploading program to ZeroPi, you then will be able to see all four stepper motors rotate clockwise a circle, then rotate counter-clockwise a circle.

(4) About Library functions

Library functions that ZeroPi used to control stepper motor are as below:

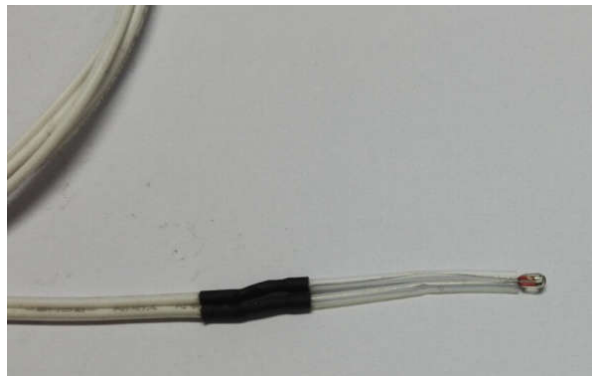
Function	Purpose
<code>ZeroPiStepper(SLOT_NUM_t slot)</code>	Define interface of stepper motor
<code>void microstep(int value, DRIVER_t = DRV8825)</code>	Set the microstep resolution of the stepper motor and choose driver chip
<code>void setDirection(int dir)</code>	Set the rotate direction of the stepper motor
<code>void step(void)</code>	Rotate the stepper motor a step
<code>void enable(void)</code>	Enable the stepper motor driver
<code>void disable(void)</code>	Disable the stepper motor driver

4. Read Temperature Data with ZeroPi

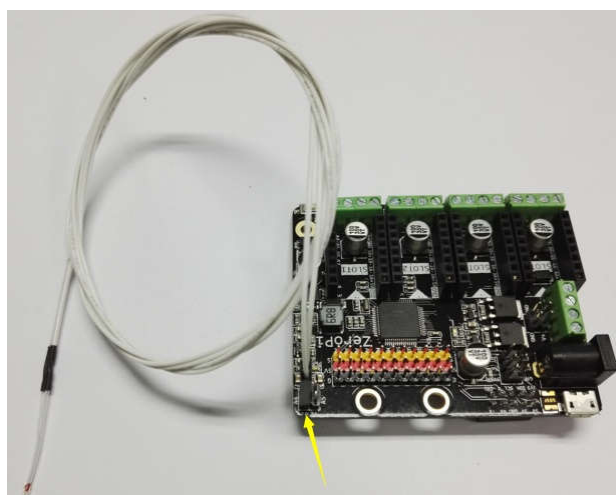
The temperature sensor interfaces (T0, T1) on ZeroPi help collect temperature data in 3D printer. Each interface comes with a 4.7K pull-up resistor. The mode of the temperature sensor we used in this example is 100K beta 3950 1%.

(1) Do the wiring

<1> Prepare two temperature sensors (temperature sensor mode: 100K beta 3950 1%)

