Preface

About SunFounder

SunFounder is a technology company focused on Raspberry Pi and Arduino open source community development. Committed to the promotion of open source culture, we strive to bring the fun of electronics making to people all around the world and enable everyone to be a maker. Our products include learning kits, development boards, robots, sensor modules and development tools. In addition to high quality products, SunFounder also offers video tutorials to help your own project. If you have interest in open source or making something cool, welcome to join us! Visit www.sunfounder.com for more!

About Universal Kit

This kit is suitable for SunFounder Uno, SunFounder Mega 2560, SunFounder Duemilanove and SunFounder NANO. All the code in this user guide is compatible with these boards.

Our SunFounder board is fully compatible with Arduino board.

With this kit, we will walk you through the know-how of using the SunFounder board in a hands-on way. Starting with the basics of electronics, you'll learn through building several creative projects. Including a selection of the most common and useful electronic components, this kit will help you "control" the physical world.

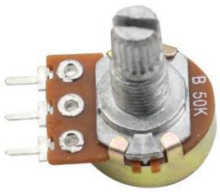
In this book, we will show you circuits with both realistic illustrations and schematic diagrams. You can go to our official website www.sunfounder.com to download related code by clicking **LEARN** -> **Get Tutorials** and watch related videos under **VIDEO**.

If you have any questions, please send an email to support@sunfounder.com. You can also leave a message and share your projects on our **FORUM**.

Reprint 3.0

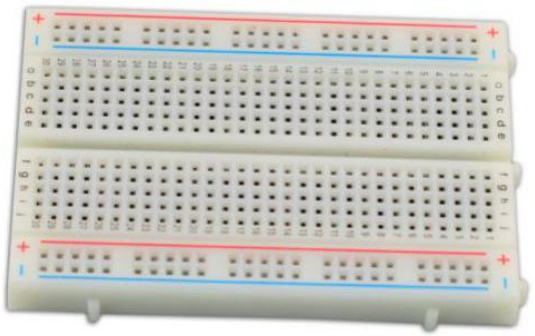
Contents

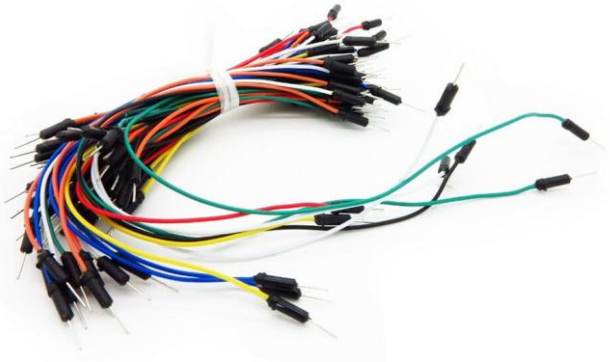
Components List

No	Name	Qty.	Component
1	Tilt Switch	1	
2	Photoresistor (Photocell)	1	
3	Thermistor	1	
4	Button (Small)	2	
5	Potentiometer	1	

6	RGB LED	1	
7	Green LED	2	
8	Red LED	8	
9	Yellow LED	2	
10	Active Buzzer	1	
11	Relay	1	

12	Resistor (220Ω)	8	 (red, red, black, black, brown)
13	Resistor (1KΩ)	4	 (brown, black, black, brown, brown)
14	Resistor (10KΩ)	4	 (brown, black, black, red, brown)
15	Resistor (100KΩ)	4	 (brown, black, black, orange, brown)
16	Resistor (1MΩ)	1	 (brown, black, green, gold)
17	Resistor (5.1MΩ)	1	 (green, brown, green, gold)
18	NPN Transistor (S8050)	2	

19	FET Transistor (2N7000)	1	
20	Diode Rectifier (1N4007)	2	
21	Diode (Zener)	1	
22	Breadboard	1	

23	USB Cable	1	
24	Jumper Wires	65	

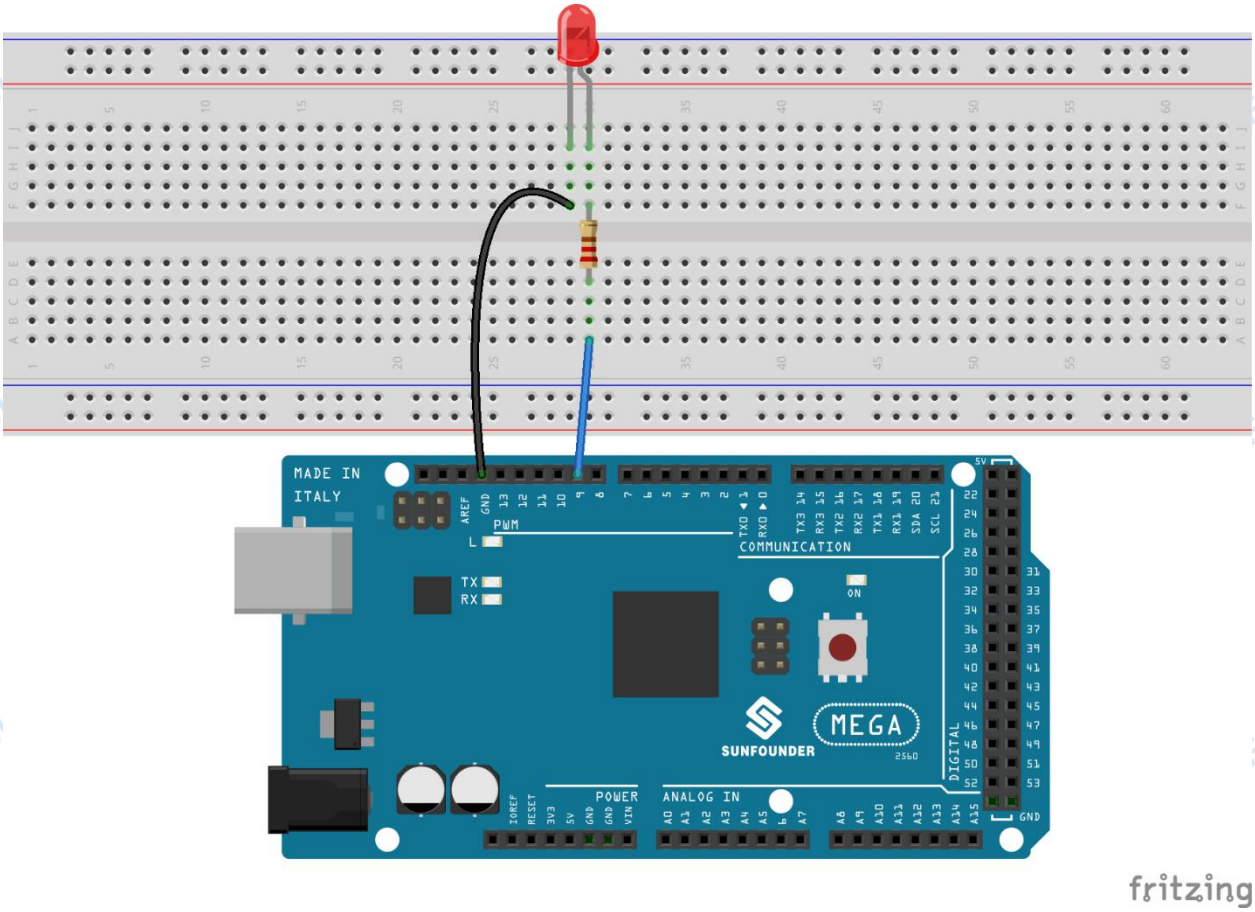
Note:

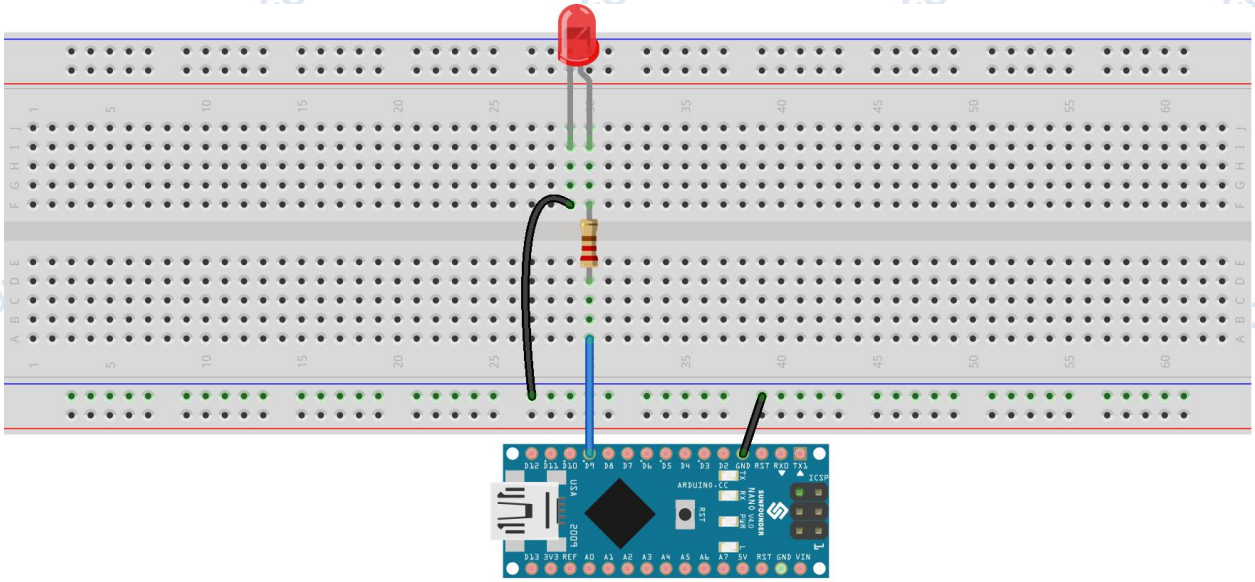
After unpacking, please check that the number of components is correct and that all components are in good condition.

Notice

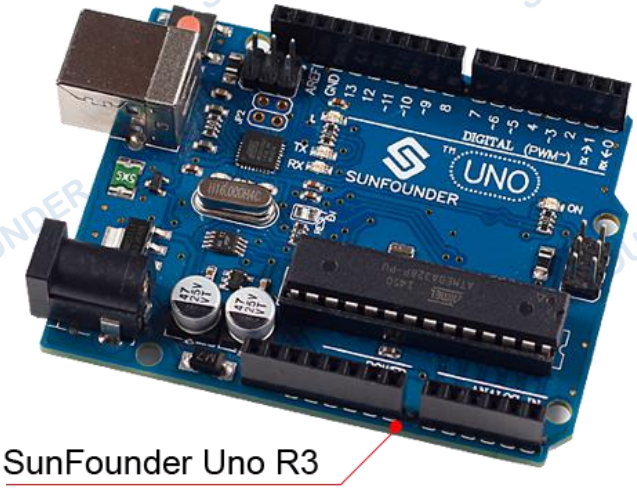
All the experiments in this kit are done with SunFounder Uno R3 board, but they are also compatible with SunFounder Mega 2560, SunFounder Nano and all official Arduino Boards. All the code included in this kit works with these boards.

