

Starter Kit for Arduino

From Epalsite Wiki

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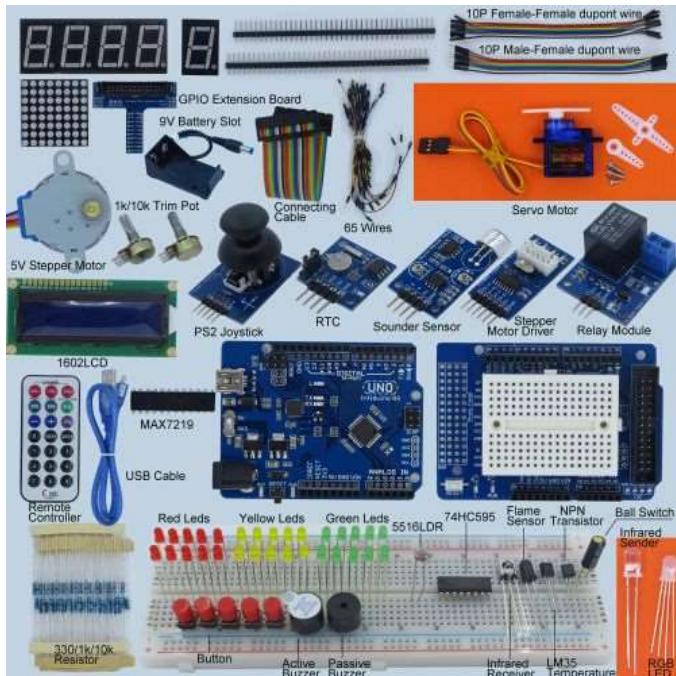
Introduction

This is a Starter Kit for Arduino beginners. It includes some discrete components, some wires, some modules and the extension board. The purpose for this kit is to help you learn some basics for Arduino programming language and some electronic knowledge. Some learning lessons are provided based on these parts. But you can also do some awesome projects of your own by using these components, just make your thoughts fly. The Kit includes many common components that you may come across during your electronic journey in the future. Please see the following Part List to see what is included in the Kit.

- **Part List**
 1. 1 x **Infiduino Uno R3** board +1 x USB cable
 2. 1 x **Infiduino Extension board** + 1 x **GPIO Extension Board** + 1 x Connecting Cable
 3. 1 x **Breadboard**
 4. 10 x 3mm Red LEDs
 5. 10 x 3mm Green LEDs
 6. 10 x 3mm Yellow LEDs
 7. 1 x 5mm RGB LED
 8. 5 x Button
 9. 20 x (330 ohm + 1k ohm +10k ohm)resistor
 10. 1 x 1K potentiometer
 11. 1 x 10K potentiometer
 12. 1 x 2.54mm Straight 40 Pin Header
 13. 1 x 2.54mm Elbow 40 Pin Header
 14. 1 x 5516 LDR (Photoresistor)
 15. 1 x Ball switch
 16. 1 x Active Buzzer
 17. 1 x Passive Buzzer

18. 1 x 74HC595 8bit Shift Register
19. 1 x LM35
20. 1 x NPN Transistor
21. 1 x **Infrared Receiver**
22. 1 x Infrared Sender
23. 1 x Infrared Phototransistor
24. 1 x **Infrared Remote controller**
25. 1 x Stepper Motor
26. 1 x Servo motor
27. 1 x 1602 LCD
28. 1 x 1-Digit Eight-segment Display
29. 1 x 4-Digit Eight-segment Display
30. 1 x 8*8 Dot Matrix Led Display
31. 1 x **Stepper Motor Driver Board**
32. 1 x **Sound Sensor Module**
33. 1 x **PS2 Joystick module**
34. 1 x **RTC module**
35. 1 x **Relay Module**
36. 65 x Jump Wires
37. 10 x Female-Female Dupont wires
38. 10 x Male-Female Dupont wires

■ The above parts are showed in the following picture.



Learning Lessons List

The following contents list all the lessons that is provided in this page. These lessons will help you practice most of the components included in this Kit. But attention, we can't provide all the knowledge needed for these test here, you need to refer to other tutorials or internet for some special electronic knowledge.

1. Welcome to Arduino
2. LED Blink
3. Rolling Light
4. Button Controlled LED
5. PWM fading
6. RGB LED various color display
7. Buzzer Warning
8. Tilt Switch
9. Potentiometer Analog Reading
10. PS2 Joystick
11. Light controlled lamps
12. Sound controlled lamps
13. Remote controlled lamps
14. 1 Digital 8-Segment LED Display
15. 4 Digital 8-Segment LED Display Dynamic Scanning Display
16. 8*8 Dot Matrix LED Display
17. Infrared Sender
18. Infrared Receiver
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- 24. Stepper motor driving
- 25. PWM servo control
- 26. Relay controlling
- 27. Interactive Servo Motor
- 28. Electronic Clock
- 29. Alarm clock
- 30. Infrared Remote Controlled Stepper
- 31. 74HC595 IO expansion
- 32. PIR Motion Sensor playing
- 33. Ultrasonic Distance Measurement
- 34. RFID playing

Learning Lessons Details

For all the lessons below, the board we use is Infiduino Uno R3. The official Arduino and other compatible boards can also work.

Lesson 1 Welcome to Arduino

This part is for the newbies to Arduino. If you already have some knowledge about Arduino then you can skip this part.

Arduino is one of the most popular open-source hardware item throughout the world now. If you're not a professional electronic designer and you want to do some awesome electronic project by your own, then Arduino is a good choice. For in-depth understanding of Arduino you can visit the official website:<http://arduino.cc/>. For this part we will show how to write the basic code using Arduino programming language. First please make sure you already have an Arduino Board or other compatible board like Infiduino in hand. Then install the Arduino development environment properly for your system(**download Arduino** (<http://arduino.cc/en/Main/Software>)). Then LET'S GO!

■ Step by Step downloading.

1. Step 1:Hardware connection

Connect your arduino and PC using the USB cable.

2. Step 2:Install the USB driver

When you do the above step for the first time, your PC should find a new hardware. Then your system will try to install the USB driver. Please browser to the folder named ".../drivers" of your Arduino IDE folder, and install the USB driver manually.

3. Step 3:Set up a new file

Open your Arduino IDE and set up a new file (through commands "File->New").

4. Step 4:Code writing

The following lines shows the basic structure for writing a code in **Arduino IDE** using "**Arduino programming language**". Please refer to this page:<http://arduino.cc/en/Reference/HomePage>" for more information about "**Arduino programming language**".

```
/*Note:This code is used for Arduino 1.0 or later*/
void setup() {
  /*put your setup code here, to run once:*/
  Serial.begin(9600); //This is to set the serial port baud rate used to communicate with the computer(or other MCU that communicate with Arduino)
}

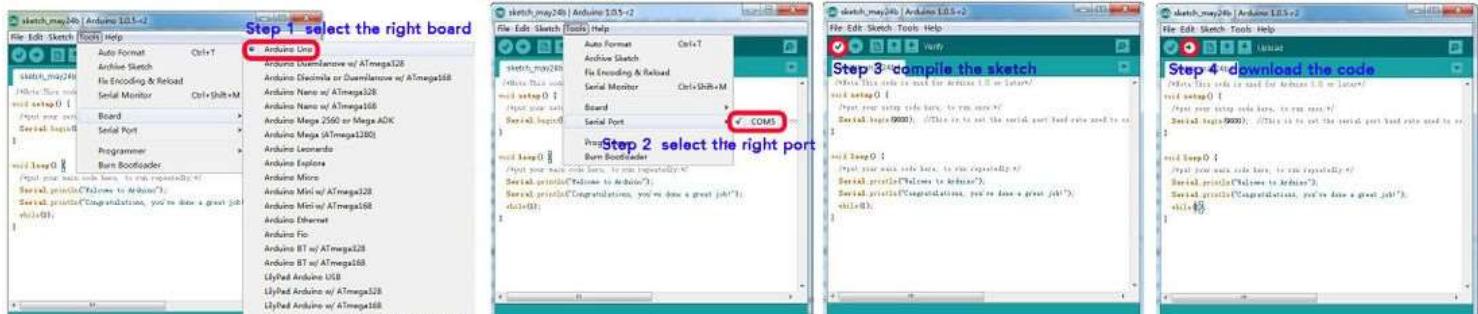
void loop() {
  /*put your main code here, to run repeatedly:*/
  Serial.println("Welcome to Arduino");
  Serial.println("Congratulations, you've done a great job!");
  while(1);
}
```

5. Step 5 Code downloading

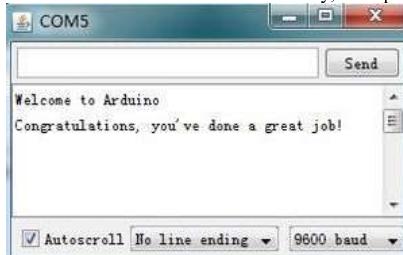
Before downloading the code to Arduino you should do several things in Arduino IDE.

- 1.Selet the right board.
- 2.Selet the right COM port.
- 3.Compile the code you've written.
- 4.Press the download button.

Please see the following pictures for these steps.



If the code is downloaded successfully, then please open the serial monitor, you will see the following output.



Lesson 2 LED Blink

In this lesson we'll use Arduino to control a LED to blink every one second.

■ Components Needed

1. Uno R3 board
2. 1 x LED(Red color)
3. 1 x 330ohm resistor
4. 1 x Breadboard
5. Wires

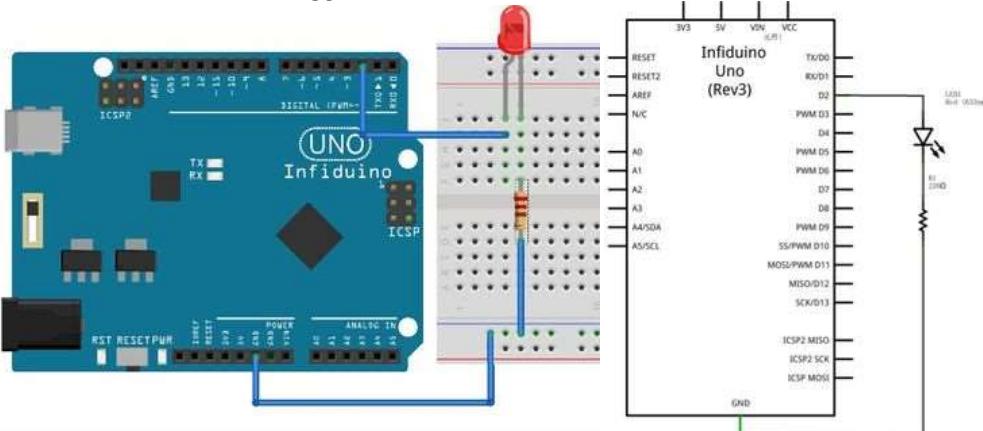
■ Knowledge Needed

1. First we should know, an IO port of Arduino can be set as "INPUT" or "OUTPUT". But it can't be "INPUT" and "OUTPUT" at the same time. When set as "INPUT", it can sense the outside voltage as "HIGH" or "LOW". When set as "OUTPUT", it can source current to drive the external device, like LED or Buzzer,etc. "pinMode()" function is used to set the IO as "INPUT" or "OUTPUT".
2. Secondly, for Arduino Uno R3 works under 5V, when the IO port output a "HIGH" voltage, it will output a voltage that is near the working voltage, that is about 5V. For Infiduino Uno R3, when the switch is at the 3.3V position, when an IO output a "HIGH" voltage, the output voltage will be about 3.3V.
3. For each digital IO port of Arduino, it can source at least 20mA current.
4. LED is the abbreviation of light emitting diode. It has two pins, one is anode, the other is cathode. To make it light, anode should have a higher voltage than the cathode. Different kinds of LED has different standard lighting current(forward current). Usually every kind of LED has a wide range of working current, the bigger the current, the stronger the lighting. We can use the power voltage and a resistor to control the forward current. Normally every kind of LED can work under 10mA forward current. The drop-down voltage on a LED is basically the same no matter what forward current is, usually this value is 1.9 to 2.1 V for red LEDs, 3.0 to 3.4 V for green and blue, 2.9 to 4.2 V for violet, pink, purple and white.
5. Because the IO port of Arduino can source at least 20mA current, So we can use the Digital IO to drive an LED directly. We just need 10mA current here.
6. In this test, we will drive the LED with a current of about 10mA. The circuit is as the following picture. What value of resistor we should use? We can use Ohm law to select the resistor. "Current=(VCC-Vd)/R."

In the up formula, VCC instead of the output voltage of the IO when it output a "HIGH" voltage, we'll use 5V here. Vd instead of the drop-down voltage of the LED, usually we can select 2.0V for red LED(to be accurate for this, you can use a multi-meter to measure it or referring to the datasheet of the LED). So if we want the LED works with a current of about 10mA, we can make R=300ohm. So we will choose a 330ohm resistor here.

■ Hardware Connection

The circuit is showed in the following picture.