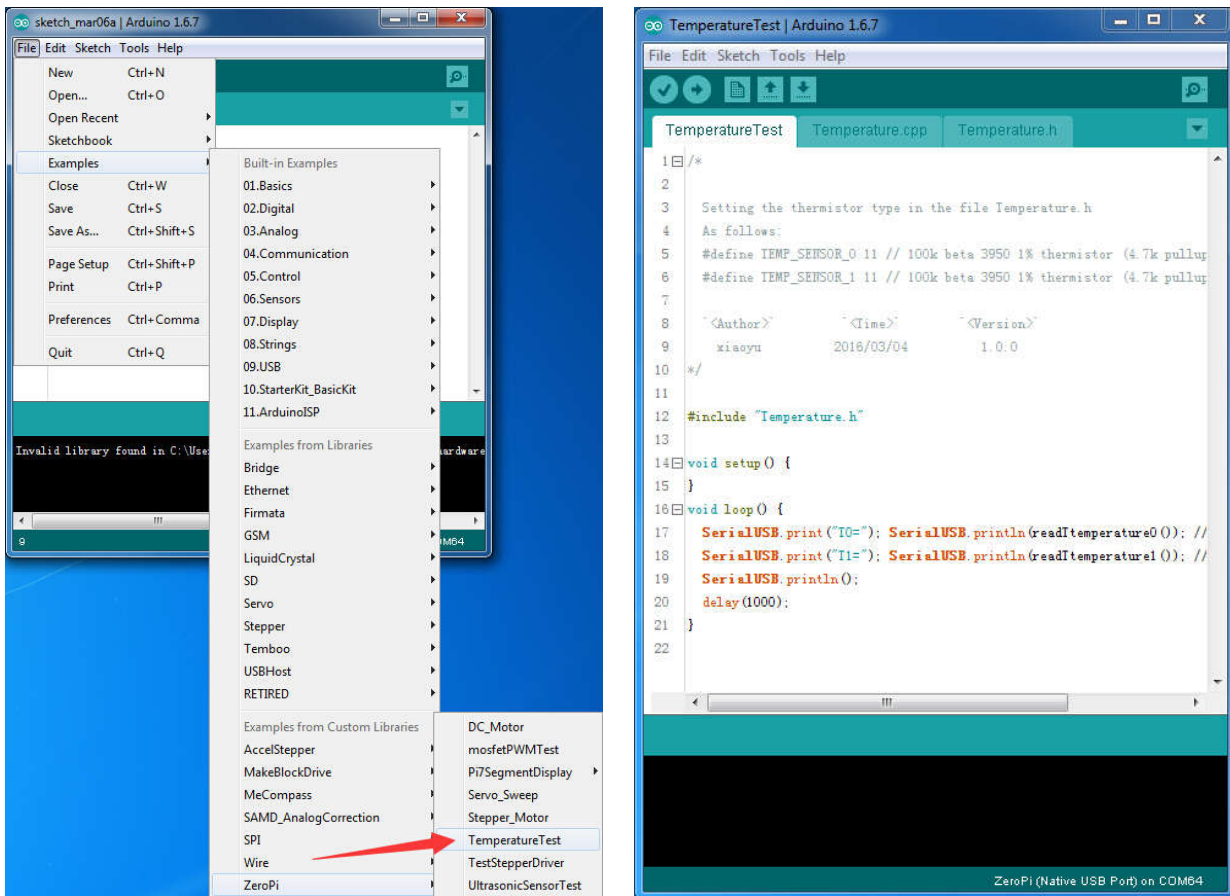


<2> Connect two temperature sensors with T0, T1 interface separately



(2) Upload Program

<1> Open up the Arduino IDE, click “File” -> “Examples” -> “ZeroPi” -> “TemperatureTest” to open the examples that ZeroPi used to test temperature.

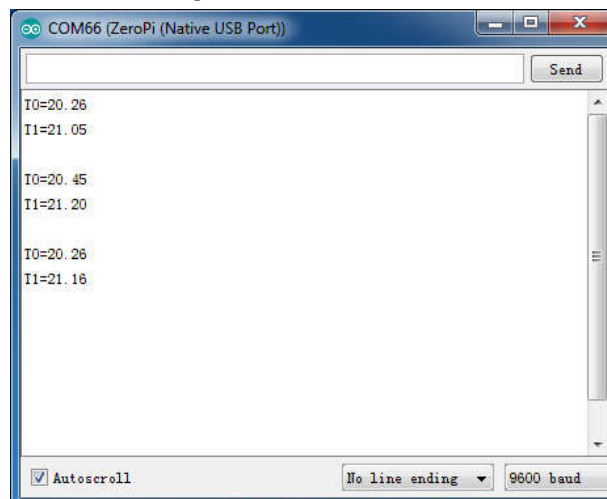


<2>Go to “Tools” -> “Board” and choose “ZeroPi (Native USB Port)” ;

<3>Click “Tools” -> “Port”, and find “COM66 (ZeroPi (Native USB Port))” . Then click “Upload” to upload program.

(3) Function of Program

The function of this program is to read the temperature value of T0, T1 interface and then print the temperature data via serial port. The default baud rate of serial port is 9600bps.



