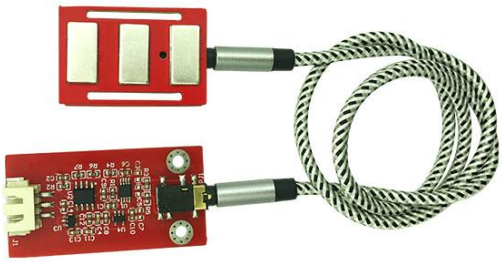
Dry Electrode muscle electrical sensor



一、INTRODUCTION

Dry Electrode electromyography sensor detects the surface electromyography signal of human body (sEMG) , and then reflect the activity of human muscles and nerves.

Dry Electrode electromyography the sensor integrates filtering and amplification circuits, amplifies the weak EMG signal on the human body surface within ± 1.5MV by 1000 times, and effectively suppresses noise (especially power frequency interference) through differential input and analog filter circuits. The output signal is in the form of analog quantity, with 1.5V as the reference voltage and 0~3.0V range output. The size of the output signal depends on the activity of the selected muscle, and the waveform of the output signal can significantly indicate the situation of the subcutaneous muscle at the observed position, which is convenient for analysis and research of myoelectric signals, if Arduino is used as the controller detect muscle activity, such as muscle tightness, strength, fatigue, etc.

Dry Electrode electromyography sensor it is an active sensor that can provide high-quality signal collection and is easy to use. Whether it is used in static or dynamic application fields, only some extremely simple preparations are needed. This product uses dry electrodes lead , Good signal quality can be obtained without conductive gel, so it has the characteristics of long service life, simple and convenient use, and is more suitable for ordinary users. however, medical

electrodes using gel probes are usually disposable, which is more troublesome to use.

The measurement of dry electrode myoelectric sensor has the advantages of non-invasive, non-invasive, simple operation and so on, and can be used for human-computer interaction and other related applications. Although measuring muscle activity has always been used in medical research, with the improvement of microcontrollers and integrated circuits that are shrinking but more powerful, electromyography circuits and sensors are gradually applied to various control systems.

1.The supply voltage is between 3.3 and 5.5V, the supply current is not less than 20mA, and the ripple and other noise are small. A regulated DC voltage is recommended.

2.The effective spectrum range of EMG signals is 20Hz ~ 500Hz, and it is recommended to use an analog-to-digital converter (ADC) with a resolution of not less than 8bit and an effective sampling frequency of not less than 1KHz for sampling and digitization to retain as much original information as possible.

3.The supporting metal dry electrode plate should be kept in the same direction as the muscle.

4.This product is not a professional medical instrument, can not be used as an auxiliary accessories to participate in diagnosis and treatment.

二、Technical specifications

1. Dry electrode myoelectric sensor

●supply Voltage: +3.3V ~ 5.5V
●output voltage: 0~3.0V
●detection range: +/-1.5MV
●electrode interface: PJ-342
●module interface: XH2.54 -3P

●output range: 0~3.0V

●operating temperature: 0 ~ 50℃

●board size: 25*48mm

2. Dry electrode guide plate

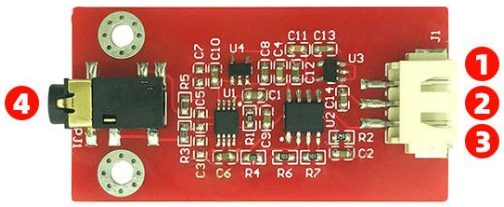
●electrode interface: PJ-342

●electrode line length: 50cm

●board size: 23*35mm

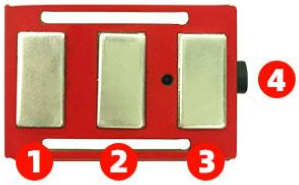
三、description

1. Dry electrode myoelectric sensor



- 1 --> power input negative pole
- 2 --> power input positive pole (3.3~5.5V)
- 3 --> analog signal output (0~3.0V)
- 4 --> PJ-342 dry electrode interface

