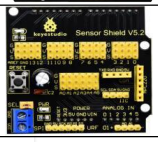
Keyestudio New Sensor Kit With REV4

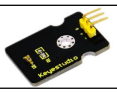
Sensor kit for Arduino
Based on open-source hardware
30 various sensors in one box
For you to make interesting projects

1. Summary:

This is an Arduino sensor learning kit developed by Keyes. We bring together 30 basic sensors and modules, aiming for the convenience of its learning for starters. Inside this box, there are digital and analog sensors and also some special modules such as buzzer, ultrasonic, acceleration modules etc. For each module, there is clear connection diagram and sample code. So even if you are totally new at this, you can get started easily.
The sample codes for this sensor kit are based on ARDUINO because it's open source and easy. And if you are good at this, you can also apply this kit to other MCU development platform, such as 51, STM32, Raspberries Pi. The working principle is pretty much the same.
Now, let us embrace this fascinating world of ARDUINO and learn together!

2. Kit list:

No.	Name	QTY	Picture
1	Keyestudio REV4 controller board	1	
2	V5 sensor shield	1	
3	Female to female Dupont line	40	
4	usb cable	1	
5	White LED module	1	
6	Red LED module	1	
7	Passive Buzzer module	1	
8	Hall Magnetic Sensor	1	
9	LM35 Temperature Sensor	1	
10	18B20 Temperature Sensor	1	
11	Digital Tilt Sensor	1	
12	Photocell sensor	1	
13	Digital Push Button	1	
14	Capacitive Touch Sensor	1	

15	DHT11 Temperature and Humidity Sensor	1	
16	Analog Sound Sensor	1	
17	Flame Sensor	1	
18	3231 Clock Module	1	
19	MQ-2 Analog Gas Sensor	1	
20	MQ-3 Analog Alcohol Sensor	1	
21	Water sensor	1	
22	Soil humidity sensor	1	
23	Infrared Obstacle Avoidance Sensor	1	
24	PIR Motion Sensor	1	
25	Joystick Module	1	
26	photo interrupter module	1	
27	5V Relay Module	1	
28	ADXL345 Three Axis Acceleration Module	1	
29	Rotary Encoder module	1	
30	Analog Rotation Sensor	1	
31	HC-SR04 Ultrasonic Sensor	1	
32	Pulse Rate Monitor	1	
33	Reed Switch Module	1	
34	TEMT6000 ambient light sensor	1	

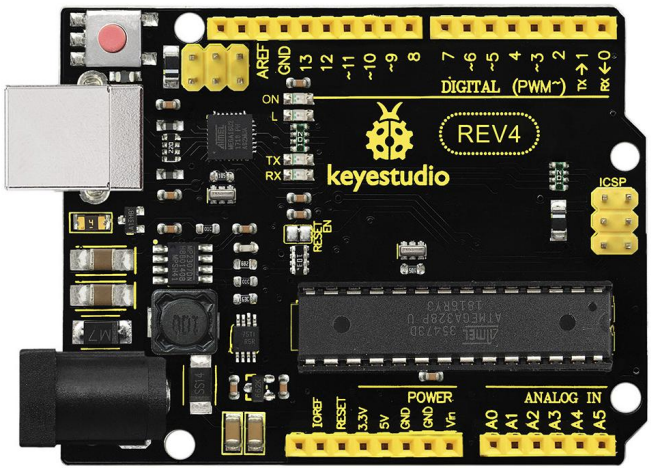
3. Project list:

1. White LED module
2. Red LED module
3. Passive Buzzer module
4. Hall Magnetic Sensor
5. LM35 Temperature Sensor
6. 18B20 Temperature Sensor
7. Digital Tilt Sensor
8. Photocell sensor
9. Digital Push Button
10. Capacitive Touch Sensor
11. DHT11 Temperature and Humidity Sensor
12. Analog Sound Sensor
13. Flame Sensor
14. 3231 Clock Module
15. MQ-2 Analog Gas Sensor
16. MQ-3 Analog Alcohol Sensor
17. Water sensor
18. Soil humidity sensor
19. Infrared Obstacle Avoidance Sensor
20. PIR Motion Sensor
21. Joystick Module
22. photo interrupter module
23. 5V Relay Module
24. ADXL345 Three Axis Acceleration Module
25. Rotary Encoder module
26. Analog Rotation Sensor
27. HC-SR04 Ultrasonic Sensor
28. Pulse Rate Monitor
29. Reed Switch Module
30. TEMT6000 ambient light sensor

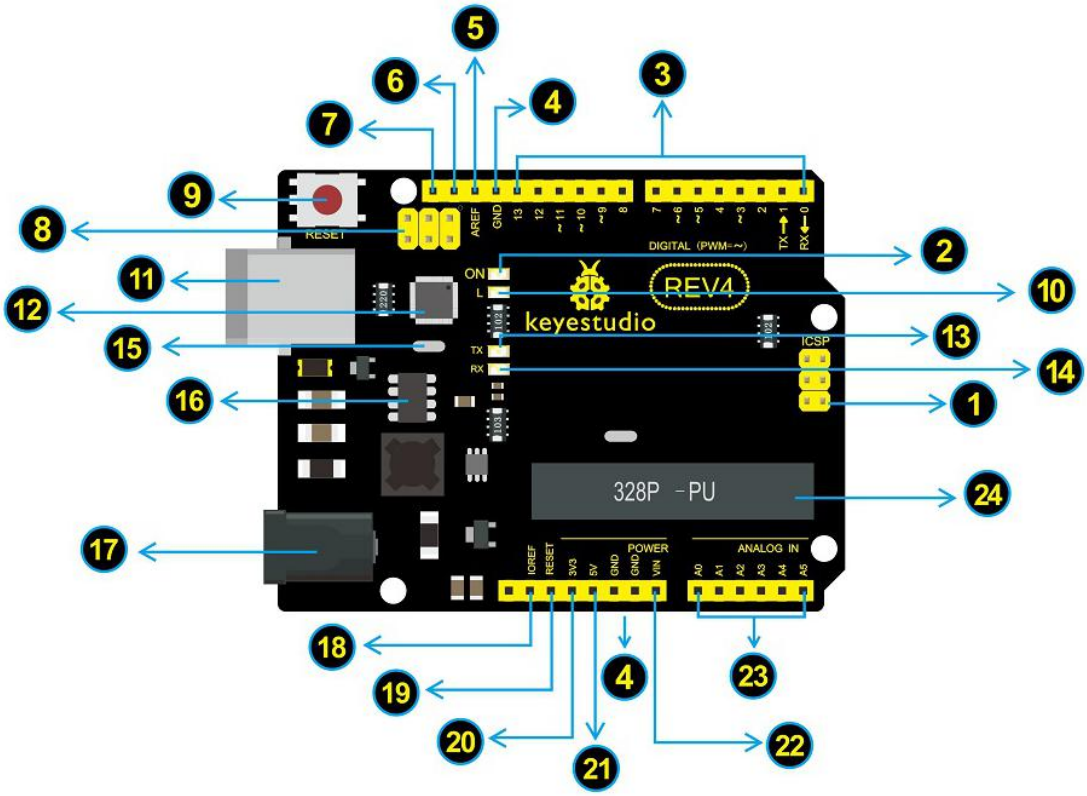
4. Arduino software download and driver installation:

1)Element and Interface

The Keyestudio REV4 (Black) Main Control Board is the best board to get started with electronics and coding. If this is your first experience tinkering with the platform, the Keyestudio REV4 (Black) Main Control Board is the most robust board you can start playing with.



Here is an explanation of what every element and interface of the board does:

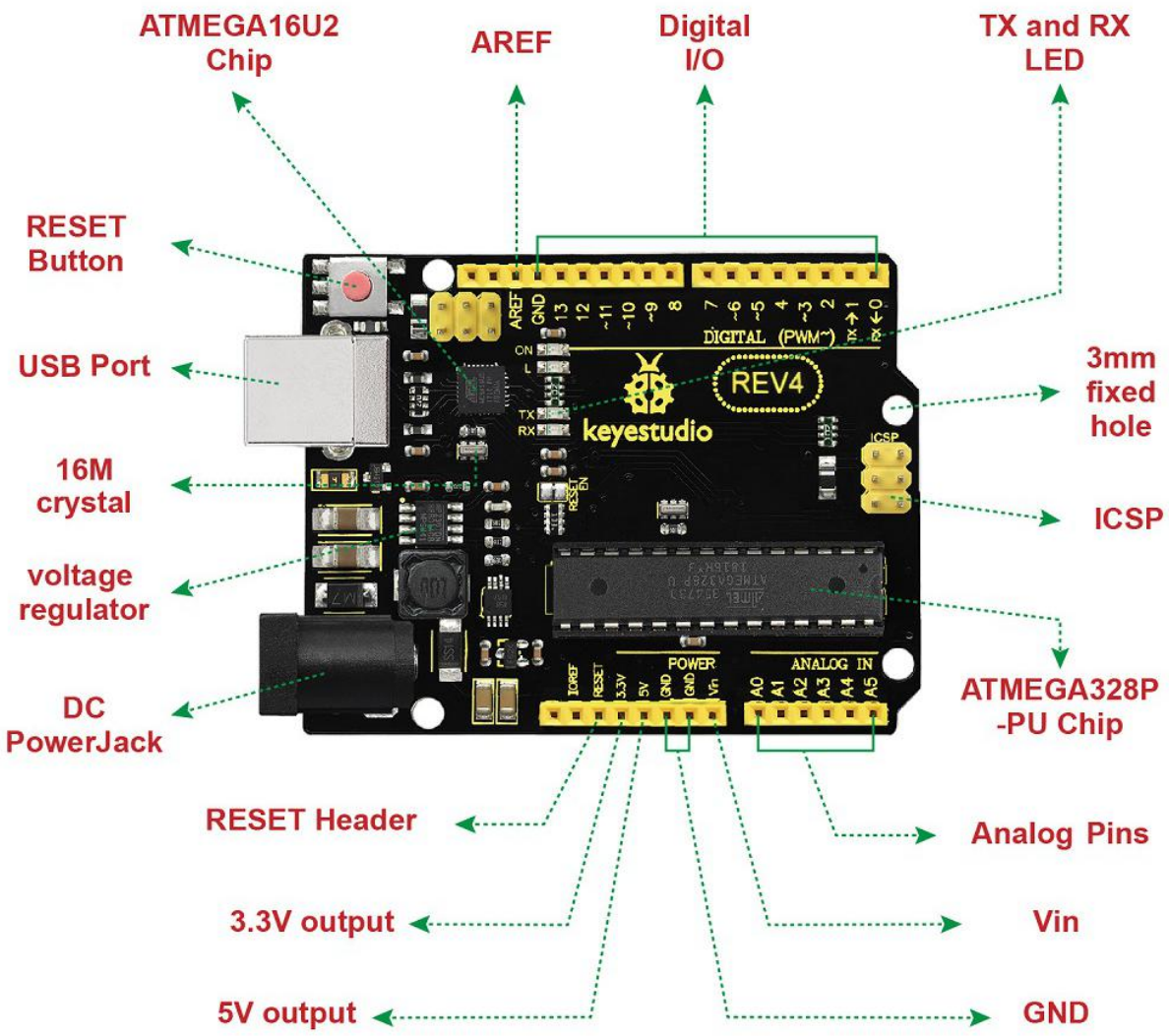


	**ICSP (In-Circuit Serial Programming) Header** In most case, ICSP is the AVR, an Arduino micro-program header consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often called the SPI (serial peripheral interface) and can be considered an "extension" of the output. In fact, slave the output devices under the SPI bus host. When connecting to PC, program the firmware to ATMEGA328P-PU.
	**Power LED Indicator** Powering the Arduino, LED on means that your circuit board is correctly powered on. If LED is off, connection is wrong.
	**Digital I/O** Keyestudio REV4 (Black) Main Control Board has 14 digital input/output pins (of which 6 can be used as PWM outputs). These pins can be configured as digital input pin to read the logic value (0 or 1). Or used as digital output pin to drive different modules like LED, relay, etc. The pin labeled "∽" can be used to generate PWM.
	**GND (Ground pin headers)** Used for circuit ground
	**AREF** Reference voltage (0-5V) for analog inputs. Used with analogReference().
	**SDA** IIC communication pin
	**SCL** IIC communication pin

8	**ICSP (In-Circuit Serial Programming) Header** In most case, ICSP is the AVR, an Arduino micro-program header consisting of MOSI, MISO, SCK, RESET, VCC, and GND. Connected to ATMEGA 16U2-MU. When connecting to PC, program the firmware to ATMEGA 16U2-MU.
9	**RESET Button** You can reset your Keyestudio REV4 (Black) Main Control Board, for example, start the program from the initial status. You can use the RESET button.
10	**D13 LED** There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
11	**USB Connection** Keyestudio REV4 (Black) Main Control Board can be powered via USB connector. All you needed to do is connecting the USB port to PC using a USB cable.
12	**ATMEGA 16U2-MU** USB to serial chip, can convert the USB signal into serial port signal.
13	**TX LED** Onboard you can find the label: TX (transmit) When Keyestudio REV4 (Black) Main Control Board communicates via serial port, send the message, TX led flashes.
14	**RX LED** Onboard you can find the label: RX(receive) When Keyestudio REV4 (Black) Main Control Board communicates via serial port, receive the message, RX led flashes.

	**Crystal Oscillator** How does Arduino calculate time? by using a crystal oscillator. The number printed on the top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16MHz.
	**Voltage Regulator** Convert an external input DC7-12V voltage into DC 5V, then switch DC 5V to the processor and other components. Output DC 5V, the drive current is 2A.
	**DC Power Jack** Keyestudio REV4 (Black) Main Control Board can be supplied with an external power DC7-12V from the DC power jack.
	**IOREF** Used to configure the operating voltage of microcontrollers. Use it less.
	**RESET Header** Connect an external button to reset the board. The function is the same as reset button (labeled 9)
	**Power Pin 3V3** A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
	**Power Pin 5V** Provides 5V output voltage

	**Vin** You can supply an external power input DC7-12V through this pin to Keyestudio REV4 (Black) Main Control Board.
	**Analog Pins** Keyestudio REV4 (Black) Main Control Board has 6 analog inputs, labeled A0 through A5. These pins can read the signal from analog sensors (such as humidity sensor or temperature sensor), and convert it into the digital value that can read by microcontrollers) Can also used as digital pins, A0=D14, A1=D15, A2=D16, A3=D17, A4=D18, A5=D19.
	**Microcontroller** Each Keyestudio REV4 (Black) Main Control Board has its own microcontroller. You can regard it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from the panel pair. Microcontrollers are usually from ATMEL. Before you load a new program on the Arduino IDE, you must know what IC is on your board. This information can be checked at the top of IC.


ATMEGA16U2 Chip
AREF
Digital I/O
TX and RX LED
RESET Button
USB Port
16M crystal
voltage regulator
DC PowerJack
3mm fixed hole
ICSP
ATMEGA328P -PU Chip
RESET Header
Analog Pins
3.3V output
Vin
5V output
GND
keyestudio
REV4
DIGITAL (PWM~)
POWER
ANALOG IN

2)Specialized Functions of Some Pins:

Serial communication: Digital pins 0 (RX) and 1 (TX).
PWM Interfaces (Pulse-Width Modulation): D3, D5, D6, D9, D10, D11
External Interrupts: D2 (interrupt 0) and D3 (interrupt 1). These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
SPI communication: D10 (SS), D11 (MOSI), D12 (MISO), D13 (SCK). These pins support SPI communication using the SPI library.
IIC communication: A4 (SDA); A5(SCL)

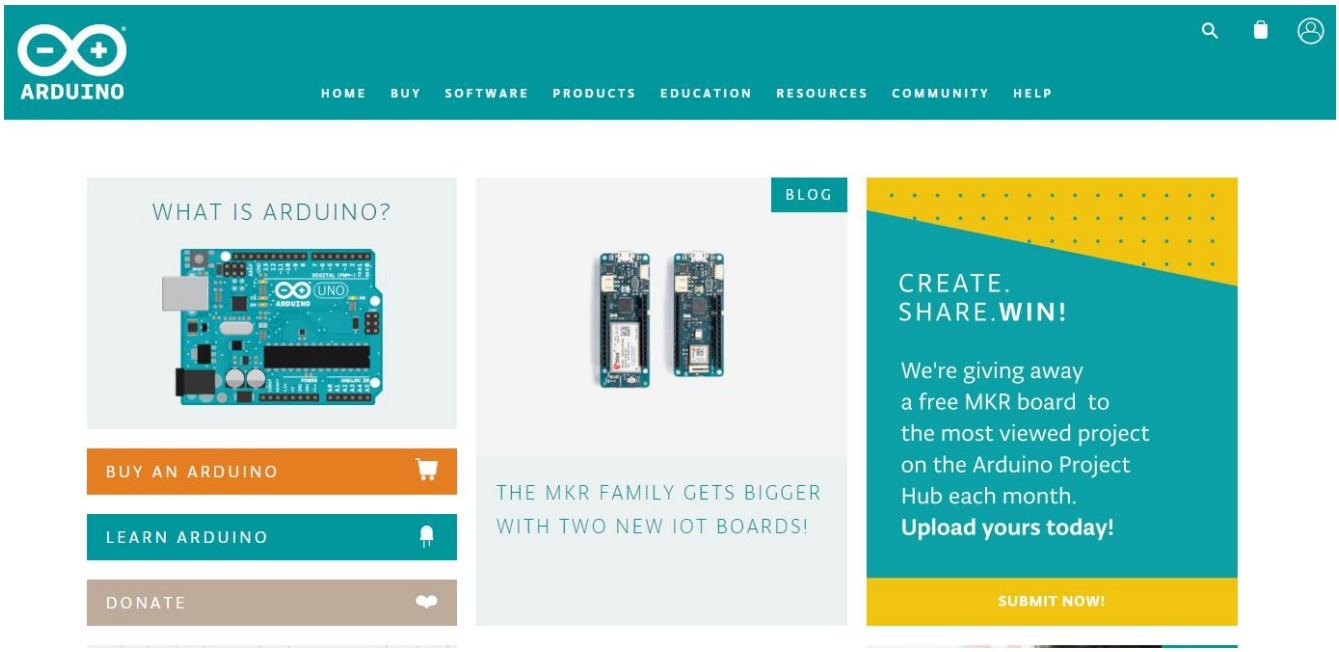
Tips:
Automatic (Software) Reset:
Rather than requiring a physical press of the reset button before an upload, the Keyestudio REV4 (Black) Main Control Board is designed in a way that allows it to be reset by software running on a connected computer.
The Keyestudio REV4 (Black) Main Control Board contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line; see this forum thread for details.

3)Detailed Use with ARDUINO Software as follows:

Step1| Download the Arduino environment (IDE)
When you get the Keyestudio REV4 (Black) Main Control Board, first you should install the Arduino software and driver.
We usually use the Windows software Arduino 1.5.6 version. You can download it from the link below:

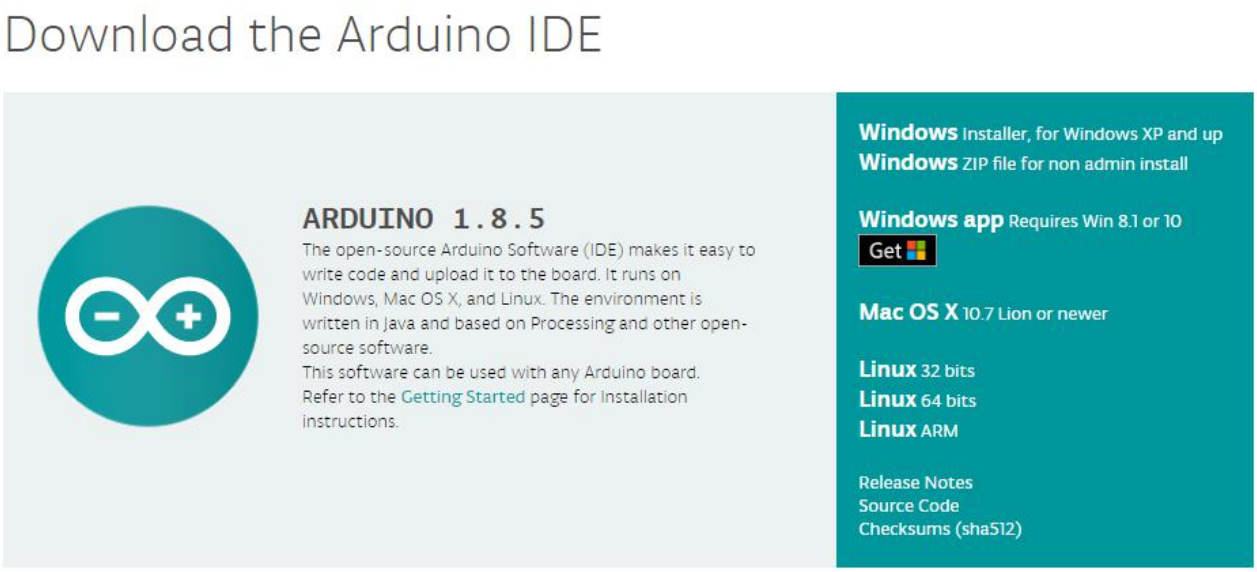
https://www.arduino.cc/en/Main/OldSoftwareReleases#1.5.x

Or you can browse the ARDUINO website to download the latest version from this link, https://www.arduino.cc, pop up the following interface.



Then click the **SOFTWARE** on the browse bar, you will have two options **ONLINE TOOLS** and **DOWNLOADS**.

Click **DOWNLOADS**, it will appear the latest software version of **ARDUINO 1.8.5** shown as below.



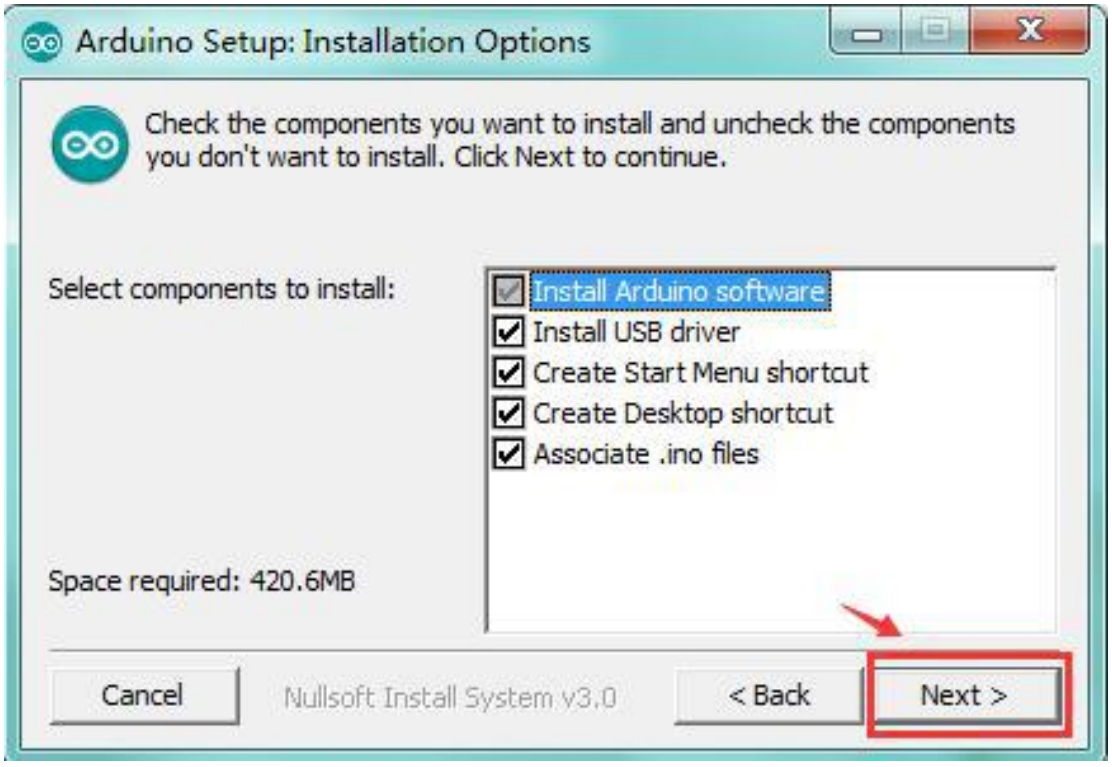
In this software page, on the right side you can see the version of development software for different operating systems. **ARDUINO** has a powerful compatibility. You should download the software that is compatible with the operating system of your computer.
We will take **WINDOWS** system as an example here. There are also two options under Windows system, one is installed version, the other is non-installed version.

For simple installed version, first click Windows Installer, you will get the following page.

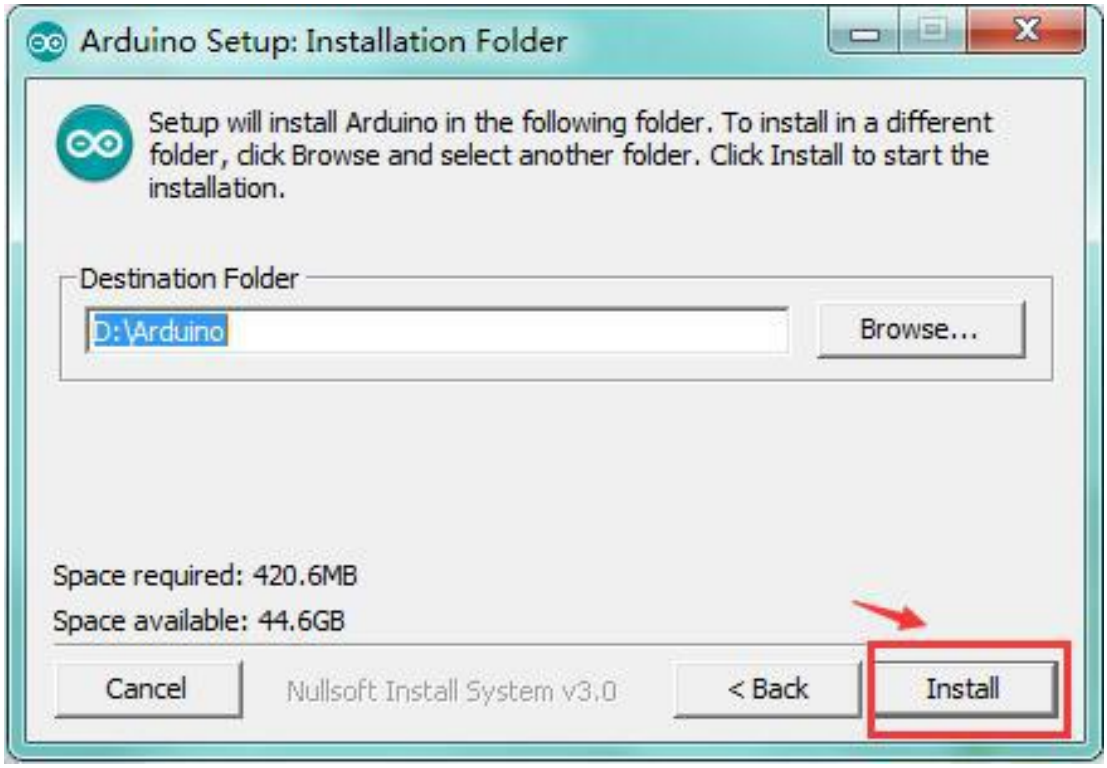
This way you just need to click **JUST DOWNLOAD**, then click the downloaded file to install it.
For non-installed version, first click **Windows ZIP** file, you will also get the pop-up interface as the above figure.
Click **JUST DOWNLOAD**, and when the **ZIP** file is downloaded well to your computer, you can directly unzip the file and click the icon of **ARDUINO** software to start it.