(4) About Library functions

Related library functions in this example are as follows:

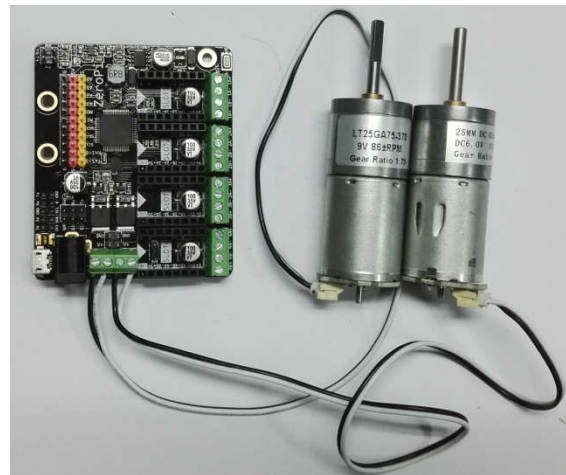
Function	Purpose
<code>float readTtemperature0();</code>	Read temperature value on T0;
<code>float readTtemperature1();</code>	Read temperature value on T1;

5. ZeroPi and Large-Current Devices

Besides the black power supply interface is two MOS driver interfaces that used to drive large-current devices. The biggest driving current of these interfaces is 10A. MOS driver interface is used to control the extruder and the fan of 3D printer. Now we will use the MOS driver interfaces to control the rotating speed of the DC motor.

(1) Do the wiring

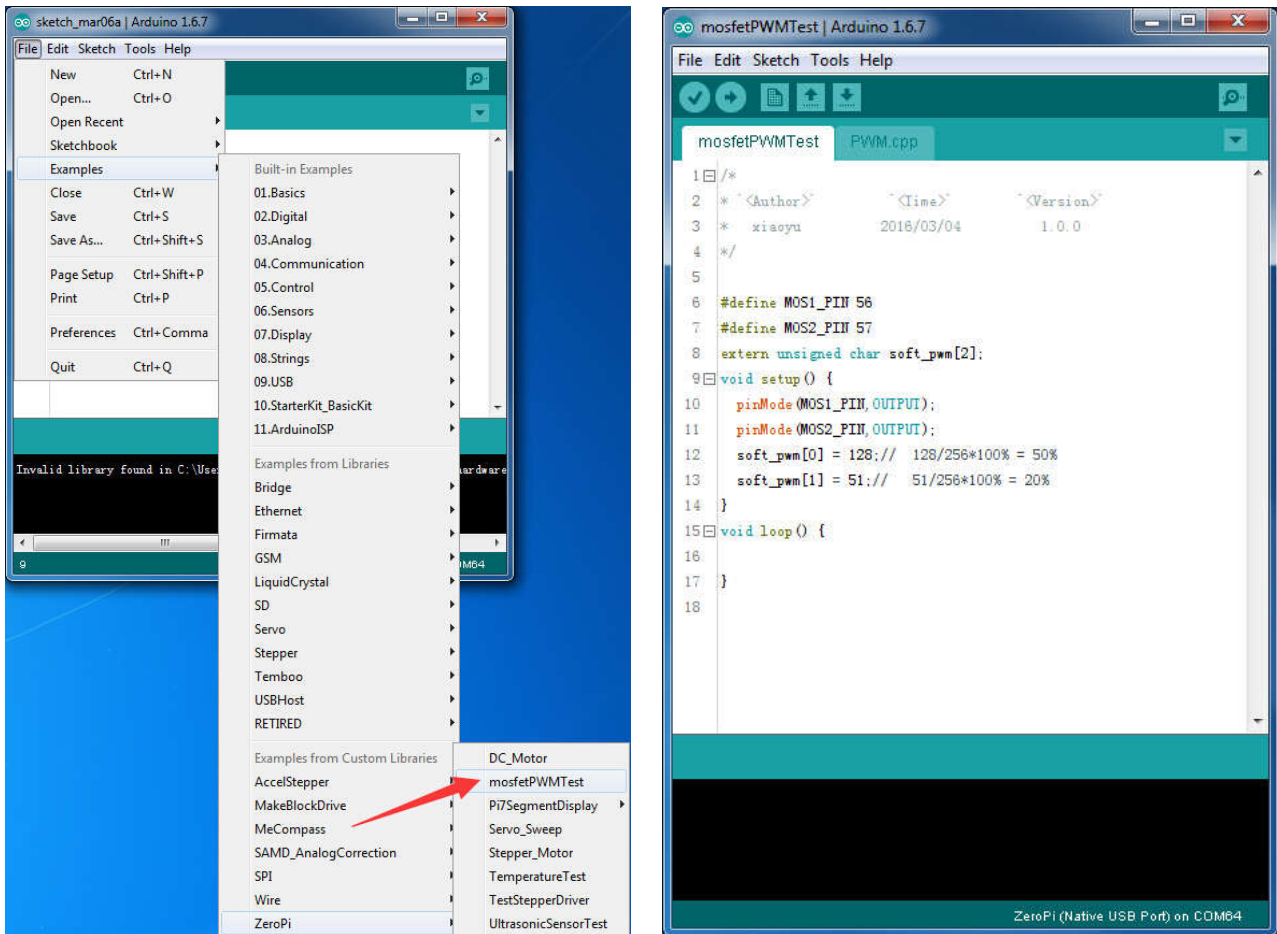
<1> Connect two DC motors with the MOS driver interface, as below