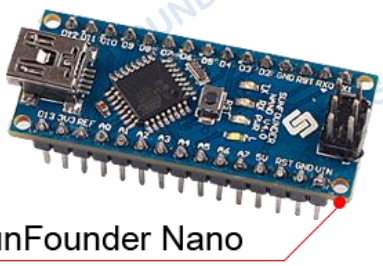
So what does COMPATIBLE mean here? It means you can use any of the three boards to do the same experiment with the same wiring. Take turning on an LED as an example. We use SunFounder Uno as the microcontroller, but you can also use SunFounder Nano or SunFounder Mega 2560 to serve the same function. Just select the right Board and COM when compiling.




fritzing


SunFounder Mega 2560 R3


SunFounder Uno R3


SunFounder Nano

Lesson 1 Button

Introduction

In this experiment, you will learn how to turn on/off an LED by using an I/O port and a button. The "I/O port" refers to the INPUT and OUTPUT port. Here the INPUT port of the SunFounder Uno board is used to read the output of an external device. Since the board itself has an LED (connected to Pin 13), so you can use this LED to do this experiment for convenience.

Components

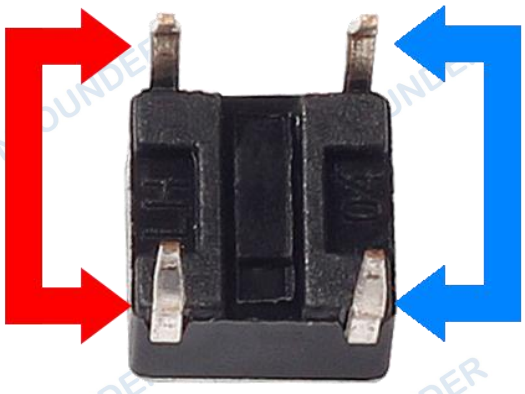
- 1 * SunFounder Uno board
- 1 * USB cable
- 1 * Button
- 1 * Resistor (10kΩ)
- Jumper wires
- 1 * Breadboard

Principle

Button

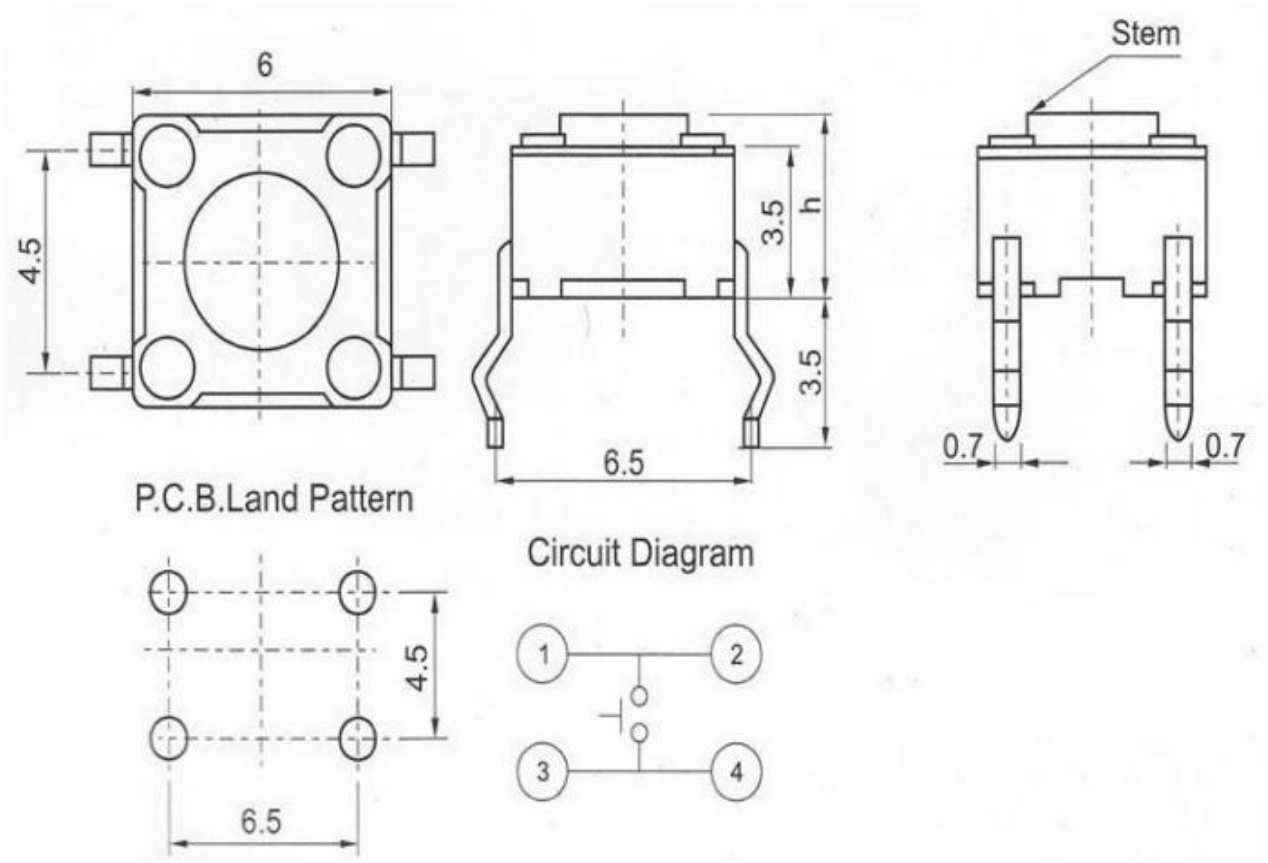
Buttons are a common component used to control electronic devices. They are usually used as switches to connect or break circuits. Although buttons come in a variety of sizes and shapes, the one used here is a 6mm mini-button as shown in the following pictures. Pins pointed out by the arrows of the same color are meant to be connected.

Front



Back

When the button is pressed, the pins pointed by the blue arrow will connect to the pins pointed by the red arrow (see the above figure), thus closing the circuit, as shown in the following diagrams.

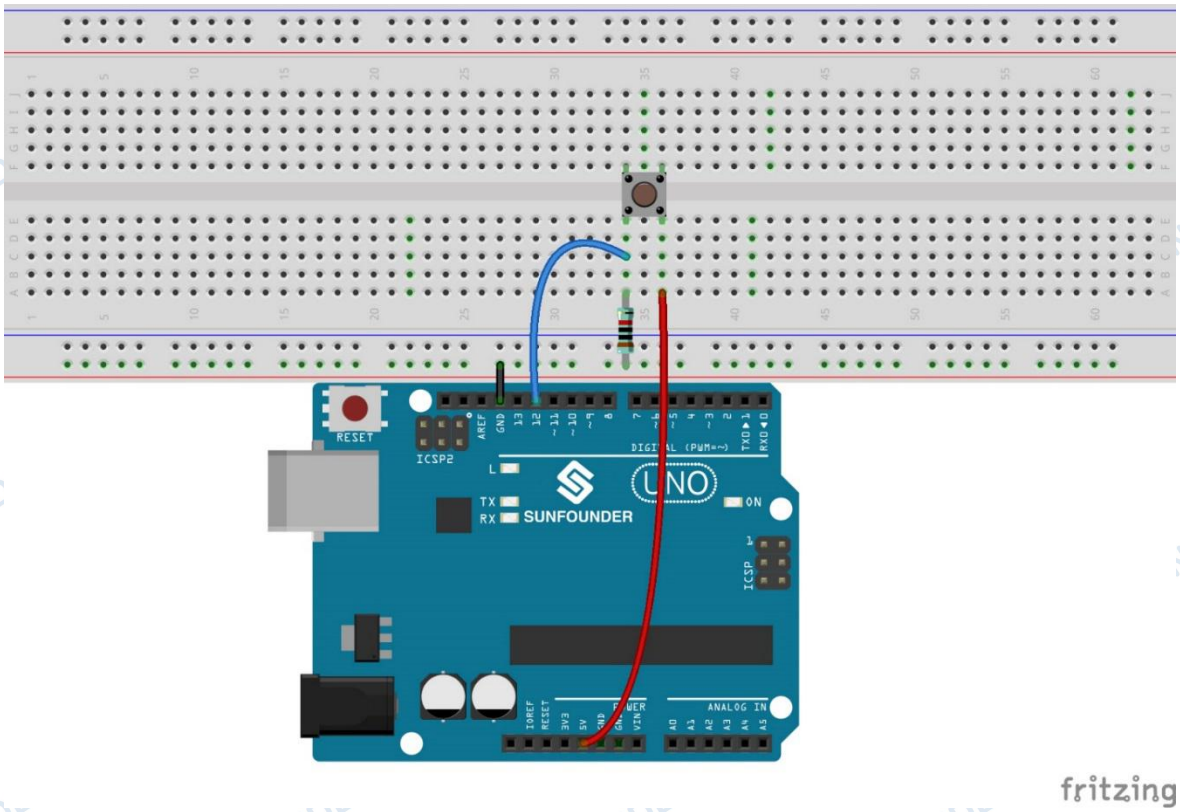


Generally, the button can be connected directly to the LED in a circuit to turn on or off the LED, which is comparatively simple. However, sometimes the LED will brighten automatically without any button pressed, which is caused by various kinds of external interference. In order to avoid this interference, a pull-down resistor is used – usually connect a 1K–10KΩ resistor between the button and GND. It can be connected to GND to consume the interference when the button is off.

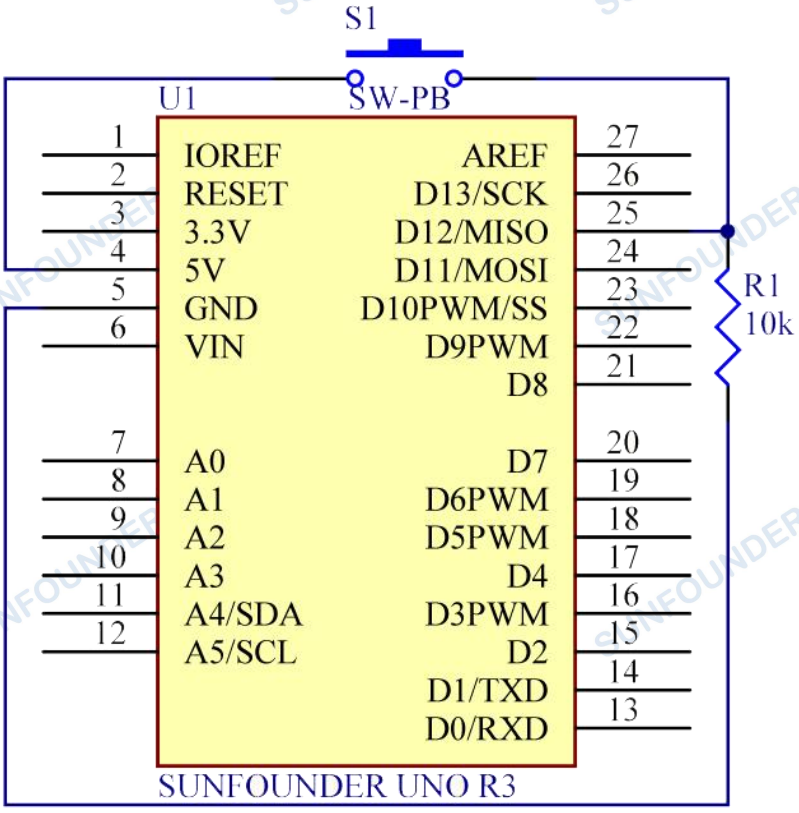
This circuit connection is widely used in numerous circuits and electronic devices. We may use the button to control a circuit later in many experiments (in or outside this kit maybe), so you might get its principle, which is very simple, and application at the beginning of your study.