■ Code Writing

For an IO, before use it to do something, we should first set it as INPUT or OUTPUT(use the `pinMode()` function). When set as INPUT, the IO can sense the outside voltage level. When set as OUTPUT, the IO can output a HIGH voltage or a LOW voltage. In this example, we should set the IO as OUTPUT, then it will light the led when it output a HIGH voltage(use the `digitalWrite()` function).

```
/*
Blink
Turns on an LED on for one second, then off for one second, repeatedly.
*/
void setup() {
  // initialize the digital pin as an output.
  pinMode(2, OUTPUT);
}
```

```
void loop() {
  digitalWrite(2, HIGH); // set the LED on
  delay(1000); // wait for a second
  digitalWrite(2, LOW); // set the LED off
  delay(1000); // wait for a second
}
```

Download the code to Infiduino then you can see the LED blinks every one second.

Lesson 3 Rolling Light

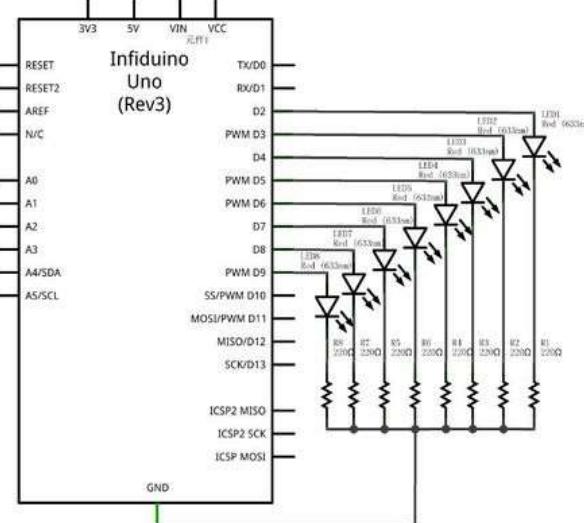
This lesson use the same hardware knowledge as the above one. But we can learn how to use the "for()" loop function. In this test we will light one LED for 100 milliseconds, then roll to the next one.

■ Components Needed

1. Uno R3 board
2. 8 x LED(Red color)
3. 8 x 330ohm resistor
4. 1 x Breadboard
5. n x Wires

■ Hardware Connection

Connect the hardware as below. We use D2-D9 to control 8 LEDs.



■ Code Writing

```
/*
Blink
Turns on one LED on for 100 milliseconds, then roll to the next one.
*/
int i;
void setup() {
  // initialize the digital pin as output.
  for(i=2;i<10;i++)
  {
    pinMode(i, OUTPUT);
  }
}

void loop() {
  for(i=2;i<10;i++)
  {
    digitalWrite(i, HIGH); // set the LED on
    delay(100); // wait for a second
    digitalWrite(i, LOW); // set the LED off
  }
}
```

Lesson 4 Button Controlled LED

For this lesson, we'll use an button to control the LED to light. When we push the button, the LED will be on. When the button is released, the LED will be off.

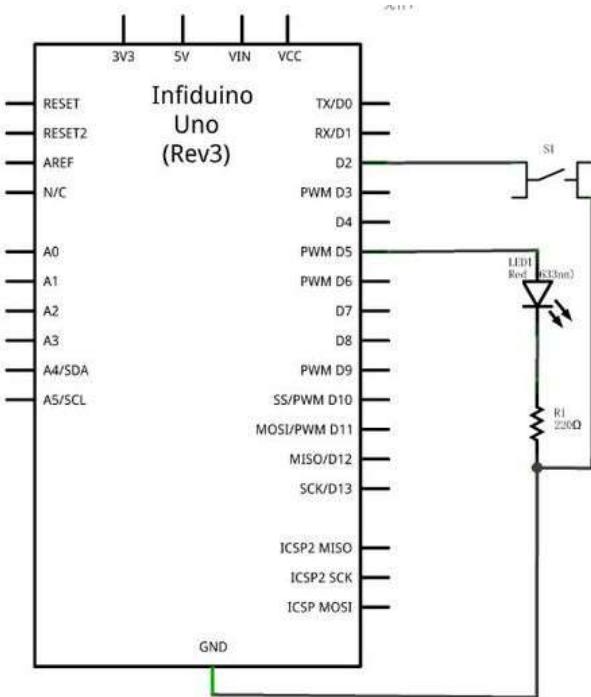
■ Components Needed

1. Uno R3 board
2. 1 x LED(Red color)
3. 1 x 330ohm resistor
4. 1 x Button
5. 1 x Breadboard
6. n x Wires

■ Knowledge Needed

1. An IO port of Arduino Uno can not only output a "HIGH" or "LOW" voltage, but also it can sense the voltage of outside. To use this function, we should set the IO as "INPUT", `pinMode()` function can do this task for us.
2. After the IO set as "INPUT", we can use `digitalRead()` to read the external voltage.

■ Hardware connection



■ Code Writing

Based on the hardware connection, we should set D2 as **INPUT**, and also we should enable the internal pull-up resistor. So we should use **INPUT_PULLUP** in `pinMode()` function.

```
/*Note: This code is used for Arduino 1.0.1 or later*/
/*
Button Controlled LED
Turns on an LED when push the button.
*/
void setup() {
  // initialize the digital pin as an output.
  pinMode(2, INPUT_PULLUP);
  pinMode(5, OUTPUT);
}

void loop() {
  int sensorValue = digitalRead(2);
  if(sensorValue)
  {
    digitalWrite(5, HIGH); // set the LED on
  }
  else
    digitalWrite(5, LOW); // set the LED off
}
```

Lesson 5 PWM fading

Previous test, we've already made an LED light. But the lighting strength is stable. For this test, we will use the PWM method to change the lighting strength of an LED, make it light from dark to bright continuous.

■ Components Needed

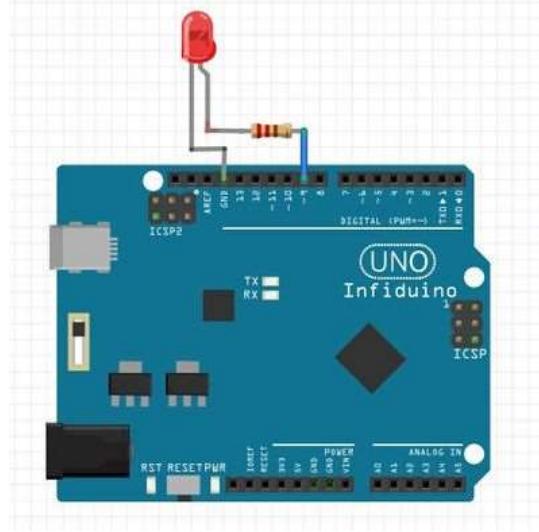
1. Uno R3 board
2. 1 x LED(Red color)
3. 1 x 330ohm resistor
4. 1 x Breadboard
5. Wires

■ Knowledge Needed

PWM means Pulse Width Modulation. It is a good method for getting analog results with digital means. For some power components like a resistor generating heat or an LED emitting light or other similar components, the PWM method will get a same result as when we exert an different analog voltage to the components. Please refer to **PWM Introduction** (<http://arduino.cc/en/Tutorial/PWM>) for reference. In this lesson we will use the `analogWrite()` (<http://arduino.cc/en/Reference/AnalogWrite>) to change the light strength of the LED. Note not all the IOs of Infiduino/Arduino has this function, this only works on pin 3, 5, 6, 9, 10, and 11.

■ Hardware Connection.

Connect the anode of the LED to digital output pin 9(D9) on your Arduino through a 330-ohm resistor. Connect the cathode directly to ground.



■ Code Writing

```
/*
Fade

This example shows how to fade an LED on pin 9
using the analogWrite() function.

This example code is in the public domain.

*/
int brightness = 0;      // how bright the LED is
int fadeAmount = 5;      // how many points to fade the LED by

void setup() {
  // declare pin 9 to be an output:
  pinMode(9, OUTPUT);
}

void loop() {
  // set the brightness of pin 9:
  analogWrite(9, brightness);

  // change the brightness for next time through the loop:
  brightness = brightness + fadeAmount;

  // reverse the direction of the fading at the ends of the fade:
  if (brightness == 0 || brightness == 255) {
    fadeAmount = -fadeAmount;
  }
  // wait for 30 milliseconds to see the dimming effect
  delay(30);
}
```

Lesson 6 RGB LED various color display

■ Components Needed

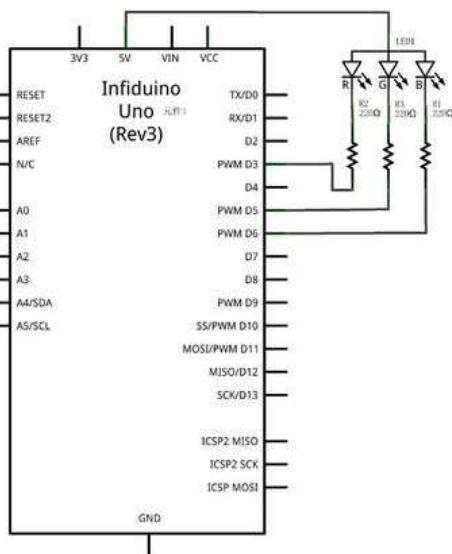
1. Uno R3 board
2. 1 x RGB LED
3. 3 x 330ohm resistor
4. 1 x Breadboard
5. Wires

■ Knowledge Needed

The RGB LED has 3 kinds of LEDs(Red, Green, Blue) integrated in one package. The RGB led included in the Starter Kit is a common-anode kind, which means the 3 LEDs have their anode connected together. Usually the longest pin is the common used pin. We can use the PWM fading function to change the lighting strength of each color led, because all color light can be gained through three primary colour(red, green,blue), so we can gain various color in this test through the RGB LED.

■ Hardware Connection

Make sure each led is controlled by a PWM port(Port 3, 5, 6, 9, 10, or 11). In this lesson we use D3/D5/D6.



■ Code Writing

```
/*
RGB LED Color Changing
This example shows how to change the color of a RGB LED
using the analogWrite() function.
*/
int led1 = 3;           // the pin that the LED1 is attached to
int led2 = 5;           // the pin that the LED2 is attached to
int led3 = 6;           // the pin that the LED3 is attached to
// the setup routine runs once when you press reset:
void setup() {
  // declare pin 3,5,6 to be an output:
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(led3, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  int i,j,k=0;
  for(i=0;i<10;i++)
  {
    analogWrite(led1, i*25);
    for(j=0;j<10;j++)
    {
      analogWrite(led2, j*25);
      for(k=0;k<10;k++)
      {
        analogWrite(led3, k*25);
        delay(10);
      }
    }
}
}
```

Lesson 7 Buzzer Warning

There are two kinds of buzzer in the kit. One is called passive buzzer (you can see the green PCB in it), and the other one is active buzzer(it's totally packaged and you can't see the PCB in it).

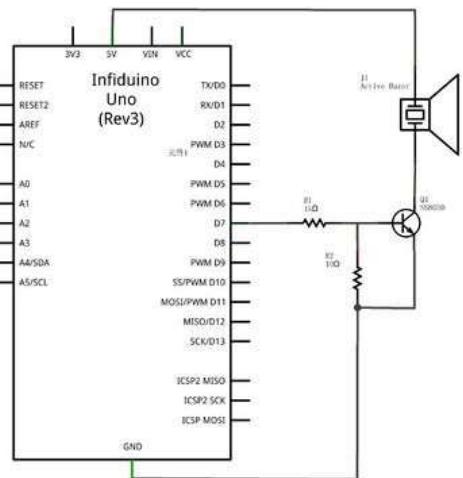
Making sound with Active Buzzer.

- Components Needed
 1. Uno R3 board
 2. 1 x Active Buzzer
 3. 1 x 1k ohm resistor
 4. 1 x 10k ohm resistor
 5. 1 x SS8050 NPN transistor
 6. 1 x Breadboard
 7. Wires
- Knowledge Needed

Active Buzzer has oscillating circuit in it. When there is a rated voltage exerted on it, it will make a sound. The active buzzer in the kit has a rated voltage of 5V, and a rated current of no more than 30mA, usually a IO port can drive it directly. But in order to prevent the IO from being damaged, we use a NPN transistor to amplify the current.

- Hardware Connection.

The following picture shows how it is connected.



■ Coding Writing

```
/*
Active Buzzer Warning
Make the Buzzer sound for one second, then off for one second, repeatedly.
*/
void setup() {
    // initialize the digital pin as an output.
    pinMode(7, OUTPUT);
}

void loop() {
    digitalWrite(7, HIGH);    // make the Buzzer sound
    delay(1000);             // wait for a second
    digitalWrite(7, LOW);     // set the Buzzer off
    delay(1000);             // wait for a second
}
```

Making sound with Passive Buzzer.