<2> Connect ZeroPi with 12V/2A power supply adapter

(2) Upload Program

<1> Open up Arduino IDE, click “File” -> “Examples” -> “ZeroPi” -> “mosfetPWMTest” to open the examples



<2>Go to “Tools” -> “Board” and choose “ZeroPi (Native USB Port)”

<3> Click “Tools” -> “Port”, COM66 (ZeroPi (Native USB Port)), then click “Upload” to upload program;

(3) Function of Program

This program is used to control one motor rotate at 50% speed and the other motor rotate at 20% speed. The negative and positive of both MOS drive interface is fixed, hence you can only control the rotating speed of the DC motors at one direction.

(4) About Library functions

If you look carefully into programs, you may find that there is no function to control MOS driver interface. That is because we define a “sysTickHook” function in “PWM.cpp” file to control the PWM output. All you need to do is to evaluate two elements “soft_pwm”.

6. Measure Distance with ZeroPi and Ultrasonic Sensor Module

The extension pins on ZeroPi can be connected with other common sensor (e.g. sound sensor, light sensor). In this example, we will measure distance with ZeroPi and ultrasonic sensor.

(1) Wiring Up

<1> Prepare an ultrasonic sensor module and wires



ultrasonic sensor

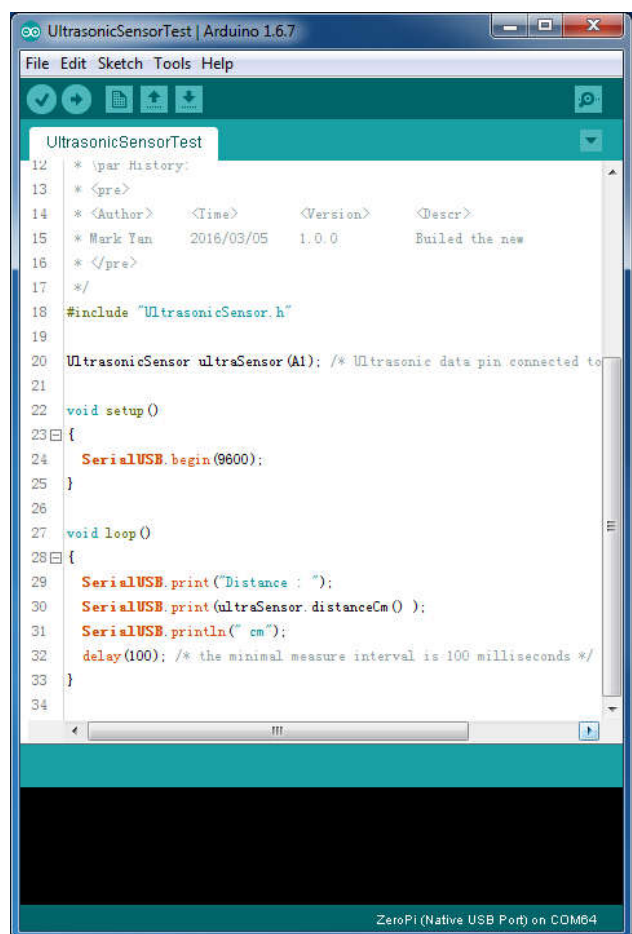
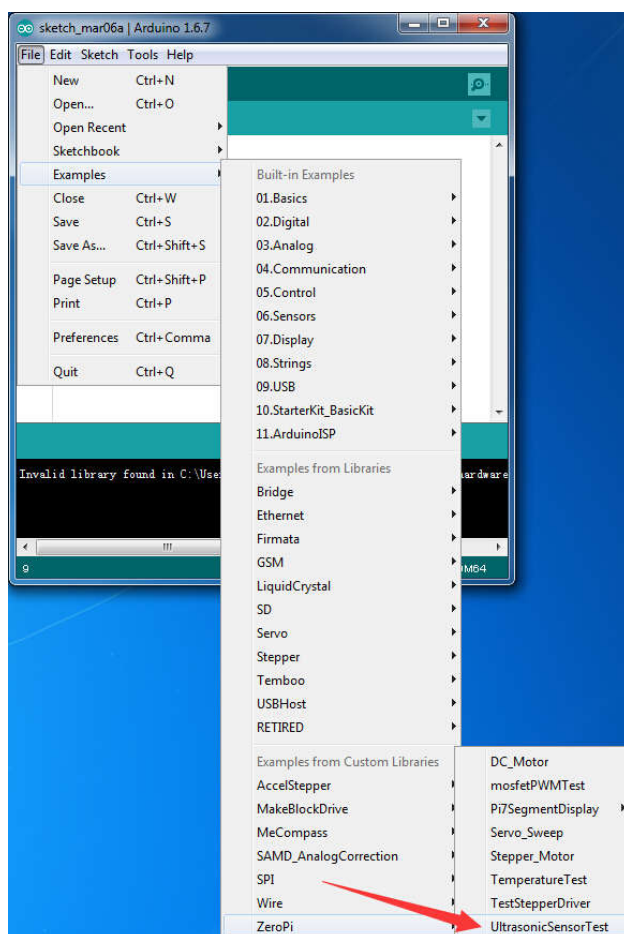


wires

<2> Wire up the ultrasonic sensor module (5V, GND), then connect the SIG to A1 pin of ZeroPi

(2) Upload Program