Installing Arduino (Windows):
Install Arduino with the exe. Installation package downloaded well.

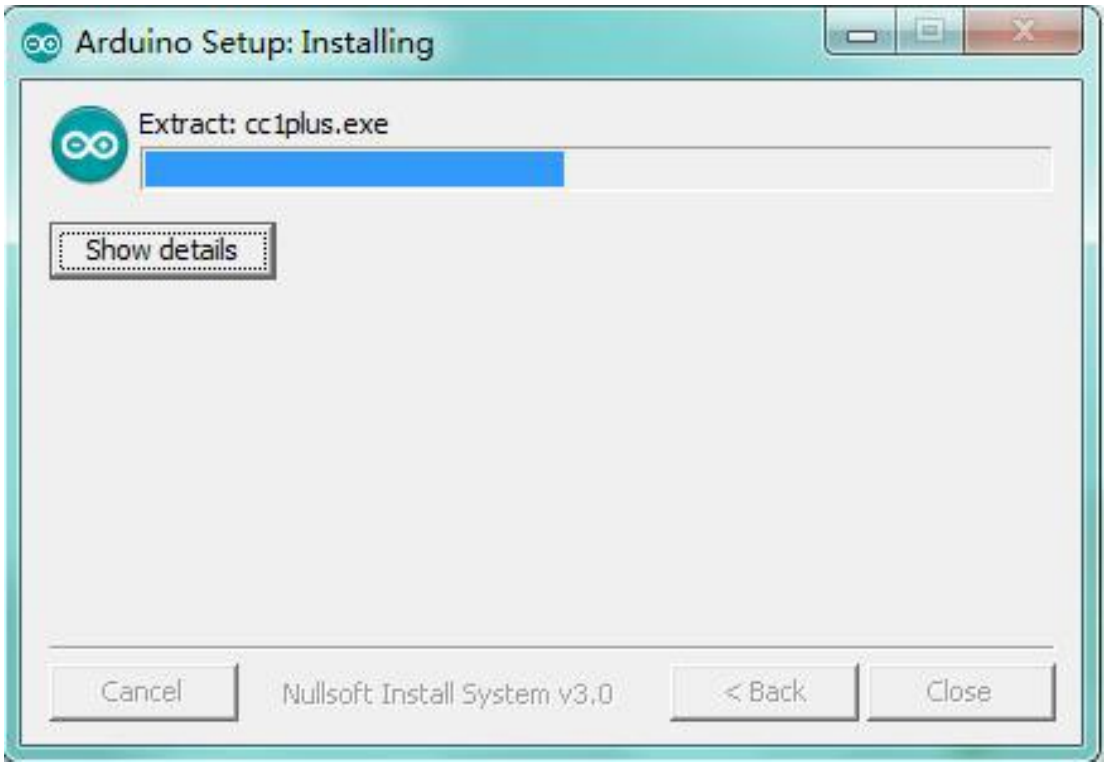
Click ***"I Agree"*** to see the following interface.



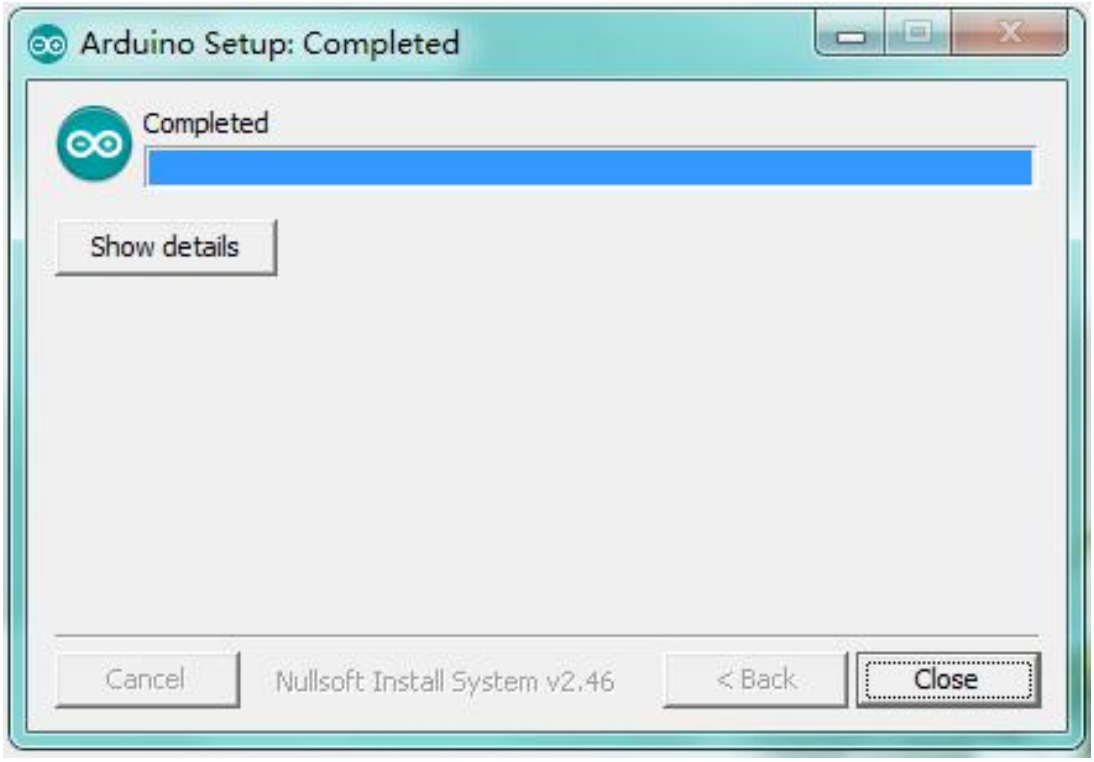
Click **"*Next*"**. Pop up the interface below.



Then click ***"Install"*** to initiate installation.



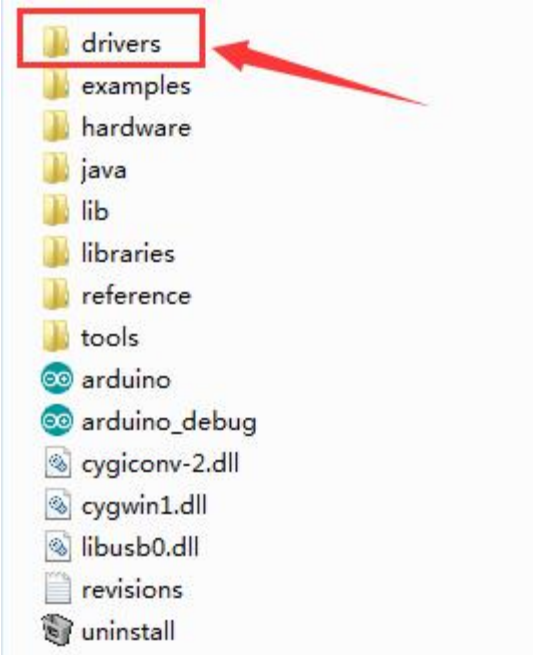
Wait for the installing process, if appear the interface of Window Security, just continue to click Install to finish the installation.



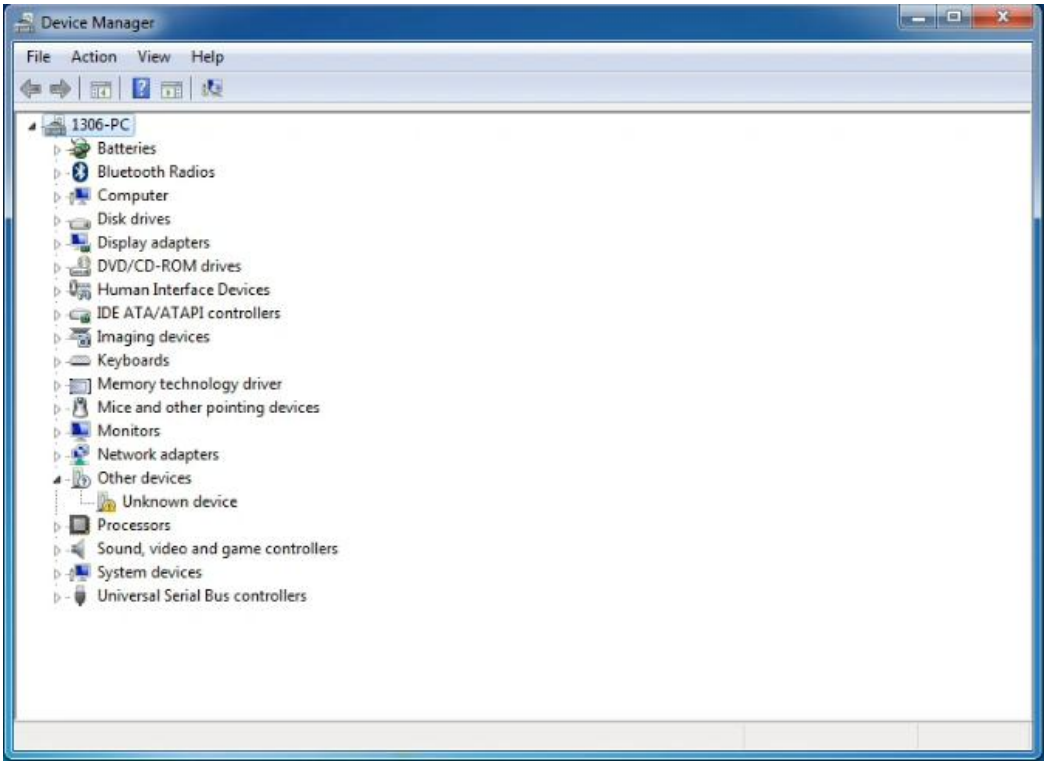
Installing Driver:

Next, we will introduce the driver installation of Keyestudio REV4 (Black) Main Control Board. The driver installation may have slight differences in different computer systems. So in the following let's move on to the driver installation in the WIN 7 system.

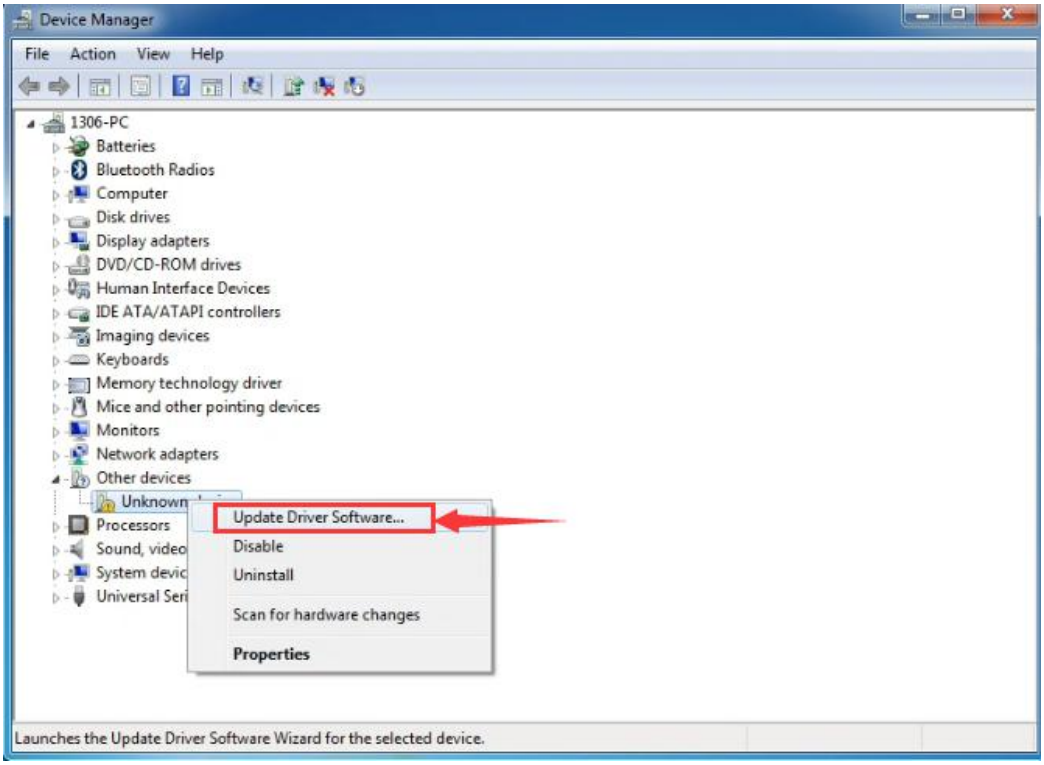
The Arduino folder contains both the Arduino program itself and the drivers that allow the Arduino to be connected to your computer by a USB cable. Before we launch the Arduino software, you are going to install the USB drivers.



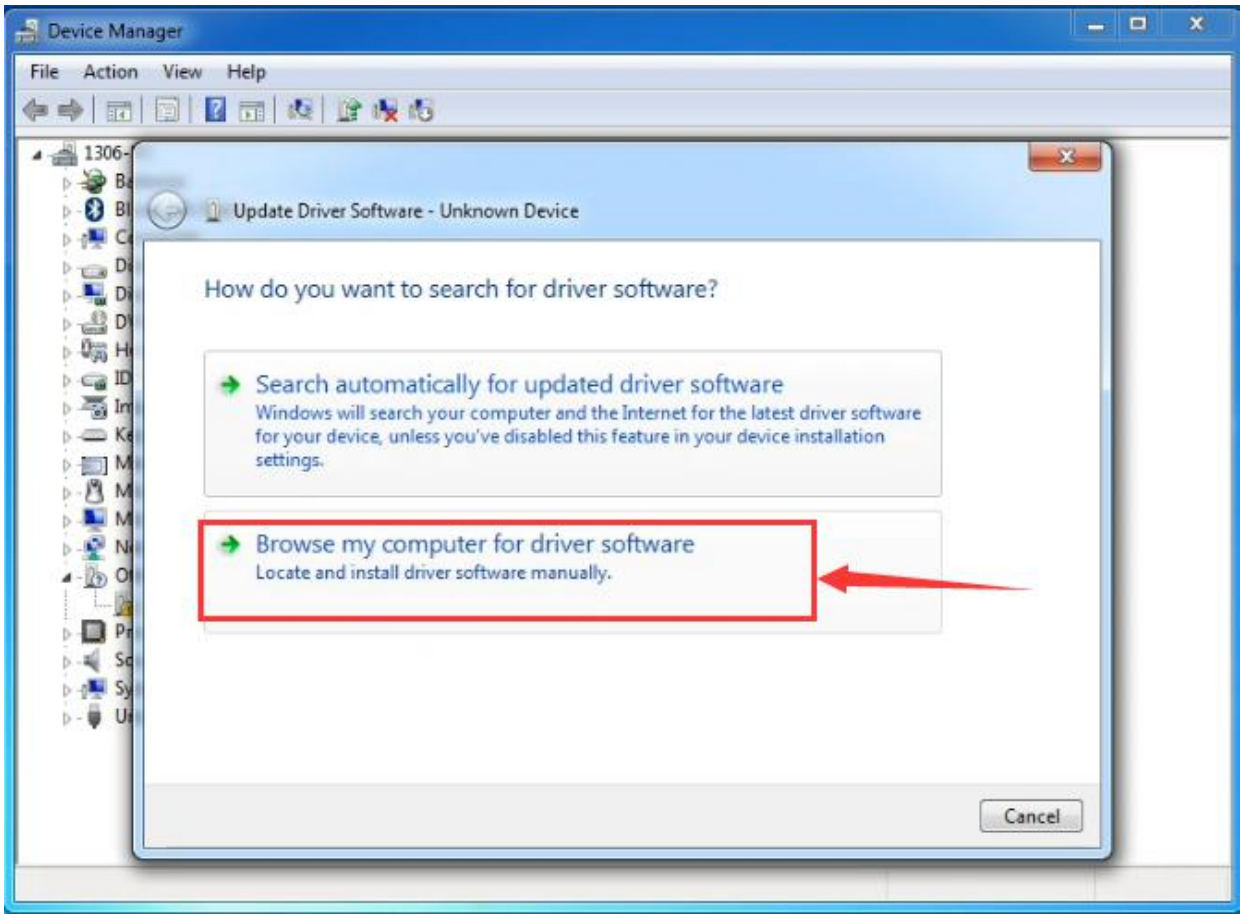
Plug one end of your USB cable into the Arduino and the other into a USB socket on your computer. When you connect Keyestudio REV4 (Black) Main Control Board to your computer at the first time, right click the icon of your **"*Computer*"** —>for **"*Properties*"**—> click the **"*Device manager*"**, under **"*Other Devices*"**, you should see an icon for **"*Unknown device*"** with a little yellow warning triangle next to it. This is your Arduino.



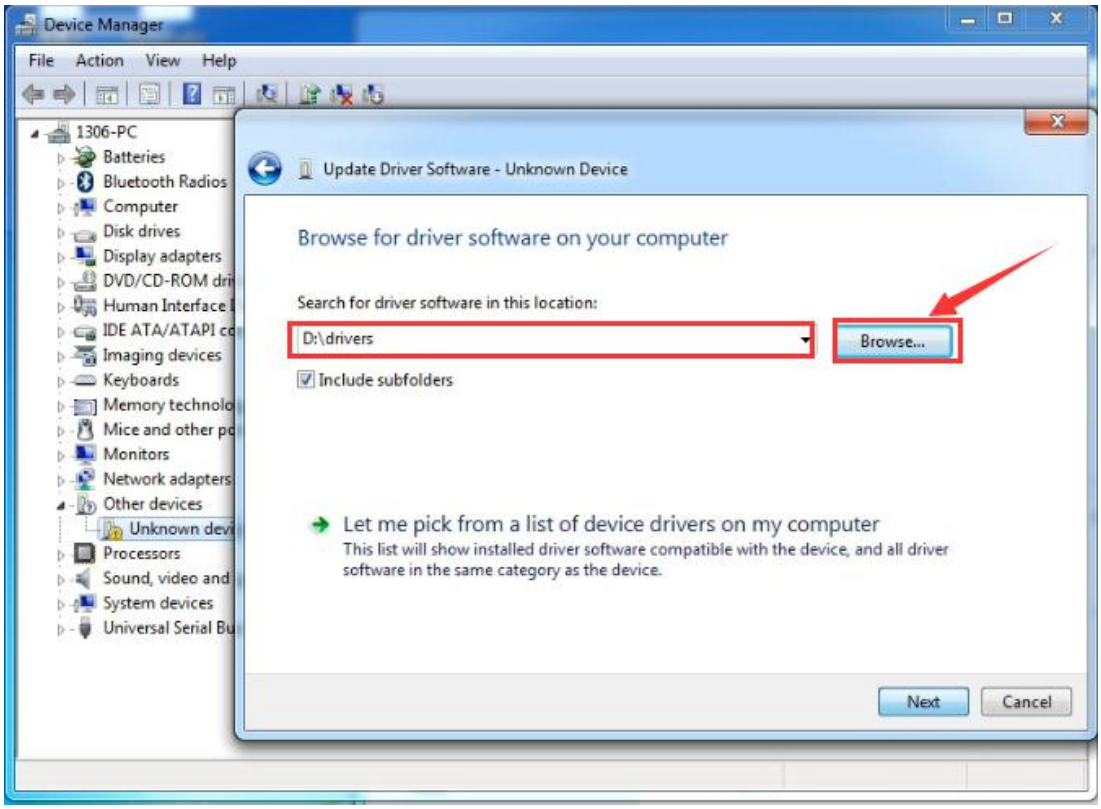
Then right-click on the device and select the top menu option (Update Driver Software...) shown as the figure below.



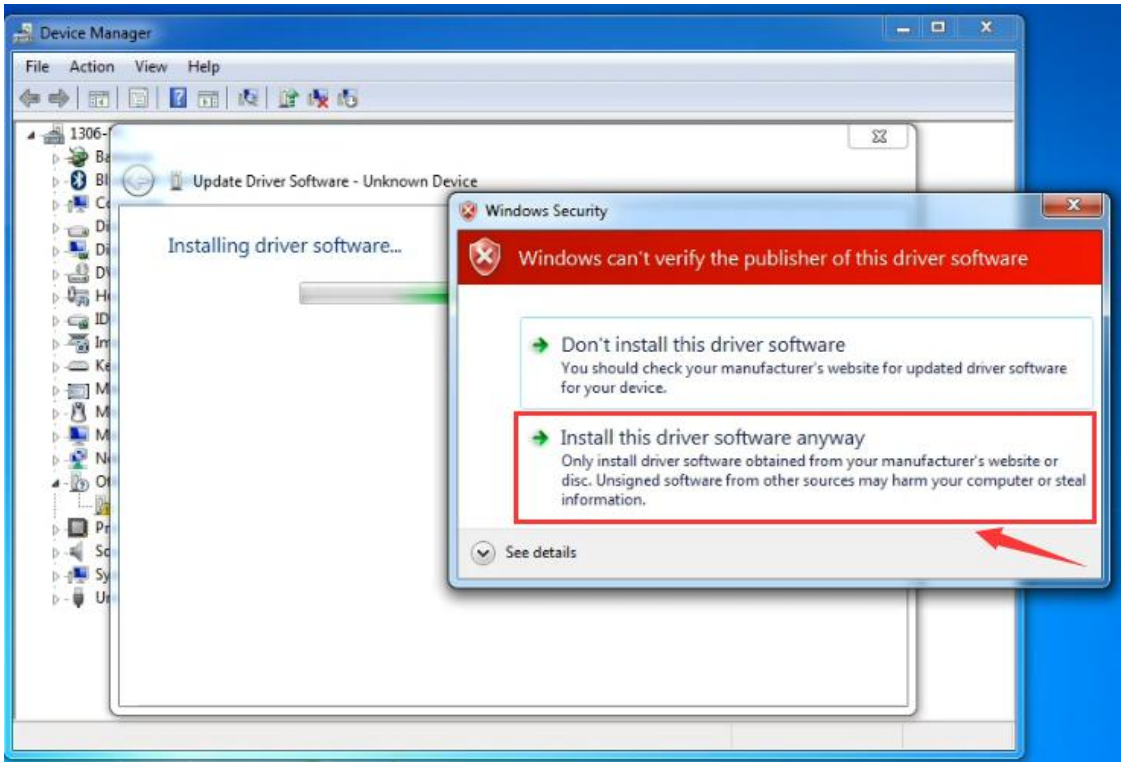
It will then be prompted to either **"*Search Automatically for updated driver software*"** or **"*Browse my computer for driver software*"**. Shown as below. In this page, select **"Browse my computer for driver software".**



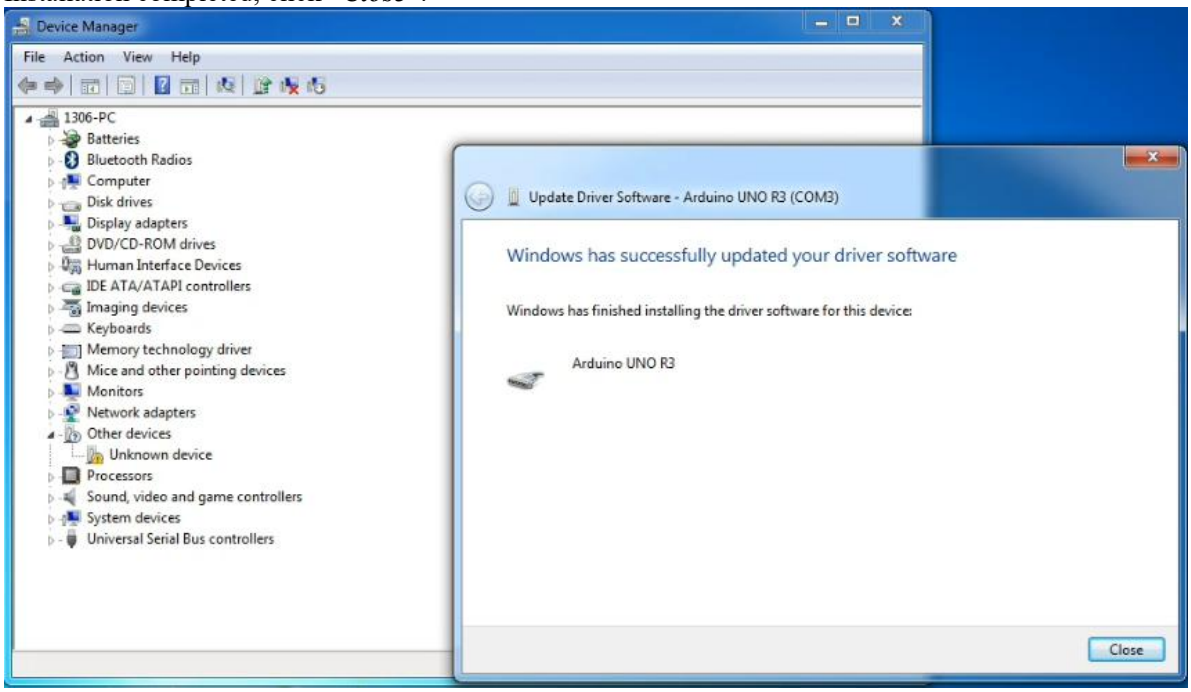
After that, select the option to browse and navigate to the ***"drivers"*** folder of Arduino installation.