Experimental Procedures

Step 1: Build the circuit



The schematic diagram

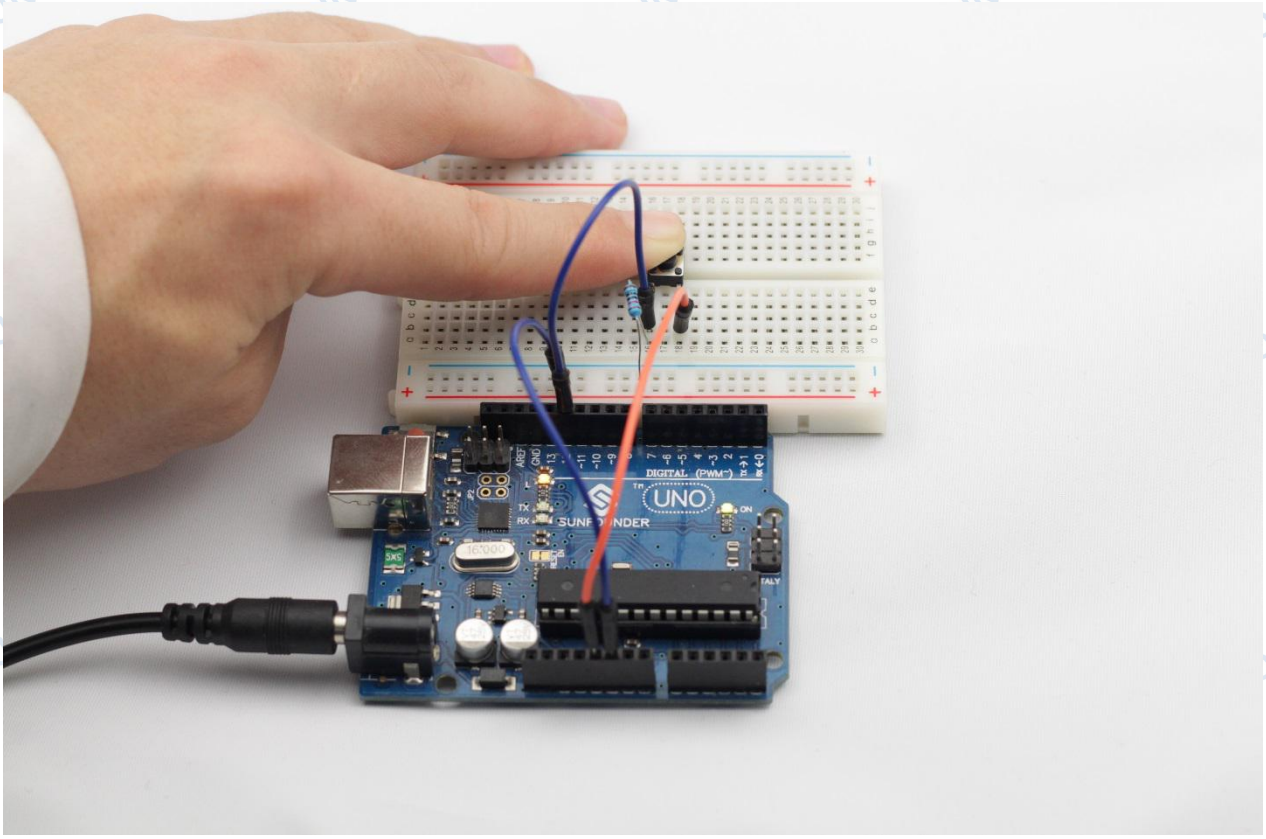


Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)

Step 3: Compile the code

Step 4: Upload the sketch to the SunFounder Uno board

Now, press the button, and the LED on the SunFounder Uno board will light up.



Lesson 2 Flowing LED Lights

Introduction

In this lesson, we will conduct a simple yet interesting experiment – using LEDs to create flowing LED lights. As the name suggests, these eight LEDs in a row successively light up and dim one after another, just like flowing water.

Components

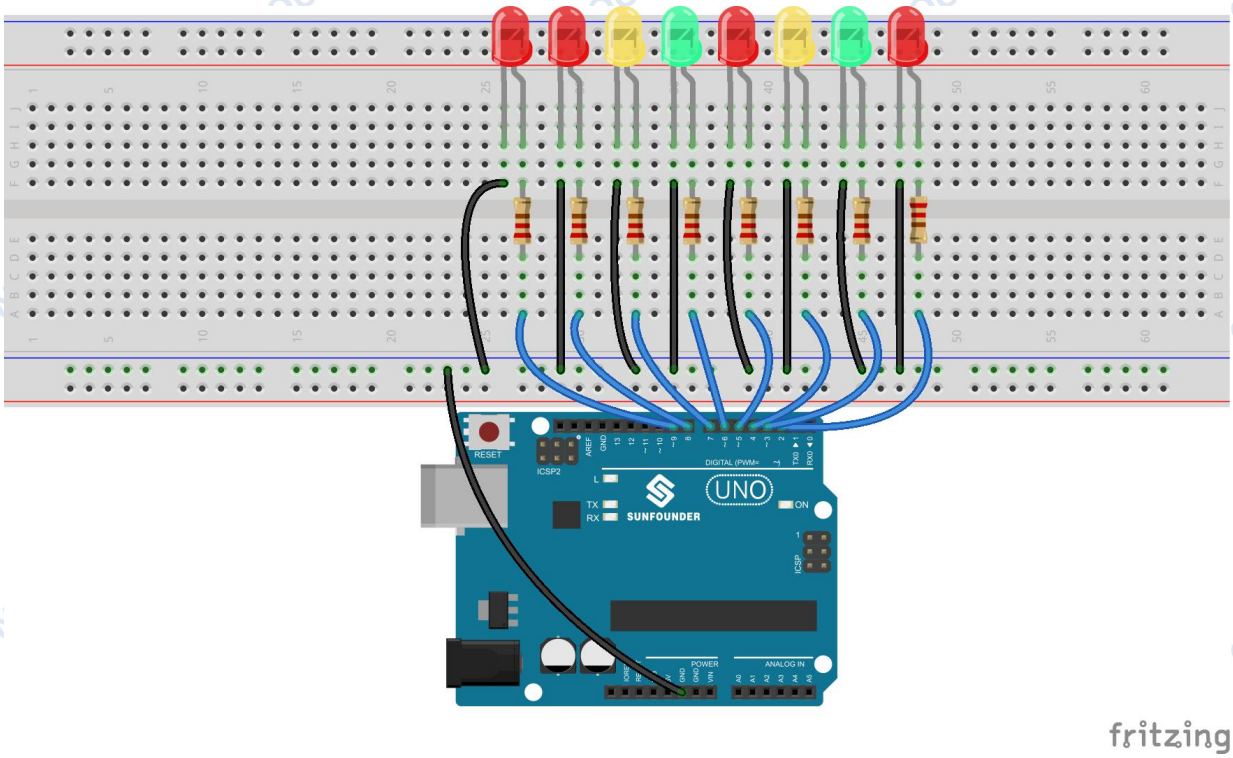
- 1 * SunFounder Uno board
- 1 * Breadboard
- Jumper wires
- 8 * LED
- 8 * Resistor (220Ω)
- 1 * USB cable

Principle

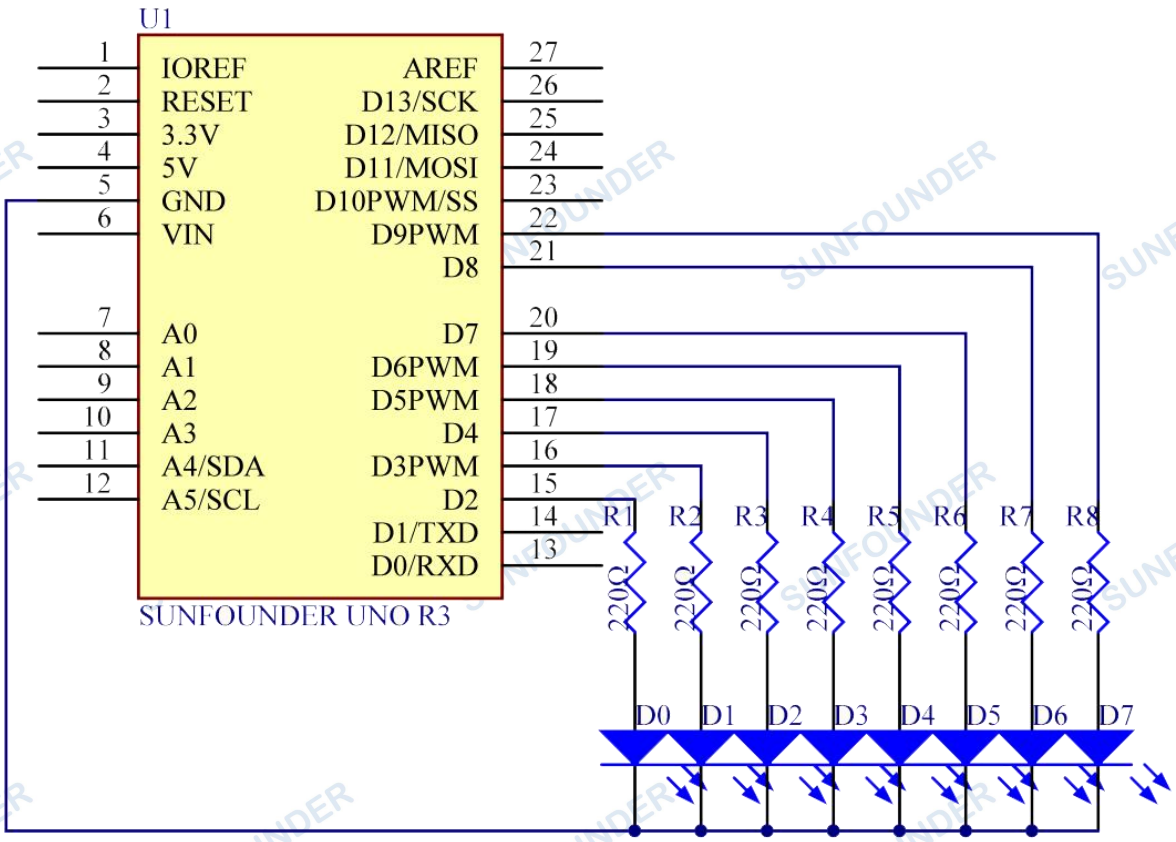
The principle of this experiment is simply to turn on eight LEDs in turn.