2. Dry electrode guide plate



- 1 --> DRY Electrode DRY+

- 2 --> reference electrode GND
- 3 --> DRY Electrode DRY-
- 4 --> PJ-342 dry electrode interface

四、Use process

1. hardware configuration list

●1 x Arduino UNO control panel (or similar)
●1 x EMG sensor signal processing board
●1 x myoelectric sensor dry electrode
●1 x dry electrode connecting line
●1 x 3p analog signal line

2. software Configuration

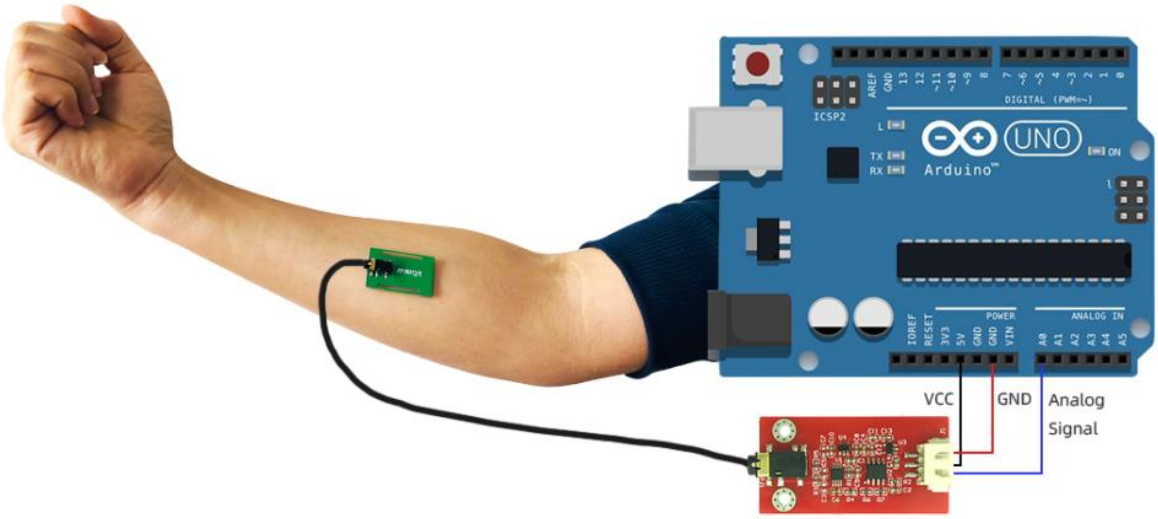
Arduino IDE(recommend 1.8.2 and above)

A file named How to install the Arduino IDE correctly?.pdf can be found in the zip package

3. wiring

- GND-GND
- 5V-5V
- sig-A0

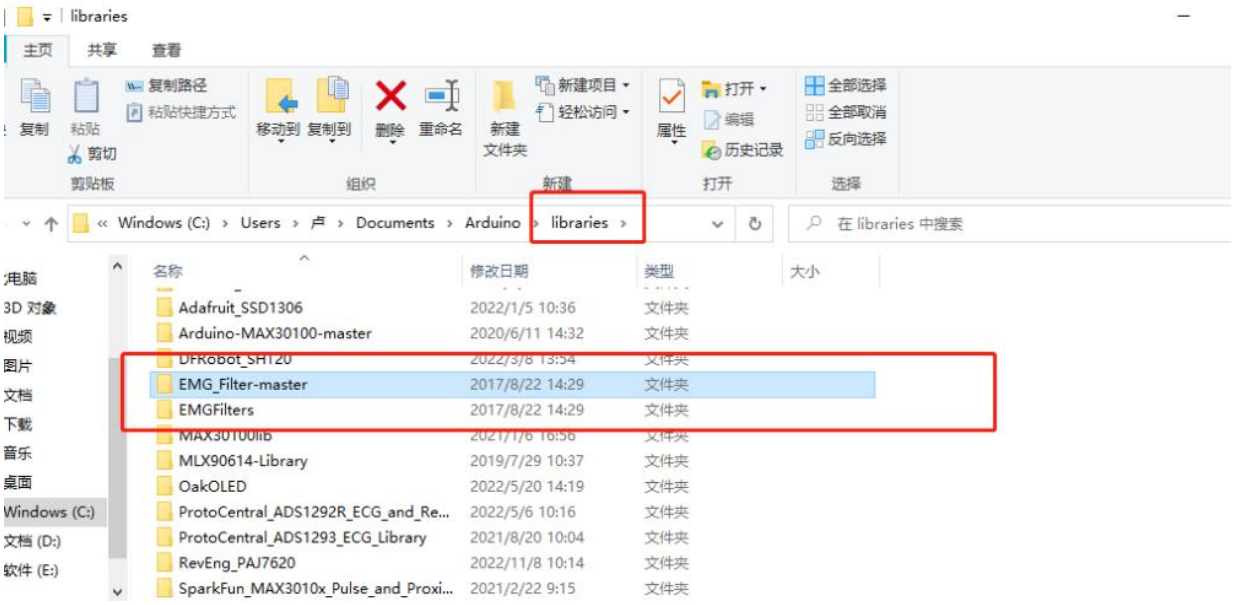
[Please wire according to the pin instructions, do not wire according to other standards]