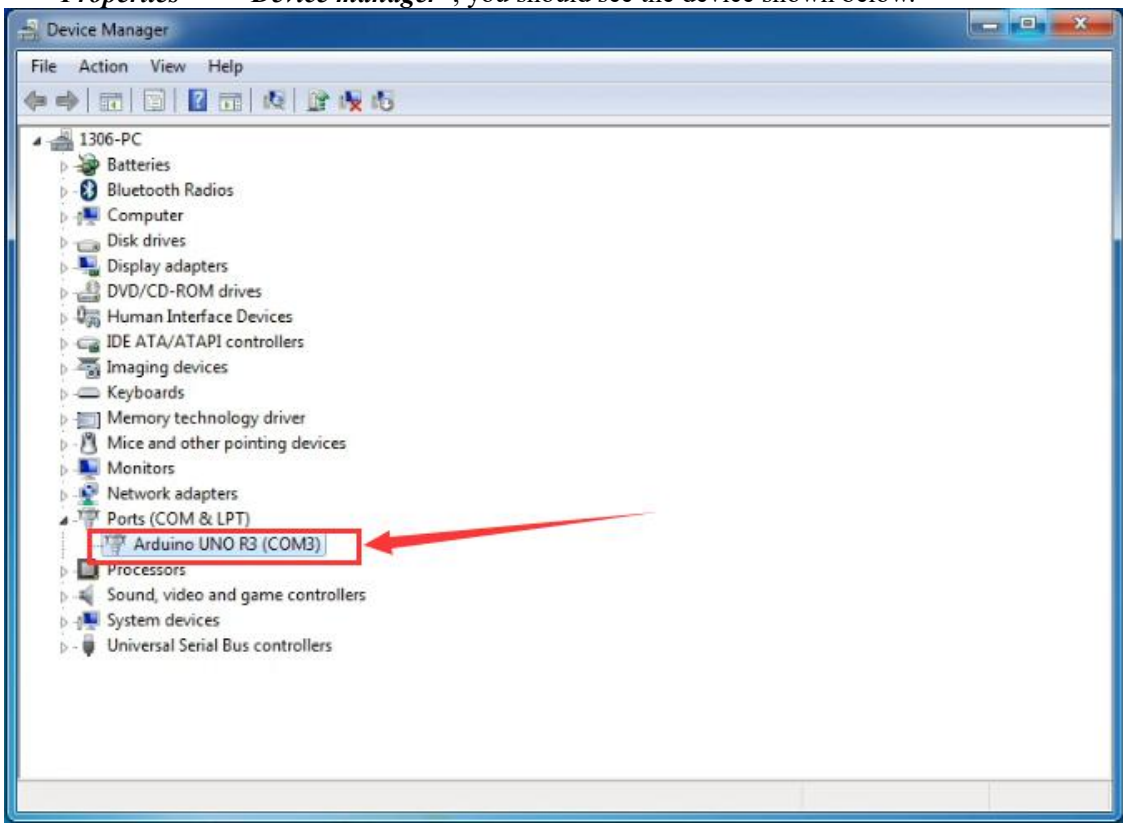
Click ***"Next"*** and you may get a security warning, if so, allow the software to be installed. Shown as below.



Installation completed, click ***"Close"***.

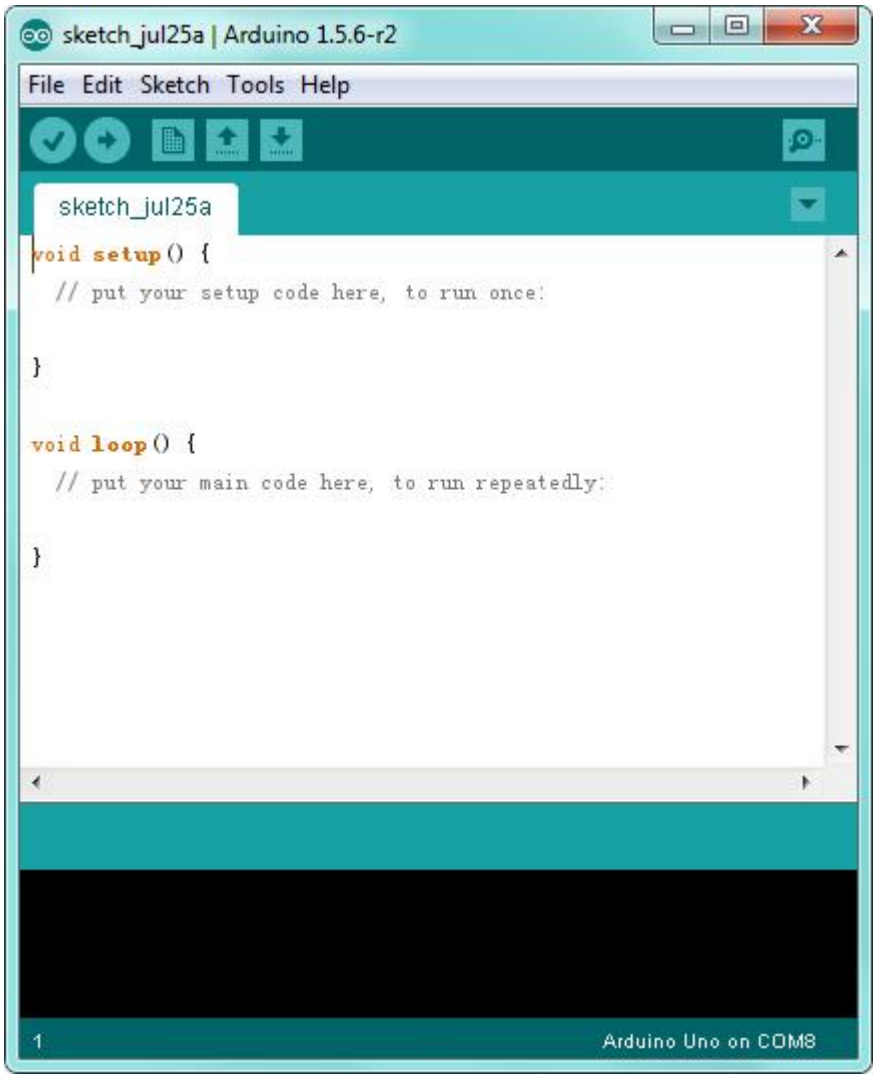


Up to now, the driver is installed well. Then you can right click ***"Computer"*** —>***"Properties"***—>***"Device manager"***, you should see the device shown below.



Introduction for Arduino IDE Toolbar:
Double-click the icon of Arduino software downloaded well, you will get the interface shown below.

(Note: if the Arduino software loads in the wrong language, you can change it in the preferences dialog. See the environment page for details.)

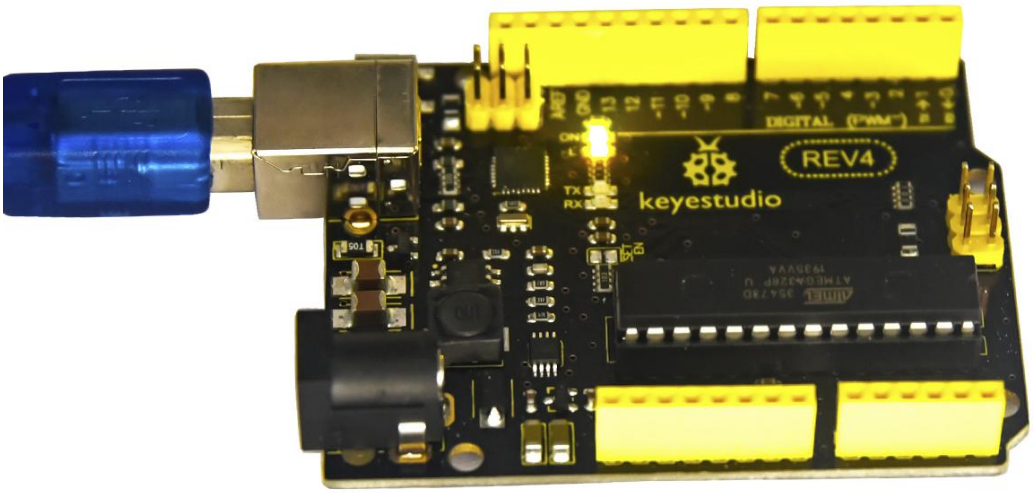


The functions of each button on the Toolbar are listed below:

 **Verify/Compile**	Check the code for errors
 **Upload**	Upload the current Sketch to the Arduino
 **New**	Create a new blank Sketch
 **Open**	Show a list of Sketches
 **Save**	Save the current Sketch
 **Serial Monitor**	Display the serial data being sent from the Arduino

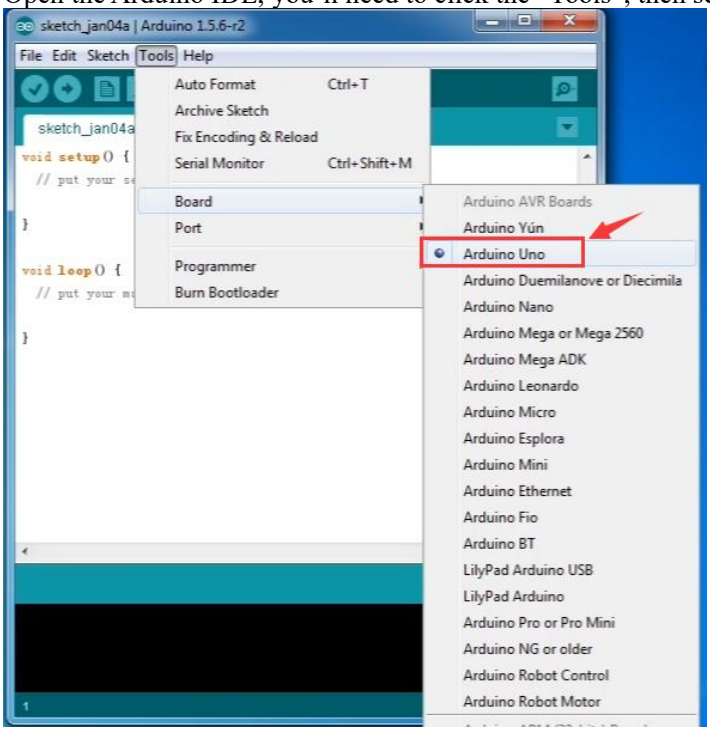
Step2| Connect the board

Connect the Keyestudio REV4 (Black) Main Control Board to your computer using the USB cable. The green power LED should go on.



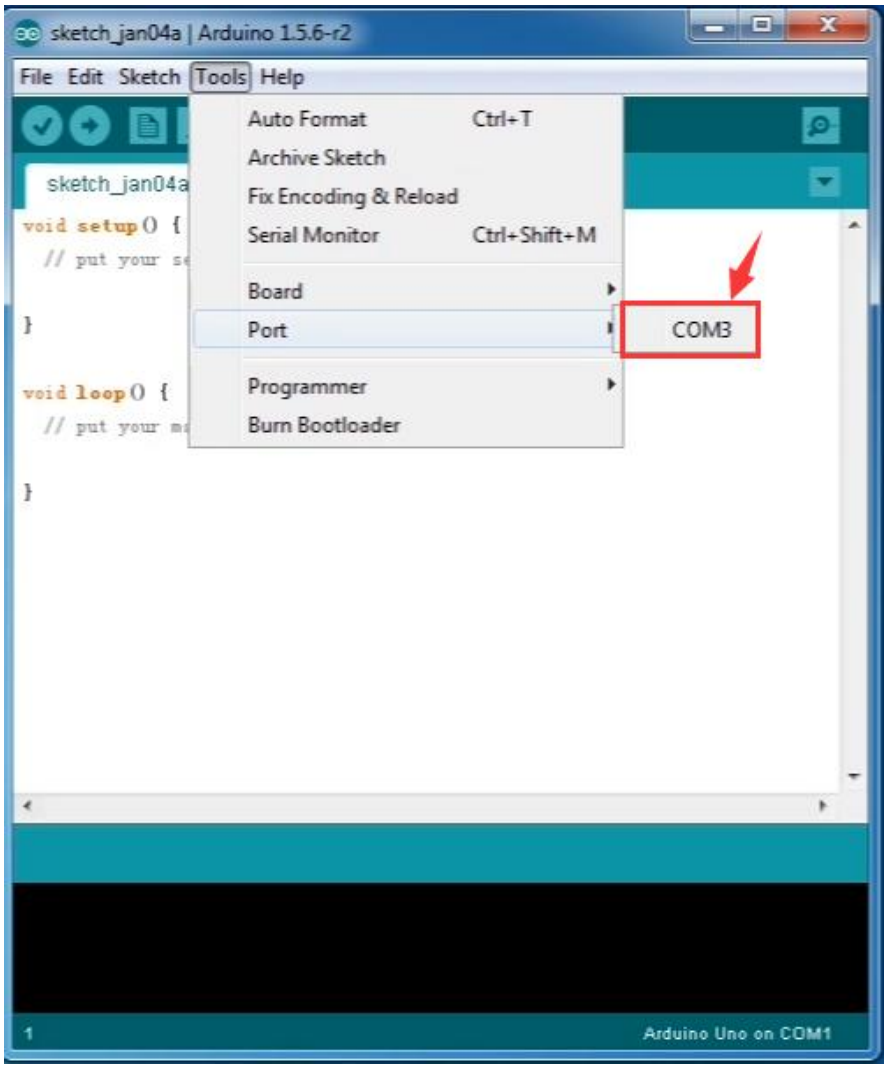
Step3| Select the Arduino Board

Open the Arduino IDE, you'll need to click the "Tools", then select the Board that corresponds to your Arduino.

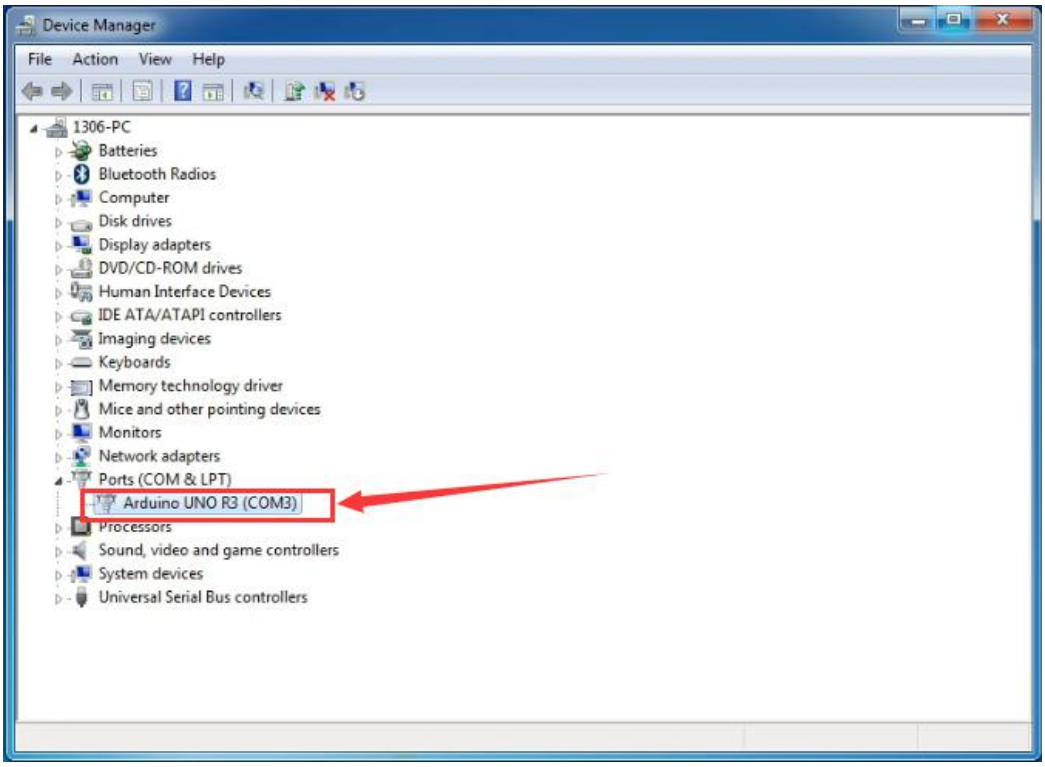


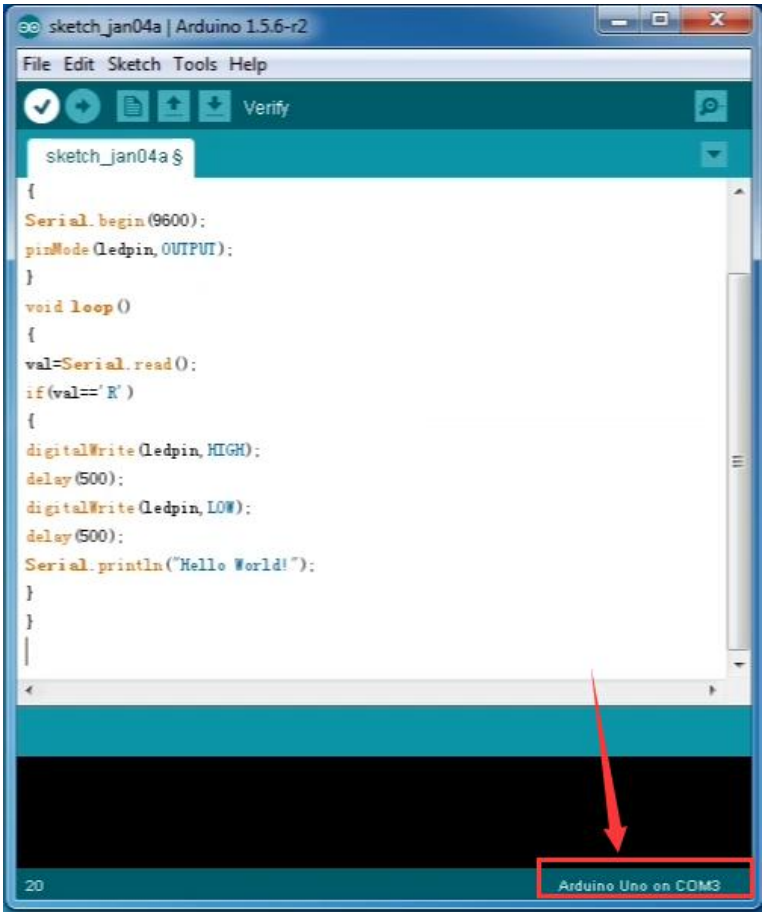
Step4| Select your serial port

Select the serial device of the Keyestudio REV4 (Black) Main Control Board from the Tools | Serial Port menu. This is likely to be **COM3** or higher (**COM1**and **COM2** are usually reserved for hardware serial ports). To find out, you can disconnect your Keyestudio REV4 (Black) Main Control Board and re-open the menu; the entry that disappears should be the Keyestudio REV4 (Black) Main Control Board. Reconnect the board and select that serial port.

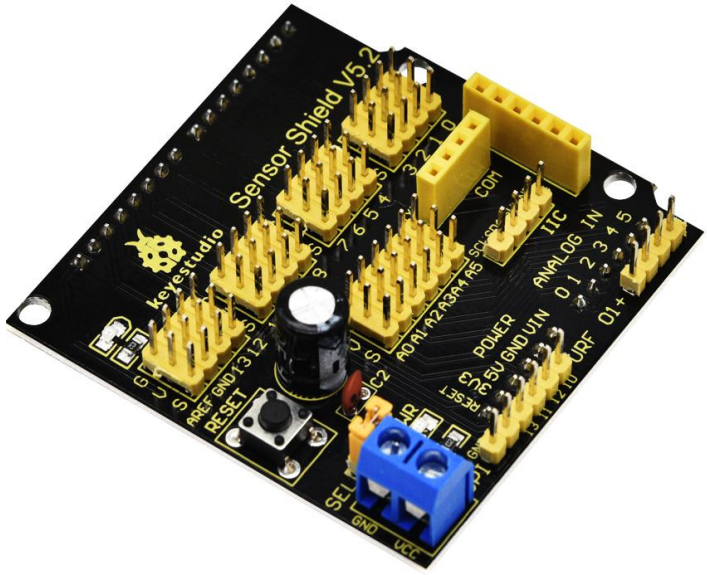


Note: to avoid errors, the COM Port should keep the same as the Ports shown on Device Manager.


Device Manager
File Action View Help
1306-PC
Batteries
Bluetooth Radios
Computer
Disk drives
Display adapters
DVD/CD-ROM drives
Human Interface Devices
IDE ATA/ATAPI controllers
Imaging devices
Keyboards
Memory technology driver
Mice and other pointing devices
Monitors
Network adapters
Ports (COM & LPT)
Arduino UNO R3 (COM3)
Processors
Sound, video and game controllers
System devices
Universal Serial Bus controllers


sketch_jan04a | Arduino 1.5.6-r2
File Edit Sketch Tools Help
Verify
sketch_jan04a §
{
Serial.begin(9600);
pinMode(ledpin,OUTPUT);
}
void loop()
{
val=Serial.read();
if(val=='R')
{
digitalWrite(ledpin,HIGH);
delay(500);
digitalWrite(ledpin,LOW);
delay(500);
Serial.println("Hello World!");
}
}
20
Arduino Uno on COM3

5.Keyestudio Sensor Shield V5:



Introduction:

In the experiments, you might often use REV4 control board and several sensor modules. If the interfaces of power output is not enough, you may need to add a breadboard and use many connection wires. Is it really troublesome ?

But now, with this keyestudio sensor shield, you can easily solve that problem. This shield is fully compatible with REV4 control board, so you can easily stack it onto REV4 for use.

This keyestudio sensor shield has extended the digital and analog ports out as 3PIN interface (G,V, S), which can directly connect 3PIN sensor modules.

It also breaks out some communication pins of 2.54mm pitch, like serial, IIC, and SPI communication.

The shield comes with a reset button and 2 signal indicators as well.

Additionally, you can supply the voltage needed to the sensor modules through blue terminal blocks on the shield. Because some sensor modules is not used with

5V or 3.3V but with special voltage.

Check out these awesome specifications:

- Extends an Arduino Reset button
- Comes with a built-in power indicator and a D13 indicator
- Breakout all the digital and analog ports of REV4 as 3PIN headers
- A serial communication interface
- A I2C communication interface
- A SPI communication interface
- Comes with a URF interface
- Comes with an APC220 interface
- You can supply the voltage needed for sensor modules via terminal blocks.

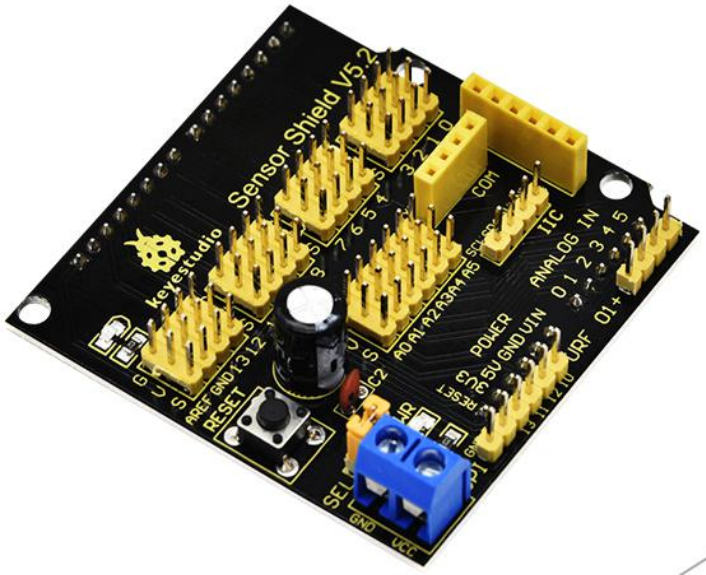
Details:

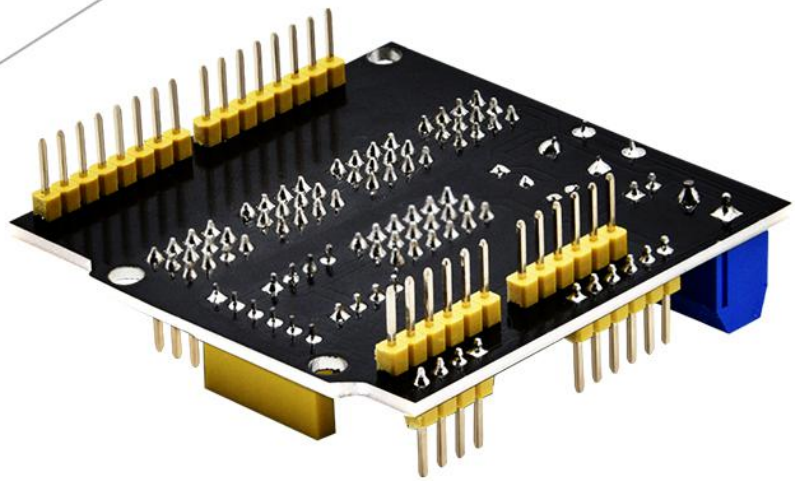
- Dimensions: 57mm x 57mm x 20mm
- Weight: 20.5g

Controllers Compatible:

- keyestudio REV4 BOARD /Arduino UNO R3
- keyestudio EASY plug Control Board
- keyestudio Leonardo R3 Development Board
- 51duino