Experimental Procedures

Step 1: Build the circuit



The schematic diagram

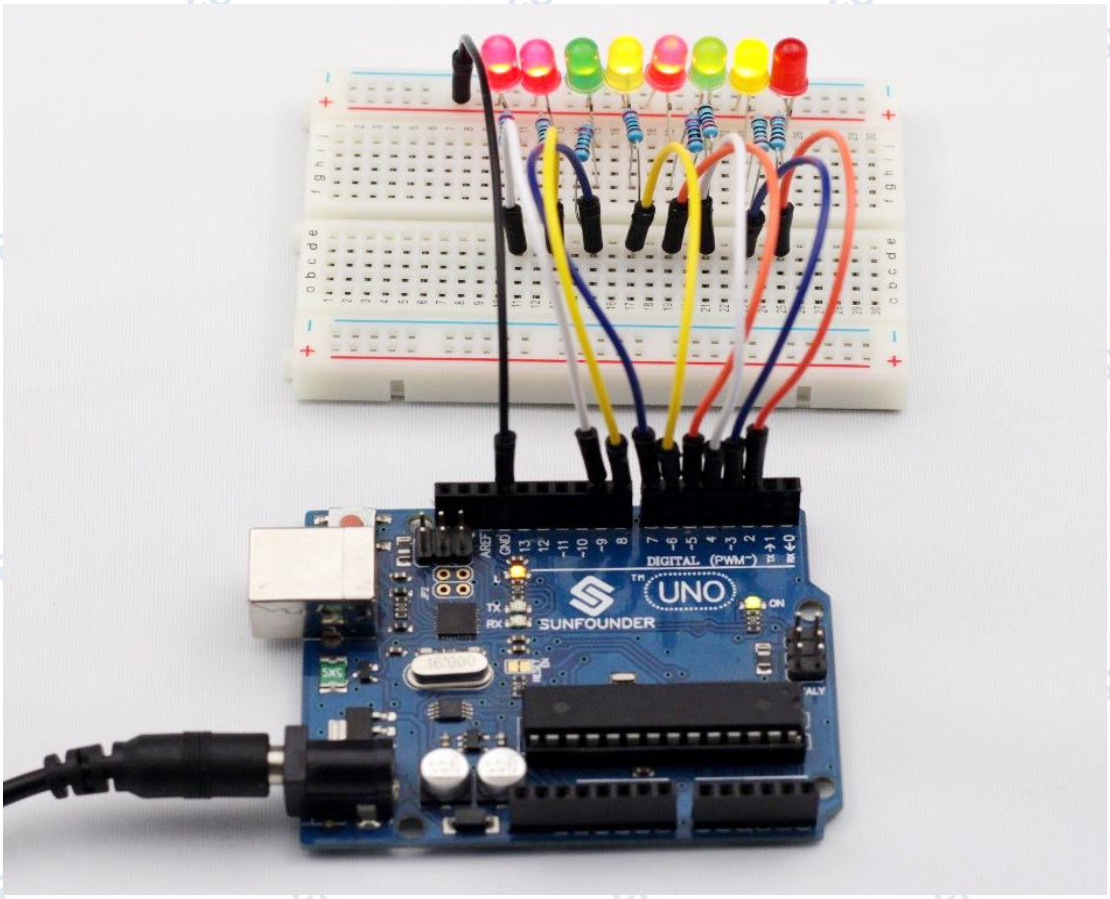


Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)

Step 3: Compile the code

Step 4: Upload the sketch to the SunFounder Uno board

Now, you should see eight LEDs brighten one by one from left to right, and then dim in turn from right to left. After that, the LEDs will light up from right to left and dim from left to right. This whole process will repeat until the circuit is power off.


SUNFOUNDER
UNO
DIGITAL (PWM~)

Lesson 3 Buzzer

Introduction

A buzzer is a great tool in your experiments whenever you want to make some sounds. In this lesson, we will learn how to drive an active buzzer to beep.

Components

- 1 * SunFounder Uno board
- 1 * Breadboard
- 1 * USB data cable
- 1 * Buzzer (Active)
- Jumper wires

Principle

As a type of electronic buzzer with integrated structure, buzzers, which are supplied by DC power, are widely used in computers, printers, photocopiers, alarms, electronic toys, automotive electronic devices, telephones, timers and other electronic products for voice devices. Buzzers can be categorized as active and passive ones (see the following picture). Turn the pins of two buzzers face up, and the one with a green circuit board is a passive buzzer, while the other enclosed with a black tape is an active one.

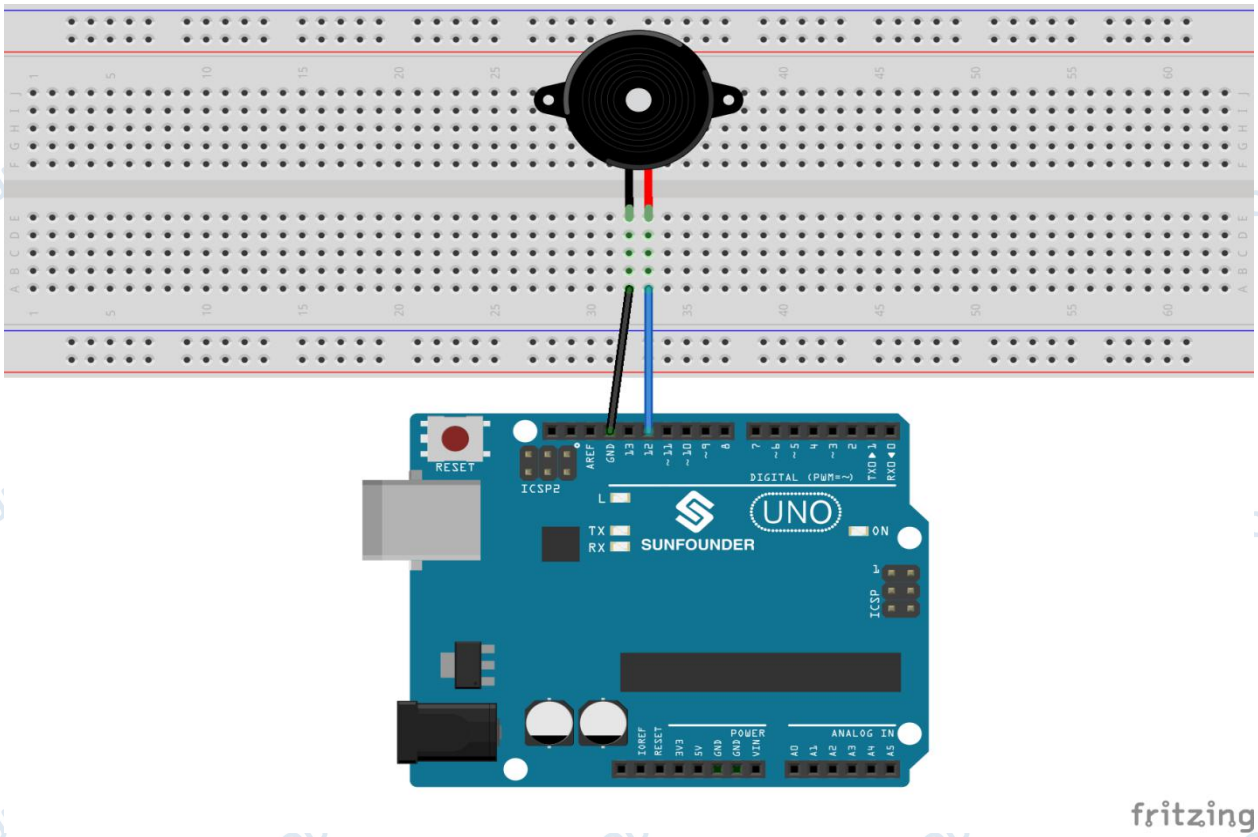
The difference between an active buzzer and a passive buzzer is:

An active buzzer has a built-in oscillating source, so it will make sounds when electrified. But a passive buzzer does not have such source, so it will not tweet if DC signals are used; instead, you need to use square waves whose frequency is between 2K and 5K to drive it. The active buzzer is often more expensive than the passive one because of multiple built-in oscillating circuits.

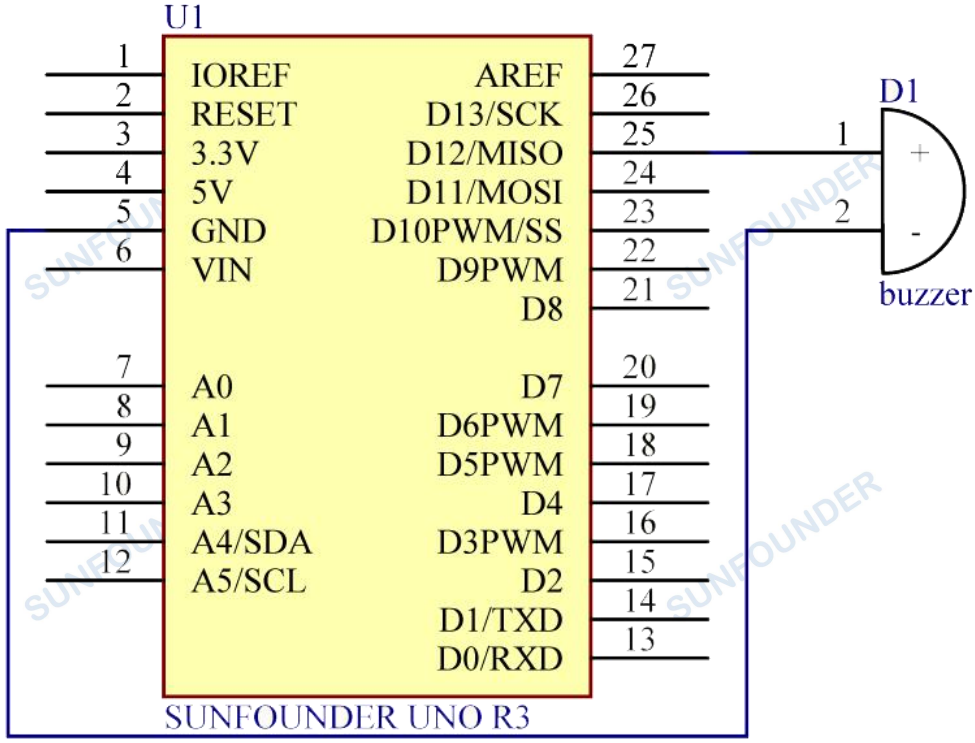
In this experiment, we use the active buzzer.

Experimental Procedures

Step 1: Build the circuit (Pay attention to the positive and negative poles of the buzzer)



The schematic diagram

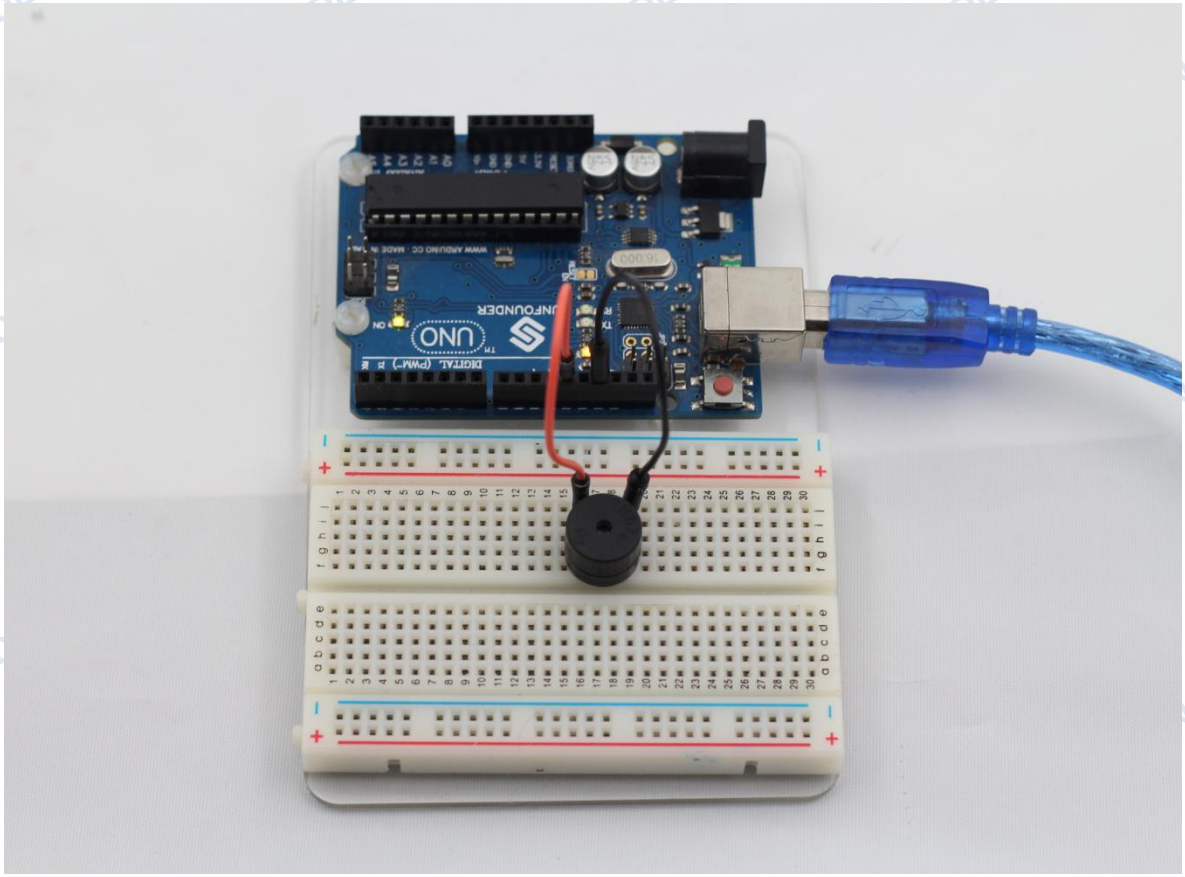


Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)

Step 3: Compile the code

Step 4: Upload the sketch to the SunFounder Uno board

Now, you should hear the buzzer make sounds.