■ Components Needed

1. Uno R3 board
2. 1 x Passive Buzzer
3. 1 x 1k ohm resistor
4. 1 x 10k ohm resistor
5. 1 x SS8050 NPN transistor
6. 1 x Breadboard
7. Wires

■ Knowledge Needed

Passive Buzzer will not make a sound if we just use a HIGH voltage to drive it. Because there is no oscillating circuit in it. We can use the PWM mechanism to make it cry. The **Resonant Frequency** of the passive buzzer in the kit is 2048HZ, the rated voltage also is 5V.

■ Hardware Connection.

The hardware connection is the same as the Active Buzzer sounding example.

■ Coding Writing

The following code will make a PWM wave with a frequency of about 2000HZ. The duty cycle is 50%.

```
/*
Passive Buzzer Warning
Make the Passive Buzzer sound continuously.
*/
void setup() {
    // initialize the digital pin as an output.
    pinMode(7, OUTPUT);
}

void loop() {
    digitalWrite(7, HIGH);    // set D7 HIGH
    delayMicroseconds(250);
    digitalWrite(7, LOW);     // set D7 LOW
    delayMicroseconds(250);
}
```

Lesson 8 Tilt Switch

The tilt switch is also a Ball switch. The following pictures to see how it works.



In fact its effect is like an button. The difference is that the Tilt switch is on or off based on the angle of it. We can use the same example as Button Controlled LED, just

change the button to the Tilt Switch.

Lesson 9 Potentiometer Analog Reading

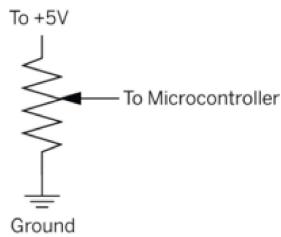
Through this test, we can learn how to use the Analog port of Arduino, and learn how to use `analogRead()` (<http://arduino.cc/en/Reference/AnalogRead>) function.

- Components Needed

1. Uno R3 board
2. 1 x Potentiometer(1k or 10k)
3. Wires

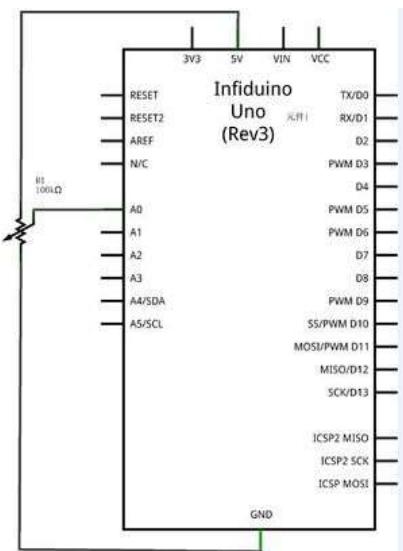
- Knowledge Needed

1. A0-A5 port of Arduino can be used as analog pins. These pin can not only be used as general IO ports, but also can read the exact voltage of the outside(0V-5V).
2. A Potentiometer is a three-terminal resistor with a sliding contact that forms an adjustable voltage divider. See the following pictures, When we connect the potentiometer as the picture shows, then we'll get a voltage from the middle point. When we rotate the stick, the middle point will output a voltage between 0V-5V. We can use A0-A5 to read this voltage, then to control some external device based on this voltage message.



In this example, we will read the analog voltage of the middle pin.

- Hardware connection.



- Code Writing

```
/*
AnalogReadSerial
Reads an analog input on A0, prints the result to the serial monitor

This example code is in the public domain.
*/
void setup() {
  Serial.begin(9600);
}

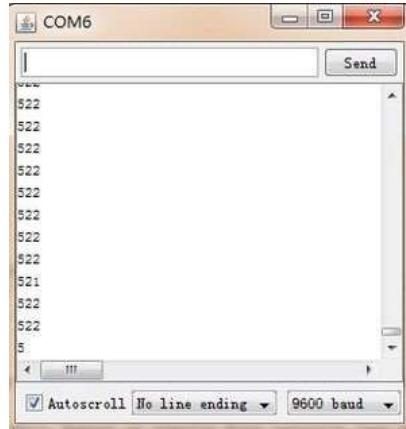
void loop() {
  int sensorValue = analogRead(A0);
}
```

```

Serial.println(sensorValue);
}

```

Download the code and we will get the following data, if we rotate the stick, then the value will change from 0-1023.



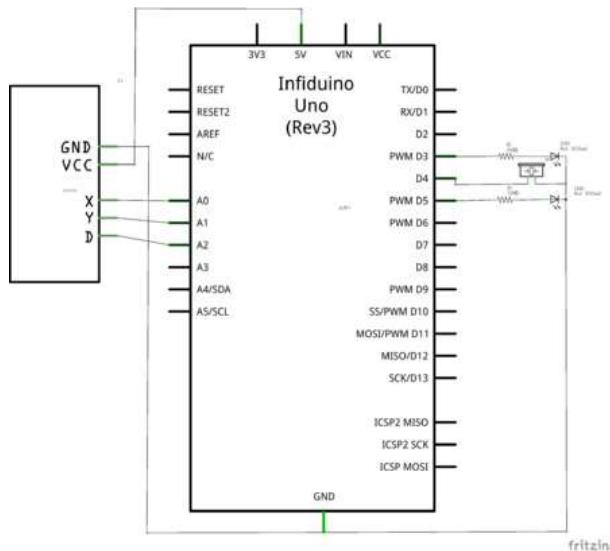
Lesson 10 PS2 Joystick

The Joystick actually is just composed of two Potentiometers and one Button. But these components can be regulated at the same time by the stick (with a cap on it). Through it you can get two analog outputs and one digital output at the same time. Then you can handle other components based on these data. In this example, we will use the Joystick to control the light strength of the 2 LEDs and a buzzer.

■ Components Needed

1. Uno R3 board
2. 1 x Joystick Module
3. 2 x LED
4. 2 x 330ohm resistor
5. 1 x Active Buzzer
6. 1 x Breadboard
7. Wires

■ Hardware Connection



■ Code Writing

```

/*
PS2 Joystick LED Fade

This example shows how to fade 2 LEDs on pin 3 and pin5, and make the buzzer speak through pin4.
using the Joystick
*/
int led1 = 3;           // the pin that the LED is attached to
int led2 = 5;           // the pin that the second LED is attached to
int BUZZER = 4;         // the pin that the buzzer is attached to
int brightness = 0;      // how bright the LED is
void setup() {
  Serial.begin(9600);
  pinMode(led1,OUTPUT);
  pinMode(led2,OUTPUT);
  pinMode(BUZZER,OUTPUT);
  pinMode(16,INPUT);
}

```

```

void loop() {
  int brightness1=analogRead(A0);
  int brightness2=analogRead(A1);
  brightness1=map(brightness1, 0, 1023, 0, 255);
  brightness2=map(brightness2, 0, 1023, 0, 255);
  analogWrite(led1,brightness1);
  analogWrite(led2,brightness2);
  if(digitalRead(16))
    digitalWrite(4,HIGH);
  else
    digitalWrite(4,LOW);
}

```

Lesson 11 Light controlled lamps

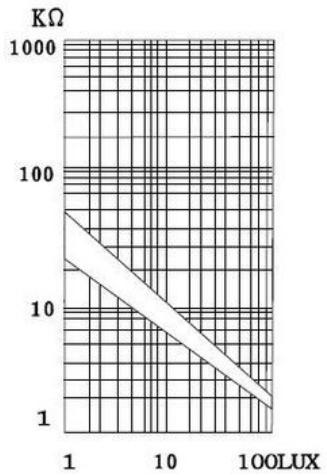
- Components Needed

1. Uno R3 board
2. 1 x 5516LDR
3. 1 x 330ohm resistor
4. 1 x 10k ohm resistor
5. 1 x LED(Red color)
6. 1 x Breadboard
7. Wires

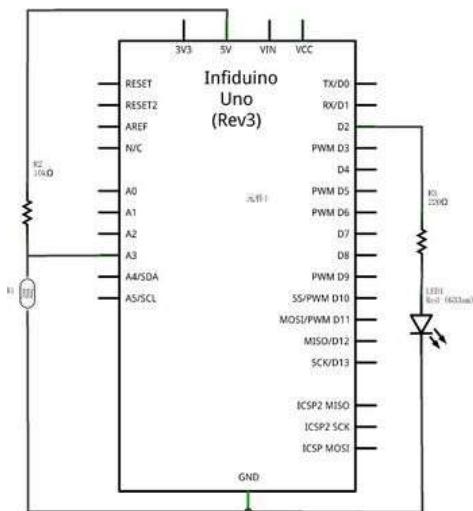
- Knowledge Needed

LDR, also is Light Dependent Resistor. It's a resistor, but not an normal one. Its resistor value can be changed by the external light strength. The stronger the light strength of the outside, the smaller the resistor value of the LDR. For the one in our kit, the LDR is named GM5516. The following pictures shows its parameters. In this experiment we will control the LED to be ON or OFF based on the environment light strength.

| Type | Maximum Power Consumption(VDC) | Maximum Peak Value(mW) | Spectrum Peak Value(nM) | Light Resistance (10Lux) (KΩ) | Dark Resistiance(MΩ) | Y 100/10 | Response Time(ms) | |
|--------|--------------------------------|------------------------|-------------------------|-------------------------------|----------------------|----------|-------------------|----------|
| | | | | | | | Increase | Decrease |
| GM5516 | 150 | 90 | 540 | 5-10 | 0.5 | 0.5 | 30 | 30 |



- Hardware Connection



■ Code Writing

```
/*
Light controlled lamps
Reads an analog input on pin 3, then make the LED on or OFF based on the reading.

This example code is in the public domain.
*/
void setup() {
  pinMode(2,OUTPUT);
}

void loop() {
  int sensorValue = analogRead(A3);
  if(sensorValue>500)
  {
    digitalWrite(2,HIGH);
  }
  else
  digitalWrite(2,LOW);
}
```

For the above code, the LED will be on if you put the LDR in a dark place. Or else, the LED will be off.

Lesson 12 Sound controlled lamps

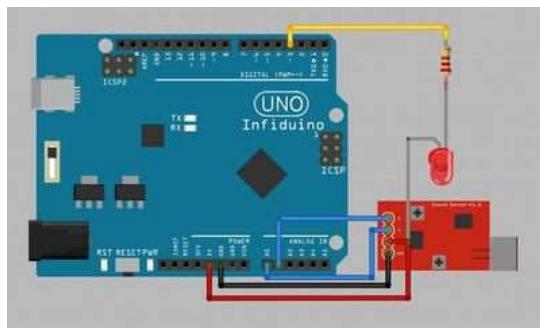
■ Components Needed

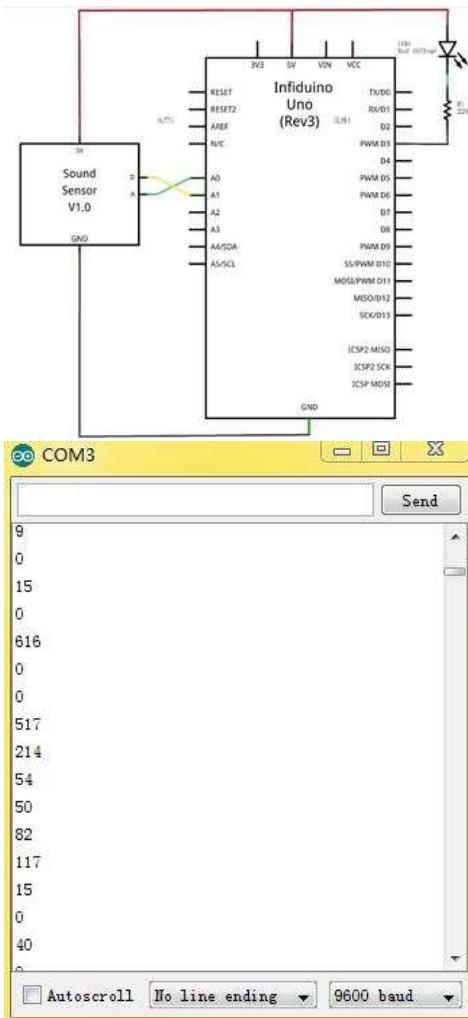
1. Uno R3 board
2. 1 x LED(Red color)
3. 1 x 330ohm resistor
4. 1 x Sound Sensor Module
5. 1 x Breadboard
6. Wires

■ Knowledge Needed

This lesson will need our Sound Sensor Module. It can measure the noise strength of the outside environment. Most of the Sound Sensor in the market only output analog data. We redesigned it and make it can output a "HIGH" value when the environment sound exceeds a threshold(which can be set by the potentiometer named "THRESHOLD"). In this example, when you make a big loud noisy near the Sound Sensor, the led will be turned on.