4. download the library file (the library file must be stored in the libraries after downloading)

A file named EMG_Filter-master.zip can be found in the zip package

(Click download)



5. Get the waveform using the Arduino IDE

① Sample code

- complex the following code into the Arduino IDE.

> Key point: when using it, you must disconnect the power supply of the notebook computer to produce the correct waveform.

```
/*
 * Wuxi Sichiray Co.,Ltd
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 */
#if defined(ARDUINO) && ARDUINO >= 100
#include "Arduino.h"
#else
#include "WProgram.h"
#endif
#include "EMGFilters.h"
#define  SensorInputPin A0       //sensor input pin number
unsigned long threshold = 0;      // threshold: Relaxed baseline values.(threshold=0:in
```

```
the calibration process)
unsigned long EMG_num = 0;      // EMG_num: The number of statistical signals
EMGFilters myFilter;
SAMPLE_FREQUENCY sampleRate = SAMPLE_FREQ_500HZ;
NOTCH_FREQUENCY humFreq = NOTCH_FREQ_50HZ;
void setup()
{
  myFilter.init(sampleRate, humFreq, true, true, true);
  Serial.begin(115200);
}
void loop()
{
  int data = analogRead(SensorInputPin);
  int dataAfterFilter = myFilter.update(data);
  int envelope = sq(dataAfterFilter);
  envelope = (envelope > threshold) ? envelope : 0;
  if (threshold > 0)
  {
    if (getEMGCount(envelope))
    {  EMG_num++;
      Serial.print("EMG_num: ");
      Serial.println(EMG_num);
    }
  }
    /*
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 */
  else {
    Serial.println(envelope);
  }
  delayMicroseconds(500);
}
int getEMGCount(int gforce_envelope)
```

```
{
  static long integralData = 0;
  static long integralDataEve = 0;
  static bool remainFlag = false;
  static unsigned long timeMillis = 0;
  static unsigned long timeBeginzero = 0;
  static long fistNum = 0;
  static int  TimeStandard = 200;
  integralDataEve = integralData;
  integralData += gforce_envelope;
  if ((integralDataEve == integralData) && (integralDataEve != 0))
  {
    timeMillis = millis();
    if (remainFlag)
    {
      timeBeginzero = timeMillis;
      remainFlag = false;
      return 0;
    }
      /*
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*/
    if ((timeMillis - timeBeginzero) > TimeStandard)
    {
      integralDataEve = integralData = 0;
      return 1;
    }
    return 0;
  }
  else {
    remainFlag = true;
    return 0;
   }
```

```
}
/*
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 * Mailbox: sichiraywuxi@gmail.com
 */
```