Lesson 4 Photoresistor

Introduction

A photoresistor or photocell is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits.

Components

- 1 * SunFounder Uno board
- 1 * USB data cable
- 1 * Photoresistor
- 1 * Resistor (10KΩ)
- 8 * LED
- 8 * Resistor (220Ω)
- Jumper wires
- 1 * Breadboard

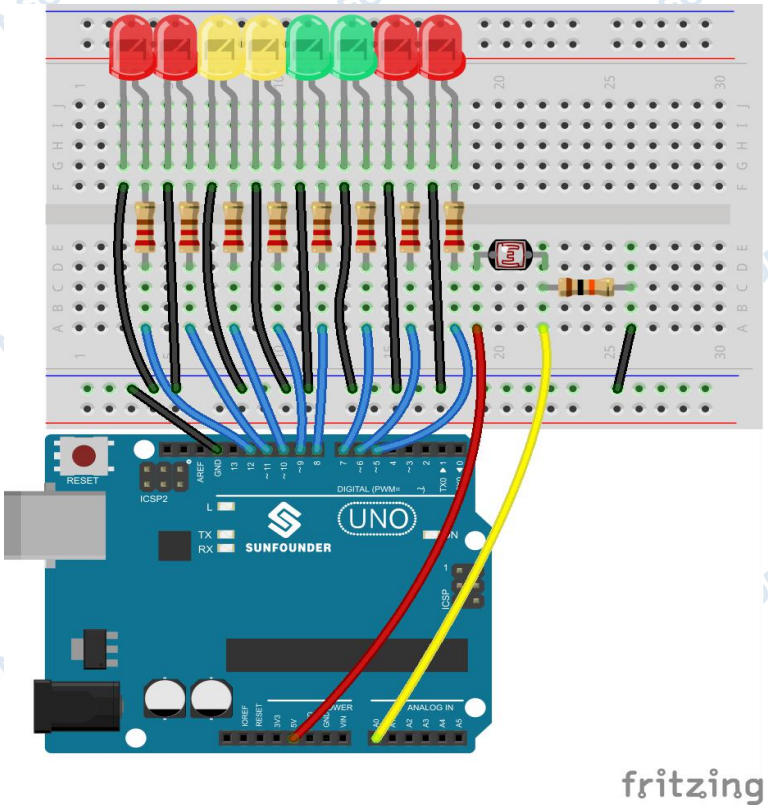
Experimental Principle

The resistance of the photoresistor changes with incident light intensity. If the light intensity gets higher, the resistance decreases; if low, the intensity increases.

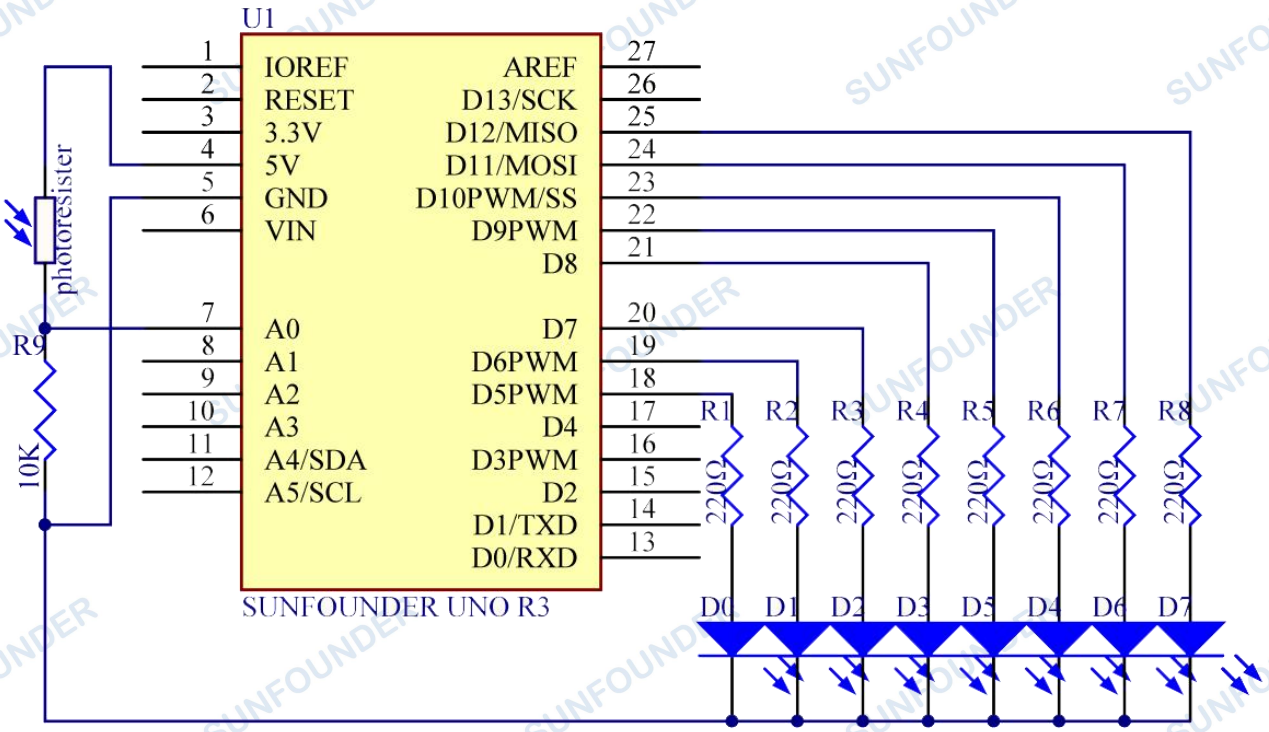
In this experiment, we will use eight LEDs to indicate light intensity. The higher the light intensity is, the more LEDs brighten. When the light intensity is high enough, all the LEDs will light up. When there is no light on the sensor, all the LEDs will go out.

Experimental Procedures

Step 1: Build the circuit



The schematic diagram

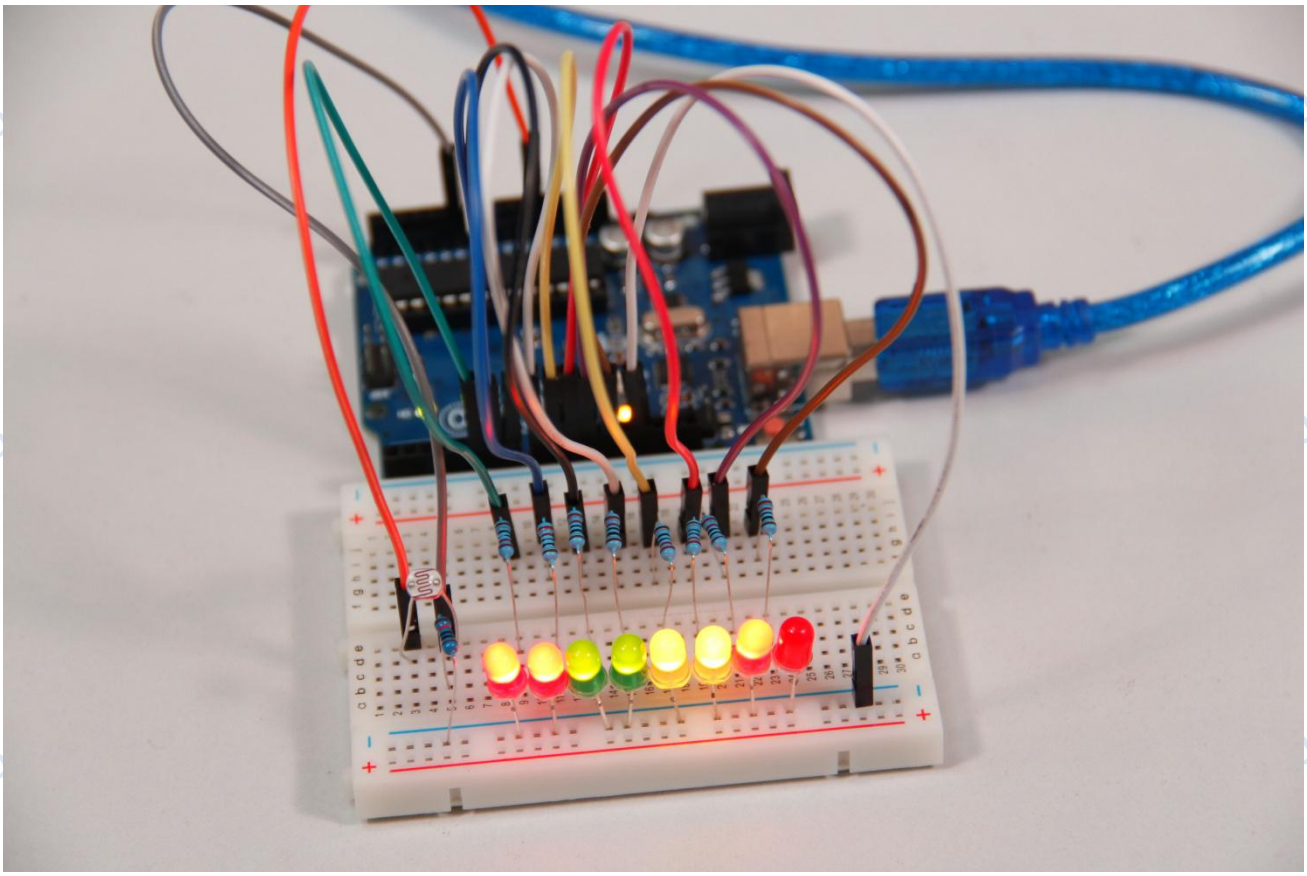


Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)

Step 3: Compile the code

Step 4: Upload the sketch to the SunFounder Uno board

Now, shine a flashlight or other light sources on the photoresistor, and you will see several LEDs light up. Change the light intensity and you will see more (or less) LEDs brighten. Place it in a dark environment, and all the LEDs will go out.



Exploration

In addition, you can replace the photoresistor with a microphone and use LEDs to indicate sound intensity. The higher the sound intensity is, the more LEDs brighten. Try to realize this effect by yourself!

Lesson 5 RGB LED

Introduction

In this lesson, we will use the PWM technology to control an RGB LED to flash various kinds of colors.

Components

- 1 * RGB LED
- 3 * Resistor (220Ω)
- 1 * Breadboard
- 1 * SunFounder Uno board
- Jumper wires
- USB cable

Principle

RGB

RGB stands for the red, green, and blue color channels and is an industry color standard. RGB displays various new colors by changing the three channels and superimposing them, which, according to statistics, can create 16,777,216 different colors.