■ Hardware Connection





■ Code Writing

```

/*
Sound controlled lamps
Reads the analog output of Sound Sensor through A0, prints the result to the serial monitor
Read the digital output of Sound Sensor through A1, then use the value to control the LED through D3

Connect the pins in the following way:
GND----GND
VCC----5V
A-----A0
D-----A1
*/
void setup() {
  Serial.begin(9600);
  pinMode(3, OUTPUT);
}

void loop() {
  digitalWrite(3, HIGH); // set the LED off
  int sensorValue = analogRead(A0); //Read the analog value of the sound sensor
  int digitalValue = digitalRead(15);
  Serial.println(sensorValue); //Print the analog value to serial monitor
  if(digitalValue){
    digitalWrite(3, LOW); // If the digital value of the sound sensor is 1, set the LED on.
    delay(1000); // wait for a second
  }
}

```

Lesson 13 Remote controlled lamps

This lesson uses the infrared communication. Read more information about the **1838T Infrared Receiver** and **Infrared Remote controller**. In this lesson we'll use the Remote Controller to control the LED to be ON or OFF.

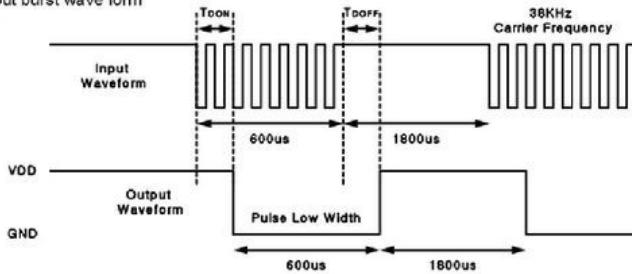
■ Components Needed

1. Uno R3 board
2. 1 x LED(Red color)
3. 1 x 330ohm resistor
4. 1 x 1838T Infrared Receiver
5. 1 x Infrared Remote controller
6. 1 x Breadboard
7. Wires

■ Knowledge Needed

1. A Remote Controller can send out infrared signal. Usually it send out a series of signal under 38KHZ. Some binary data ("0" or "1") are modulated on the 38KHZ signal and then sent out based on some particular protocol. The Remote Controller in the kit uses the NEC protocol.
2. The 1838T Infrared Receiver can receive the 38KHZ signal and demodulate it, then output the original binary signal.
3. Please see the following picture. The upper waveform stands for the signal sent out by the Remote Controller, if these signal is received by the 1838T Infrared Receiver, then 1838T will output the lower waveform signal.

Note 1:
Input burst wave form

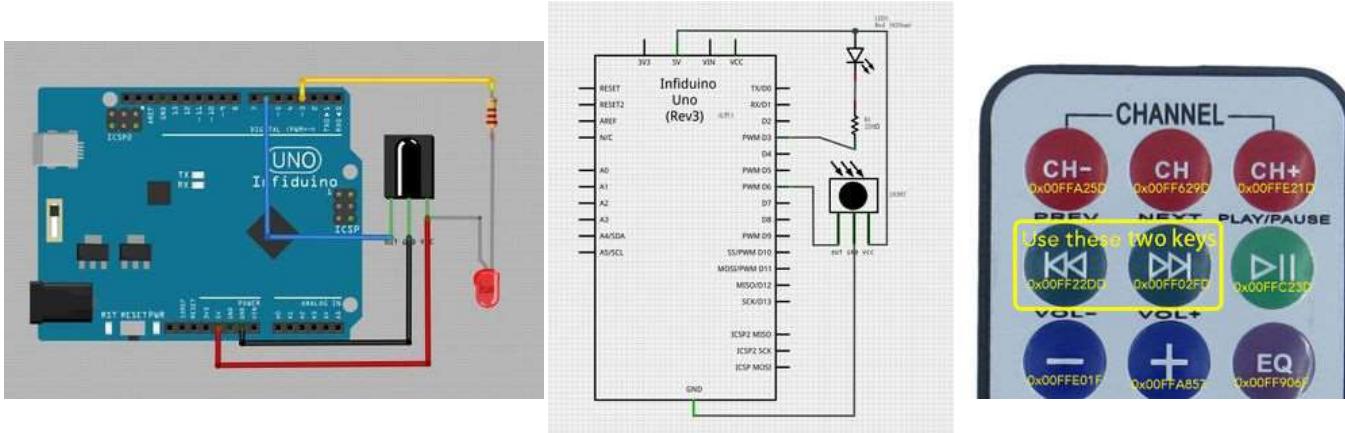


■ Example Explanation

For the test we will do here, if you push some button on the Remote Controller, like the key named "CH-", there are several steps to perform.

1. The Remote Controller will first package data "0X00FFA25D" through NEC protocol(by adding some handshake signal and so on). "0X00FFA25D" is the KEY-VALUE for "CH-".
2. The NEC protocol data will be sent out under 38KHZ signal by the Remote Controller.
3. The 1838T Infrared Receiver receives the 38KHZ signal, then it will demodulate it and transfer it to the original NEC protocol data.
4. Arduino Uno R3 receives the NEC protocol data, then unpack it and get the binary data "0X00FFA25D".
5. After these steps we will get the information what the Remote Controller send:"0X00FFA25D".

■ Hardware Connection



■ Code Writing

First please download this file:[Media:IRremote.zip](#), then extract it to the "library" folder of your Arduino IDE.

```
/*
Remote controlled lamps

This program controls the LED to be ON or OFF
The output pin of the Infrared Receiver is attached to pin 6, the LED will be controlled by D3
The LED should be OFF if you push the forward key of the Remote Controller, and be ON if you push the backward key
*/
#include <IRremote.h>
int RECV_PIN = 6;
long LED_ON = 0x00FF02FD;
long LED_OFF = 0x00FF22DD;
IRrecv irrecv(RECV_PIN);
decode_results results;

void setup() {
// initialize the digital pin as an output.
pinMode(RECV_PIN, INPUT);
pinMode(3, OUTPUT);
irrecv.enableIRIn(); // Start the receiver
}
void loop() {
int i=0;
if (irrecv.decode(&results))
{
irrecv.resume(); // Receive the next value
if (results.value == LED_ON)
{
digitalWrite(3,LOW);
}
if (results.value == LED_OFF)
{
digitalWrite(3,HIGH);
}
}
}
```

```

    {
        digitalWrite(3,HIGH);
    }
}

```

Lesson 14 1 Digital 8-Segment LED Display

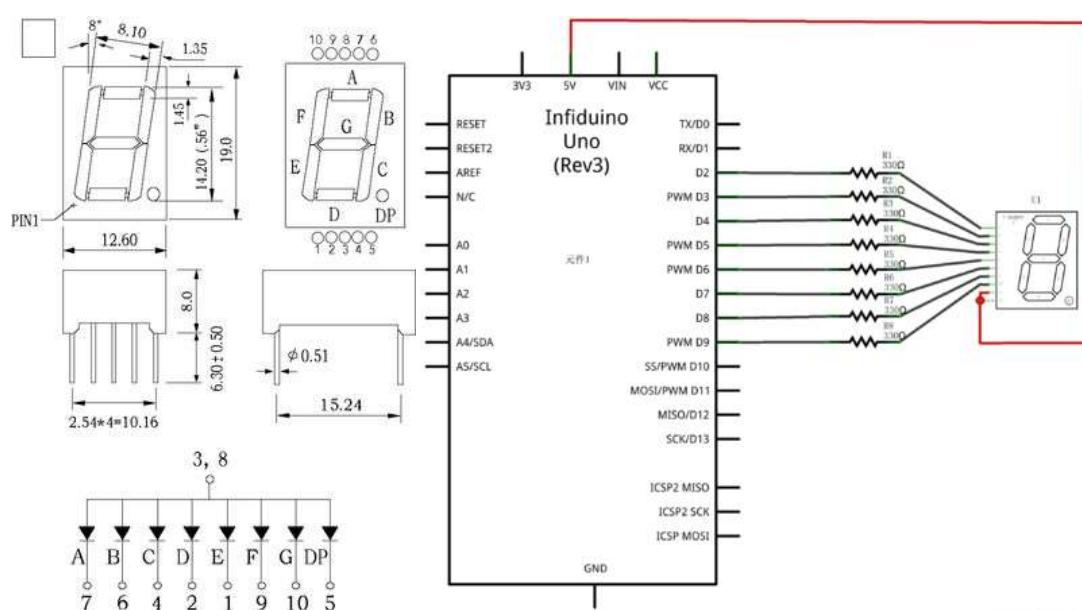
■ Components Needed

1. Uno R3 board
2. 1 x 1 Digital 8-Segment LED Display Tube
3. 8 x 330ohm resistor
4. 1 x Breadboard
5. Wires

■ Knowledge Needed

1. Eight-segment display. In fact it is composed of common LEDs. Usually there are two kinds, one is common-anode, the other is common-cathode. The one included in the kit is a common-anode one. In the following example, we'll use the Eight-segment display to display number 1-9.
2. We just need to light several led at the same time to make it show the special number.

■ Hardware Connection(Click to see the more clear picture)



■ Code Writing

```

/*
  1 Digital 8-Segment LED Display
  Display the number from 1-9
*/
byte Digital[10]={0xfc,0x60,0xda,0xf2,0x66,0xb6,0xbe,0xe0,0xfe,0xf6}; //the character code for number 1-9
void setup()
{
  int i=2;
  for(i=2;i<10;i++)
  {
    pinMode(i,OUTPUT);
    digitalWrite(i,HIGH);
  }
}
void loop()
{
  int i=0;
  int j;
  //Display number 1-9
  for(i=0;i<10;i++)
  {
    //for every number, send the character code to the digital pin
    for(j=0;j<8;j++)
    {
      if(Digital[i]&1<<j)
        digitalWrite(9-j,LOW);
      else
        digitalWrite(9-j,HIGH);
    }
    delay(500);
  }
}

```

Lesson 15 4 Digital 8-Segment LED Display Dynamic Scanning Display

■ Components Needed

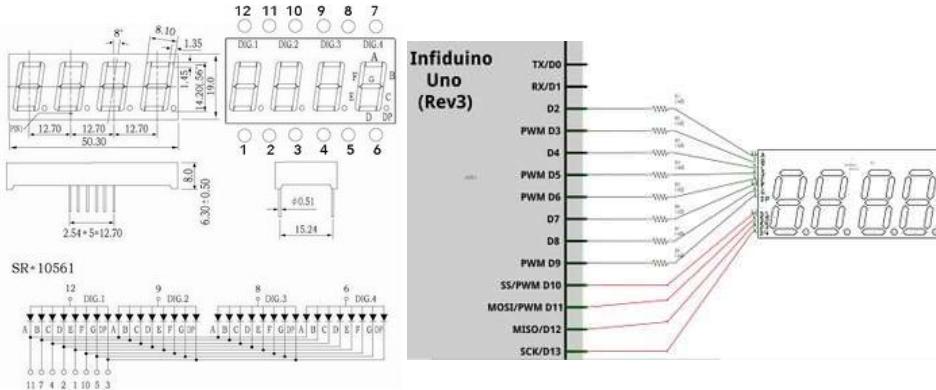
1. Uno R3 board

2. 1 x 4 Digital 8-Segment LED Display Tube
3. 8 x 330ohm resistor
4. 1 x Breadboard
5. Wires

■ Knowledge Needed

1. Please see the following picture to see the pin definition and other parameters. For this 4 bit Display Tube, we can only light one bit at one time.
2. In order to make all 4 bit tube can display numbers, the Dynamic Scanning Mechanism should be used here. We will light bit 1 to bit 4 in turn(only one bit will be lighting at a time). If the loop time is not more than 20ms(more than 50HZ) our eye usually will not see its blinking.