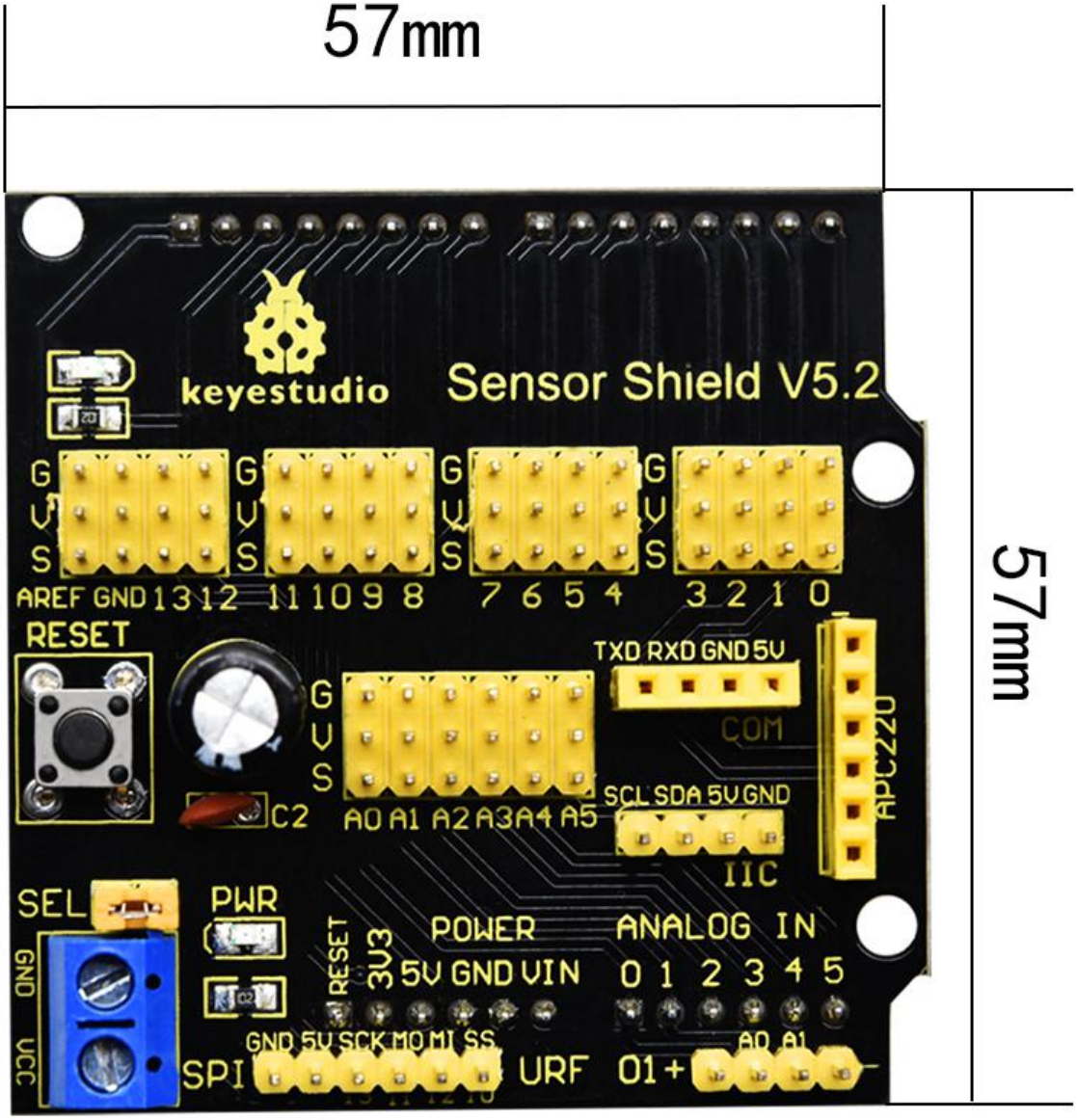
◁ Front


Sensor Shield V5.2
keyestudio
RESET
POWER
ANALOG IN
IIC
COM
GND
VCC

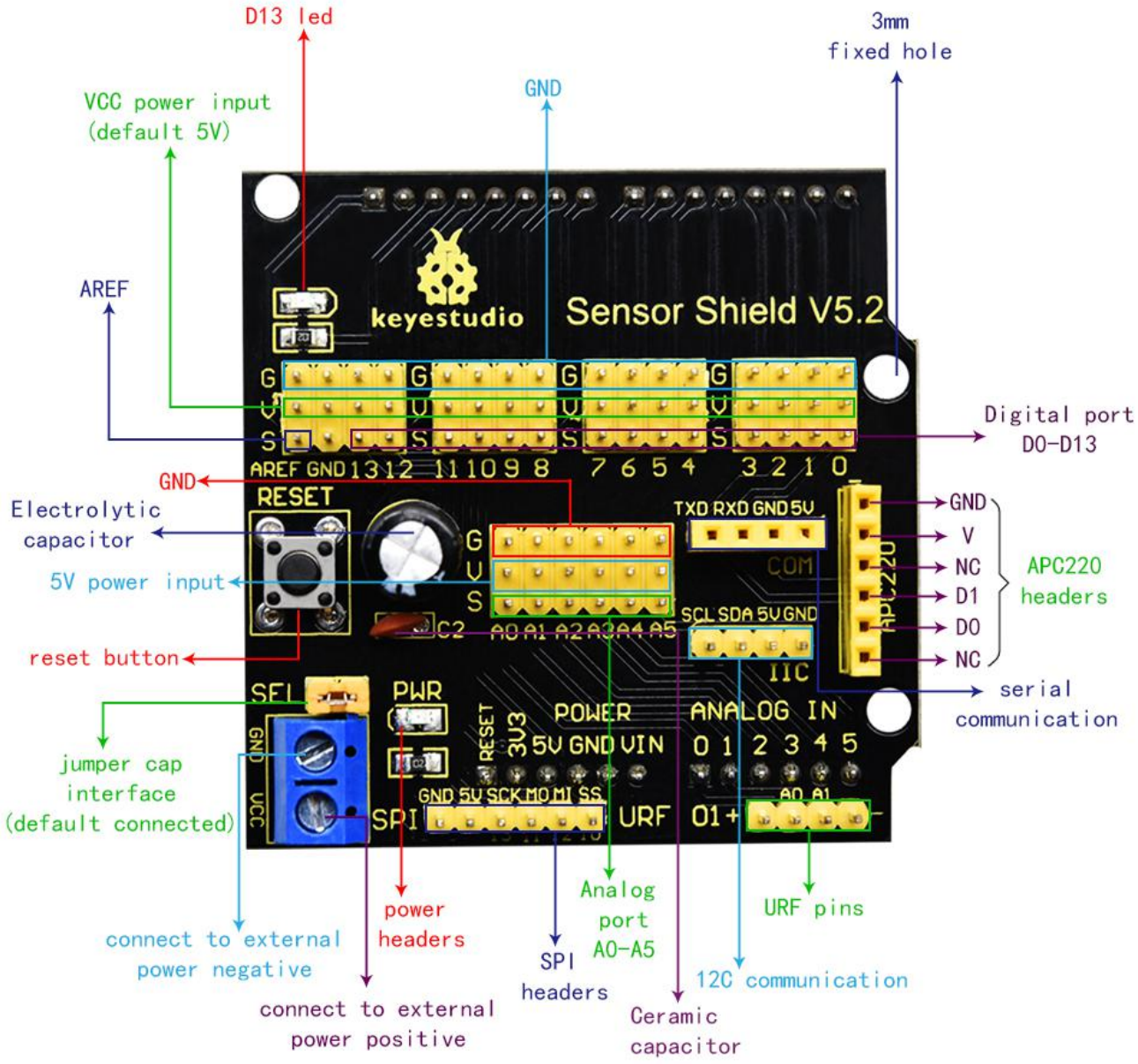


Back ▷

PCB Dimensions:



Pinout Instructions:



Note:

When SE is connected with jumper cap, and input DC 7V to VCC /GND terminal block, so the voltage of V, V1 and + pins are 7V.

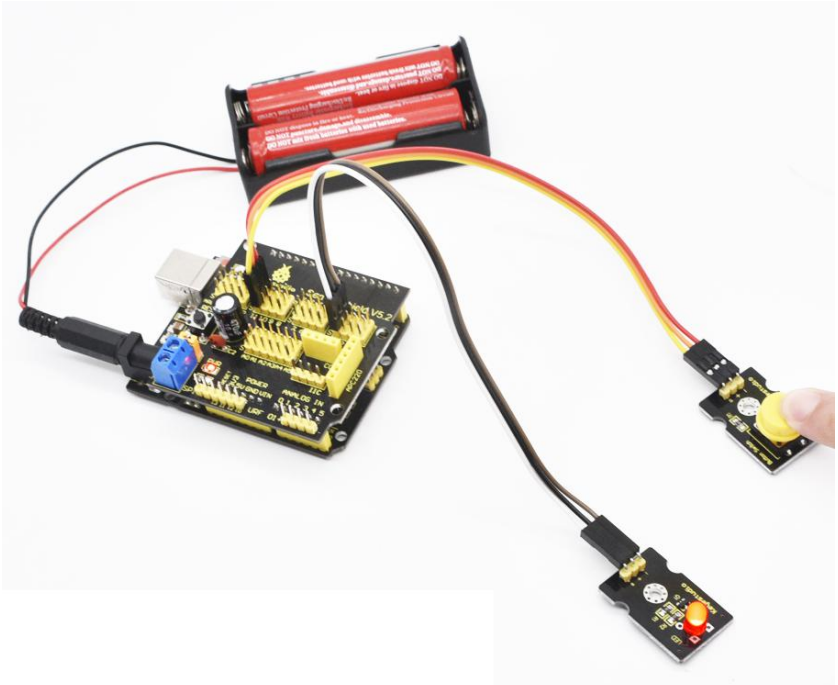
When SE is connected with jumper cap, and VCC /GND terminal block without voltage input, shield is powered via REV4, so the voltage of V, V1 and + pins are 5V.

When SE is disconnected, input DC 7V to VCC /GND terminal block, so the voltage of V pin is 7V, the voltage of V1 and + pins are 0V.

When SE is disconnected, and VCC /GND terminal block without voltage input, shield is powered via REV4, so the voltage of V pin is 0V, the voltage of V1 and + pins are 5V.

Example Use:

You can stack the shield onto REV4 board. Use a PIR motion sensor and LCD display to build the circuit experiments.



Note: In this course, the port on every sensor / module marked with (G、-、GND) indicates the negative pole, which is connected to G or GND on the Arduino board or the sensor shield. The port marked with （V、＋、VCC） indicates positive pole , which is connected to V, VCC or 5V on the Arduino board or the sensor shield.

6.Project details:

Project 1: White LED module

Introduction:

This is a special LED module. When you connect it to ARDUINO development board, after program, it can emit beautiful light. Of course, you can also control it using PWM. It will be like fireflies at night. Isn't cool? We can also combine it with other sensors to do various interesting interactive experiments.

Specifications:

Module type: digital
Working voltage: 5v
Distance between pins: 2.54mm
Size: 30*20mm
Weight: 3g

Connection Diagram:

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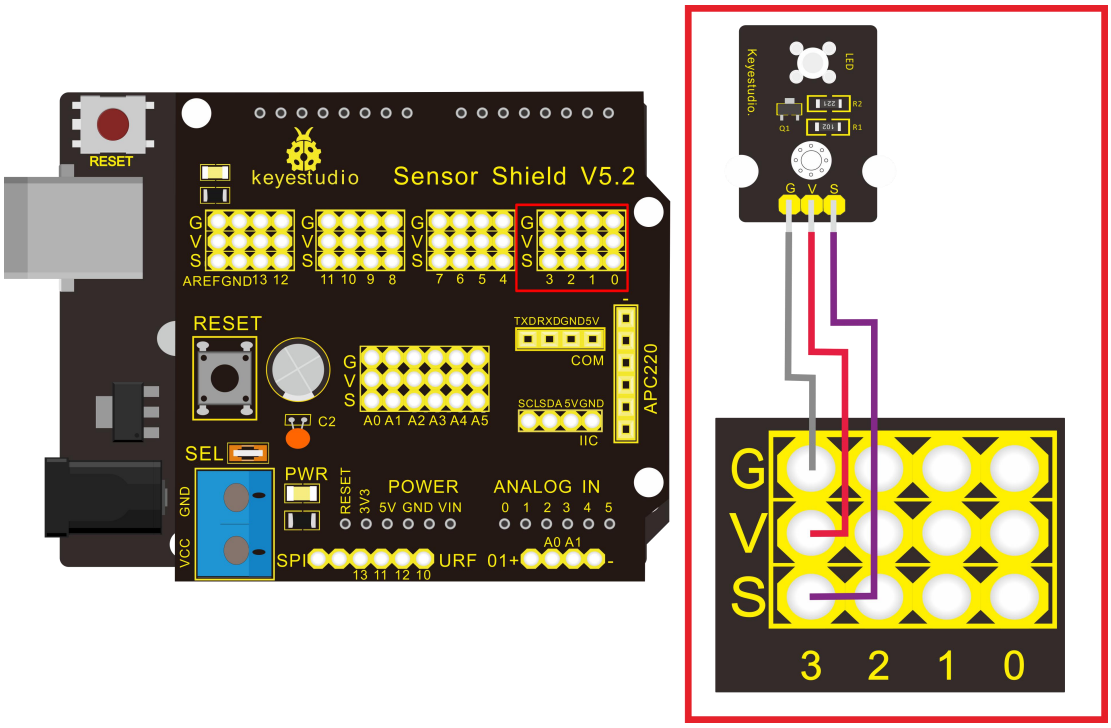

Sample Code:

```
int led = 3;
void setup()
{
  pinMode(led, OUTPUT);      //Set Pin3 as output
}
void loop()
{           digitalWrite(led, HIGH);    //Turn off led
          delay(2000);
          digitalWrite(led, LOW);     //Turn on led
          delay(2000);
}
```

****

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Project 2: Red LED module

Introduction:

This LED light module has a shiny color, ideal for Arduino starters. It can be easily connected to IO/Sensor shield.

Specification:

Type: Digital

PH2.54 socket

White LED light module

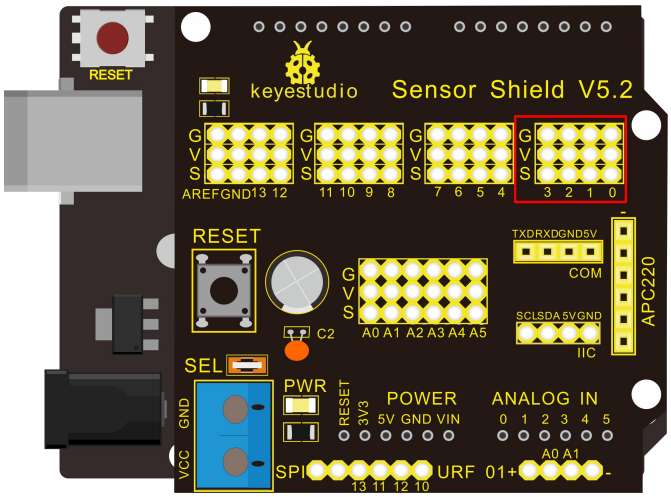
Enables interaction with light-related works

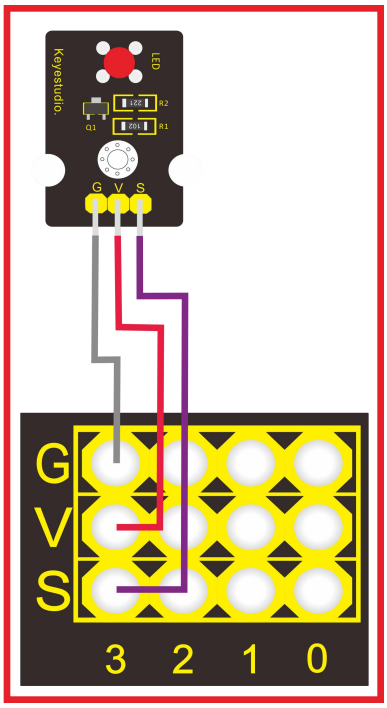
Size: 30*20mm

Weight: 3g

Connection Diagram:

keyestudio





Sample Code:

```
int led = 3;
void setup()
{
 pinMode(led, OUTPUT);        //Set Pin3 as output
}
void loop()
{
        digitalWrite(led, HIGH);     //Turn on led
        delay(2000);
        digitalWrite(led, LOW);      //Turn off led
        delay(2000);
}
```

****

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Project 3: Passive Buzzer module

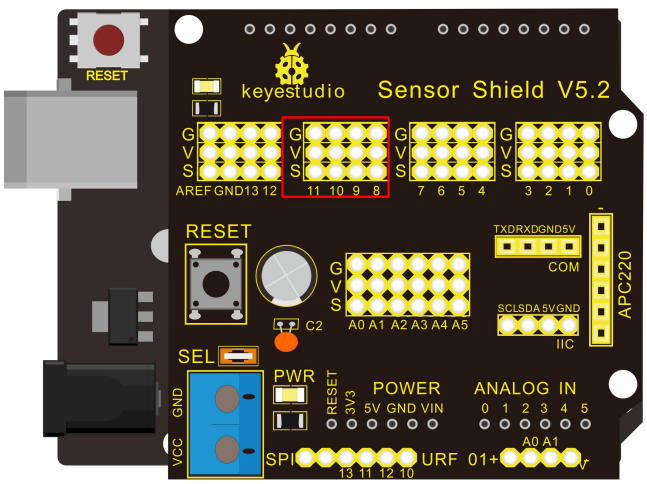
Introduction:

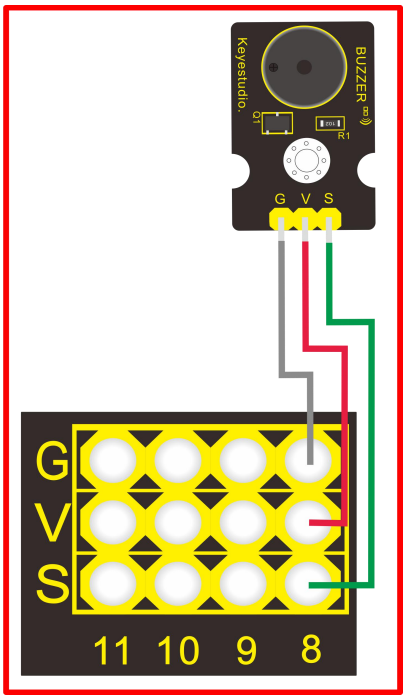
We can use Arduino to make many interactive works of which the most commonly seen is acoustic-optic display. All the previous experiment has something to do with LED. However, the circuit in this experiment can produce sound. Normally, the experiment is done with a buzzer or a speaker while buzzer is simpler and easier to use. The buzzer we introduced here is a passive buzzer. It cannot be actuated by itself, but by external pulse frequencies. Different frequencies produce different sounds. We can use Arduino to code the melody of a song, which is actually quite fun and simple.

Specification:

Working voltage: 3.3-5v
Interface type: digital
Size: 30*20mm
Weight: 4g

Connection Diagram:





Sample Code:

```
int buzzer=8;//set digital IO pin of the buzzer
void setup()
{
pinMode(buzzer,OUTPUT);// set digital IO pin pattern, OUTPUT to be output
}
void loop()
{ unsigned char i,j;//define variable
while(1)
{ for(i=0;i<80;i++)// output a frequency sound
{ digitalWrite(buzzer,HIGH);// sound
delay(1);//delay1ms
digitalWrite(buzzer,LOW);//not sound
delay(1);//ms delay
}
for(i=0;i<100;i++)// output a frequency sound
{
digitalWrite(buzzer,HIGH);// sound
digitalWrite(buzzer,LOW);//not sound
delay(2);//2ms delay
} } }
```

After downloading the program, buzzer experiment will been finished.

****

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Project 4: Hall Magnetic Sensor

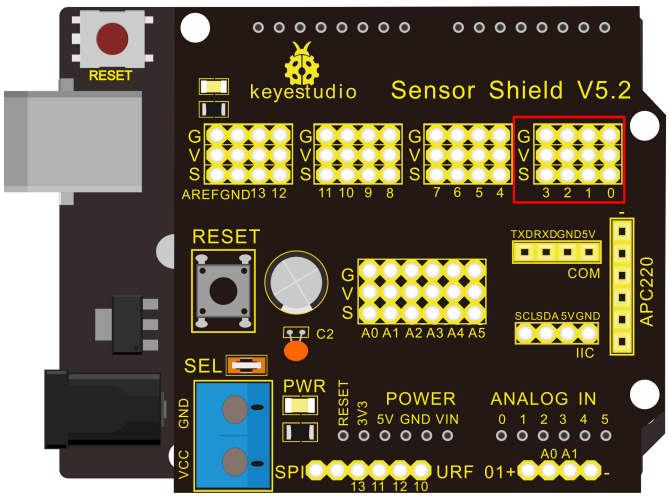
Introduction:

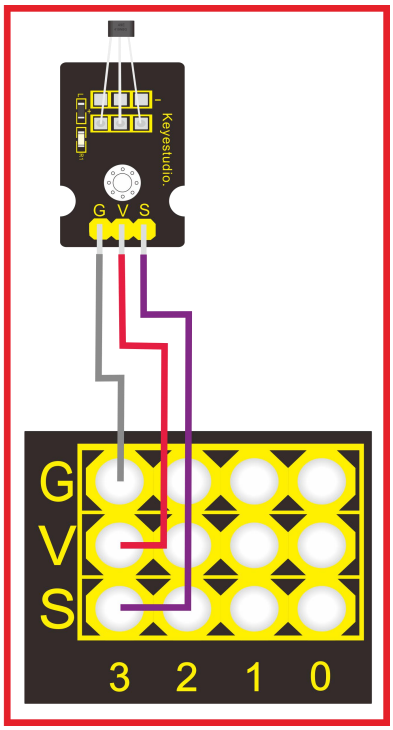
This is a Magnetic Induction Sensor. It senses the magnetic materials within a detection range up to 3cm. The detection range and the strength of the magnetic field are proportional. The output is digital on/off. This sensor uses the SFE Reed Switch - Magnetic Field Sensor.

Specification:

Sensing magnetic materials
Detection range: up to 3cm
Output: digital on/off
Detection range and magnetic field strength are proportional
Size: 30*20mm
Weight: 3g

Connection Diagram:





Sample Code:

```
int ledPin = 13;                // choose the pin for the LED
int inputPin = 3;               // Connect sensor to input pin 3
int val = 0;                    // variable for reading the pin status

void setup() {
  pinMode(ledPin, OUTPUT);      // declare LED as output
  pinMode(inputPin, INPUT);     // declare pushbutton as input
}

void loop(){
  val = digitalRead(inputPin);  // read input value
  if (val == HIGH) {            // check if the input is HIGH
    digitalWrite(ledPin, LOW);  // turn LED OFF
  } else {
    digitalWrite(ledPin, HIGH); // turn LED ON
  }
}
```

****

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Project 5: LM35 Linear Temperature Sensor

Introduction:

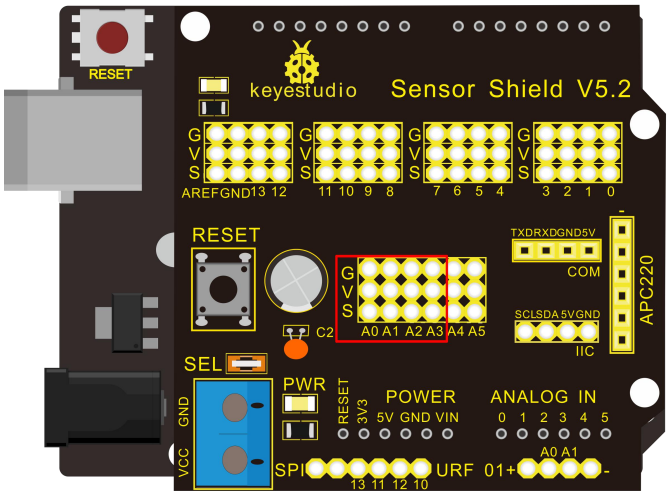
LM35 Linear Temperature Sensor is based on semiconductor LM35 temperature sensor. It can be used to detect ambient air temperature. This sensor offers a functional range among 0 degree Celsius to 100 degree Celsius. Sensitivity is 10mV per degree Celsius. The output voltage is proportional to the temperature.

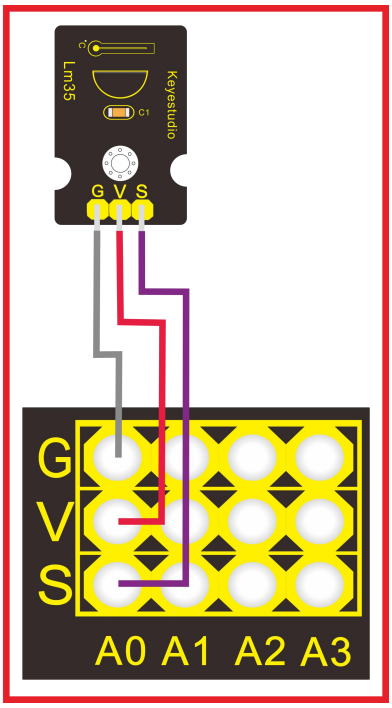
This sensor is commonly used as a temperature measurement sensor. It includes thermocouples, platinum resistance, and thermal resistance and temperature semiconductor chips. The chip is commonly used in high temperature measurement thermocouples. Platinum resistance temperature sensor is used in the measurement of 800 degrees Celsius, while the thermal resistance and semiconductor temperature sensor is suitable for measuring the temperature of 100-200 degrees or below, in which the application of a simple semiconductor temperature sensor is good in linearity and high in sensitivity. The LM35 linear temperature sensor and sensor-specific Arduino shield can be easily combined.

Specification:

Based on the semiconductor LM35 temperature sensor
Can be used to detect ambient air temperature
Sensitivity: 10mV per degree Celcius
Functional range: 0 degree Celsius to 100 degree Celsius
Size: 30*20mm
Weight: 3g

Connection Diagram:





Sample Code :

```
void setup()
{
   Serial.begin(9600);//Set Baud Rate to 9600 bps
}
 void loop()
{
   int val;
   int dat;
   val=analogRead(0);//Connect LM35 on Analog 0
   dat=(500 * val) /1024;;
   Serial.print("Temp:"); //Display the temperature on Serial monitor
   Serial.print(dat);
   Serial.println("C");
   delay(500);
}
```

****

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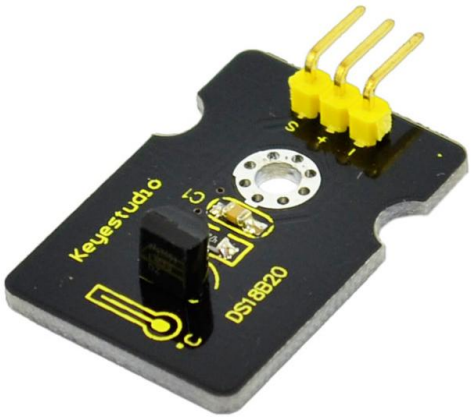
Project 6: 18B20 Temperature Sensor



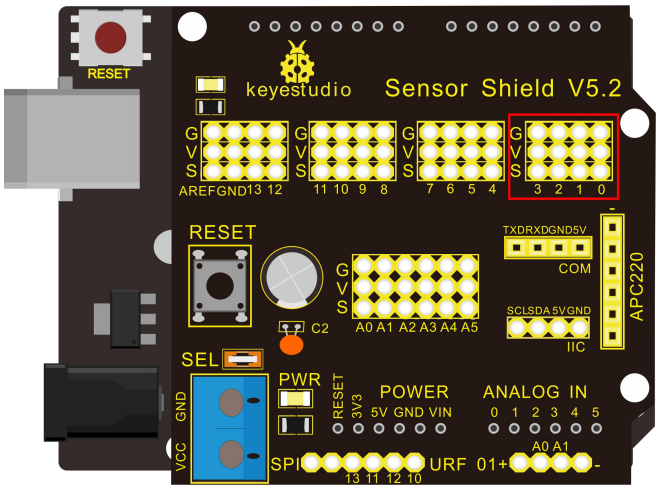
Introduction:

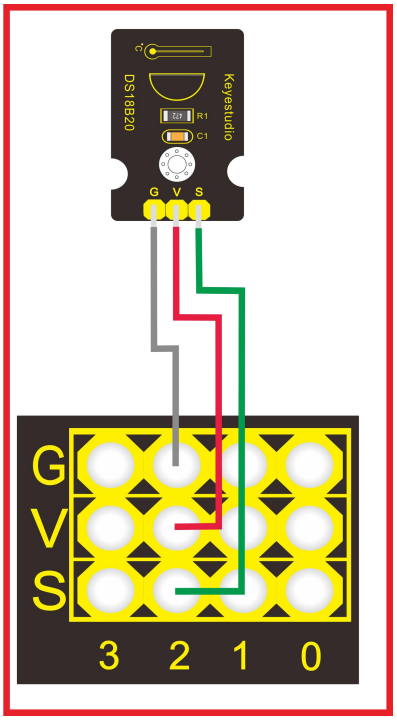
DS18B20 is a digital temperature sensor from DALLAS U.S. It can be used to quantify environmental temperature testing.
The temperature range is -55 ~ +125 ℃, inherent temperature resolution 0.5 ℃. It also support multi-point mesh networking. Three DS18B20 can be deployed on three lines to achieve multi-point temperature measurement. It has a 9-12 bit serial output.