Each of the three color channels has 255 stages of brightness. When the three primary colors are all 0, it is the least bright, thus turning it off. When the three colors are all 255, which is the brightest, the LEDs will brighten. When the light emitted of the three colors are mixed together, the colors will be mixed too. However, the brightness is equal to the sum of all brightness. And the more you mix, the brighter the LED gets. This process is known as additive mixing.

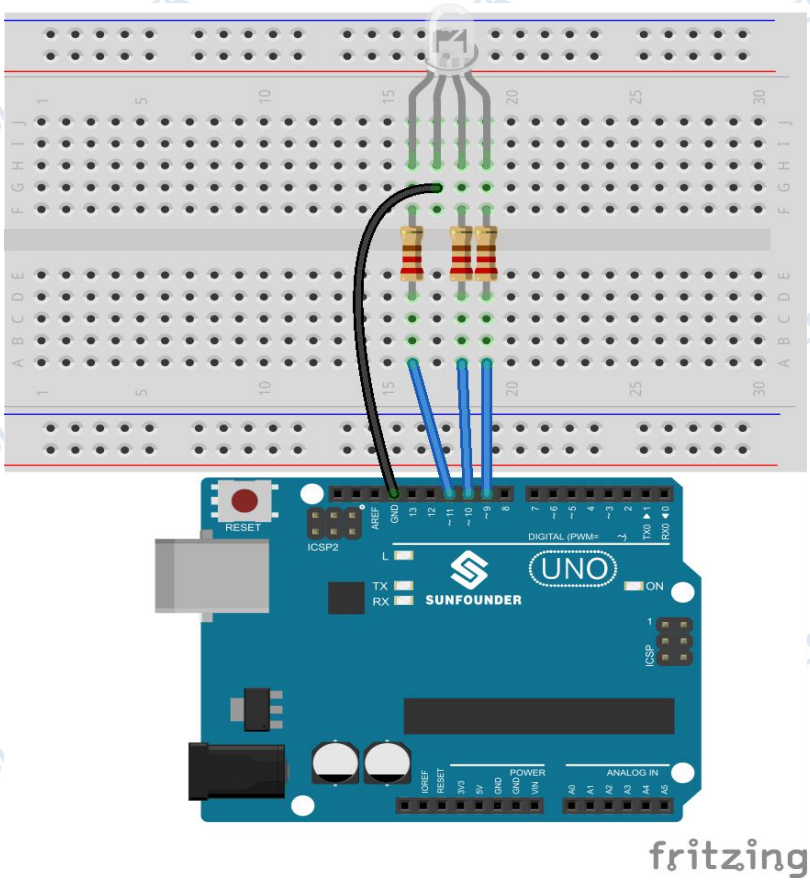
PWM

Pulse width modulation, or PWM, is a technique for getting analog results with digital means. Digital control is used to create a square wave, a signal switched between on and off. This on-off pattern can simulate voltages in between full on (5 Volts) and off (0 Volts) by changing the portion of the time the signal spends on versus the time that the signal spends off. The duration of "on time" is called pulse width. To get varying analog values, you change, or modulate, that width. If you repeat this on-off pattern fast enough with some device, an LED for example, it would be like this: the signal is a steady voltage between 0 and 5V controlling the brightness of the LED. (For more, check our website and the official website of Arduino).

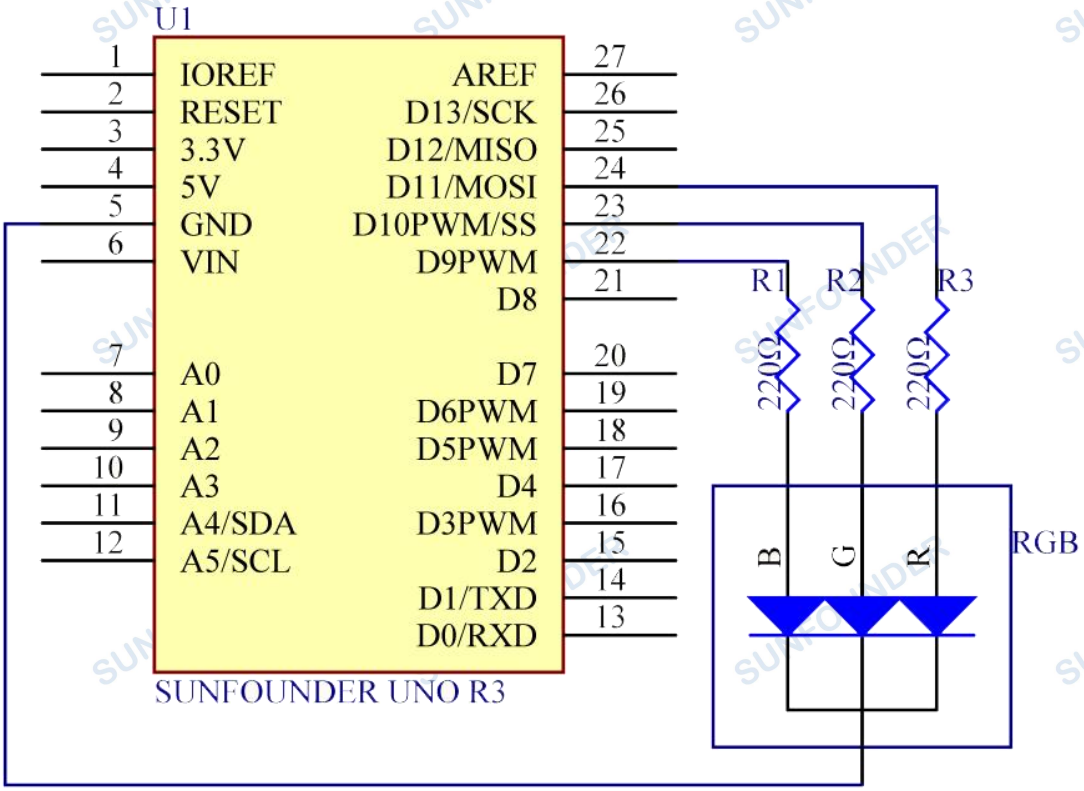
In this experiment, apply PWM and input a value between 0 and 255 to the three pins of the RGB LED to make it display different colors.

Experimental Procedures

Step 1: Build the circuit



The schematic diagram

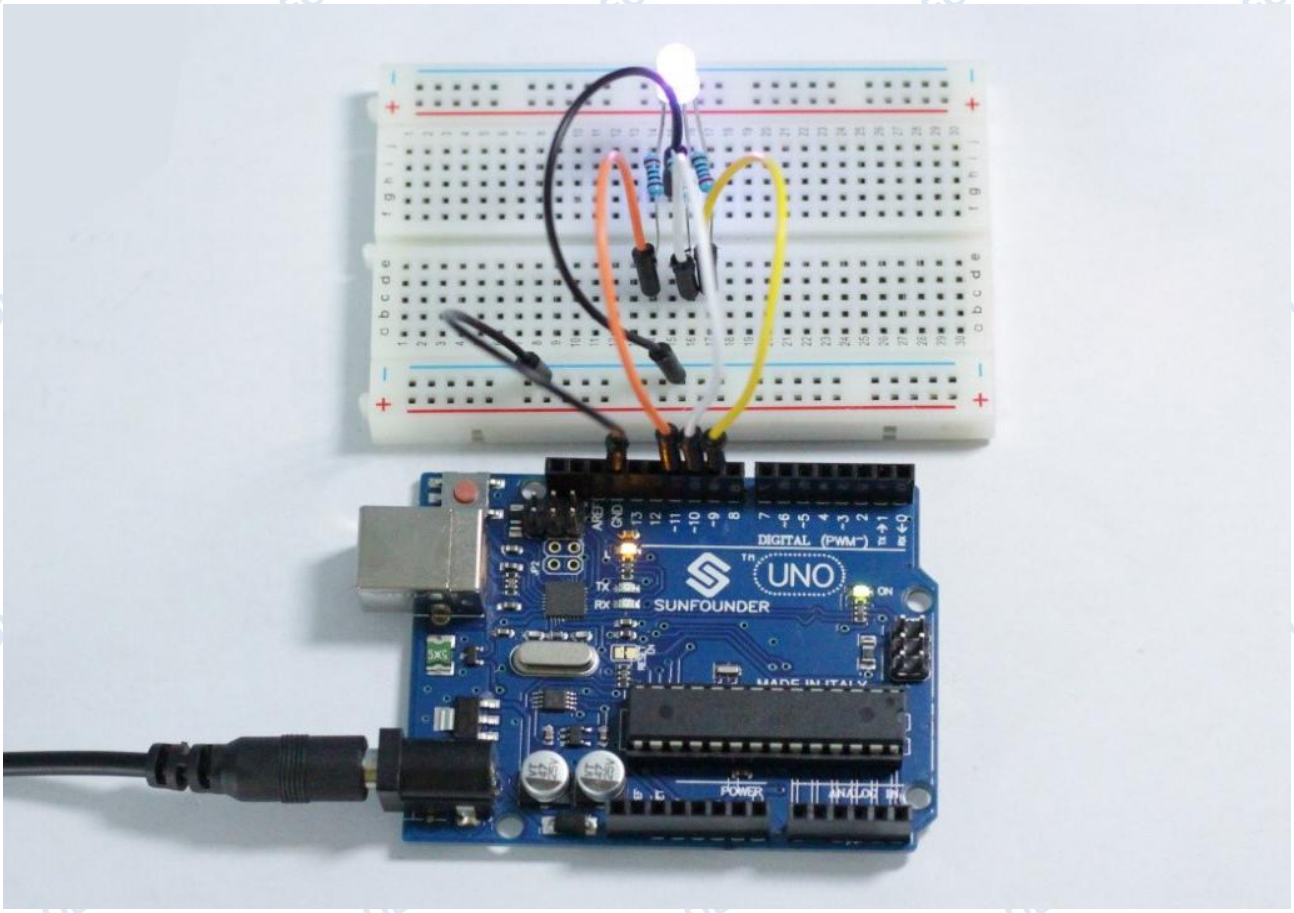


Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)

Step 3: Compile the code

Step 4: Upload the sketch to the SunFounder Uno board

Here you should see the RGB LED flash circularly red, green, and blue first, then red, orange, yellow, green, blue, indigo, and purple.


DIGITAL (PWM~)
UNO
SUNFOUNDER
ON
POWER
ANALOG IN

Lesson 6 Relay

Introduction

Relays are suitable for driving high power electronic devices, such as lights, fans and air conditioning. We can use a relay to realize the function of controlling high voltage by low voltage with an MCU.

Components

- 1 * SunFounder Uno board
- 1 * USB data cable
- 1 * Relay
- 1 * LED
- 1 * Resistor (220Ω)
- 1 * Resistor (1KΩ)
- 1 * NPN Transistor
- 1 * Diode (Rectifier)
- Several jumper wires
- 1 * Breadboard

Experimental Principle

Relay – There are 5 parts in every relay:

1. **Electromagnet** – It consists of an iron core wounded by coil of wires. When electricity is passed through, it becomes magnetic. Therefore, it is called electromagnet.

2. **Armature** – The movable magnetic strip is known as armature. When current flows through them, the coil is it energized thus producing a magnetic field which is used to make or break the normally open (N/O) or normally close (N/C) points. And the armature can be moved with direct current (DC) as well as alternating current (AC).