■ Hardware Connection

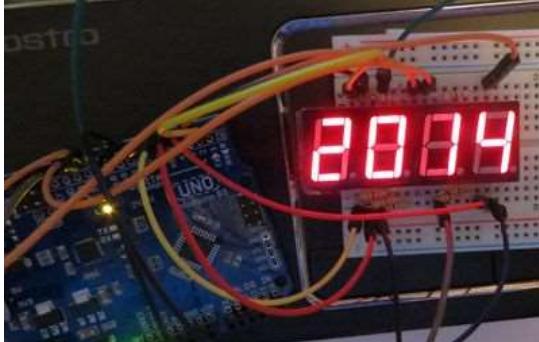


■ Code Writing

```
/*
 4 Digital 8-Segment LED Display
 Display four numbers on 4 Digital 8-Segment LED Display
 In this sketch, we use D2-D9 to control A/B/C/D/E/F/G/DP segment respectively. And use D10/D11/D12/D13 to control the anode of DIG1-DIG4 respectively.
 */
int DIG[4]={10,11,12,13}//The pins used to control the anode of the 4 bit,DIG1-DIG4.
char Str[4] = {'2', '0', '1', '4'};//The number to be displayed.
byte Numcode[10]={0xfc,0x60,0xda,0xf2,0x66,0xb6,0xbe,0xe0,0xfe,0xf6};//the character code for number 1-9
void setup()
{
int i=2;
//Set D2-D13 as OUTPUT
for(i=2;i<14;i++)
{
pinMode(i,OUTPUT);
digitalWrite(i,HIGH);
}
}
void loop()
{
int i=0;
int j;
int k=0;
//Display DIG1-DIG4
for(k=0;k<4;k++)
{
digitalWrite(DIG[k],HIGH);//Set DIG[K] to be ON.
i=Str[k]-48;//find out the number's position in the character code array.
//display the number
for(j=0;j<8;j++)
{
if(Numcode[i]&1<<j)
digitalWrite(9-j,LOW);

else
digitalWrite(9-j,HIGH);
}
delay(1);
digitalWrite(DIG[k],LOW);
}
}
```

The effect are as the following picture:



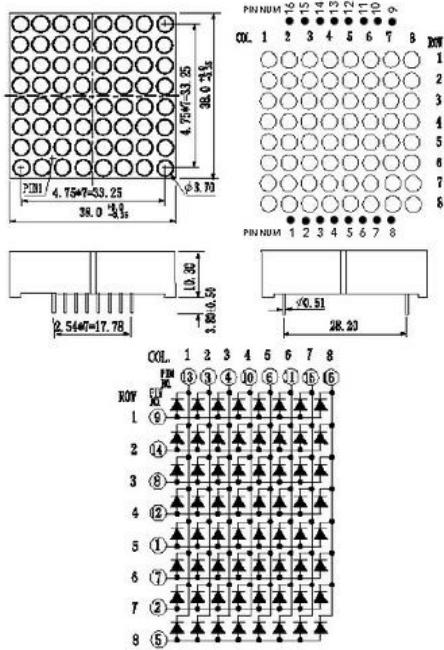
Lesson 16 8*8 Dot Matrix LED Display

■ Components Needed

1. Uno R3 board
2. 1 x 8*8 Matrix LED Display Tube
3. 8 x 330ohm resistor
4. 1 x Breadboard
5. Wires

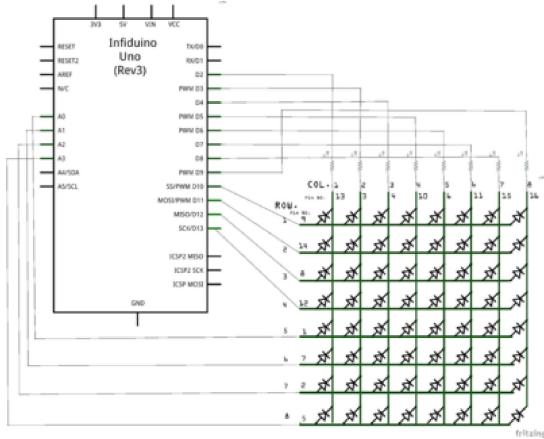
■ Knowledge Needed

The following shows some parameters of the 8*8 Matrix led display.



As the picture shows, when a row is at High voltage and a column is at a Low voltage, then the LED at the crossing point will be lighted. In this lesson, we'll still use dynamic scanning display method to make it display something, that is lighting the LEDs row by row (from row 1 to row 8, then repeat the process). If the time for one loop is not more than 20ms, then your eye will not sense its blinking.

■ Hardware Connection



■ Code Writing

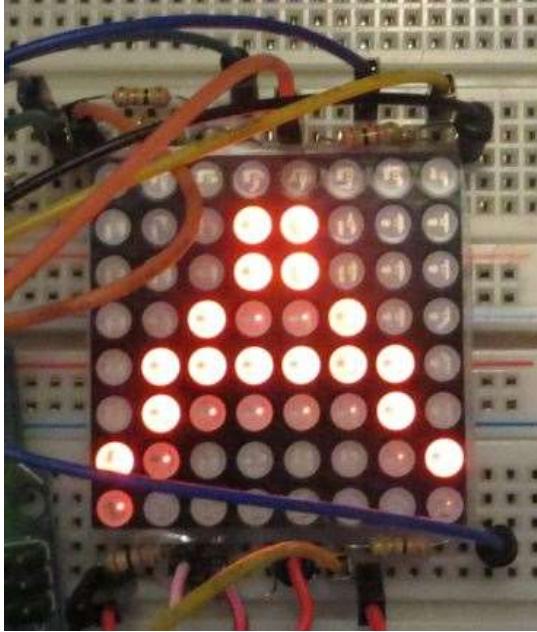
```
/*
8x8 Dot Matrix LED Display
Display four numbers or characters on 8x8 Dot Matrix LED Display
In this sketch, we use D2-D19 to control cathod. And use D10-D17 to control the anode.
*/
int DIG[8]={0x10,0x11,0x12,0x13,0x14,0x15,0x16,0x17}; //The pins used to controll the anode of the display
byte Wordcode[8]={0xFF,0xE7,0xE7,0xDB,0x81,0xBD,0xE7,0xFF}; //the character code for the character or number(it is the code for "A" here), put your code here
void setup()
{
    int i=2;
    //Set D2-D17 as OUTPUT
    for(i=2;i<18;i++)
    {
        pinMode(i,OUTPUT);
        digitalWrite(i,HIGH);
    }
}
void loop()
```

```

int j;
int k=0;
//Display ROW1-ROW8
for(k=0;k<8;k++)
{
  digitalWrite(DIG[k],HIGH);//Set DIG[K] to be ON.
  //display ROW(k)
  for(j=0;j<8;j++)
  {
    if(Wordcode[k]&1<<j)
      digitalWrite(9-j,HIGH);
    else
      digitalWrite(9-j,LOW);
  }
  delayMicroseconds(1000);
  digitalWrite(DIG[k],LOW);
}
}

```

The code effect are as following.



Lesson 17 Infrared Receiver

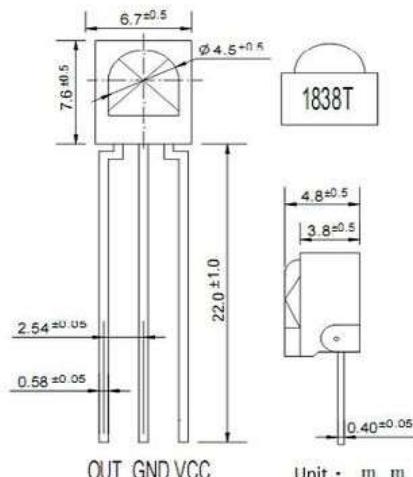
In the following example, we use an Infrared Remote Controller to send signals to Arduino(by pushing some key).

- Components Needed

1. Uno R3 board
2. 1 x 1838T Infrared Receiver
3. 1 x Infrared Remote controller
4. 1 x Breadboard
5. Wires

- Knowledge Needed

The Infrared Receiver included in the kit is **1838T**. Its pin definition and parameters are as following.

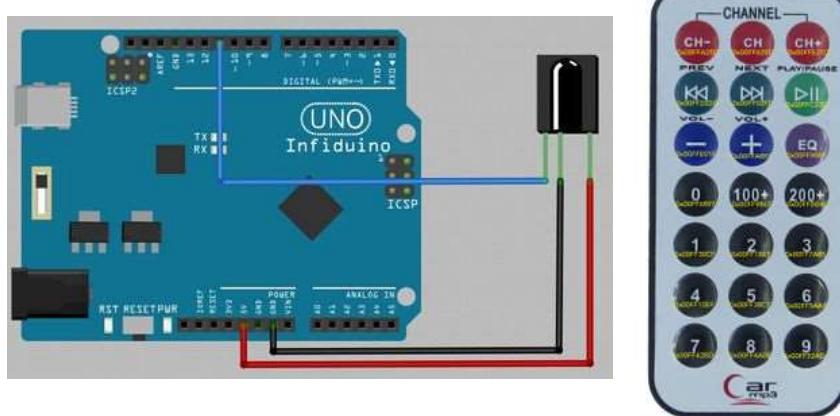


Parameters($T=25^{\circ}\text{C}$ $V_{cc}=5\text{V}$ $f_c=38\text{KHZ}$):

| Parameters | Signal | Test Condition | Min | Type | Max | Unit |
|---------------------|--------------|---------------------------------------|--------------|-------|-----|---------------|
| Working Voltage | V_{cc} | | 2.7 | | 5.5 | V |
| Working Current | I_{cc} | | 0.6 | 0.8 | - | mA |
| Static Current | I_{ce} | no signal input | 0.1 | | 0.5 | mA |
| Receiving Distance | L | ※ | 22 | 25 | | M |
| Receiving Angle | $\theta / 2$ | | | +/-35 | | Deg |
| Carrier Frequency | f_c | | | 38 | | KHZ |
| BMP Width | f_{bw} | -3Db Bandwidth | - | 8 | - | kHz |
| Low voltage output | V_{lo} | $V_{in}=0\text{V}$ $V_{cc}=5\text{V}$ | | | 0.4 | V |
| High voltage output | V_{hi} | $V_{cc}=5\text{V}$ | $V_{cc}-0.3$ | | | V |
| Output pulse width | T_{rec} | $V_{in}=50\text{mVp-p}$ | 500 | 600 | 700 | μs |
| | T_{pw} | $V_{in}=50\text{mVp-p}$ | 540 | 640 | 740 | μs |

About the transfer mechanism, please refer to this section [Remote controlled lamps](#) for some information.

- Hardware Connection



- Code Writing

First please download this file:[Media:IRremote.zip](#), then extract it to the "library" folder of your Arduino IDE.

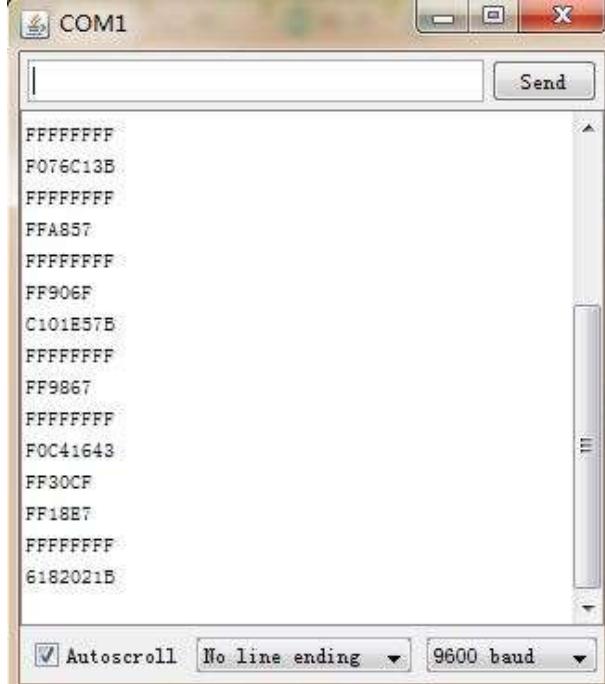
```
#include <IRremote.h>

int RECV_PIN = 11;
IRrecv irrecv(RECV_PIN);
decode_results results;

void setup()
{
  Serial.begin(9600);
  irrecv.enableIRIn(); // Start the receiver
}

void loop() {
  if (irrecv.decode(&results)) {
    Serial.println(results.value, HEX);
    irrecv.resume(); // Receive the next value
  }
}
```

Use the Remote Controller to send signal to 1838T. Open the serial monitor on PC, you will see the following data(every key will send a different data to it).



Lesson 18 Infrared Sender

During this test we will use the infrared emitting diode on one Uno R3 board to control the LED on the second Uno R3 board to blink every 0.5 second.

- Components Needed

1. 2 x Uno R3 board
2. 1 x LED(Red color)

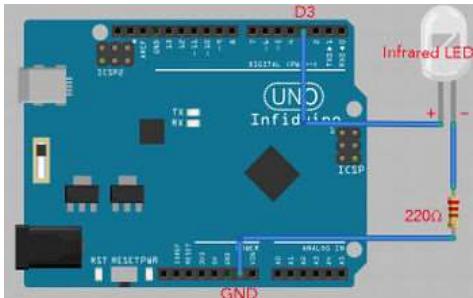
3. 2 x 330ohm resistor
4. 1 x 1838T Infrared Receiver
5. 1 x Infrared Sender(infrared emitting diode,IR333C-A)
6. 1 x Breadboard
7. Wires

- Knowledge Needed

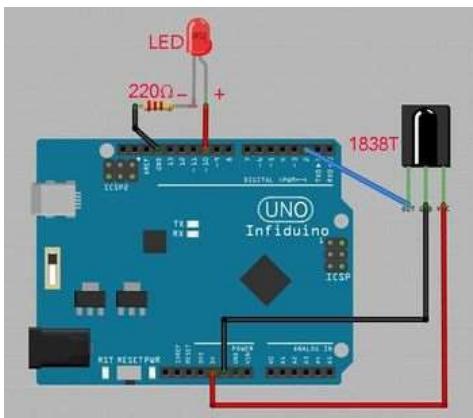
1. The infrared emitting diode(Infrared Sender) in this kit it is IR333C-A. When it is lighting we can't see the light, because it is 940nm infrared light.
 2. In order to make the Receiver can "seen" what the Infrared Sender send out, we should send the data out through a 38KHZ waveform, which means the Infrared Sender should blink 38K times a second.