Specification:

Supply Voltage: 3.3V to 5V
Temperature range: -55 °C ~ +125 °C
Interface: Digital
Size: 30*20mm
Weight: 3g

Connection Diagram:





Sample Code:

```
// http://www.pjrc.com/teensy/arduino_libraries/OneWire.zip
#include <OneWire.h>
 int DS18S20_Pin = 2; //DS18S20 Signal pin on digital 2
 //Temperature chip i/o
OneWire ds(DS18S20_Pin);  // on digital pin 2
 void setup(void) {
  Serial.begin(9600);
}
 void loop(void) {
  float temperature = getTemp();
  Serial.println(temperature);

  delay(100); //just here to slow down the output so it is easier to read

}

float getTemp(){
  //returns the temperature from one DS18S20 in DEG Celsius

  byte data[12];
  byte addr[8];

  if ( !ds.search(addr)) {
```

```
    //no more sensors on chain, reset search
    ds.reset_search();
    return -1000;
  }

  if ( OneWire::crc8( addr, 7) != addr[7]) {
    Serial.println("CRC is not valid!");
    return -1000;
  }

  if ( addr[0] != 0x10 && addr[0] != 0x28) {
    Serial.print("Device is not recognized");
    return -1000;
  }

  ds.reset();
  ds.select(addr);
  ds.write(0x44,1); // start conversion, with parasite power on at the end

  byte present = ds.reset();
  ds.select(addr);
  ds.write(0xBE); // Read Scratchpad


  for (int i = 0; i < 9; i++) { // we need 9 bytes
    data[i] = ds.read();
  }
  ds.reset_search();

  byte MSB = data[1];
  byte LSB = data[0];

  float tempRead = ((MSB << 8) | LSB); //using two's compliment
  float TemperatureSum = tempRead / 16;

  return TemperatureSum;

}
```

****

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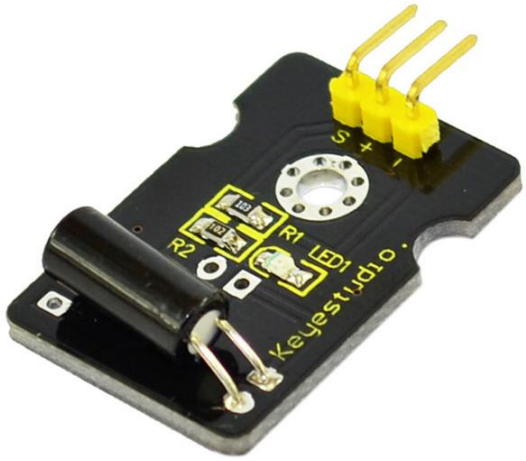
Project 7: Digital Tilt Sensor



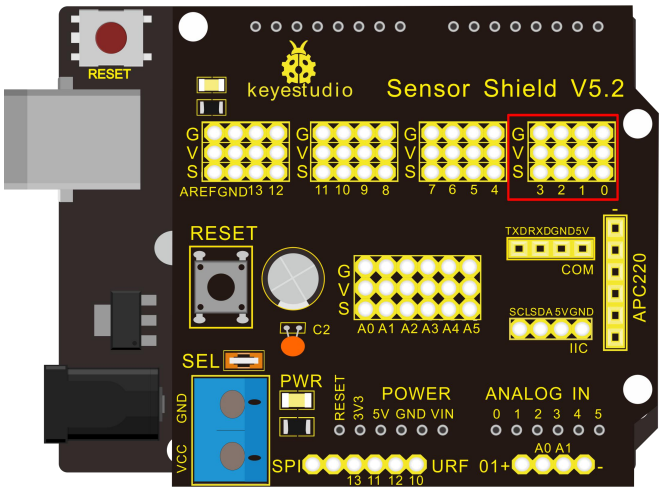
Introduction:

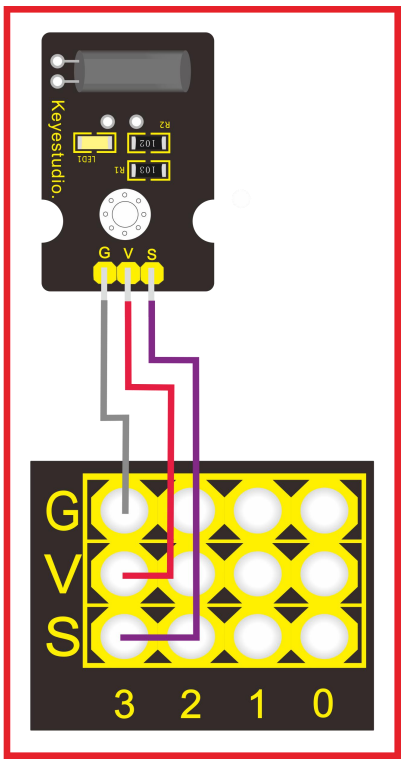
Tilt Sensor is a digital tilt switch. It can be used as a simple tilt sensor. Simplly plug it to our IO/Sensor shield; you can make amazing interactive projects. With dedicated sensor shield and Arduino, you can achieve interesting and interactive work.

Specification:

Supply Voltage: 3.3V to 5V
Interface: Digital
Size: 30*20mm
Weight: 3g

Connection Diagram:





Sample Code:

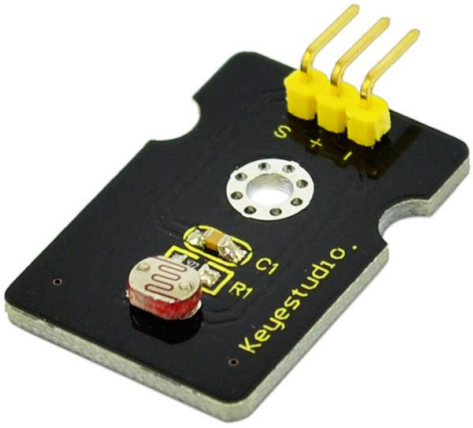
```
int ledPin = 13;                // Connect LED to pin 13
int switcher = 3;               // Connect Tilt sensor to Pin3

void setup()
{
 pinMode(ledPin, OUTPUT);       // Set digital pin 13 to output mode
 pinMode(switcher, INPUT);      // Set digital pin 3 to input mode
}
void loop()
{

  if(digitalRead(switcher)==HIGH) //Read sensor value
    {
      digitalWrite(ledPin, HIGH);    // Turn on LED when the sensor is tilted
    }
  else
    {
      digitalWrite(ledPin, LOW);     // Turn off LED when the sensor is not triggered
    }
}
```

****

Project 8: Photocell sensor



Introduction:

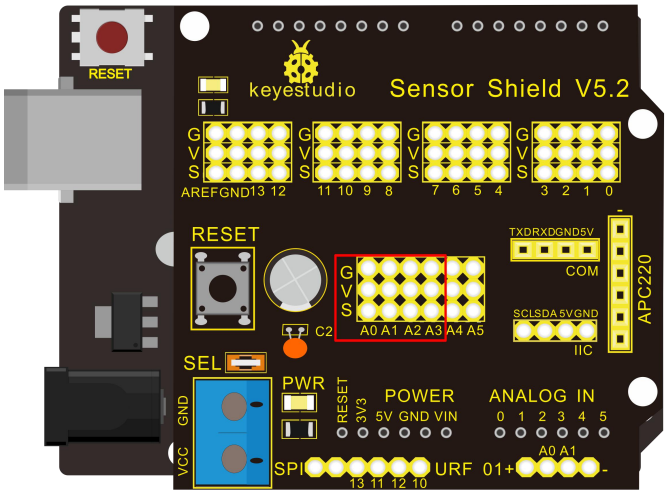
Photocell is commonly seen in our daily life and is mainly used in intelligent switch, also in common electronic design. To make it easier and more effective, we supply corresponding modules.

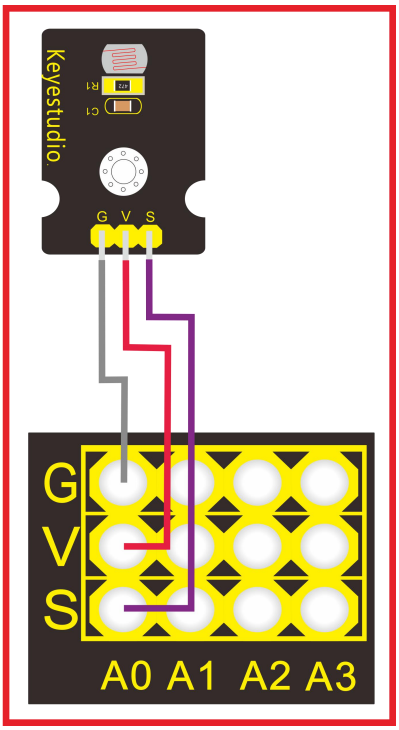
Photocell is a semiconductor. It has features of high sensitivity, quick response, spectral characteristic, and R-value consistence, maintaining high stability and reliability in environment extremes such as high temperature, high humidity. It's widely used in automatic control switch fields like cameras, garden solar lights, lawn lamps, money detectors, quartz clocks, music cups, gift boxes, mini night lights, sound and light control switches, etc.

Specification:

Interface type: analog
Working voltage: 5V
Size: 30*20mm
Weight: 3g

Connection Diagram:





Sample Code:

```
int sensorPin =A0 ;
int value = 0;
void setup()
{
  Serial.begin(9600); }

void loop()
{
  value = analogRead(sensorPin);
Serial.println(value, DEC);

delay(50); }
```

****

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Project 9: Digital Push Button

Introduction:

This is a basic application module. You can simply plug it into an IO shield to have your first taste of Arduino.

Advantages:

Wide voltage range from 3.3V to 5V

Standard assembling structure (two 3mm diameter holes with multiple of 5mm as distance from center)

Easily recognizable interfaces of sensors ("A" for analog and "D" for digital)

Icons illustrate sensor function clearly

High quality connector

Immersion gold surface

Specification:

Supply Voltage: 3.3V to 5V

Easy to 'plug and operate'

Large button keypad and high-quality first-class cap

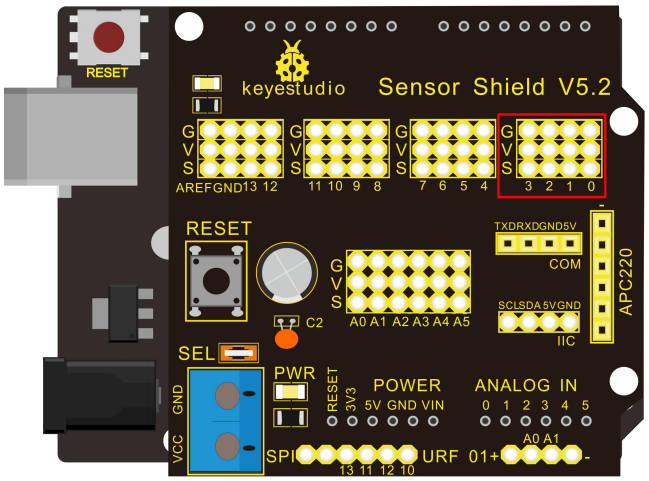
Achieve interesting and interactive work

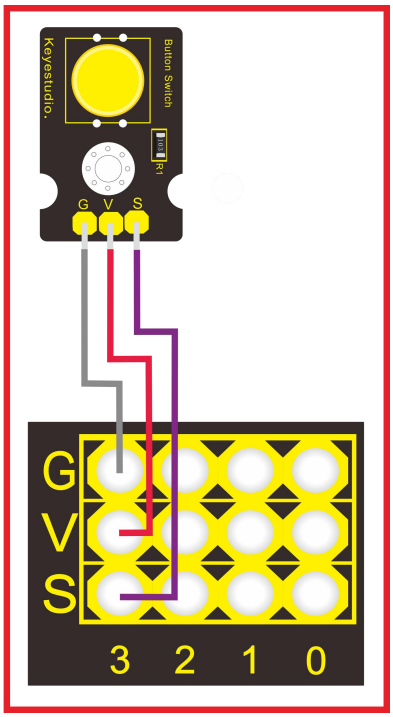
Interface: Digital

Size: 30*20mm

Weight: 4g

Connection diagram:





Sample Code

```
/* # When you push the digital button, the Led 13 on the board will turn on. Otherwise,the led
turns off.
*/
int ledPin = 13;                    // choose the pin for the LED
int inputPin = 3;                   // Connect sensor to input pin 3
void setup() {
  pinMode(ledPin, OUTPUT);          // declare LED as output
  pinMode(inputPin, INPUT);         // declare pushbutton as input
}
void loop(){
  int val = digitalRead(inputPin);  // read input value
  if (val == HIGH) {                // check if the input is HIGH
    digitalWrite(ledPin, LOW);  // turn LED OFF
  } else {
    digitalWrite(ledPin, HIGH); // turn LED ON
  }
}
```

****

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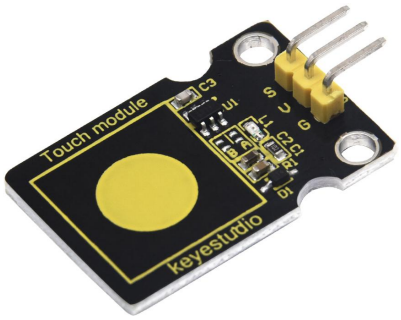
Project 10: Capacitive Touch Sensor



Introduction:

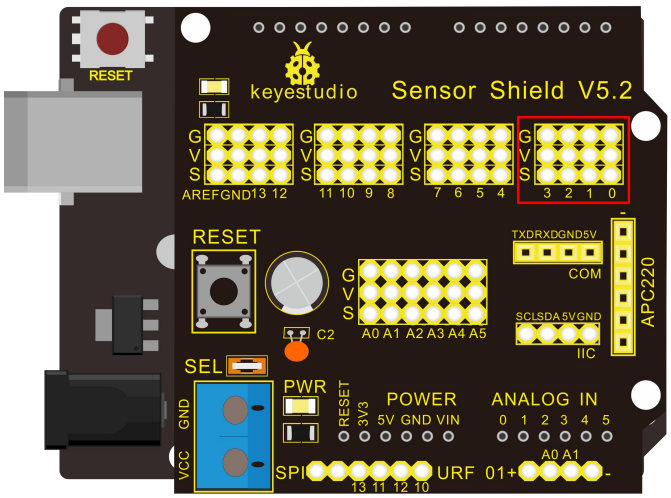
Are you tired of clicking mechanic button? Well, try our capacitive touch sensor. We can find touch sensors mostly on electronic device. So upgrade your Arduino project with our new version touch sensor and make it cool!!

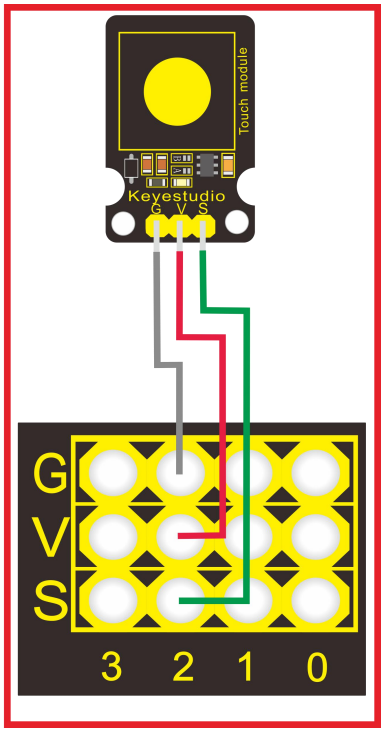
This little sensor can "feel" people and metal touch and feedback a high/low voltage level. Even isolated by some cloth and paper, it can still feel the touch. Its sensetivity decrease as isolation layer gets thicker. For detail of usage, please check our wiki. To perfect user's experience of our sensor module, we made following improvements.

Specification:

Supply Voltage: 3.3V to 5V
Interface: Digital
Size: 30*20mm
Weight: 3g

Connection Diagram:





Sample Code:

```
int ledPin = 13;                // Connect LED on pin 13, or use the onboard one
int KEY = 2;                    // Connect Touch sensor on Digital Pin 2

void setup(){
  pinMode(ledPin, OUTPUT);      // Set ledPin to output mode
  pinMode(KEY, INPUT);          //Set touch sensor pin to input mode
}

void loop(){
   if(digitalRead(KEY)==HIGH) {      //Read Touch sensor signal
       digitalWrite(ledPin, HIGH);   // if Touch sensor is HIGH, then turn on
     }
   else{
       digitalWrite(ledPin, LOW);    // if Touch sensor is LOW, then turn off the led
     }
}
```

****

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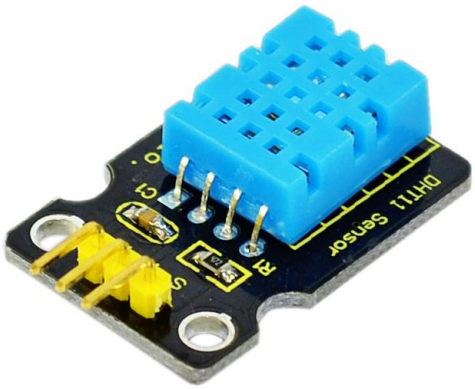
Project 11: DHT11 Temperature and Humidity Sensor



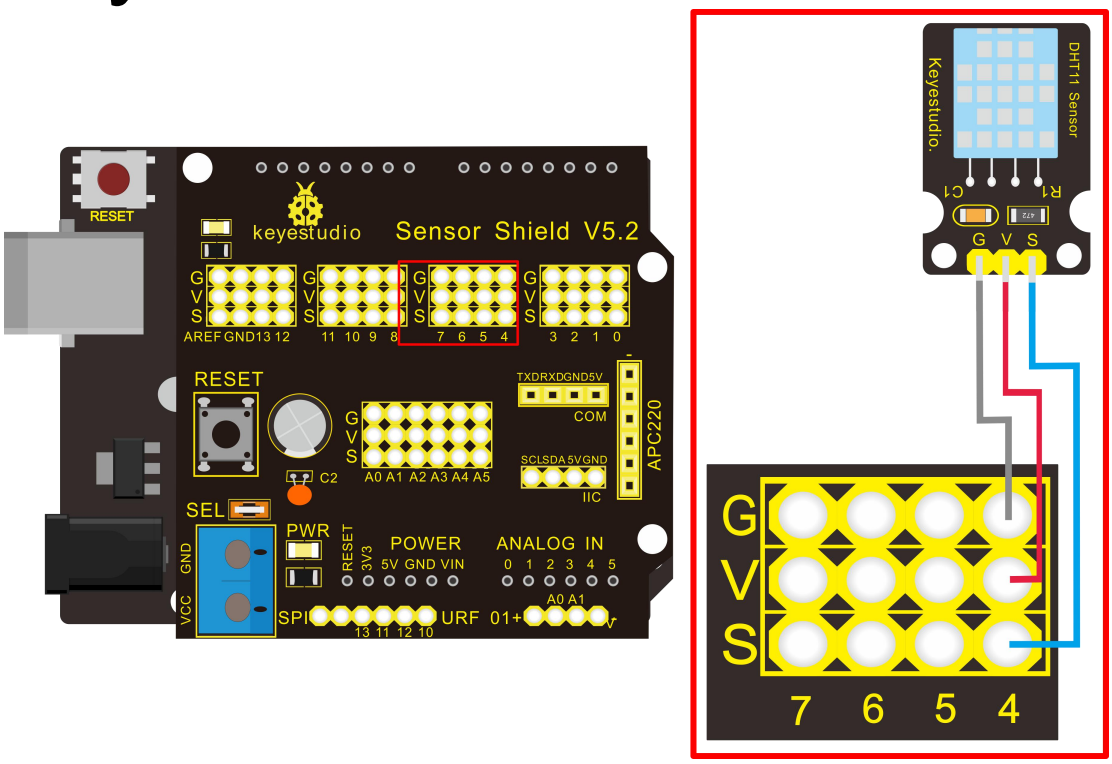
Introduction:

This DHT11 Temperature and Humidity Sensor features calibrated digital signal output with the temperature and humidity sensor complex. Its technology ensures high reliability and excellent long-term stability. A high-performance 8-bit microcontroller is connected. This sensor includes a resistive element and a sense of wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high cost performance advantages.
Each DHT11 sensor features extremely accurate calibration data of humidity calibration chamber. The calibration coefficients stored in the OTP program memory, internal sensors detect signals in the process, and we should call these calibration coefficients. The single-wire serial interface system is integrated to make it quick and easy. Qualities of small size, low power, and 20-meter signal transmission distance make it a wide applied application and even the most demanding one. Convenient connection, special packages can be provided according to users need.

Specification:

Supply Voltage: +5 V
Temperature range: 0-50 °C error of ± 2 °C
Humidity: 20-90% RH ± 5% RH error
Interface: Digital
Size: 30*20mm
Weight: 4g

Connection diagram:



Sample Code:

Please download the DHT11Lib firstly.Or,see the website

```
#include <dht11.h>
dht11 DHT;
#define DHT11_PIN 4

void setup(){
  Serial.begin(9600);
  Serial.println("DHT TEST PROGRAM ");
  Serial.print("LIBRARY VERSION: ");
  Serial.println(DHT11LIB_VERSION);
  Serial.println();
  Serial.println("Type,\tstatus,\tHumidity (%),\tTemperature (C)");
}

void loop(){
  int chk;
  Serial.print("DHT11, \t");
  chk = DHT.read(DHT11_PIN);    // READ DATA
  switch (chk){
    case DHTLIB_OK:
                Serial.print("OK,\t");
                break;
    case DHTLIB_ERROR_CHECKSUM:
```

```
            Serial.print("Checksum error,\t");
            break;
    case DHTLIB_ERROR_TIMEOUT:
            Serial.print("Time out error,\t");
            break;
    default:
            Serial.print("Unknown error,\t");
            break;
  }
 // DISPLAT DATA
  Serial.print(DHT.humidity,1);
  Serial.print(",\t");
  Serial.println(DHT.temperature,1);

  delay(1000);
}
```

****

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Project 12: Analog Sound Sensor

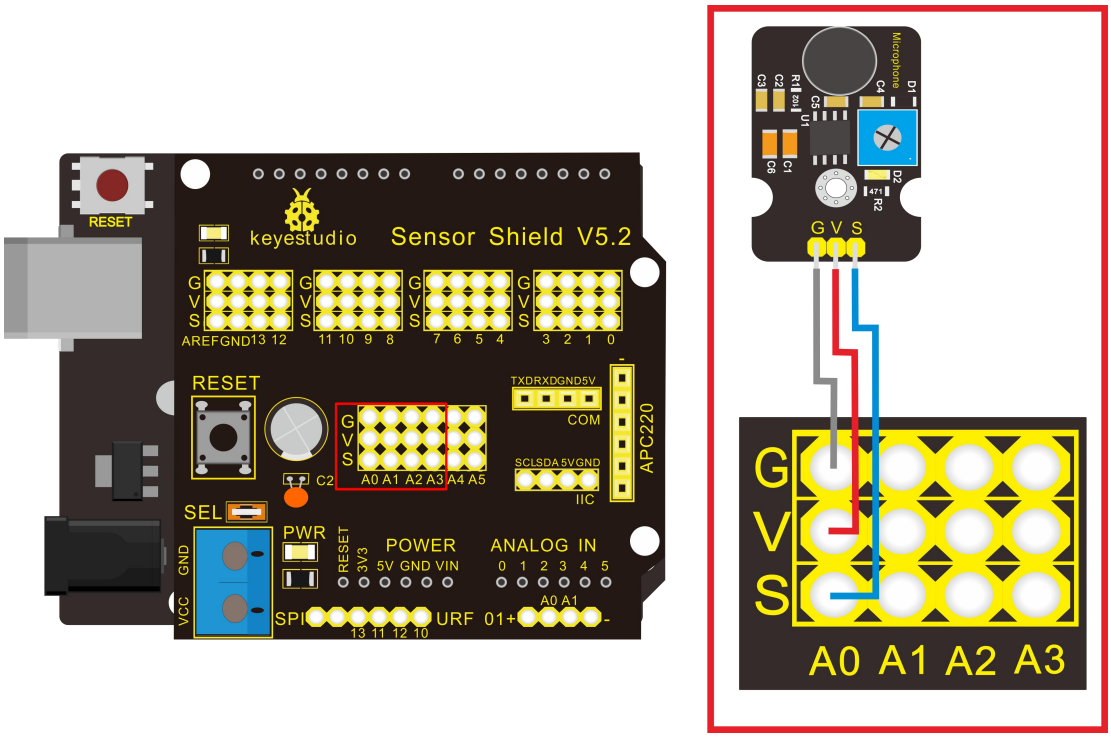
Introduction:

Analog Sound Sensor is typically used in detecting the loudness in ambient environment. The Arduino can collect its output signal by imitating the input interface. You can use it to make some interesting interactive works such as a voice operated switch.

Specification:

Supply Voltage: 3.3V to 5V
Detecting sound intensity
Interface: Analog
Size: 30*20mm
Weight: 4g

Connection Diagram:



Sample Code:

```
void setup()
{
  Serial.begin(9600); // open serial port, set the baud rate to 9600 bps
}
void loop()
{
    int val;
    val=analogRead(0);    //connect mic sensor to Analog 0
    Serial.println(val,DEC);//print the sound value to serial
    delay(100);
}
```

****

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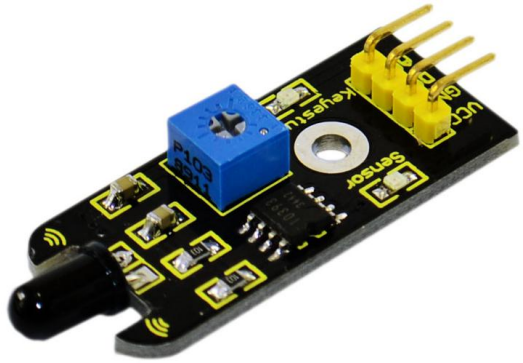
Project 13: Flame Sensor



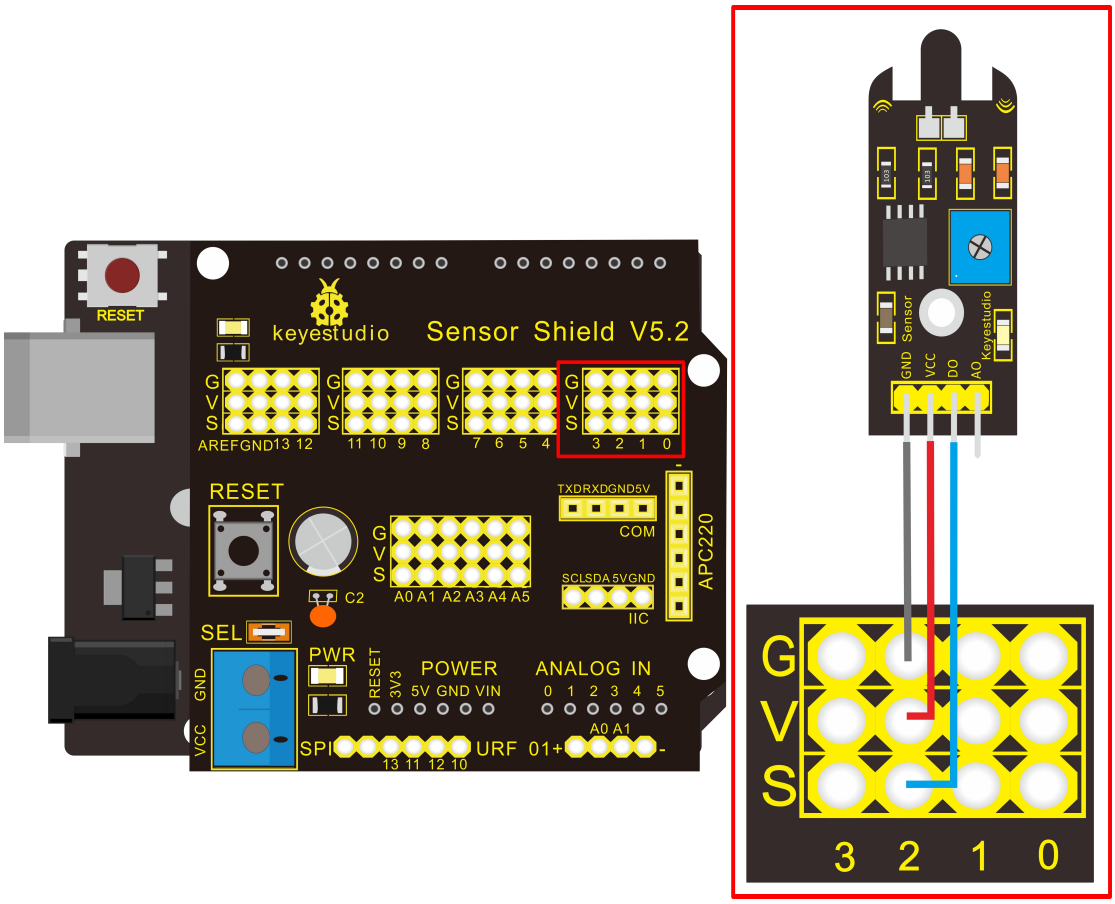
Introduction:

This flame sensor can be used to detect fire or other lights whose wavelength stands at 760 nm ~ 1100 nm. In the fire-fighting robot game, the flame plays an important role in the probe, which can be used as the robot's eyes to find fire source.