② set ports and singlechip

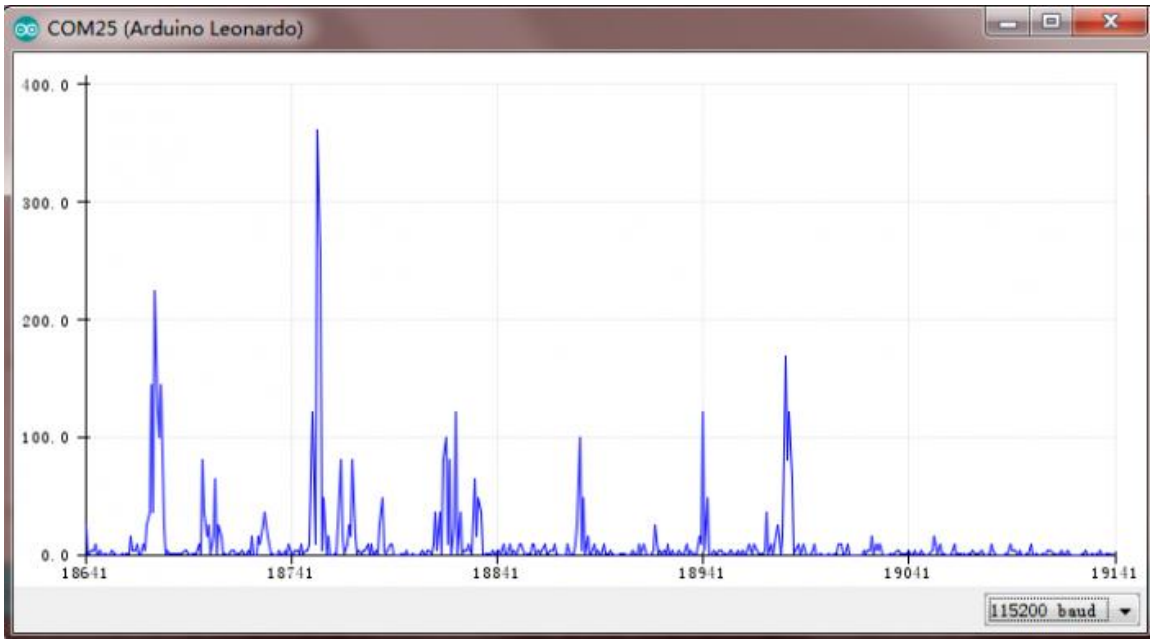
A file named How do I view the serial port.pdf can be found in the zip package

A file named How to select the port and SCM type in the Arduino IDE.pdf can be found in the zip package

③ compile and upload code

④ view the waveform

after the code is uploaded, "Tool"-"serial port plotter" , lower right corner baud rate setting: 115200 , to display the waveform