- Hardware Connection

- The Sender Circuit



- The Receiver circuit



- Code Writing

- Code for Sender

```
/*
Infrared Sender
Make an remote LED on another Arduino board blink. Uses the 38Khz signal to send the message.
*/
// Pin 3 has an Infrared LED connected.
int Infra = 3;

void setup() {
  // initialize the digital pin as an output.
  pinMode(Infra, OUTPUT);
}

void loop() {
  int i;
  //Send out a 38KHZ signal,the 1838T infrared receiver will output a LOW voltage when receive this signal
  for(i=0;i<100;i++)
  {
    digitalWrite(Infra, HIGH); // turn the LED on (HIGH is the voltage level)
    delayMicroseconds(13); // wait for 13us
    digitalWrite(Infra, LOW); // turn the LED off
    delayMicroseconds(13); // wait for 13us
  }
  //Stop sending the 38KHZ signal, the 1838T will output a HIGH signal
  digitalWrite(Infra, HIGH);
  delay(500);
}
```

- Code for Receiver

```
/*
Infrared Controlled LED blinking
Reads a digital input on pin 2(the output of 1838T), then use the state of it to control the LED on pin10 to blink
*/
// the output of 1838T, based on the Sender
int signal = 2;
int ledpin = 10;
void setup() {
  pinMode(signal, INPUT);
  pinMode(ledpin, OUTPUT);
}
```

```
void loop() {
// read the input pin,then make the led blink based on it
int signalState = digitalRead(signal);
if(signalState)
digitalWrite(ledpin,LOW);
else
digitalWrite(ledpin,HIGH);
}
```

Lesson 19 1602LCD

■ Components Needed

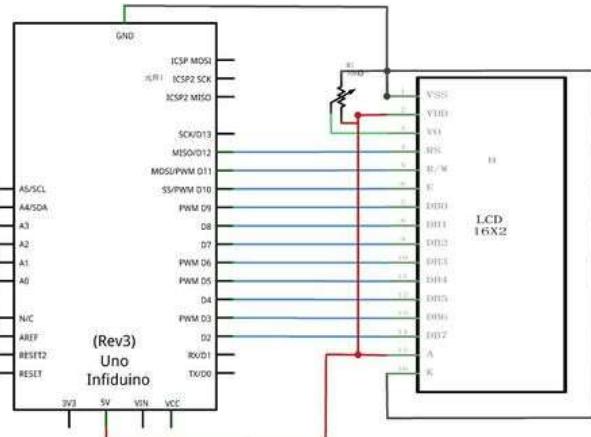
1. Uno R3 board
2. 1 x 1602LCD
3. 1 x 10k Potentiometer
4. 1 x Breadboard
5. Wires

■ Knowledge Needed

Arduino language has a LCD library which can support all HD44780(or other compatible driver) driven LCDs. Please check this page for more information:LiquidCrystal Library (<http://arduino.cc/en/Reference/LiquidCrystal>).For the 1602 lcd in the kit, the pin definition are as following.

| Pin Number | Sign | Description |
|------------|-------|--|
| 1 | VSS | The Power Ground signal,connect to 0V |
| 2 | VDD | Power supply,connect to +5V |
| 3 | V0 | Contrast regulation pin, use an 10k potentiometer to regulate the contrast. |
| 4 | RS | Data/Command selection |
| 5 | R/W | Read/Write selection, HIGH for reading, LOW for writing. |
| 6 | E | LCD enable signal, when chaning from HIGH to LOW, the LCD can execute the command. |
| 7-14 | D0-D7 | Data line |
| 15 | BLA | Back light positive, connect to 5V normally, 3.3V also works, but a bit dark. |
| 16 | BLK | Back light negative, connect to ground. |

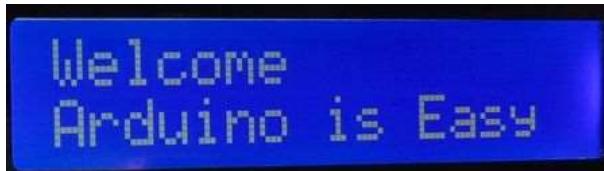
■ Hardware connection



■ Code Writing

```
#include <LiquidCrystal.h>
// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12,11,10,9,8,7,6,5,4,3,2);
void setup()
{
  lcd.begin(16,2); // set up the LCD's number of columns and rows:
  lcd.setCursor(0,0); // set the cursor to column 0, line 0
  lcd.print("Welcome"); // Print a message to the LCD.
  lcd.setCursor(0,2); // set the cursor to column 0, line 2
  lcd.print("Arduino is Easy"); //Print a message to the LCD.
}
void loop()
{}
```

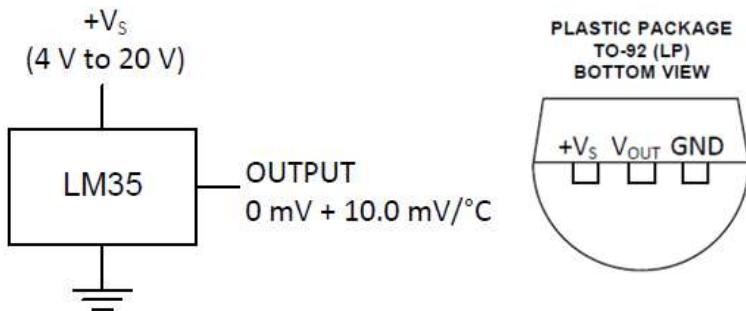
Download the code and run it in Arduino, the lcd will display as following picture.



Lesson 20 Temperature Measurement

LM35DZ is a sensor which can measure the room temperature. It is very easy to use. The one included in the kit is LM35DZ and can measure the temperature between 0°C to +100°C.

- Hardware Connection



Connect the LM35 with Arduino based on the above picture, that's

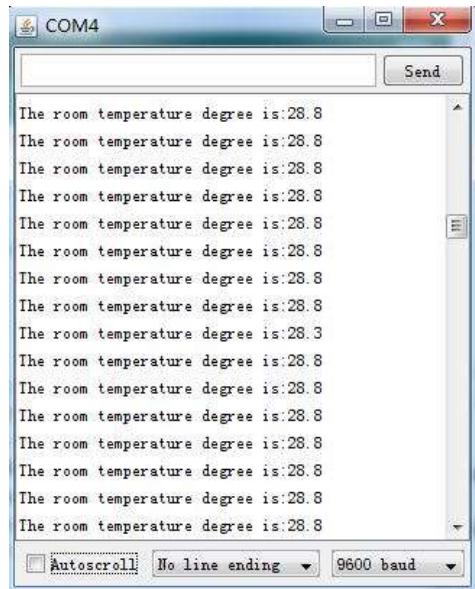
GND <=> GND

+Vs <=> +5V

Vout<=> A0

- Code Writing.

```
/*
 * Temperature Measurement
 * Reads an analog input on A0(output from LM35DZ), change it to the real room temperature and print it to serial monitor.
 */
float powervoltage=5;//define the power supply voltage.
void setup() {
 // initialize serial communication at 9600 bits per second:
 Serial.begin(9600);
}
void loop() {
 float temperature;
 // read the input on analog pin 0:
 float sensorValue = analogRead(A0);
 // print out the value you read:
 temperature=(sensorValue/1023)*powervoltage*100;
 Serial.print("The room temperature degree is:");
 Serial.println(temperature,1);
 delay(1); // delay in between reads for stability
}
```



Lesson 21 Sound Sensor Playing

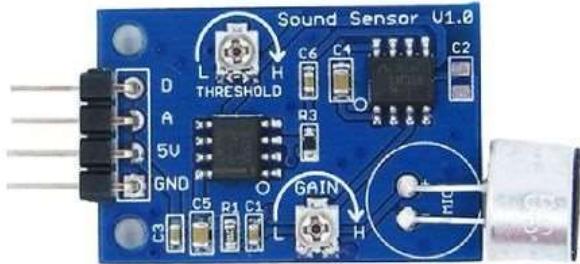
For this test, we'll learn how to use the Sound Sensor Module

- Components Needed

1. Uno R3 board
2. 1 x Sound Sensor Module
3. Wires

- Knowledge Needed

The Sound Sensor in the kit has 4 pins: GND,5V,A,D.



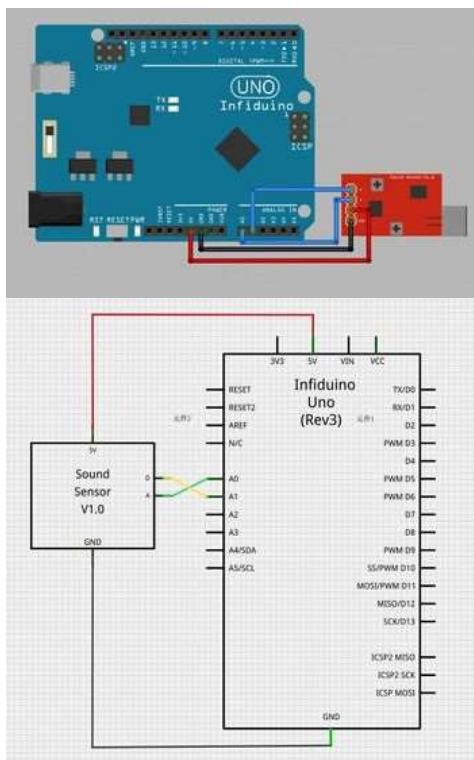
- Pin A

When there is a sound nearby, the sound sensor will detect its strength and output a analog value through pin A. The louder the sound, the bigger the analog value. You can also regulate the gain through the potentiometer named "GAIN".

- Pin D

Pin D can output a digital value(0 or 1) based on the environment sound. If the sound strength is bigger than a specified value, pin D will output 1. The specified value(named threshold) can also be changed by the potentiometer named "THRESHOLD".

- Hardware Connection



- Code Writing

```
/*
Sound Sensor Playing
Reads the analog output of Sound Sensor through A0, prints the result to the serial monitor
Read the digital output of Sound Sensor through A1, prints the result to the serial monitor

Connect the pins in the following way:
GND----GND
VCC----5V
A-----A0
D-----A1
*/
void setup() {
  Serial.begin(9600);
}

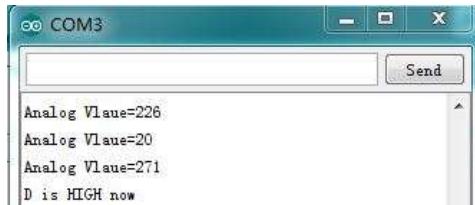
void loop() {
```

```

int sensorValue = analogRead(A0); //Read the analog value of the sound sensor
int digitalVlaue = digitalRead(15); //Read the digital value of the sound sensor
Serial.print("Analog Vlaue=");
Serial.println(sensorValue); //Print the analog value to serial monitor
if(digitalVlaue){
Serial.println("D is HIGH now");
delay(1000); // wait for a second
}

```

Clap you hands near the Sound Sensor. The following picture shows the output of the serial monitor



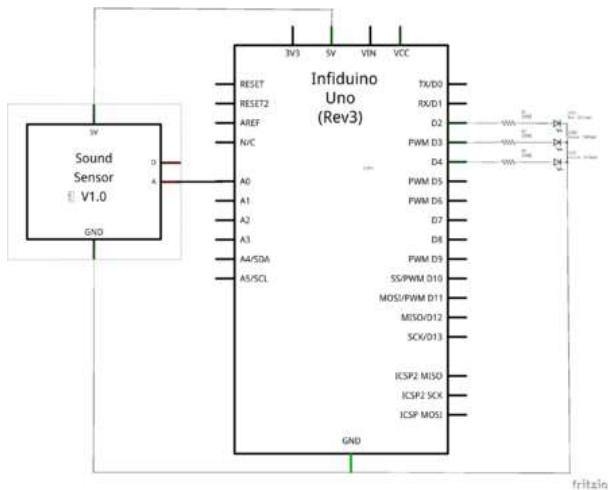
Lesson 22 Noise Warning

In this section we use the Sound Sensor and 3 LEDs to test and indicate the noise level of the environment.