Specification:

Supply Voltage: 3.3V to 5V
Detection range: 20cm (4.8V) ~ 100cm (1V)
Rang of Spectral Bandwidth: 760nm to 1100nm
Operating temperature: -25℃to 85℃
Interface: digital
Size: 44*16.7mm
Weight: 4g

Connection Diagram:



Sample Code:

```
const int flamePin = 2;          // the number of the flame pin
const int ledPin =    13;          // the number of the LED pin
// variables will change:
int State = 0;                 // variable for reading status
void setup() {
   // initialize the LED pin as an output:
   pinMode(ledPin, OUTPUT);
   // initialize the pushbutton pin as an input:
   pinMode(flamePin, INPUT);
}
void loop(){
   // read the state of the value:
State = digitalRead(flamePin);
   if (State == HIGH) {
      // turn LED on:
      digitalWrite(ledPin, HIGH);
   }
   else {
      // turn LED off:
```

```
      digitalWrite(ledPin, LOW);
   }
}
```

****

Project 14: DS3231 Clock Module

Introduction:

DS3231 is equipped with integrated TCXO and crystal, which makes it a cost-effective I2C real time clock with high precision. The device carries a battery input, so if you disconnect the main power supply, it can still maintain accurate timing. The integrated oscillator ensures the long-term accuracy of the device and reduces the number of components. DS3231 provides both commercial and industrial temperature range and supports 16 pins small-outline package (300mil). The module itself can adapt to the system of 3.3V and 5V without level switch, which is quite convenient!

Specification:

Temperature range: -40 to +85; Timing accuracy : ± 5ppm (±0.432 seconds / day)
Provide battery backup for continuous timing
Low power consumption
Device package and function compatible with DS3231
Complete clock calendar function contains seconds and minutes, hour, week, date, month, and year timing and provides leap year compensation until 2100.
Two calendar clock
Output: 1Hz and 32.768kHz
Reset output and Input Debounce of Pushbutton
High speed (400kHz), I2C serial bus
Supply voltage: +3.3V to +5.5V
Digital temperature sensor with a precision of±3℃

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Working temperature: -40 ~ C to +85 ~ C

16 pins Small Outline Package (300mil)

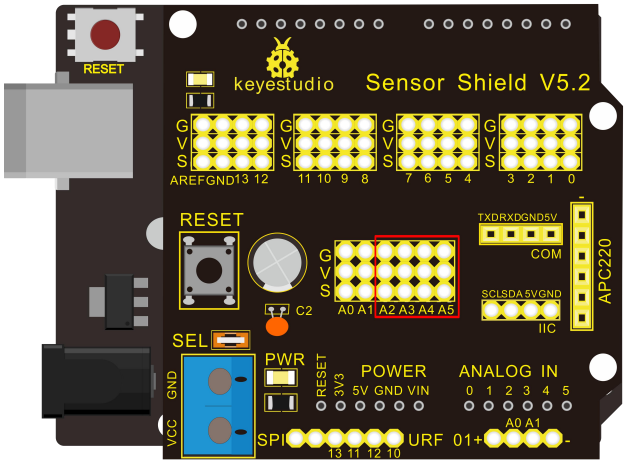
Certified by American Association of Underwriters Laboratories (UL)

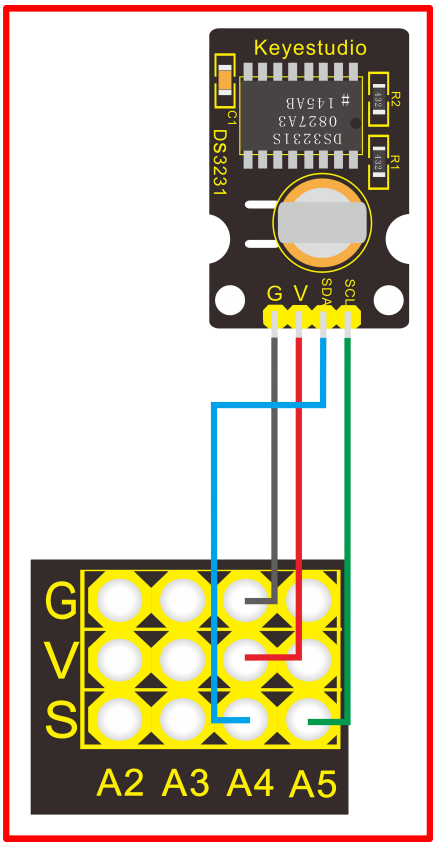
Size: 30*20mm

Weight: 4g

Connection Diagram:

This module adopts the IIC test method, so we only need to connect 'SDA' to Arduino A4, 'SCL' to A5, '+' to VCC and '-' to GND as follows:



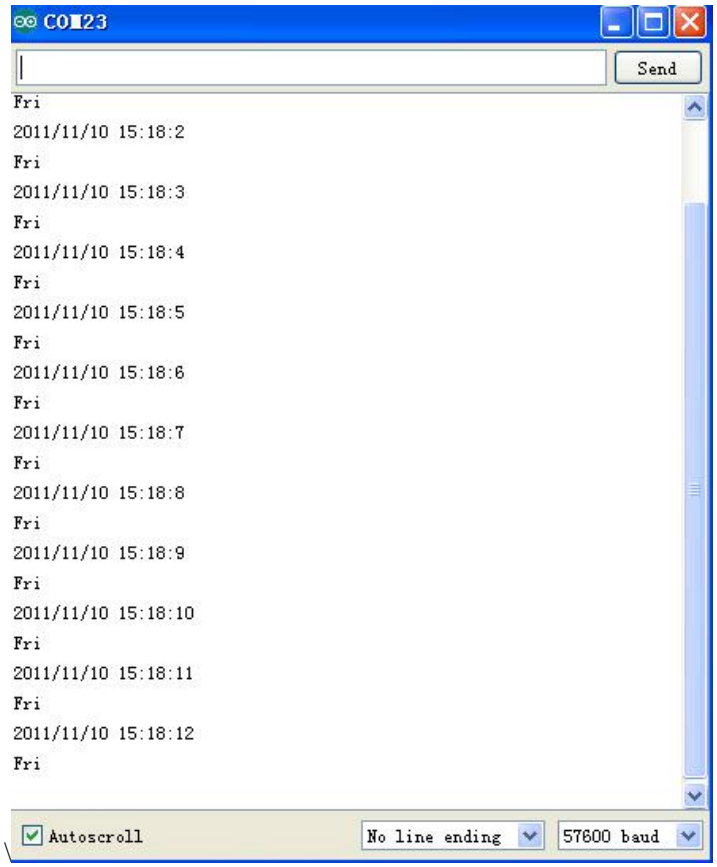


Sample Code:

```
#include <Wire.h>
#include "DS3231.h"
DS3231 RTC; //Create the DS3231 object
char weekDay[][4] = {"Sun", "Mon", "Tue", "Wed", "Thu", "Fri", "Sat" };
//year, month, date, hour, min, sec and week-day(starts from 0 and goes to 6)
//writing any non-existent time-data may interfere with normal operation of the RTC.
//Take care of week-day also.
DateTime dt(2011, 11, 10, 15, 18, 0, 5);//open the series port and you can check time here or make a change to the time as needed.
void setup ()
{     Serial.begin(57600);//set baud rate to 57600
```

```
    Wire.begin();
    RTC.begin();
    RTC.adjust(dt); //Adjust date-time as defined 'dt' above
}
void loop ()
{   DateTime now = RTC.now(); //get the current date-time
    Serial.print(now.year(), DEC);
    Serial.print('/');
    Serial.print(now.month(), DEC);
    Serial.print('/');
    Serial.print(now.date(), DEC);
    Serial.print(' ');
    Serial.print(now.hour(), DEC);
    Serial.print(':');
    Serial.print(now.minute(), DEC);
    Serial.print(':');
    Serial.print(now.second(), DEC);
    Serial.println();
    Serial.print(weekDay[now.dayOfWeek()]);
    Serial.println();
    delay(1000);
}
```

Before compiling the code, you'd better put DS3231 library under file into Arduino catalogue,. When the above steps are done, you can upload the code to arduino and open the series monitor and get following results:



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Project 15: Analog Gas Sensor

Introduction:

This analog gas sensor - MQ2 is used in gas leakage detecting equipment in consumer electronics and industrial markets. This sensor is suitable for detecting LPG, I-butane, propane, methane, alcohol, Hydrogen and smoke. It has high sensitivity and quick response. In addition, the sensitivity can be adjusted by the potentiometer.

Specification:

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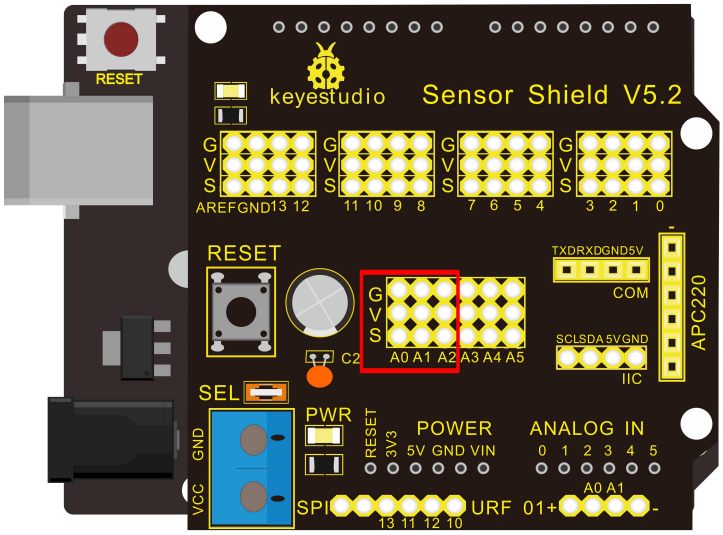
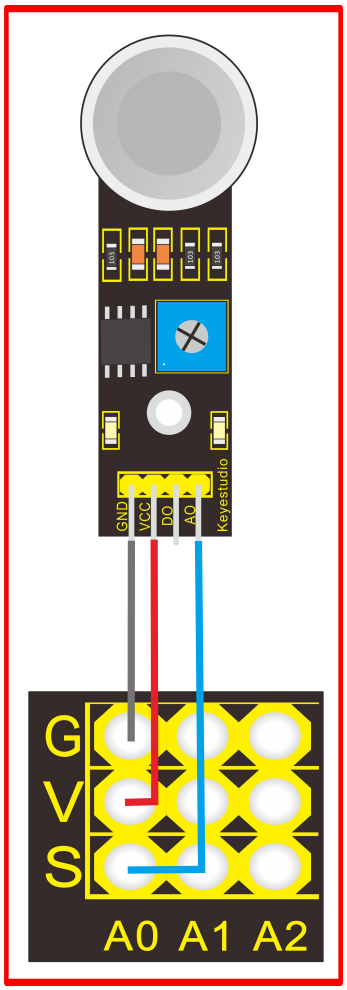
Power supply: 5V
Interface type: Analog
Wide detecting scope
Quick response and High sensitivity
Simple drive circuit
Stable and long lifespan
Size: 49.7*20mm
Weight: 8g

Connection Diagram:





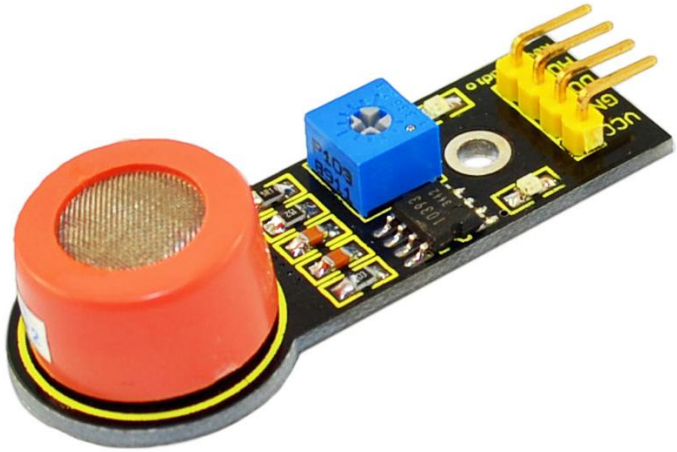
Sample Code:

```
///Arduino Sample Code
void setup()
{
  Serial.begin(9600); //Set serial baud rate to 9600 bps
}
void loop()
{
```

```
int val;
val=analogRead(0);//Read Gas value from analog 0
Serial.println(val,DEC);//Print the value to serial port
delay(100);
}
```

****

Project 16: Analog Alcohol Sensor



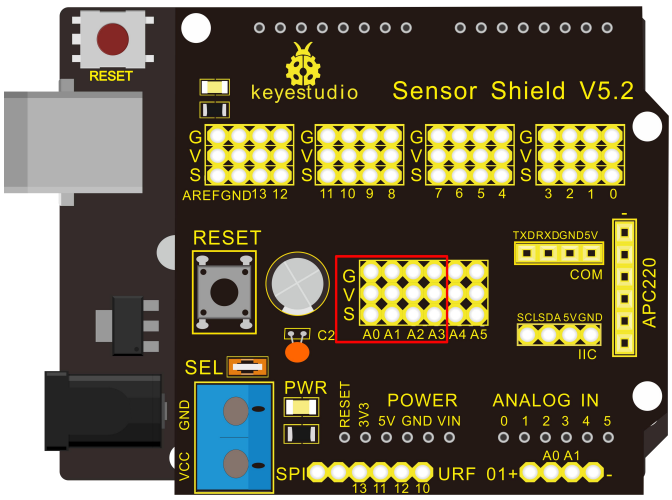
Introduction:

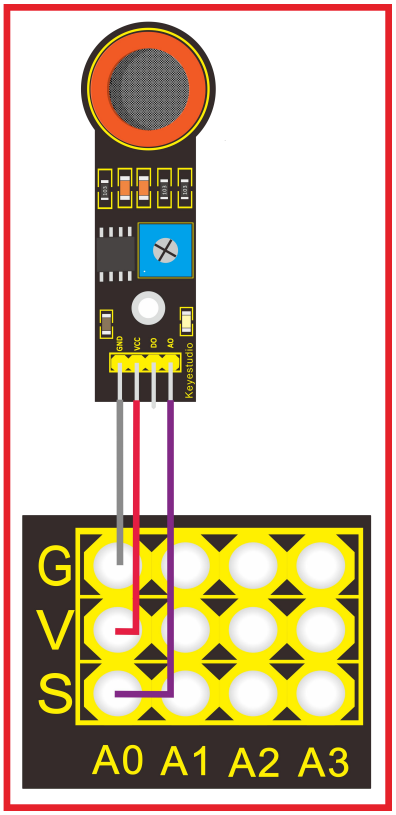
This analog gas sensor - MQ3 is suitable for detecting alcohol. It can be used in a Breath analyzer. Also it has high sensitivity to alcohol and low sensitivity to Benzine. The sensitivity can be adjusted by the potentiometer.

Specification:

Power supply: 5V
Interface type: Analog
Quick response and High sensitivity
Simple drive circuit
Stable and long service life
Size: 49.7*20mm
Weight: 6g

Connection Diagram:





Sample Code:

```
      ///Arduino Sample Code
void setup()
{
  Serial.begin(9600); //Set serial baud rate to 9600 bps
}
void loop()
{
int val;
val=analogRead(0);//Read Gas value from analog 0
Serial.println(val,DEC);//Print the value to serial port
delay(100);
}
```

****

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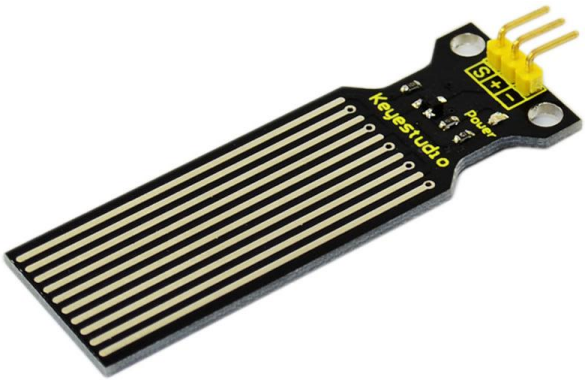
Project 17: keyestudio Water Sensor



Introduction:

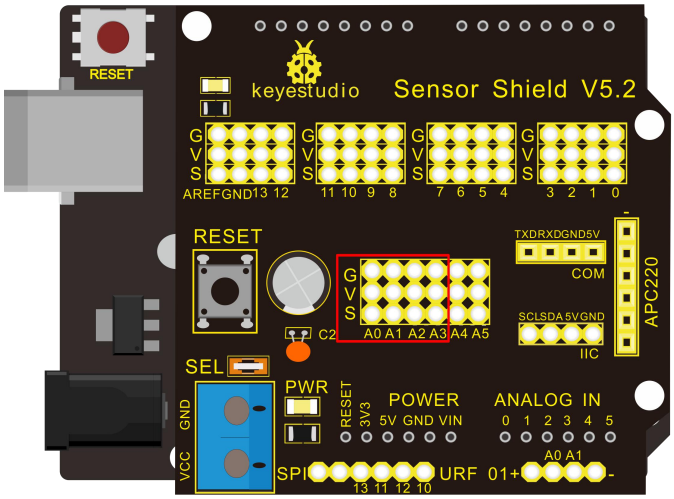
Our water sensor is easy- to-use, portable and cost-effective designed to identify and detect water level and water drop. This sensor measures the volume of water drop and water quantity through an array of traces of exposed parallel wires. Compared with its competitors, this sensor is not only smaller and smarter but also ingeniously equipped with following features:

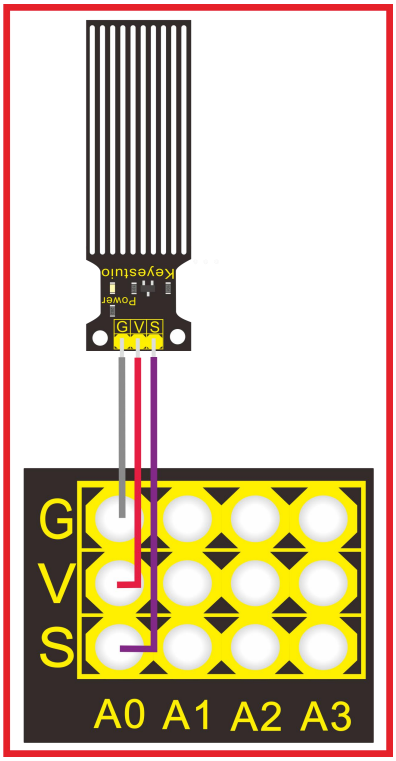
- smooth conversion between water quantity and analog quantity;
- strong flexibility, this sensor outputs basic analog value;
- low power consumption and high sensitivity;
- directly connected to microprocessor or other logic circuits, suitable for a variety of development boards and controllers such as Arduino controller, STC single-chip microcomputer, AVR single-chip microcomputer etc.

Specification:

Product name: Water Sensor
Operating voltage: DC5V
Operating current: < 20mA
Sensor type: Analog
Detection area: 40mm x16mm
Production process: FR4 double-side tinned
Humanized design: Anti-slippery semi-lunar recess
Operating temperature: 10%~90% without condensation
Product weight: 3g
Product size: 65mm x 20mm x 8mm

Connection Diagram:





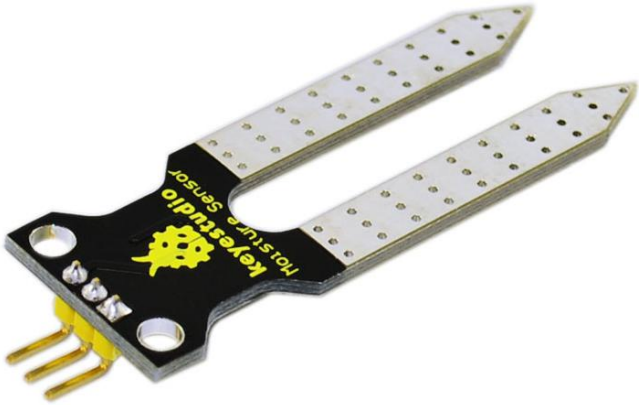
Sample Code:

```
int analogPin = 0; //connect water sensor to analog interface 0
int led = 13; //LED to digital interface 13
int val = 0; //define the initial value of variable 'val' as 0
int data = 0; //define the initial value of variable 'data' as 0
void setup()
{
pinMode(led, OUTPUT); //define led as output pin
Serial.begin(9600); //set baud rate at 9600
}
void loop()
{
val = analogRead(analogPin); //read and assign analog value to variable 'val'
if(val>700){ //decide whether variable 'val' is over 700 digitalWrite(led,HIGH); //turn on
LED when variable 'val' is over 700
}
else{
digitalWrite(led,LOW); //turn off LED when variable 'val' is under 700
}
data = val; //variable 'val' assigns value to variable 'data'
Serial.println(data); //print variable 'data' by Serial.print
delay(100);
```

```
}
```

After the above steps are done, let's do a test on lower water level and check what happens:
The LED can't light up when water level haven't reach alarm value;
The LED turns on and released an alarm when water level reaches alarm value;
****

Project 18: Soil Humidity Sensor



Introduction:

This is a simple soil humidity sensor aims to detect the soil humidity. If the soil is in lack of water, the analog value output by the sensor will decrease, otherwise, it will increase. If you use this sensor to make an automatic watering device, it can detect whether your botany is thirsty to prevent it from withering when you go out. Using the sensor with Arduino controller makes your plant more comfortable and your garden smarter.

The soil humidity sensor module is not as complicated as you might think, and if you need to detect the soil in your project , it will be your best choice.

The sensor is set with two probes inserted into the soil, then with the current go through the soil, the sensor will get resistance value by reading the current changes between the two probes and convert such resistance value into moisture content. The higher moisture (less resistance), the higher conductivity the soil has.

The surface of the sensor have undergone metallization process to prolong its service life. Insert it into the soil and then use the AD converter to read it. With the help of this sensor, the plant can remind you: I need water.

Specification:

Power Supply Voltage: 3.3V or 5V

Working Current: ≤ 20mA

Output Voltage: 0-2.3V (When the sensor is totally immersed in water, the voltage will be 2.3V) 5V power supply， the higher humidity, the higher the output voltage

Packaging : Electrostatic bag sealing

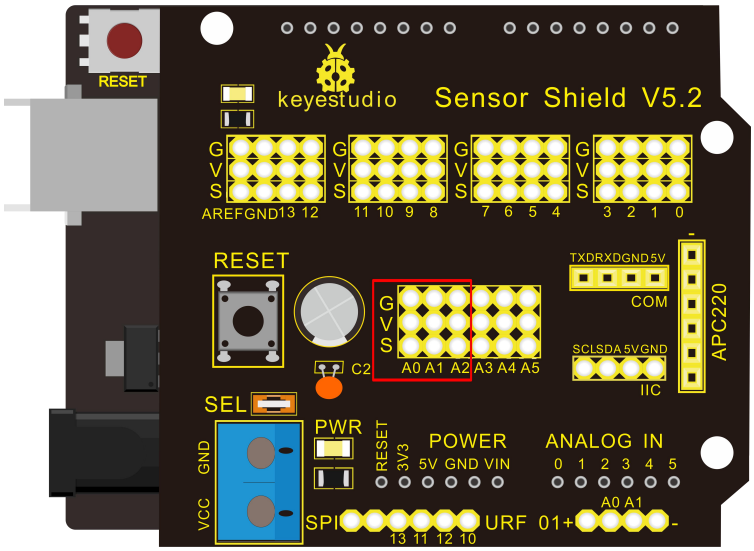
Sensor type: Analog output

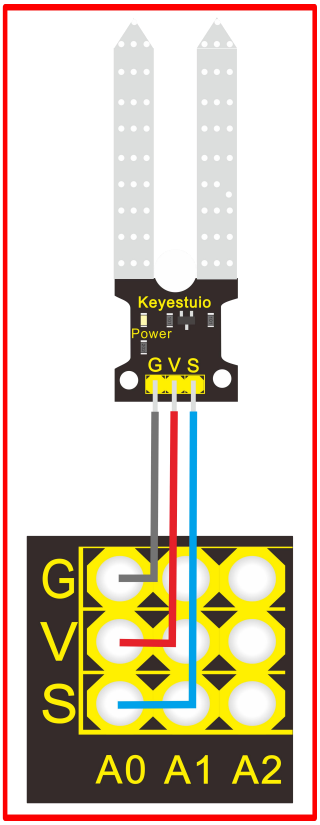
Interface definition: Pin1- signal, pin2- GND, pin3 - VCC

Service life: About one year (gold-plated surface for enhancing conductivity and corrosion resistance)

Module size: 20X60mm

Connection diagram:





Sample code:

```
/*
  # Example code for the moisture sensor
 # Connect the sensor to the A0(Analog 0) pin on the Arduino board
  # the sensor value description
  # 0   ~300      dry soil
  # 300~700      humid soil
  # 700~950      in water
*/
void setup(){
  Serial.begin(57600);
}
void loop(){
  Serial.print("Moisture Sensor Value:");
  Serial.println(analogRead(0));
  delay(100);
}
```

****

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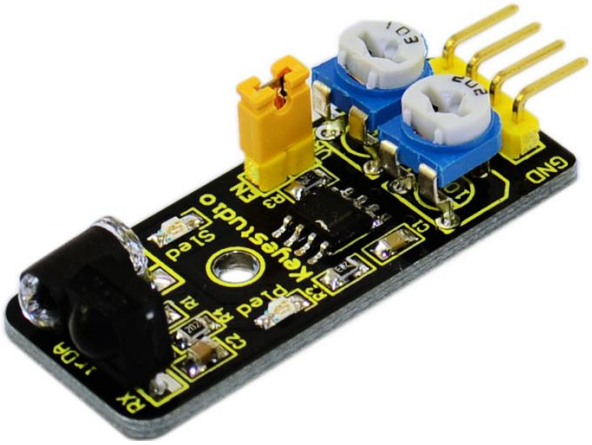
Project 19: Infrared Obstacle Avoidance Sensor



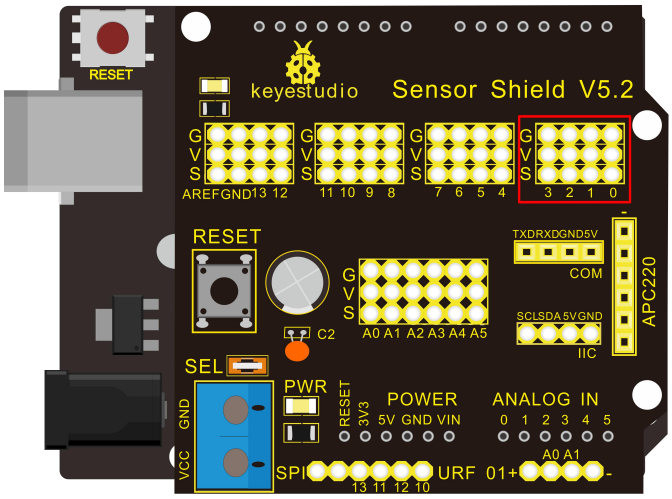
Introduction:

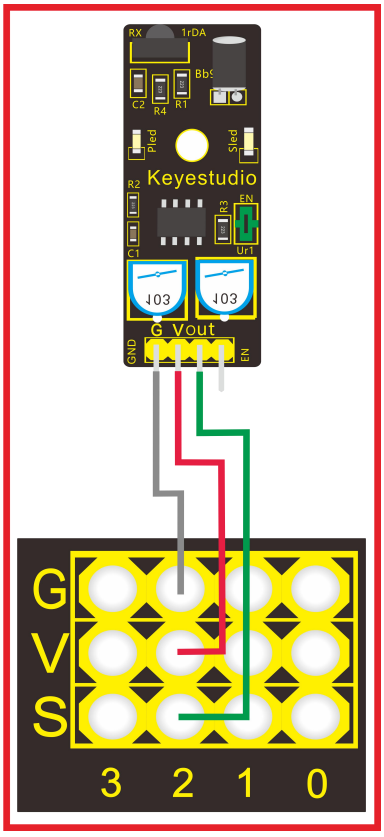
Infrared obstacle avoidance sensor is equipped with distance adjustment function and is especially designed for wheeled robots. This sensor has strong adaptability to ambient light and is of high precision. It has a pair of infrared transmitting and receiving tube. When infrared ray launched by the transmitting tube encounters an obstacle (its reflector), the infrared ray is reflected to the receiving tube, and the indicator will light up; the signal output interface outputs digital signal. We can adjust the detection distance through the potentiometer knob (effective distance: 2～40cm, working Voltage: 3.3V-5V). Thanks to a wide voltage range, this sensor can work steadily even under fluctuating power supply voltage and is suitable for the use of various micro-controllers, Arduino controllers and BS2 controllers. A robot mounted with the sensor can sense changes in the environment.