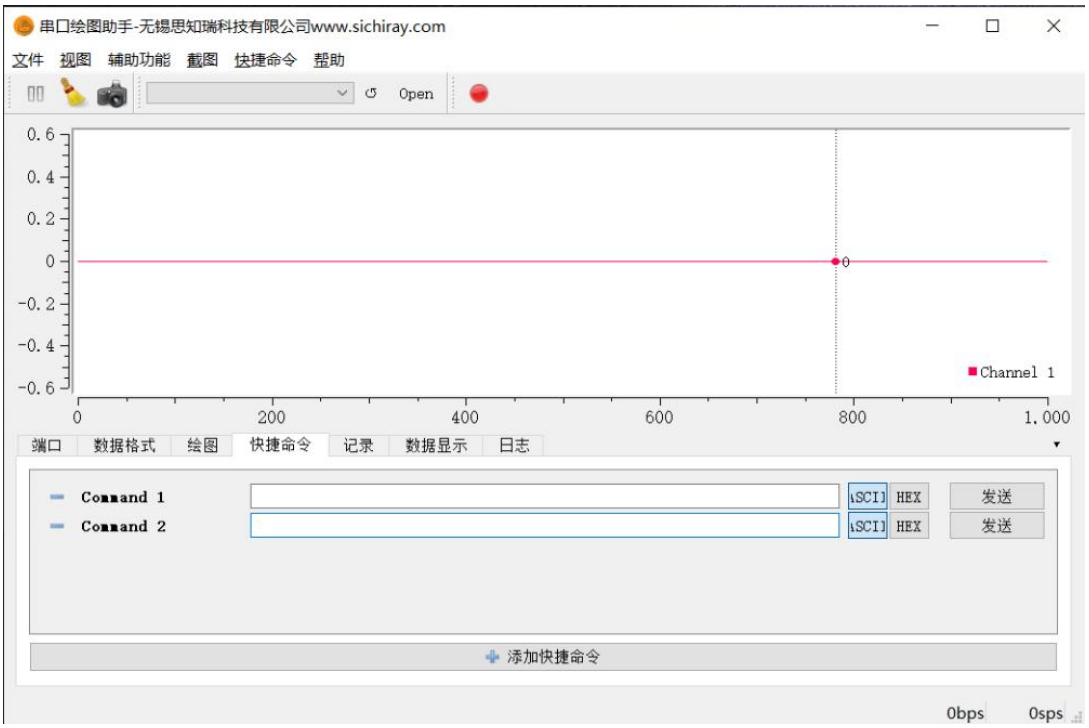
⑤ operation Video

A file named Dry electrode tutorial.mp4 can be found in the zip package

●place the sensor in the position where muscle activity needs to be detected, and then calibrate it to accurately count muscle activity, such as push-ups counting and dumbbell meter.

●it can also be used for human-computer interaction in several fitness occasions.