■ Components Needed

1. Uno R3 board
2. 3 x LED(red color, green color and yellow color)
3. 3 x 330ohm resistor
4. 1 x Sound Sensor Module
5. 1 x Breadboard
6. Wires

■ Hardware Connection



■ Code Writing

```

/*
Noise Warning
Reads an analog input on pin 0, then light the 3 leds based on the value
*/
void setup() {
Serial.begin(9600);
pinMode(2,OUTPUT);
pinMode(3,OUTPUT);
pinMode(4,OUTPUT);
}

void loop() {
// read the input on analog pin 0:
int noisyValue = analogRead(A0);
//light the specific LED based on the analog value
if(noisyValue<=100)
{
digitalWrite(2,HIGH);
digitalWrite(3,LOW);
digitalWrite(4,LOW);
}
else if((100<noisyValue)&&(noisyValue<=600)
{
digitalWrite(2,LOW);
digitalWrite(3,HIGH);
digitalWrite(4,LOW);
}
else
{
digitalWrite(2,LOW);
digitalWrite(3,LOW);
digitalWrite(4,HIGH);
}
}

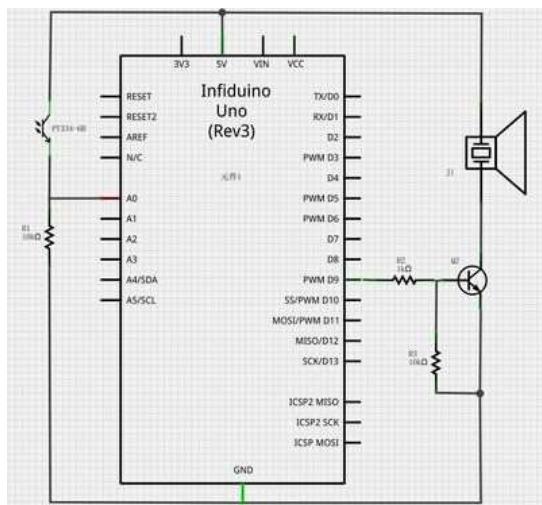
```



Lesson 23 Fire Alarm

The Infrared Phototransistor included in the kit is PT334-6B. It is very sensitive to infrared light. And the flame usually emitting a lot of infrared light, so we can use the PT334-6B to detect the flame. For the following circuit, if there is a flame nearby the PT334-6B, the Buzzer will make a sound.

- Hardware Connection.



- Code writing

```
/*
Fire Alarm
Reads an analog input on pin 0, prints the result to the serial monitor, and use it to control the Buzzer through D9
*/
void setup() {
// initialize serial communication at 9600 bits per second:
Serial.begin(9600);
pinMode(9,OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
// read the input on analog pin 0:
int sensorValue = analogRead(A0);
// print out the value you read:
Serial.println(sensorValue);
//If there is a flame nearby, make the Buzzer speak.
if(sensorValue<500)
digitalWrite(9,HIGH);
else
digitalWrite(9,LOW);
}
```

Lesson 24 Stepper Motor Driving

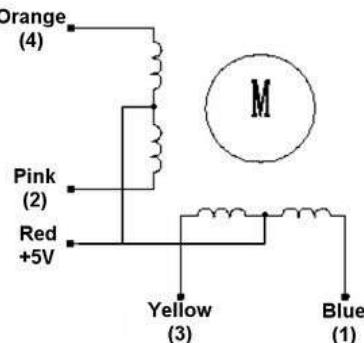
- Components Needed

1. Uno R3 board
2. 1 x Stepper Motor Driver
3. 1 x Stepper Motor

- Knowledge Needed

The stepper in the kit is 28BYJ48-5V. The wire diagram and the driving sequence are showed in the following pictures. There are 5 wires. The red wire is the positive power input and should be connected to 5V.

WIRING DIAGRAM



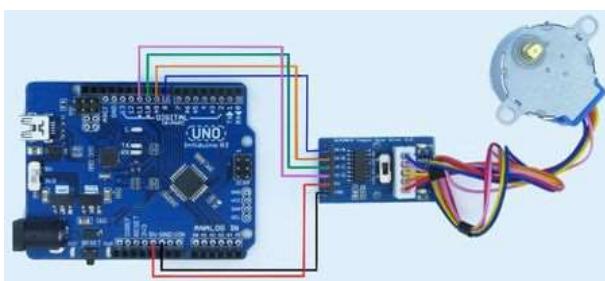
SWITCHING SEQUENCE

| Lead Wire Color | ---> CW Direction (1-2 Phase) | | | | | | | |
|--------------------|-------------------------------|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 4 Orange | - | - | | | | | | - |
| 3 Yellow | | - | - | - | | | | |
| 2 Pink | | | | - | - | - | | |
| 1 Blue | | | | | - | - | - | - |

| | |
|-----------------------------|-----------------------------|
| Rated voltage : | 5VDC |
| Number of Phase | 4 |
| Speed Variation Ratio | 1/64 |
| Stride Angle | 5.625°/64 |
| Frequency | 100Hz |
| DC resistance | 50Ω±7%(25°C) |
| Idle In-traction Frequency | > 600Hz |
| Idle Out-traction Frequency | > 1000Hz |
| In-traction Torque | >34.3mN.m(120Hz) |
| Self-positioning Torque | >34.3mN.m |
| Friction torque | 600-1200 gf.cm |
| Pull in torque | 300 gf.cm |
| Insulated resistance | >10MΩ(500V) |
| Insulated electricity power | 600VAC/1mA/1s |
| Insulation grade | A |
| Rise in Temperature | <40K(120Hz) |
| Noise | <35dB(120Hz, No load, 10cm) |
| Model | 28BYJ-48 – 5V |

As the above picture shows, there are 8 different steps(these 8 steps is one **step loop**) for the stepper to move forward. Every step will make the shaft rotate with an angle of 5.625/64 degree. So if we want the shaft to revolve one circle, then the **step loops** we should make is $360/(8 \times 5.625/64) = 512$ (step loops). The following code is to make the stepper move clockwise for one circle, then move counterclockwise for one circle.

■ Hardware Connection



■ Code Writing

```
/*
Stepper Motor Control - one revolution

This program drives a unipolar stepper motor.
The motor is attached to digital pins 8 - 11 of the Arduino.

The motor should revolve one revolution in one direction, then
one revolution in the other direction.
*/
void setup() {
  // initialize the digital pin as an output.
  pinMode(8, OUTPUT);
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT);
  pinMode(11, OUTPUT);
}
```

```

};

void loop() {
    int i=0;
    //revolve one revolution clockwise
    for(i=0;i<512;i++){
        clockwiserotate();
        delay(1000);           // wait for a second
    //revolve one revolution counterclockwise
    for(i=0;i<512;i++){
        counterclockwiserotate();
        delay(1000);           // wait for a second
    }
}

void clockwiserotate() { //revolve clockwise
    step1();
    step2();
    step3();
    step4();
    step5();
    step6();
    step7();
    step8();
}

void counterclockwiserotate() { //revolve counterclockwise
    step1();
    step7();
    step6();
    step5();
    step4();
    step3();
    step2();
    step1();
}

void step1(){
    digitalWrite(8, HIGH);
    digitalWrite(9, LOW);
    digitalWrite(10, LOW);
    digitalWrite(11, LOW);
    delay(2);
}

void step2(){
    digitalWrite(8, HIGH);
    digitalWrite(9, HIGH);
    digitalWrite(10, LOW);
    digitalWrite(11, LOW);
    delay(2);
}

void step3(){
    digitalWrite(8, LOW);
    digitalWrite(9, HIGH);
    digitalWrite(10, LOW);
    digitalWrite(11, LOW);
    delay(2);
}

void step4(){
    digitalWrite(8, LOW);
    digitalWrite(9, HIGH);
    digitalWrite(10, HIGH);
    digitalWrite(11, LOW);
    delay(2);
}

void step5(){
    digitalWrite(8, LOW);
    digitalWrite(9, LOW);
    digitalWrite(10, HIGH);
    digitalWrite(11, LOW);
    delay(2);
}

void step6(){
    digitalWrite(8, LOW);
    digitalWrite(9, LOW);
    digitalWrite(10, HIGH);
    digitalWrite(11, HIGH);
    delay(2);
}

void step7(){
    digitalWrite(8, LOW);
    digitalWrite(9, LOW);
    digitalWrite(10, LOW);
    digitalWrite(11, HIGH);
    delay(2);
}

void step8(){
    digitalWrite(8, HIGH);
    digitalWrite(9, LOW);
    digitalWrite(10, LOW);
    digitalWrite(11, HIGH);
    delay(2);
}

```

Lesson 25 PWM Servo Control

- Components Needed

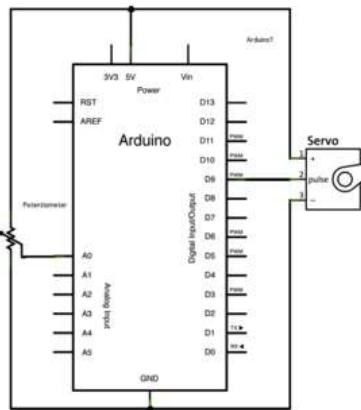
1. Uno R3 board
2. 1 x 10k Potentiometer
3. SG90 Servo Motor
4. Wires

- Knowledge Needed

Servo Motor can be controlled through the PWM. The frequency of the control signal is 50hz, the width of positive pulse controls the angle. For detailed information about Servo please refer to this page:Servo Motor. A servo usually has 3 pins. For the servo in the kit(named SG90), the red wire is the power signal and should be connected 5V voltage. The brown wire is the ground signal and should be connected to 0V. The orange wire is the controlling signal and should be fed with a PWM signal. Arduino has a

"Servo library" to control a servo. In this lesson we will control the position of the rudder through the Potentiometer.

■ Hardware Connection



■ Code writing

```
// Controlling a servo position using a potentiometer (variable resistor)
#include <Servo.h>
Servo myservo; // create servo object to control a servo
int potpin = 0; // analog pin used to connect the potentiometer
int val; // variable to read the value from the analog pin

void setup()
{
    myservo.attach(9); // attaches the servo on pin 9 to the servo object
}

void loop()
{
    val = analogRead(potpin); // reads the value of the potentiometer (value between 0 and 1023)
    val = map(val, 0, 1023, 0, 179); // scale it to use it with the servo (value between 0 and 180)
    myservo.write(val); // sets the servo position according to the scaled value
    delay(15); // waits for the servo to get there
}
```

Lesson 26 Relay controlling

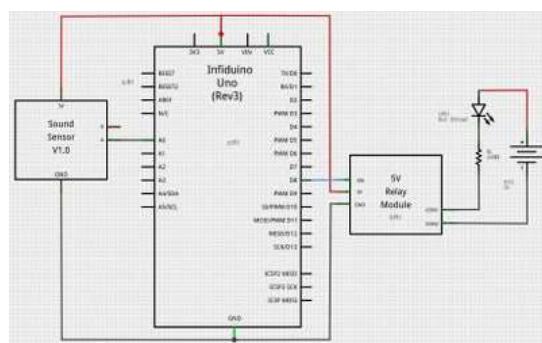
■ Components Needed

1. Uno R3 board
2. 1 x Sound Sensor Module
3. 1 x Relay Module
4. 1 x LED(Red color)
5. 1 x 330ohm resistor
6. 1 x Breadboard
7. Wires
8. External 3V power

■ Knowledge Needed

A relay is an electronic switch that can be controlled by a MCU. In this lesson we will use the sound sensor to control the relay module which act as a switch for the led. If there is a big sound near the Sound Sensor, it will output a higher analog value. We use Arduino to read this value, if it exceeds a threshold, then make the relay work and the LED will light. There are many similar sound controlled lamps in the buildings.

■ Hardware Connection



■ Code Writing

```
/*
Relay controlling
Reads an analog input on pin 0, prints the result to the serial monitor, and use it to control the Relay through D8
*/
```

```
/*
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
  pinMode(8,OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
  int sensorValue = analogRead(A0);
  // print out the value you read:
  Serial.println(sensorValue);
  //If there is a big sound nearby, make the led light for one second.
  if(sensorValue>500)
  {
    digitalWrite(8,HIGH);
    delay(1000);
  }
  else
  digitalWrite(8,LOW);
}
```

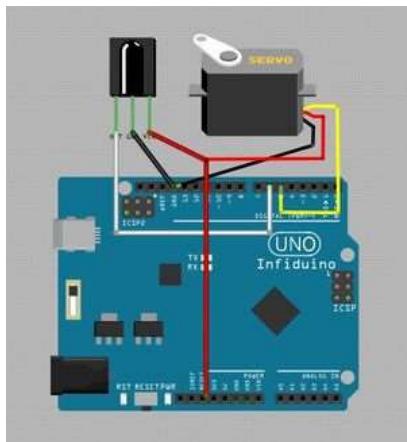
Lesson 27 Interactive Servo Motor

In this lesson we'll use the Remote Controller to control the Servo Motor. We'll push a KEY on the Remote Controller. If we push KEY 1 to KEY 9, then the Servo will move to the designated position. KEY 1 at the 20 degree position, and till KEY9 at the 180 degree position (the interval is 20 degree). For SG90 servo,500-2400 μ s pulse width is mapped to 0°-180°, the period cycle is 20 milliseconds(50HZ).