Specification：

Working voltage: DC 3.3V-5V
Working current: ≥20mA
Working temperature: －10℃—＋50℃
Detection distance: 2-40cm
IO Interface: 4 wire interface (-/+/S/EN)
Output signal: TTL voltage
Accommodation mode: Multi-circle resistance regulation
Effective Angle: 35°
Size: 41.7*16.7mm
Weight: 5g

Connection Diagram：





Sample Code:

```
const int sensorPin = 2;          // the number of the sensor pin
const int ledPin =    13;          // the number of the LED pin
int sensorState = 0;               // variable for reading the sensor status
void setup() {
   pinMode(ledPin, OUTPUT);
   pinMode(sensorPin, INPUT); }
void loop(){
   // read the state of the sensor value:
   sensorState = digitalRead(sensorPin);
   // if it is, the sensorState is HIGH:
   if (sensorState == HIGH) {
        digitalWrite(ledPin, HIGH);
   }
   else {
           digitalWrite(ledPin, LOW);
   }
}
```

****

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Project 20: PIR Motion Sensor

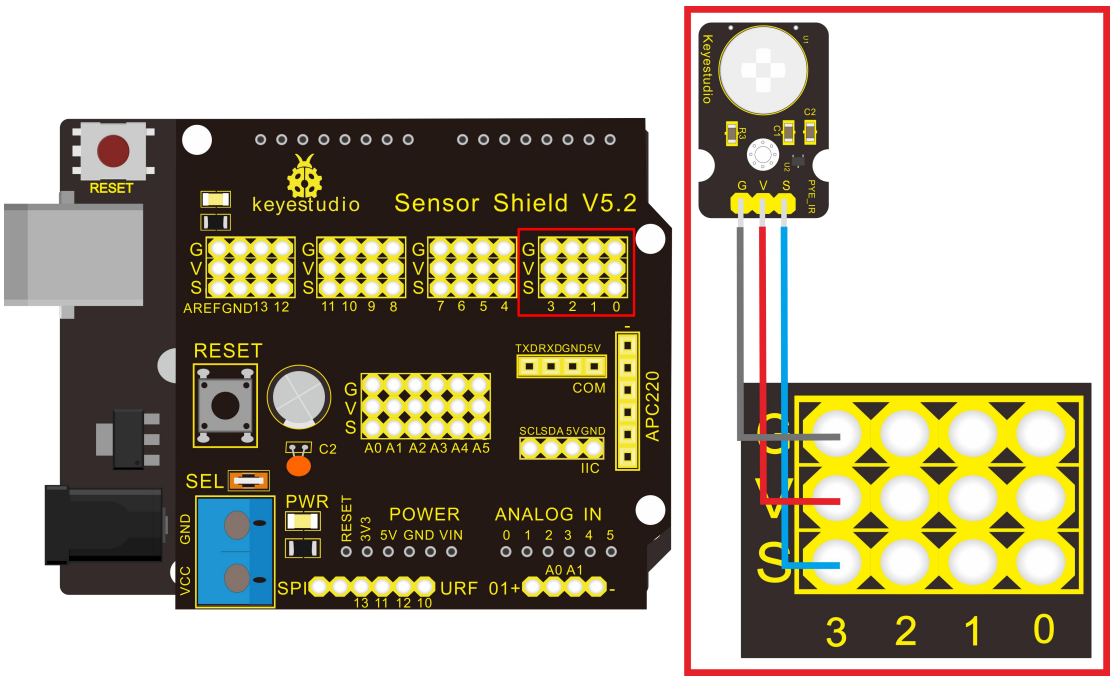
Introduction:

Pyroelectric infrared motion sensor can detect infrared signals from a moving person or moving animal, and output switching signals. It can be applied to a variety of occasions to detect the movement of human body. Conventional pyroelectric infrared sensors require body pyroelectric infrared detector, professional chip, complex peripheral circuit, so the size is bigger, with complex circuit, and lower reliability. Now we launch this new pyroelectric infrared motion sensor, specially designed for Arduino. It uses an integrated digital body pyroelectric infrared sensor, has smaller size, higher reliability, lower power consumption and simpler peripheral circuit.

Specification:

Input Voltage: 3.3 ~ 5V, 6V Maximum
Working Current: 15uA
Working Temperature: -20 ~ 85 ℃
Output Voltage: High 3V, low 0V
Output Delay Time (High Level): About 2.3 to 3 Seconds
Detection angle: 100 °
Detection distance: 7 meters
Output Indicator LED (When output HIGH, it will be ON)
Pin limit current: 100mA
Size: 30*20mm
Weight: 4g

Connection Diagram:



Sample Code:

```
byte sensorPin = 3;
byte indicator = 13;
void setup()
{
   pinMode(sensorPin,INPUT);
   pinMode(indicator,OUTPUT);
   Serial.begin(9600);
}
void loop()
{
   byte state = digitalRead(sensorPin);
   digitalWrite(indicator,state);
   if(state == 1)Serial.println("Somebody is in this area!");
   else if(state == 0)Serial.println("No one!");
   delay(500);
}
```

****

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Project 21: Joystick Module

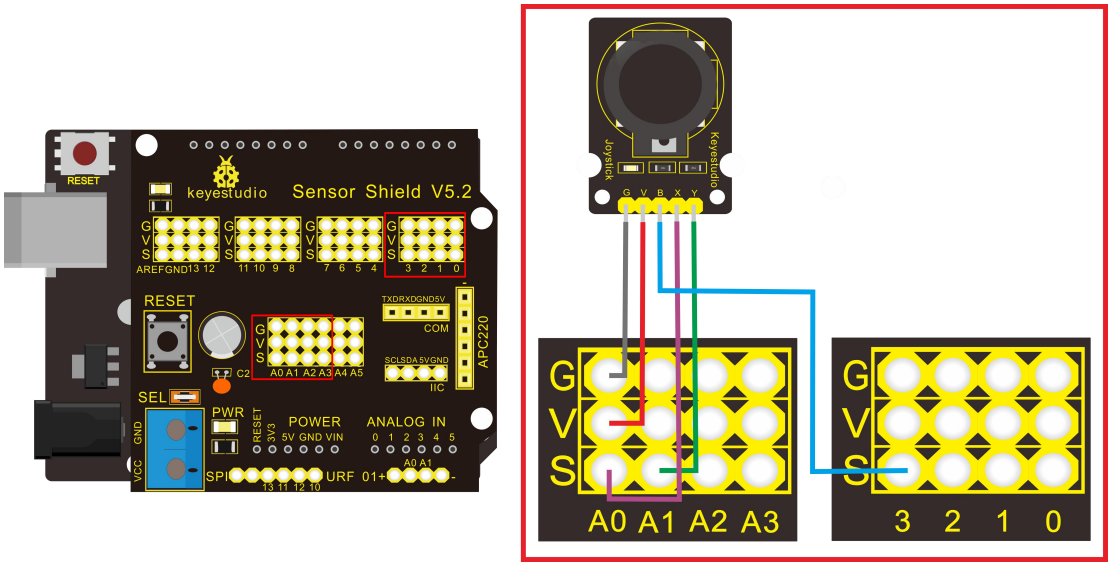
Introduction:

Lots of robot projects need joystick. This module provides an affordable solution. By simply connecting to two analog inputs, the robot is at your commands with X, Y control. It also has a switch that is connected to a digital pin. This joystick module can be easily connected to Arduino by IO Shield. This module is for Arduino(V5) with cables supplied.

Specification:

Supply Voltage: 3.3V to 5V
Interface: Analog x2, Digital x1
Size: 40*28mm
Weight: 12g

Connection Diagram:



Sample Code:

```
int JoyStick_X = 0; //x
int JoyStick_Y = 1; //y
int JoyStick_Z = 3; //key

void setup()
{
  pinMode(JoyStick_Z, INPUT);
  Serial.begin(9600); // 9600 bps
}
void loop()
{
  int x,y,z;
  x=analogRead(JoyStick_X);
  y=analogRead(JoyStick_Y);
  z=digitalRead(JoyStick_Z);
  Serial.print(x ,DEC);
  Serial.print(",");
  Serial.print(y ,DEC);
  Serial.print(",");
  Serial.println(z ,DEC);
  delay(100);
}
```

****

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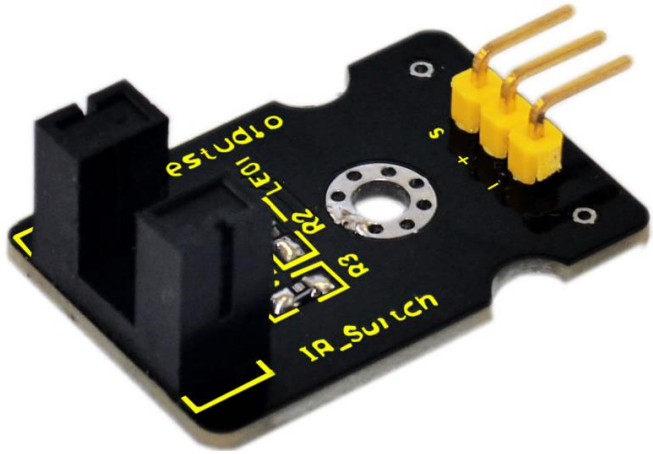
Project 22: Photo interrupter module



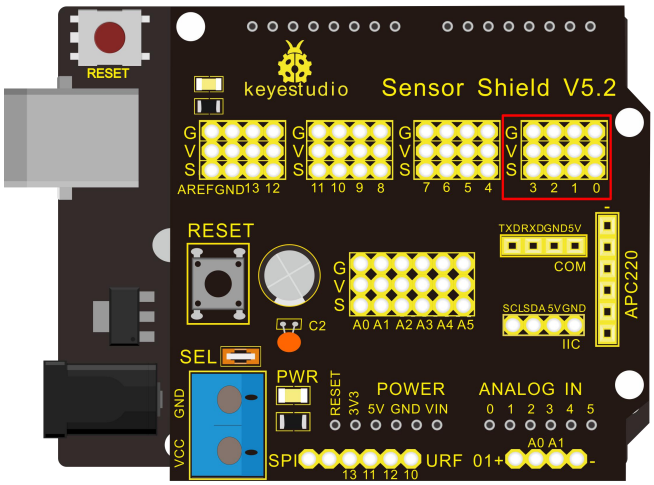
Introduction:

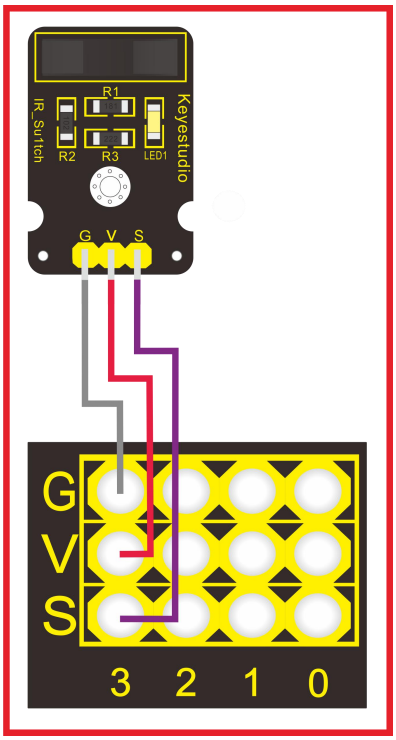
Upright part of this sensor is an infrared emitter and on the other side, it's a shielded infrared detector. By emitting a beam of infrared light from one end to other end, the sensor can detect an object when it passes through the beam. It is used for many applications including optical limit switches, pellet dispensing, general object detection, etc.

Specification:

Supply Voltage: 3.3V to 5V
Interface: Digital
Size: 30*20mm
Weight: 3g

Connection Diagram:





Sample code

```
// photo interrupter module

int Led = 13 ;// define LED Interface
int buttonpin = 3; // define the photo interrupter sensor interface
int val ;// define numeric variables val
void setup ()
{
   pinMode (Led, OUTPUT) ;// define LED as output interface
   pinMode (buttonpin, INPUT) ;// define the photo interrupter sensor output interface
}
void loop ()
{
   val = digitalRead (buttonpin) ;// digital interface will be assigned a value of 3 to read val
   if (val == HIGH) // When the light sensor detects a signal is interrupted, LED flashes
   {
      digitalWrite (Led, HIGH);
   }
   else
   {
      digitalWrite (Led, LOW);
   }
}
```

****

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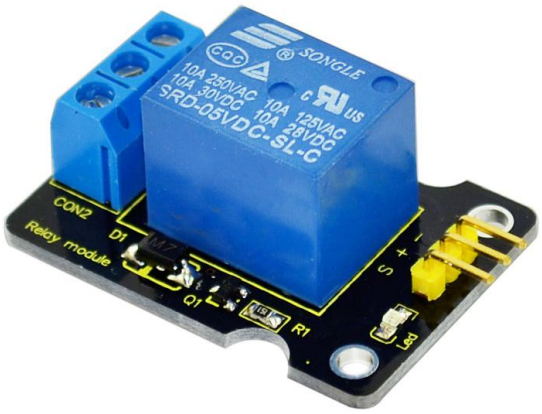
Project 23: 5V Relay Module



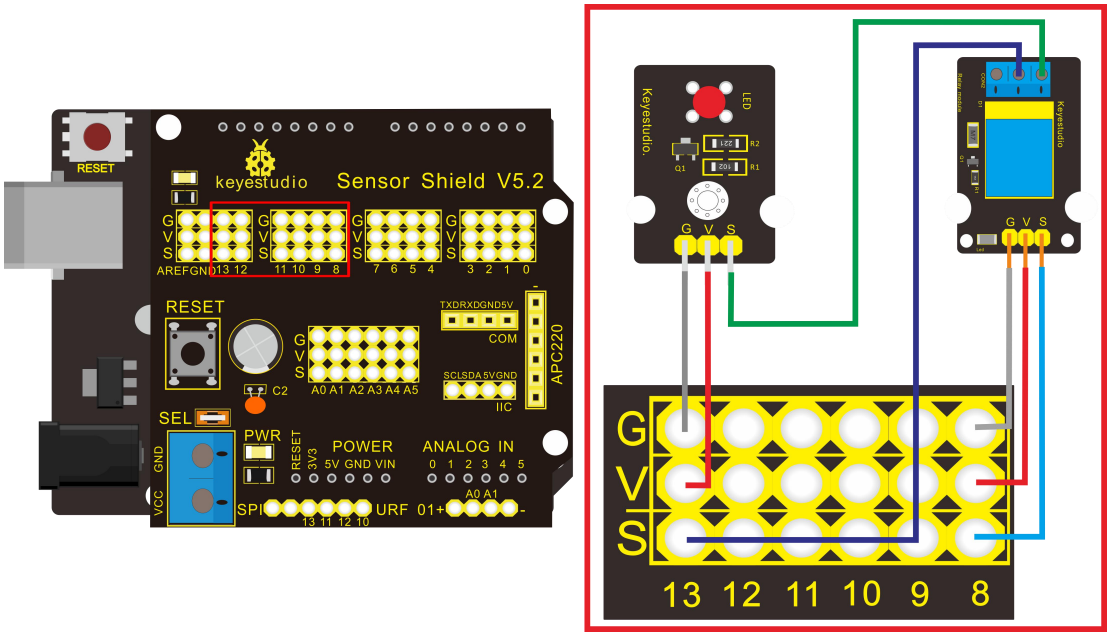
Introduction:

This single relay module can be used in interactive projects. This module uses SONGLE 5v high-quality relay. It can also be used to control lighting, electrical and other equipment. The modular design makes it easy to expand with the Arduino board (not included). The Relay output is by a light-emitting diode. It can be controlled through digital IO port, such as solenoid valves, lamps, motors and other high current or high voltage devices.

Specification:

Type: Digital
Rated current: 10A (NO) 5A (NC)
Maximum switching voltage: 150VAC 24VDC
Digital interface
Control signal: TTL level
Rated load: 8A 150VAC (NO) 10A 24VDC (NO), 5A 250VAC (NO/NC) 5A 24VDC (NO/NC)
Maximum switching power: AC1200VA DC240W (NO) AC625VA DC120W (NC)
Contact action time: 10ms
Size: 40*28mm
Weight: 15g

Connection Diagram:



Sample Code:

```
 int Relay = 8;
  void setup()
{
  pinMode(13, OUTPUT);          //Set Pin13 as output
  digitalWrite(13, HIGH);       //Set Pin13 High
  pinMode(Relay, OUTPUT);       //Set Pin3 as output
}
void loop()
{
        digitalWrite(Relay, HIGH);    //Turn off relay
        delay(2000);
        digitalWrite(Relay, LOW);     //Turn on relay
        delay(2000);
}
```

****

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Project 24: ADXL345 Three Axis Acceleration Module

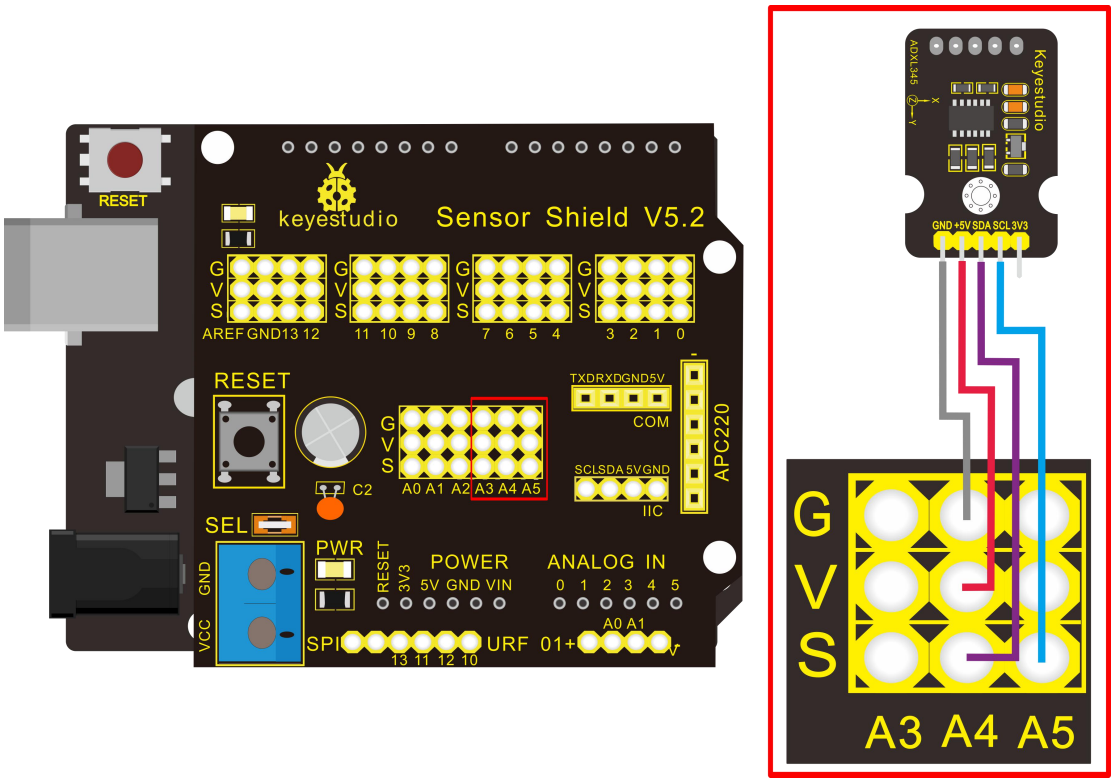
Introduction:

The ADXL345 is a small, thin, low power, 3-axis MEMS accelerometer with high resolution (13-bit) measurement at up to +-16 g. Digital output data is formatted as 16-bit twos complement and is accessible through either a SPI (3- or 4-wire) or I2C digital interface.
The ADXL345 is well suited to measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (4 mg/LSB) enables measurement of inclination changes less than 1.0 degrees;.

Specification:

2.0-3.6VDC Supply Voltage
Ultra Low Power: 40uA in measurement mode, 0.1uA in standby@ 2.5V
Tap/Double Tap Detection
Free-Fall Detection
SPI and I2C interfaces
Size: 30*20mm
Weight: 3g

Connection Diagram:



Sample Code:

```
/*
The circuit:
  VCC: 5V
  GND: ground
  SCL: REV4 SLC
  SDA: REV4 SDA

  This example code is in the public domain.

*/
#include <Wire.h>
// Registers for ADXL345
#define ADXL345_ADDRESS (0xA6 >> 1)    // address for device is 8 bit but shift to the
                                       // right by 1 bit to make it 7 bit because the
                                       // wire library only takes in 7 bit addresses
#define ADXL345_REGISTER_XLSB (0x32)

int accelerometer_data[3];
// void because this only tells the cip to send data to its output register
// writes data to the slave's buffer
void i2c_write(int address, byte reg, byte data) {
```

```
  // Send output register address
  Wire.beginTransmission(address);
  // Connect to device
  Wire.write(reg);
  // Send data
  Wire.write(data); //low byte
  Wire.endTransmission();
}

// void because using pointers
// microcontroller reads data from the sensor's input register
void i2c_read(int address, byte reg, int count, byte* data) {
  // Used to read the number of data received
  int i = 0;
  // Send input register address
  Wire.beginTransmission(address);
  // Connect to device
  Wire.write(reg);
  Wire.endTransmission();

  // Connect to device
  Wire.beginTransmission(address);
  // Request data from slave
  // Count stands for number of bytes to request
  Wire.requestFrom(address, count);
  while(Wire.available()) // slave may send less than requested
  {
    char c = Wire.read(); // receive a byte as character
    data[i] = c;
    i++;
  }
  Wire.endTransmission();
}

void init_adxl345() {
  byte data = 0;

  i2c_write(ADXL345_ADDRESS, 0x31, 0x0B);     // 13-bit mode  +_ 16g
  i2c_write(ADXL345_ADDRESS, 0x2D, 0x08);     // Power register

  i2c_write(ADXL345_ADDRESS, 0x1E, 0x00);     // x
  i2c_write(ADXL345_ADDRESS, 0x1F, 0x00);     // Y
  i2c_write(ADXL345_ADDRESS, 0x20, 0x05);     // Z
```

```
  // Check to see if it worked!
  i2c_read(ADXL345_ADDRESS, 0X00, 1, &data);
  if(data==0xE5)
    Serial.println("it work Success");
  else
    Serial.println("it work Fail");
}

void read_adxl345() {
  byte bytes[6];
  memset(bytes,0,6);

  // Read 6 bytes from the ADXL345
  i2c_read(ADXL345_ADDRESS, ADXL345_REGISTER_XLSB, 6, bytes);
  // Unpack data
  for (int i=0;i<3;++i) {
    accelerometer_data[i] = (int)bytes[2*i] + (((int)bytes[2*i + 1]) << 8);
  }
}
// initialise and start everything
void setup() {
  Wire.begin();
  Serial.begin(9600);
  for(int i=0; i<3; ++i) {
    accelerometer_data[i]   = 0;
  }
  init_adxl345();
}
void loop() {
  read_adxl345();
  Serial.print("ACCEL: ");
  Serial.print(float(accelerometer_data[0])*3.9/1000);//3.9mg/LSB scale factor in 13-bit mode
  Serial.print("\t");
  Serial.print(float(accelerometer_data[1])*3.9/1000);
  Serial.print("\t");
  Serial.print(float(accelerometer_data[2])*3.9/1000);
  Serial.print("\n");
  delay(100);
}
```

****

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Project 25: Rotary Encoder module

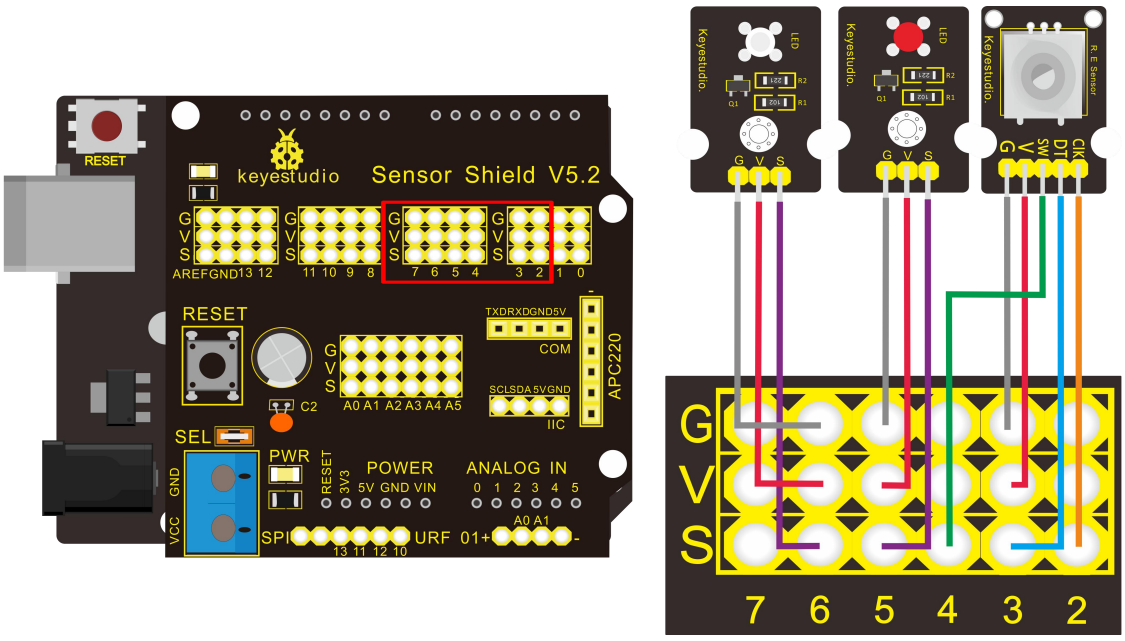
Introduction:

The rotary encoder can count the pulse outputting times during the process of its rotation in positive and reverse direction by rotating. This rotating counting is unlimited, not like potential counting. It can be restored to initial state to count from 0 with the button on rotary encoder.