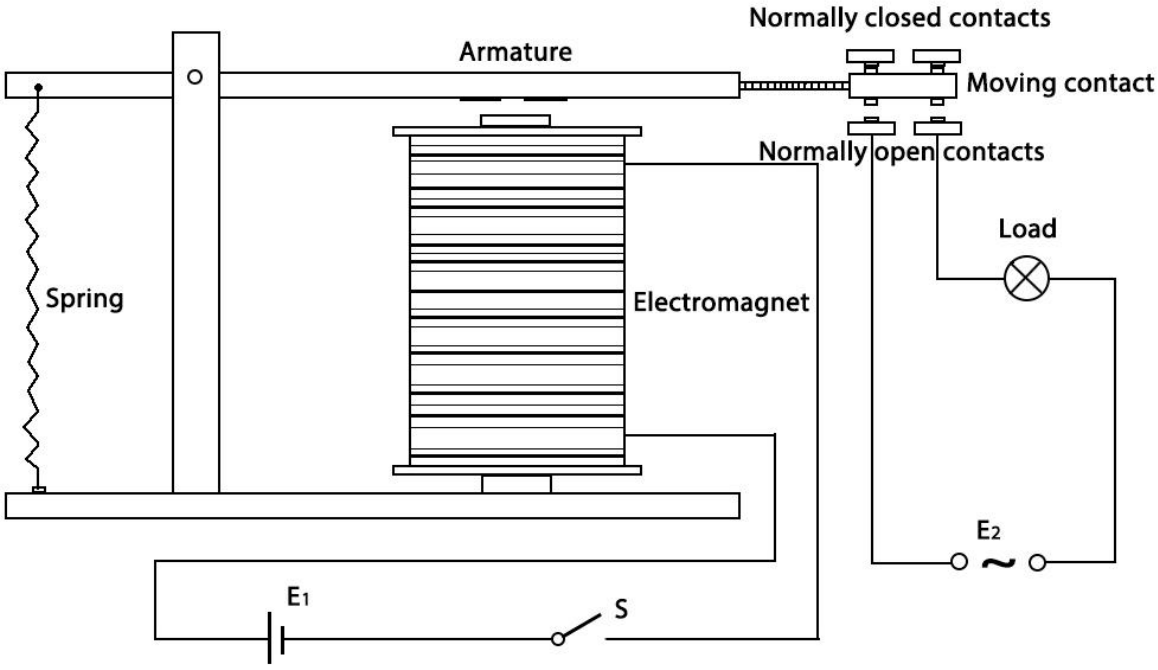
3. **Spring** – When no currents flow through the coil on the electromagnet, the spring pulls the armature away so the circuit cannot be completed.

4. Set of electrical **contacts** – There are two contact points:
    - Normally open - connected when the relay is activated, and disconnected when it is inactive.
    - Normally close – not connected when the relay is activated, and connected when it is inactive.

5. Molded frame – Relays are covered with plastic for protection.

Working of Relay

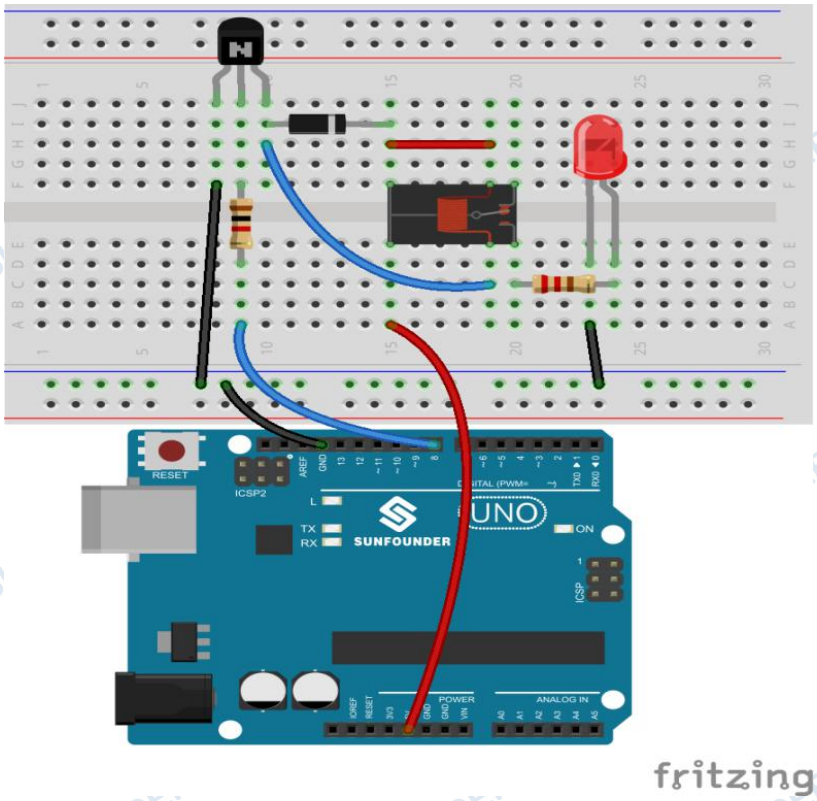
The working principle of relay is simple. When power is supplied to the relay, currents start flowing through the control coil; as a result, the electromagnet starts energizing. Then the armature is attracted to the coil, pulling down the moving contact together thus connecting with the normally open contacts. So the circuit with the load is energized. Then breaking the circuit would a similar case, as the moving contact will be pulled up to the normally closed contacts under the force of the spring. In this way, the switching on and off of the relay can control the state of a load circuit.



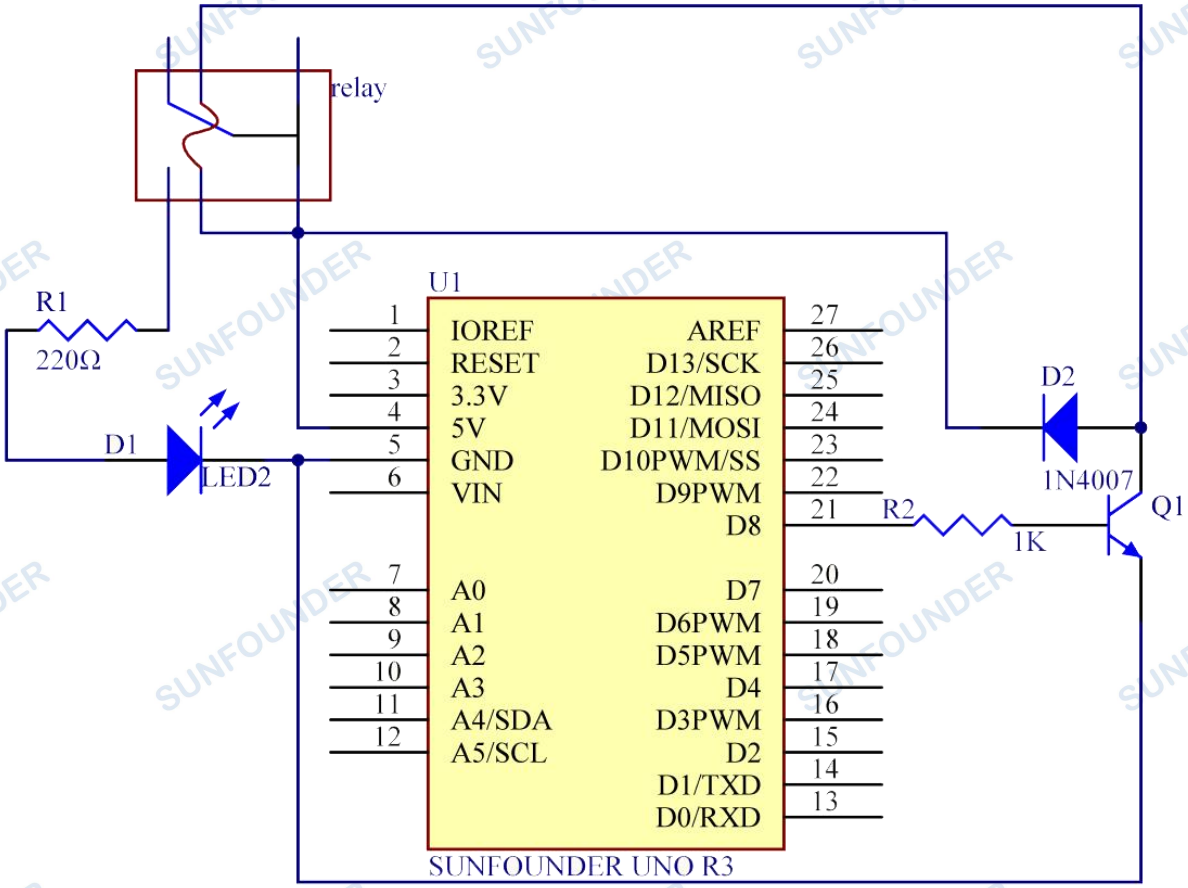
In this experiment, when the relay closes, the LED will light up; when it opens, the LED will go out.

Experimental Procedures

Step 1: Build the circuit

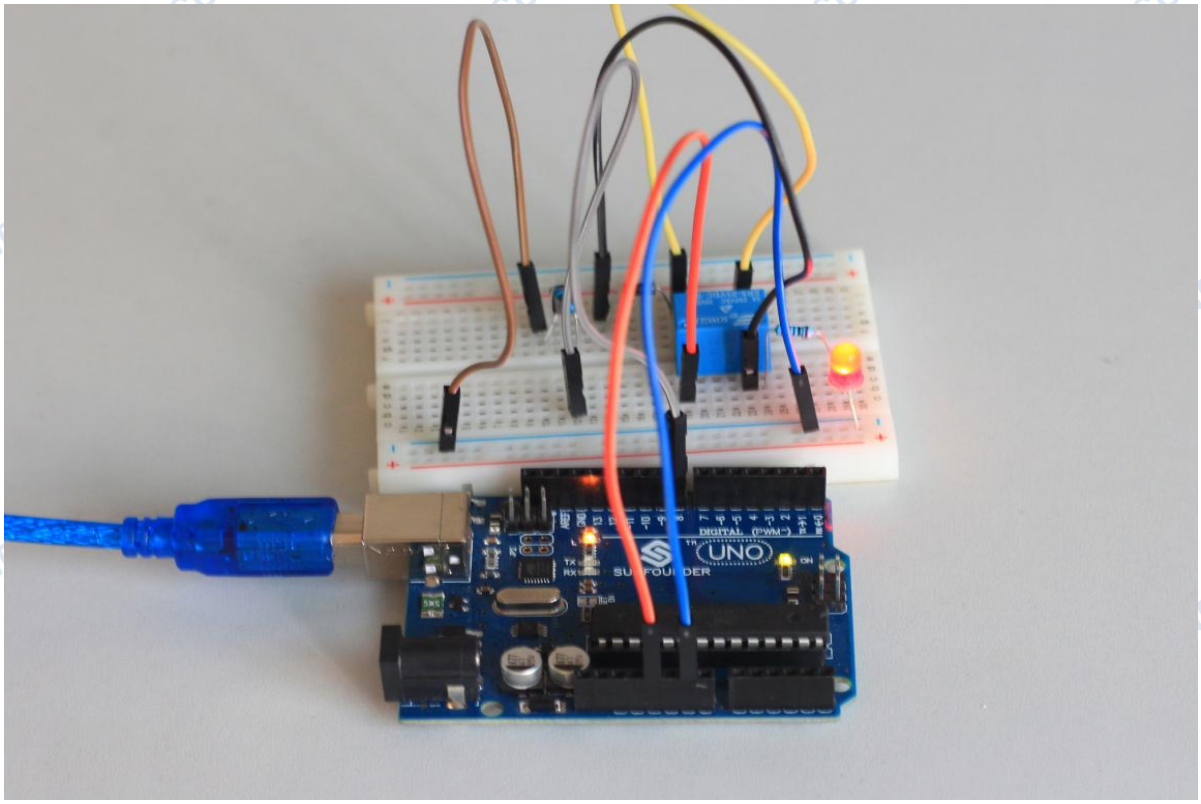


The schematic diagram



Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)
Step 3: Compile the code
Step 4: Upload the sketch to the SunFounder Uno board

Now, if a high voltage is supplied, the relay will be closed and the LED lights up; if a low voltage is supplied, it will be opened and the LED goes out. In addition, you can hear a ticktock when the contact is closed or opened.