- Components Needed

1. Uno R3 board
2. 1 x 1838T Infrared Receiver
3. 1 x Infrared Remote Controller
4. 1 x Servo Motor
5. 1 x Breadboard
6. Wires

- Hardware Connection



- Code writing

First please download this file:[Media:IRremote.zip](#), then extract it to the "library" folder of your Arduino IDE.

```
/*
Interactive Servo Motor - one revolution

This program drives a Servo motor by the Remote Controller.
The Servo motor is attached to digital pins D5 of the Arduino. The output pin of the Infrared Receiver is attached to pin 6

The motor should revolve to an angle(0 degree to 180 degree) if you push the KEY named 1-9 on the Remote Controller.Each KEY will set the shaft at an paticular position.
*/
#include <IRremote.h>
int Servopin=5;
int RECV_PIN = 6;

long KEY_1 = 0x00FF30CF;
long KEY_2 = 0x00FF18E7;
long KEY_3 = 0x00FF7A85;
long KEY_4 = 0x00FF10EF;
long KEY_5 = 0x00FF38C7;
long KEY_6 = 0x00FF5AA5;
long KEY_7 = 0x00FF42BD;
long KEY_8 = 0x00FF44AB5;
long KEY_9 = 0x00FF52AD;

IRrecv irrecv(RECV_PIN);
decode_results results;
int Position;
void setup() {
  // initialize the digital pin as an output.
  pinMode(RECV_PIN, TDIDITY);
```

```

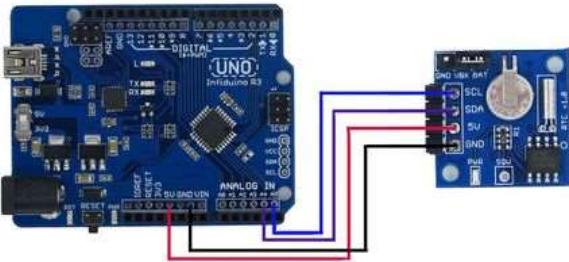
pinMode(IRrecv_PIN, INPUT);
pinMode(Servopin,OUTPUT);
irrecv.enableIRIn(); // Start the receiver
}
void loop() {
int i=0;
if (irrecv.decode(&results))
{
irrecv.resume(); // Receive the next value
if (results.value == KEY_1 )
{
Position=1;
}
else if (results.value == KEY_2 )
{
Position=2;
}
else if (results.value == KEY_3 )
{
Position=3;
}
else if (results.value == KEY_4 )
{
Position=4;
}
else if (results.value == KEY_5 )
{
Position=5;
}
else if (results.value == KEY_6 )
{
Position=6;
}
else if (results.value == KEY_7 )
{
Position=7;
}
else if (results.value == KEY_8 )
{
Position=8;
}
else
Position=9;
}
int angle=Position*(180/9); //Calculate the angle should be moved based on the key pushed on the Remote Controller.
for(int i=0;i<5;i++)
{
moveangle(Servopin,angle); //move the shaft to an angle based on the key pushed on the Remote Controller
}
}
void moveangle(int Servopin,int angle)//the pulsedwidth function,move the shaft to an angle based on the KEY pushed.
{
int pulsedwidth=(angle*11)+500; //change the angle to 500-2480us pulsedwidth
digitalWrite(Servopin,HIGH);
delayMicroseconds(pulsedwidth);
digitalWrite(Servopin,LOW);
delay(20-pulsewidth/1000);
}

```

Lesson 28 Electronic Clock

The RTC module is based on the DS1307, it communicates with Arduino through I2C port. You can download File:DS1307RTC.rar to test it.

- Hardware Connection.



- Code Writing
 - Unzip the library file into the libraries file of Arduino IDE by the path: ..\arduino-1.x\libraries.
 - Open the sketch under the path:File -> Example -> RTC->SetTimeAndDisplay.

Download the code and use the serial monitor to see the time.

Lesson 29 Alarm clock

An Alarm clock also is simple. In fact you just need to add several lines of code to the sketch()(File:DS1307RTC.rar). In this example we'll make the buzzer make a sound when the time is 0 second of the minute and continue 10 seconds.

- Hardware Connection

- Code Writing.

You just need to change this code

```
void loop()
{
    printTime();
}
```

to this code

```
void loop()
{
    printTime();
    if(clock.second==0)
        digitalWrite(3,HIGH);
    if(clock.second==10)
        digitalWrite(3,LOW);
}
```

Lesson 30 Infrared Remote Controlled Stepper

In fact this example is similar with Interactive Servo Motor, the difference is that in this lesson we'll use the remote controller to control the motor's moving direction.

- Components Needed

1. Uno R3 board
2. 1 x 1838T Infrared Receiver
3. 1 x Stepper Motor Driver
4. 1 x Stepper Motor
5. 1 x Remote Controller
6. Wires

- Hardware Connection

■ Code Writing

```
/*
Infrared Stepper Motor Control - one revolution

This program drives a unipolar stepper motor by the Remote Controller.
The motor is attached to digital pins 8 - 11 of the Arduino. The output pin of the Infrared Receiver is attached to pin 2

The motor should revolve one revolution clockwise if you push the forward key of the Remote Controller, and revolve one revolution counterclockwise if you push the backward key then
one revolution in the other direction.
*/
#include <IRremote.h>
int RECV_PIN = 2;
long clockwise_cmd = 0x00FF02FD;
long counterclockwise_cmd = 0x00FF22DD;
IRrecv irrecv(RECV_PIN);
decode_results results;

void setup() {
    // initialize the digital pin as an output.
    pinMode(RECV_PIN, INPUT);
    pinMode(8, OUTPUT);
    pinMode(9, OUTPUT);
    pinMode(10, OUTPUT);
    pinMode(11, OUTPUT);
    Serial.begin(9600);
    irrecv.enableIRIn(); // Start the receiver
}
void loop() {
    int i=0;
    if (irrecv.decode(&results))
    {
        irrecv.resume(); // Receive the next value
        if (results.value == clockwise_cmd )
        {
            for(i=0;i<512;i++)
            {
                clockwiserotate();
            }
        }
        if (results.value == counterclockwise_cmd )
        {
            for(i=0;i<512;i++)
            {
                counterclockwiserotate();
            }
        }
    }
}
void clockwiserotate() { //revolve clockwise
    step1();
    step2();
    step3();
    step4();
    step5();
    step6();
    step7();
    step8();
}
void counterclockwiserotate() { //revolve counterclockwise
    step1();
    step7();
    step6();
    step5();
    step4();
    step3();
    step2();
    step1();
}
void step1(){
    digitalWrite(8, LOW);
    digitalWrite(9, HIGH);
    digitalWrite(10, HIGH);
    digitalWrite(11, HIGH);
    delay(2);
}
void step2(){
    digitalWrite(8, LOW);
    digitalWrite(9, LOW);
    digitalWrite(10, HIGH);
    digitalWrite(11, HIGH);
    delay(2);
}
void step3(){
    digitalWrite(8, HIGH);
    digitalWrite(9, LOW);
    digitalWrite(10, HIGH);
    digitalWrite(11, LOW);
    delay(2);
}
```

```

digitalWrite(11, HIGH);
delay(2);
}
void step4(){
  digitalWrite(8, HIGH);
  digitalWrite(9, LOW);
  digitalWrite(10, LOW);
  digitalWrite(11, HIGH);
  delay(2);
}
void step5(){
  digitalWrite(8, HIGH);
  digitalWrite(9, HIGH);
  digitalWrite(10, LOW);
  digitalWrite(11, HIGH);
  delay(2);
}
void step6(){
  digitalWrite(8, HIGH);
  digitalWrite(9, HIGH);
  digitalWrite(10, LOW);
  digitalWrite(11, LOW);
  delay(2);
}
void step7(){
  digitalWrite(8, HIGH);
  digitalWrite(9, HIGH);
  digitalWrite(10, HIGH);
  digitalWrite(11, LOW);
  delay(2);
}
void step8(){
  digitalWrite(8, LOW);
  digitalWrite(9, HIGH);
  digitalWrite(10, HIGH);
  digitalWrite(11, LOW);
  delay(2);
}
void stoprotate()
{
  digitalWrite(8, HIGH);
  digitalWrite(9, HIGH);
  digitalWrite(10, HIGH);
  digitalWrite(11, HIGH);
}

```

Lesson 31 74HC595 IO expansion

The Arduino/Infiduino board has 14 digital input/output pins. But sometimes this maybe not enough. 74HC595 can help us to solve this problem. With its help we an change 3 IOs to 8. For this lesson we'll redo the Lesson 3 Rolling Light example. The difference is that we only use 3 IOs this time.

- Components Needed
 1. Uno R3 board
 2. 8 x LED(Red color)
 3. 8 x 330ohm resistor
 4. 1 x 74HC595 chip
 5. 1 x Breadboard
 6. n x Wires
- Hardware Connection

- Code Writing

```

/*
74HC595 LED rolling blink
Turns on 8 LEDs in turn through 74HC595.
*/
#define SER 2 //define the serial date input pin
#define SRCLK 3 //define the serial input clock pin(the shift register clock input)
#define RCLK 4 //define the latch pin(storage register clock input)

void setup() {
  // initialize the digital pin as an output.
  pinMode(SER, OUTPUT);
  pinMode(SRCLK, OUTPUT);
  pinMode(RCLK, OUTPUT);
  digitalWrite(SRCLK,LOW);
  digitalWrite(RCLK,LOW);
}

```

```

}
void loop()
{
    int i=0;
    byte j=0x80;
    for(i = 0 ; i < 8; i++)
    {
        write595(j);
        j>> 1;
        delay(100);
    }
void write595(byte data)
{
    int i;
    for(i = 0 ; i < 8; i++)
    {
        if(data & 0x80)  digitalWrite(SER,HIGH); //SER=1
        else            digitalWrite(SER,LOW); //SER=0

        data <= 1;
        digitalWrite(SRCLK,HIGH); //SRCLK=1
        digitalWrite(SRCLK,LOW); //SRCLK=1
    }
    digitalWrite(RCLK,HIGH); //SRCLK=1
    digitalWrite(RCLK,LOW); //SRCLK=1
}

```

Lesson 32 PIR Motion Sensor playing

PIR Motion Sensor can be used to detect the human motion. When somebody moves within the detecting range then the sensor will output a HIGH state voltage, no motion, no output. In this example we use the PIR Motion Sensor named HC-SR501. Please check [this page](#) for more information.

Lesson 33 Ultrasonic Distance Measurement

Ultrasonic module as this can be used to measure the distance of an object. For this module: **HC-SR04 Ultrasonic module**, there are several steps to measure the distance.

1. First you should send a HIGH signal of at least 10us to trig the measuring process. The signal should be sent to the pin named "Trig".
2. The module will send out eight 40kHz square wave ultrasonic signal.
3. If the signal is reflected by some object, the module will output HIGH on the pin named "Echo".
4. The distance can be calculated by this formula: $\text{Distance} = \text{High_Time} * \text{Sound_Speed} / 2$.
High_Time is the duration of the HIGH signal, and the Sound_Speed is the sound velocity in the atmosphere.

Example

In this example we will use this library: **Media:NewPing.zip** to measure the distance of an object. Just download the zip file and put the folder named "NewPing" in the "libraries\" folder of your Arduino IDE, then select "File->Examples->NewPing->NewPingExample" and download it to Arduino.

- Hardware Connection

- Result

Open the serial monitor and set the baud rate as 115200, we'll get the following result.

Lesson 34 RFID playing

There are some useful information on this page: "<http://playground.arduino.cc/Learning/MFRC522>". To make it easy to use, we'll make something more clear here. As for using SPI communication, the following pin connection should be noted.

| Pin of RC522 module | Pin of Arduino |
|---------------------|----------------|
| 3.3V | 3.3V |
| RST | D9 |

| | |
|-----------------|-----|
| GND | GND |
| IRQ | - |
| MISO | D12 |
| MOSI | D11 |
| SCK | D13 |
| SDA(SS for SPI) | D10 |

For using SPI to "Read And Write Tags", just download the following two libraries and add them to the folder "**libraries**" of your Arduino IDE.

- Media:Mfrc522_rfid_lib.zip
- Media:Rfid_tutorial_sketch.zip

Then use the following example to read and write the s50 tag:**"File->Examples->T11_RFID_Tutorial_Sketch"**. We'll get the following result.

Lesson 37 I2C 2004LCD

■ Components Needed

1. Uno R3 board
2. 1 x I2C 2004LCD
3. Wires

■ Knowledge Needed

In fact, the 2004LCD is similar to 1602LCD, just it have more pixels to display more words. This module also has an I2C adapter, you only need to use the I2C port of Arduino to control it, it will save the IOs.

■ Hardware Connection

Connect the I2C 2004LCD module with Arduino via the I2C port.

1. GND(LCD)<->GND(Arduino)
2. VCC(LCD)<->5V(Arduino)
3. SDA(LCD)<->A4(Arduino)
4. SCL(LCD)<->A5(Arduino)

■ Code Writing

Connect the I2C 2004LCD module with Arduino via the I2C port. Please download the File:LiquidCrystal I2C NEW.zip.(**This library also works for 1602LCD**). library and extract it to the library folder of Arduino. The following picture shows the display of the "Hello World" example.

Lesson 36 HMC5883L(Or QMC5883L) Electronic Compass

Please refer to [this page](#) for more detail

Lesson 35 MPU6050 Gyro&Accelerometer

Please refer to this page for more detail

Resources

- This page in PDF format:[File:Starter Kit Specification-PDF.pdf](#)

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