<1> Open up Arduino IDE, click “File” -> “Examples” -> “ZeroPi” -> “UltrasonicSensorTest” to open examples that ZeroPi use to test temperature



<2> Go to “Tools” -> “Board” and choose “ZeroPi (Native USB Port)” ;

<3> Click “Tools” -> “Port, COM66 (ZeroPi (Native USB Port))” to upload program;

(3) Function of Program

This program is to set the A1 pin of ZeroPi to control pin of ultrasonic sensor. The value that the ultrasonic sensor measures will be printed via serial port. We use the centimeter as the measure unit.

The baud rate of the serial port is 9600bps. After uploading programs to ZeroPi, please open the serial port monitor, you will be able to see the distances that ZeroPi reads.

(4) About Library functions

Library function used in this example are as below:

Function	Purpose
<code>UltrasonicSensor(uint8_t port)</code>	Define the control pin of the ultrasonic sensor module
<code>double distanceCm()</code>	Read distance(Cm)
<code>double distanceInch()</code>	Read distance(Inch)

III. Conclusion

Above 6 examples show you how to program ZeroPi with Arduino IDE. What is more, Arduino' s library functions can also be used to control any pins on ZeroPi. The motor driver board on ZeroPi is replaceable, which enables you to control more mechanical structure according to your needs.

If you encounter some problem while using ZeroPi, please feel free to contact us. We will do our best to address all issue. Thank you for purchasing ZeroPi, and hope ZeroPi can help you build more fantastic projects.