Specification:

Power Supply: 5V
Interface: Digital
Size: 30*20mm
Weight: 7g

Connection Diagram:



Sample Code:

```
const int interruptA = 0;
const int interruptB = 1;
int CLK = 2;          // PIN2
int DAT = 3;          // PIN3
int BUTTON = 4;    // PIN4
int LED1 = 5;        // PIN5
int LED2 = 6;        // PIN6
int COUNT = 0;

void setup()
  {
    attachInterrupt(interruptA, RoteStateChanged, FALLING);
  // attachInterrupt(interruptB, buttonState, FALLING);
    pinMode(CLK, INPUT);
    digitalWrite(2, HIGH);    // Pull High Restance
    pinMode(DAT, INPUT);
    digitalWrite(3, HIGH);    // Pull High Restance
    pinMode(BUTTON, INPUT);
    digitalWrite(4, HIGH);    // Pull High Restance
    pinMode(LED1, OUTPUT);
    pinMode(LED2, OUTPUT);
      Serial.begin(9600);
  }

void loop()
{
   if    (!(digitalRead(BUTTON)))
        {
          COUNT = 0;
          Serial.println("STOP COUNT = 0");
          digitalWrite(LED1, LOW);
          digitalWrite(LED2, LOW);
          delay (2000);
        }
          Serial.println(COUNT);
}

//-----------------------------------------
void RoteStateChanged() //When CLK    FALLING READ DAT
{
  if    (digitalRead(DAT)) // When DAT = HIGH IS FORWARD
```

```
    {
     COUNT++;
     digitalWrite(LED1, HIGH);
     digitalWrite(LED2, LOW);
     delay(20);
    }
 else                          // When DAT = LOW IS BackRote
    {
     COUNT--;
     digitalWrite(LED2, HIGH);
     digitalWrite(LED1, LOW);
     delay(20);
    }
}
```

****

Project 26: Analog Rotation Sensor

Introduction:

This analog Rotation Sensor is arduino compatible. It is based on a potentiometer. Its voltage can be subdivided into 1024, easy to be connected to Arduino with our sensor shield. Combined with other sensors, we can make interesting projects by reading the analog value from the IO port.

Specification:

Supply Voltage: 3.3V to 5V
Interface: Analog

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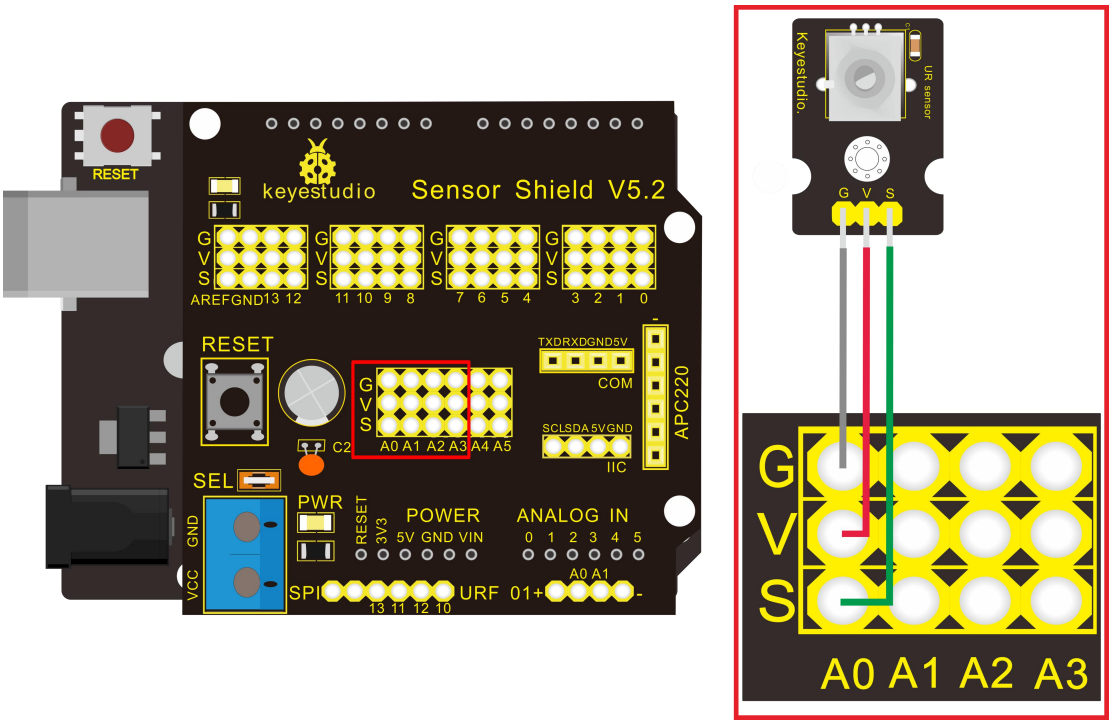
Size: 30*20mm

Weight: 8g

Connection Diagram:



Sample Code:

```
      ///Arduino Sample Code
void setup()
{
  Serial.begin(9600); //Set serial baud rate to 9600 bps
}
void loop()
{
int val;
val=analogRead(0);//Read rotation sensor value from analog 0
Serial.println(val,DEC);//Print the value to serial port
delay(100);
}
*********************************************************************************
```

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Project 27: HC-SR04 Ultrasonic Sensor

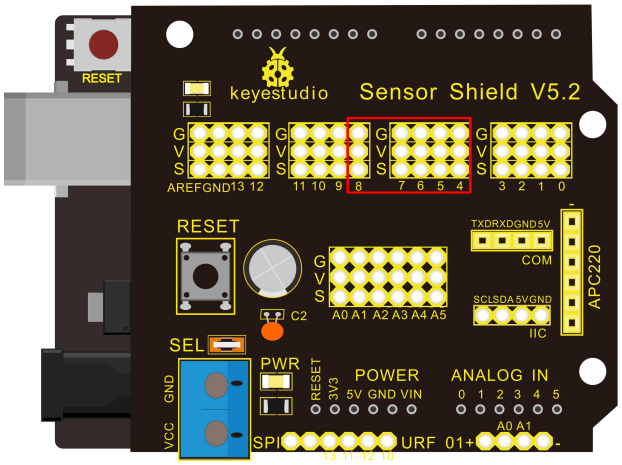
Introduction:

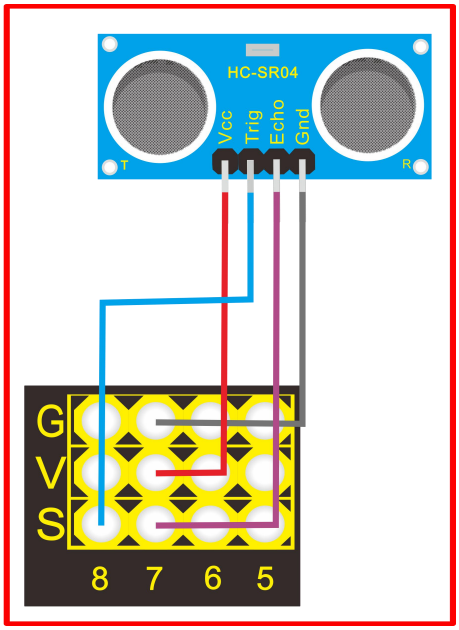
The HC-SR04 Ultrasonic Sensor is a very affordable proximity/distance sensor that has been used mainly for object avoidance in various robotics projects. It essentially gives your Arduino eyes / spacial awareness and can prevent your robot from crashing or falling off a table. It has also been used in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

Specification：

Working Voltage: DC 5V
Working Current: 15mA
Working Frequency: 40Hz
Max Range: 4m
Min Range: 2cm
Measuring Angle: 15 degree
Trigger Input Signal: 10μS TTL pulse
Echo Output Signal Input TTL lever signal and the range in proportion
Size: 46*20.4mm
Weight: 9g

Connection Diagram:





Sample Code:

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

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

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

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

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

```
 delayMicroseconds(2);

 digitalWrite(trigPin, HIGH);
 delayMicroseconds(10);

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

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

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

 //Delay 50ms before next reading.
 delay(50);
}
```

****

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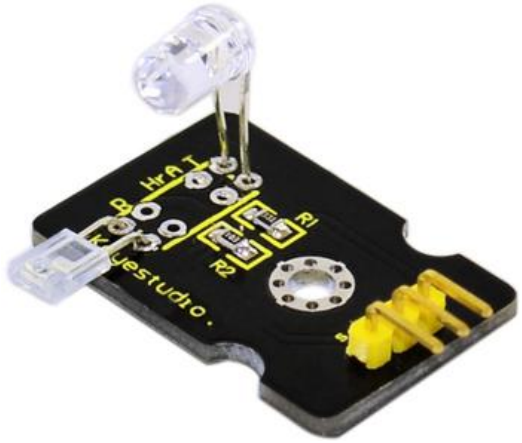
Project 28: Pulse Rate Monitor

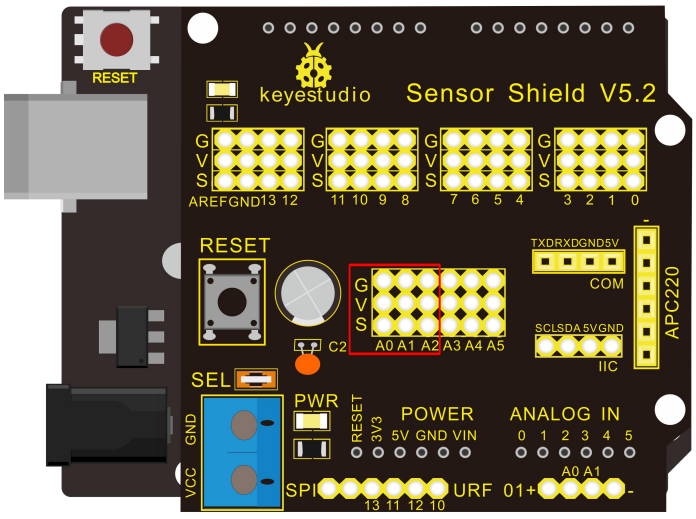


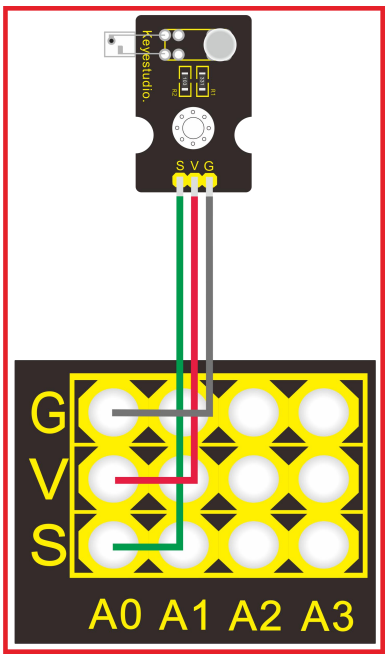
Introduction:

This module uses a ultra-bright infrared (IR) LED and a phototransistor to detect the pulse in your finger. The red LED then flashes in time with your pulse.

Working principle: Shine the bright LED onto one side of your finger while the phototransistor on the other side of your finger picks up the amount of transmitted light. The resistance of the phototransistor will vary slightly as the blood pulses through your finger.

Connection Diagram:





Sample Code：

The program for this project is quite tricky to get right. Indeed, the first step is not to run the entire

final script, but rather a test script that will gather data that we can then paste into a spreadsheet and chart to test out the smoothing algorithm (more on this later).

The test script is provided in Listing Project 12.

```
int ledPin = 13;
int sensorPin = 0;
double alpha = 0.75;
int period = 20;
double change = 0.0;
void setup()
{
pinMode(ledPin, OUTPUT);
Serial.begin(115200);
}
void loop()
{
static double oldValue = 0;
static double oldChange = 0;
int rawValue =
analogRead(sensorPin);
double value = alpha * oldValue
+ (1 - alpha) * rawValue;
Serial.print(rawValue);
Serial.print(",");
Serial.println(value);
oldValue = value;
delay(period);
}
```

This script reads the raw signal from the analog input and applies the smoothing function and then writes both values to the Serial Monitor, where we can capture them and paste them into a spreadsheet for analysis. Note that the Serial Monitor’scommunications is set to its fastest rate to minimize the effects of the delays caused by sending the data. When you start the Serial Monitor, you will need to change the serial speed to 115200 baud.

Copy and paste the captured text into a spreadsheet. The resultant data and a line chart drawn from the two columns are shown in Figure 5-17. The more jagged trace is from the raw data read from the analog port, and the smoother trace clearly has most of the noise removed. If the smoothed

trace shows significant noise—in particular, any false peaks that will confuse the monitor—increase the level of smoothing by decreasing the value of alpha.

Once you have found the right value of alpha for your sensor arrangement, you can transfer this value into the real sketch and switch over to using the real sketch rather than the test sketch. The real sketch is provided in the following listing on the next page.

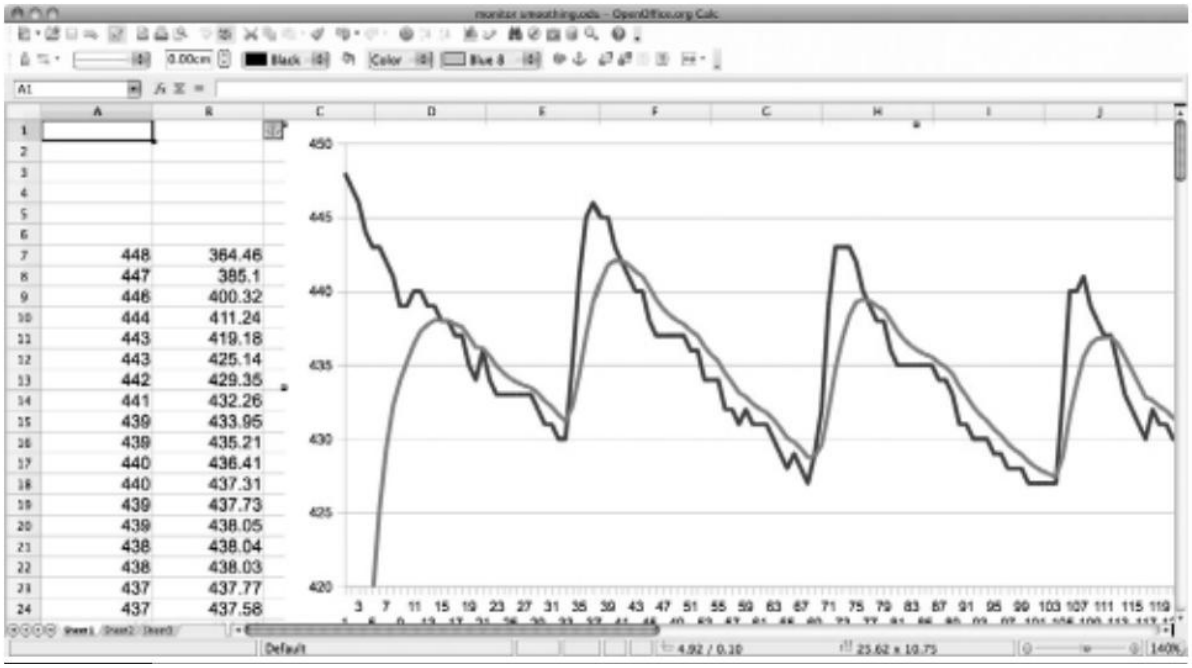
```
int ledPin = 13;
int sensorPin = 0;
double alpha = 0.75;
int period = 20;
double change = 0.0;
void setup()
{
pinMode(ledPin, OUTPUT);
Serial.begin(115200);
}
void loop()
{
static double oldValue = 0;
static double oldChange = 0;
int rawValue =
analogRead(sensorPin);
double value = alpha * oldValue
+ (1 - alpha) * rawValue;
Serial.print(rawValue);
Serial.print(",");
Serial.println(value);
oldValue = value;
delay(period);
}
```

LISTING PROJECT 12—TEST SCRIPT

There now just remains the problem of detecting the peaks. Looking at Figure 5-17, we can see that if we keep track of the previous reading, we can see that the readings are gradually increasing until the change in reading flips over and becomes negative. So, if we lit the LED whenever the old change was positive but the new change was negative, we would get a brief pulse from the LED at the peak of each pulse. Putting It All Together Both the test and real sketch for Project 12 are in your Arduino Sketchbook. For instructions on downloading it to the board, see Chapter 1. As mentioned, getting this project to work is a little tricky. You will probably find that you have to

get your finger in just the right place to start getting a pulse. If you are having trouble, run the test script as described previously to check that your detector is getting a pulse and the smoothing factor alpha is low

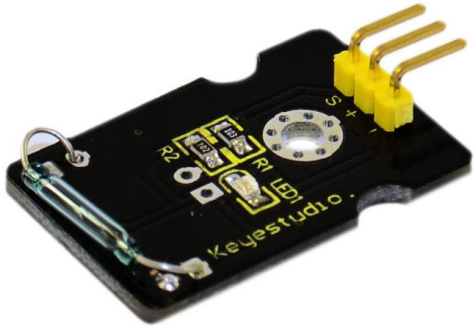
enoug



1		
2		
3		
4		
5		
6		
7	448	364.46
8	447	385.1
9	446	400.32
10	444	411.24
11	443	419.18
12	443	425.14
13	442	429.35
14	441	432.26
15	439	433.95
16	439	435.21
17	440	436.41
18	440	437.31
19	439	437.73
20	439	438.05
21	438	438.04
22	438	438.03
23	437	437.77
24	437	437.58

****

Project 29: Reed Switch Module



Introduction:

Reed Switch is a special switch and a main component for reed relay and proximity switch. Reed switch is usually comprised of two soft magnetic material and metal reed contacts which will disconnect itself when there is no magnetic. In addition, some reed switches are also equipped with another reed acting as the third normally-closed contact. These reed contacts are encapsulated in a glass tube full of inert gases(such as nitrogen and helium) or in a vacuum glass tube. The

reeds encapsulated in the glass tube are placed in parallel with ends overlapped. Certain amount of space or mutual contaction will be reserved so as to constitute the normally-open or normally-closed contacts of the switch.

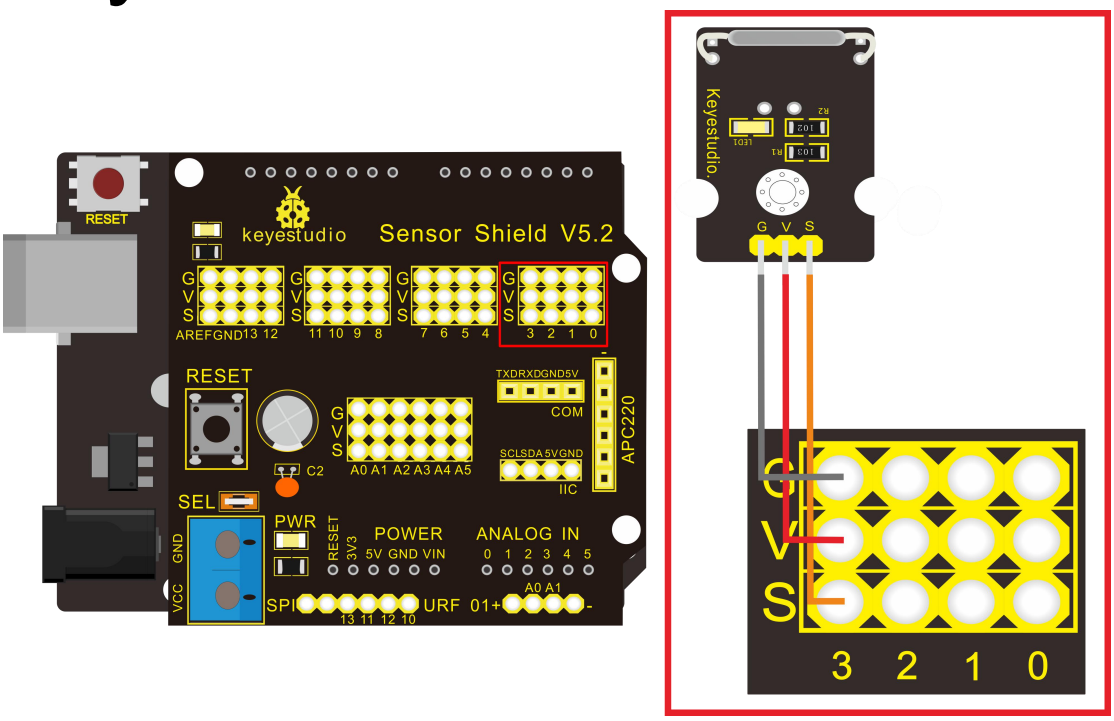
Reed switch can be used as sensor for count, limit and other purposes. For instance, a kind of bike-kilometer is constituted by sticking magnetic to the tire and mounting reed switch aside. We can mount reed switch on the door for alarming purpose or as switches.

Reed switch has been widely applied in household appliances, cars, communication, industry, healthcare and security areas. Furthermore, it can also be applied to other sensors and electric devices such as liquidometer, door magnet, reed relay, oil level sensor and proximity sensor(magnetic sensor). It can be used under high-risk environment.

Specification:

Working voltage: DC 3.3V-5V
Working current: ≥20mA
Working temperature: - 10℃— + 50℃
Detection distance: ≤10mm
IO Interface: 3 wire interface (-/+/S)
Size: 30*20mm
Weight: 3g

Connection diagram:



Sample code:

```
int Led=13;//define LED interface
int buttonpin=3; //define magnetic ring sensor interface
int val;//define digital variable val
void setup()
{
pinMode(Led,OUTPUT);//define LED as output interface
pinMode(buttonpin,INPUT);//define magnetic ring sensor as output interface
}
void loop()
{
val=digitalRead(buttonpin);// read and assign the value of digital interface 3 to val
if(val==HIGH)//When a signal is detected by magnetic ring sensor, LED will flash
{
digitalWrite(Led,HIGH);
}
else
{
digitalWrite(Led,LOW);
}
}
```

****

Project 30: TEMT6000 ambient light sensor

Introduction:

At some point you are going to want to sense ambient brightness with better precision than your trusty photoresistor without adding complexity to your project. When that day comes, go get yourself a TEMT6000 ambient light sensor.

The TEMT6000 is supposed to be adapted to the sensitivity of the human eye, but I found it preformed sub-par in low light conditions. It does however work very well reacting to very small changes in a large range of brightnesses. Because it is meant to mimic the human eye, it does not react well to IR or UV light, so just make sure to note that when considering using it in your project.

Specification：

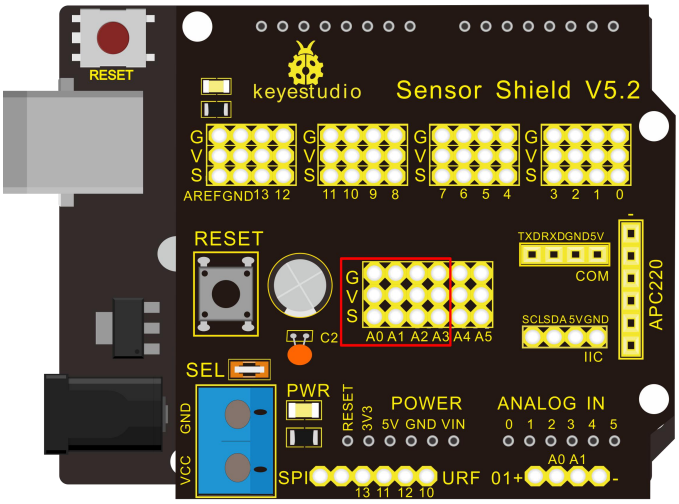
Supply Voltage: +5VDC 50mA

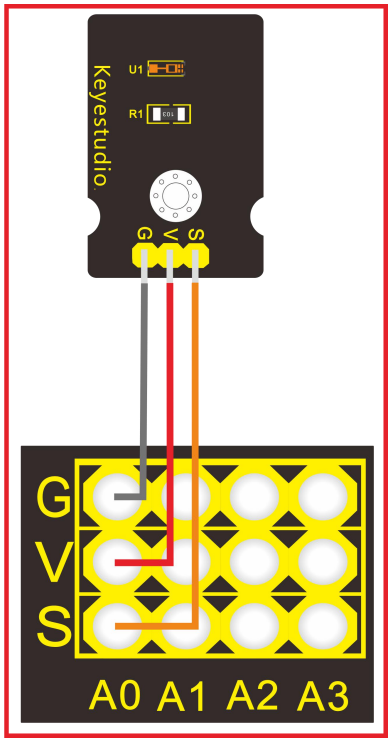
Size: 36.5*16mm

Weight: 4g

Connection Diagram:

This is an incredibly simple part, just connect power and ground, and the signal pin to your favorite analog input and you are done, the sensor will output analog voltage, that ramps up when it gets brighter. You can power this off of 3.3v if you would like, the output value will just be lower.





Sample Code：

You can not get more simple than this – This just reports the reading from the sensor to the serial terminal: 0-1023 with 1023 being very bright, and 0 being very dark.

```
int temt6000Pin = 0;
void setup() {
 Serial.begin(9600);
}
void loop() {
 int value = analogRead(temt6000Pin);
 Serial.println(value);
 delay(100); //only here to slow down the output so it is easier to read
}
```

****