6. use sichiray debugging assistant display waveform



① burning code

burn the following Arduino sample code(the procedure of burning is the same as above);

```
/*
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 */
#include <Arduino.h>
#include <Adafruit_SSD1306.h>

#define OLED_Address 0x3C
Adafruit_SSD1306 oled(128, 64);

#define DEBUG  //Uncomment, display in the upper computer
```

```
typedef struct  // Curve parameter
{
  float Draw_Buf[128];  // Curve data cache
  float Draw_Min;       // The minimum value of the cached data is in percentage
  float Draw_Max;       // The maximum value of cached data
} _DrawCurve;           // Curve parameter

static _DrawCurve DrawCurve;

void PlotDataInput(_DrawCurve *Draw, float val) {
  uint8_t i;
  for (i = 1; i < 128; i++) {
    Draw->Draw_Buf[i - 1] = Draw->Draw_Buf[i];
  }
  Draw->Draw_Buf[127] = val;

  if (Draw->Draw_Buf[127] > 1)
    Draw->Draw_Buf[127] = 1;
  else if (Draw->Draw_Buf[127] < 0)
    Draw->Draw_Buf[127] = 0;
/*
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 */
  Draw->Draw_Max = 0;
  Draw->Draw_Min = 1;
  for (i = 0; i < 128; i++)  // Gets the maximum and minimum range
  {
    if (Draw->Draw_Min > (Draw->Draw_Buf[i])) {
      Draw->Draw_Min = Draw->Draw_Buf[i];
      Draw->Draw_Min = (float)((uint8_t)(Draw->Draw_Min * 100) / 5) / 20;

      if (Draw->Draw_Min < 0)
        Draw->Draw_Min = 0;
```

```
      if ((Draw->Draw_Max - Draw->Draw_Min) < 0.05)
        Draw->Draw_Max = Draw->Draw_Min + 0.05;
    } else if (Draw->Draw_Max < Draw->Draw_Buf[i]) {
      Draw->Draw_Max = Draw->Draw_Buf[i];
      Draw->Draw_Max = (float)((uint8_t)(Draw->Draw_Max * 100) / 5 + 1) / 20;
      if (Draw->Draw_Max > 1.0)
        Draw->Draw_Max = 1.0;
      if ((Draw->Draw_Max - Draw->Draw_Min) < 0.05)
        Draw->Draw_Min = Draw->Draw_Max - 0.05;
    }
  }
}

void PlotDataPrint(_DrawCurve *Draw, int fllor, int upper, int lineColor) {

  for (int x = 1; x < 128; x++) {
    float k = (upper - fllor) / (Draw->Draw_Max - Draw->Draw_Min);  // Y-axis scaling
factor

    float last_y = upper - ((Draw->Draw_Buf[x - 1] - Draw->Draw_Min) * k);
    float now_y = upper - ((Draw->Draw_Buf[x] - Draw->Draw_Min) * k);

    oled.drawLine(x - 1, last_y, x, now_y, lineColor);
  }
}

void setup() {

#ifndef DEBUG
  oled.begin(SSD1306_SWITCHCAPVCC, OLED_Address);
  oled.clearDisplay();
#else
  Serial.begin(115200);

#endif
  delay(100);
```

```
}

void loop() {
  static uint16_t value = 0;
  value = analogRead(A0);

#ifndef DEBUG
  PlotDataInput(&DrawCurve, value / 1024.0);  // Incoming data
  oled.clearDisplay();
  PlotDataPrint(&DrawCurve, 10, 60, WHITE);  // Print curve
  oled.display();

#else
  Serial.println(value);
  delay(5);
#endif
}
/*
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 * Mailbox: sichiraywuxi@gmail.com
 */
```
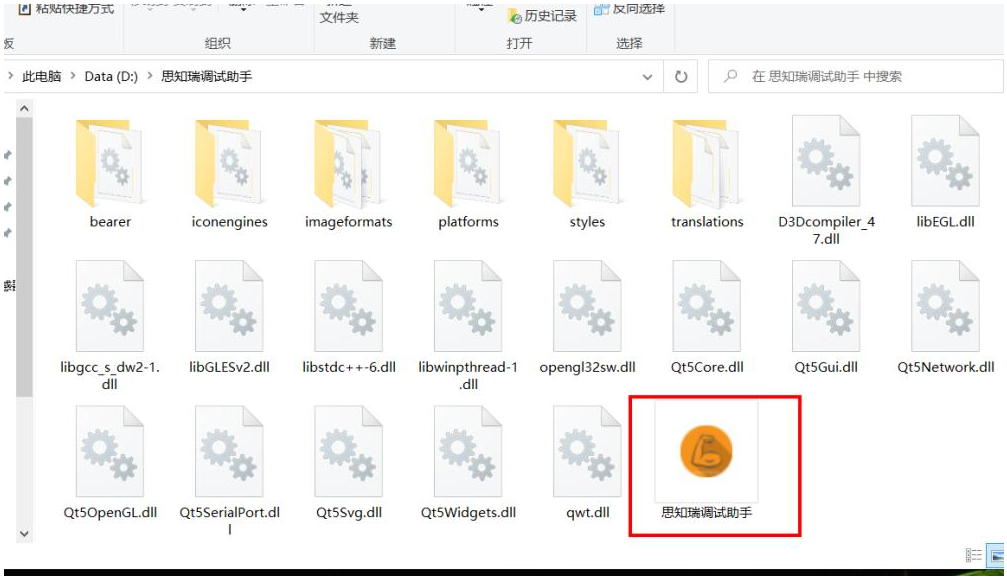

② Download sichiray debugging assistant software

A file named sichiray debugging assistant.rar can be found in the zip package

download and decompress, double-click to open the program



Import the Settings, download the following file, and open the software. Click File, import Settings, select this file, select serial port number, open the serial port.

A file named Muscle electric setting.ini can be found in the zip package

五、FAQ

1. where can dry electrodes be placed on the arm? Do you have any requirements?

> The three-metal dry electrode plate is adopted, which does not need to pay attention to the reference level, but only needs to keep the electrode plate consistent with the muscle direction.
>
> **For more information about the location, see the following figure:**
>
> 

---

2. the serial port plotter has no waveform after burning the code.

Set baud rate to 115200.

---

3. wiring is not based on the color of the wire, but in the order of the interface

> the order is GND→5V→A0。

---

4. waveform no response

> in this case, check several solutions:
>
> ●whether it is attached to the position of muscle activity;
>
> ●whether it is tied tightly;

> ●whether the laptop power is unplugged;
>
> ●whether the connection interface is plugged tightly;
>
> ●wipe the electrode and skin with water.

---

5. the library file is invalid.

> You need to drag out the two downloaded files from the downloaded library.