Lesson 7 Tilt-Switch

Introduction

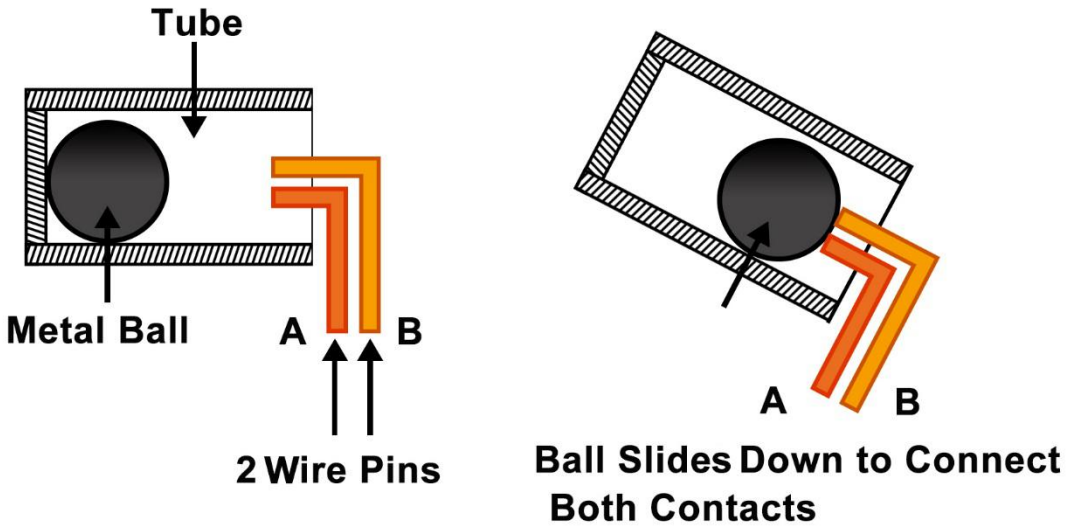
The tilt switch used here is a ball one with a metal ball inside. It is used to detect small angle of inclination.

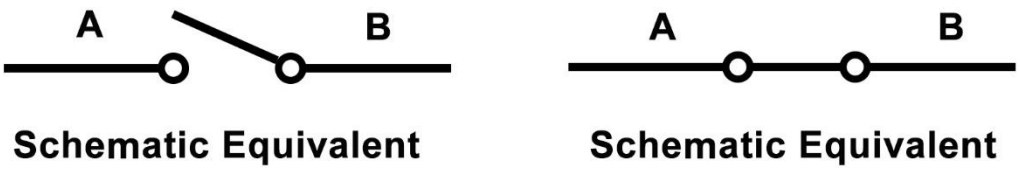
Components

- 1 * SunFounder Uno board
- 1 * USB data cable
- 1 * Tilt switch
- Several jumper wires

Experimental Principle

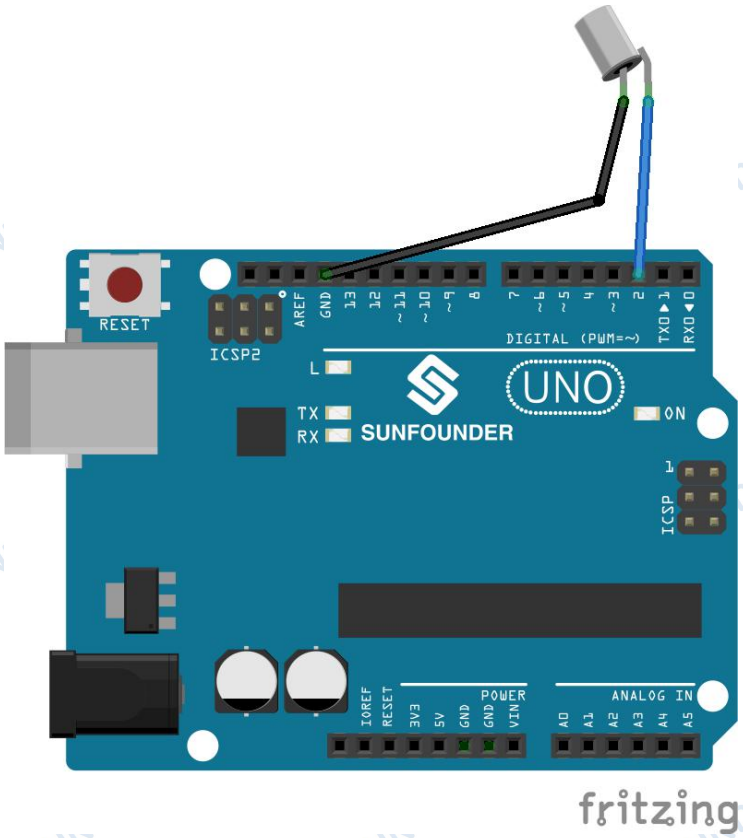
The principle is very simple. When the switch is tilted in a certain angle, the ball inside rolls down and touches the two contacts connected to the pins outside, thus triggering circuits. Otherwise the ball will stay away from the contacts, thus breaking the circuits.



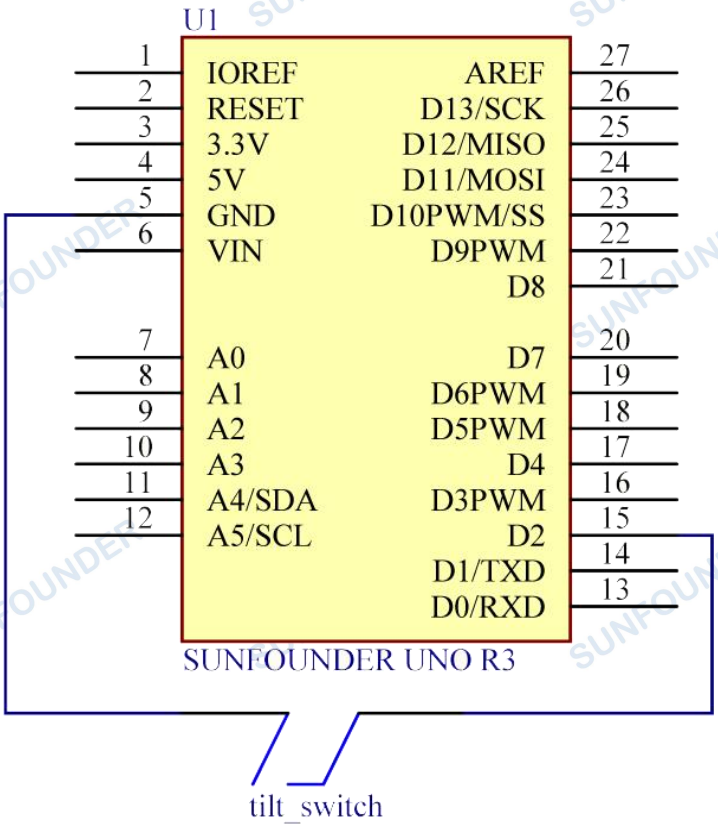


Experimental Procedures

Step 1: Build the circuit



The schematic diagram

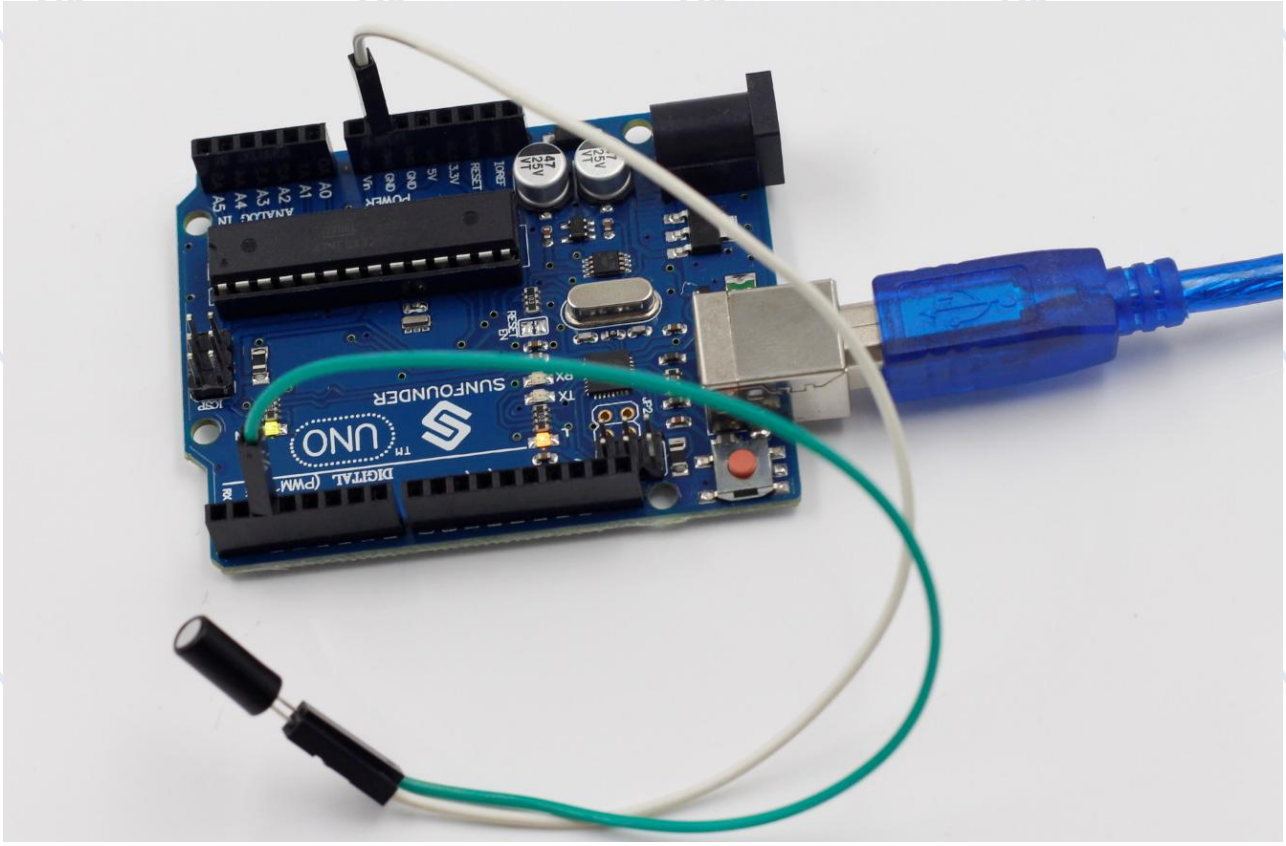


Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)

Step 3: Compile the code

Step 4: Upload the sketch to the SunFounder Uno board

Now, tilt the switch, and the LED attached to pin 13 on SunFounder Uno board will light up.



Lesson 8 Thermistor

Introduction

A thermistor is a type of resistor whose resistance varies significantly with temperature.

Components

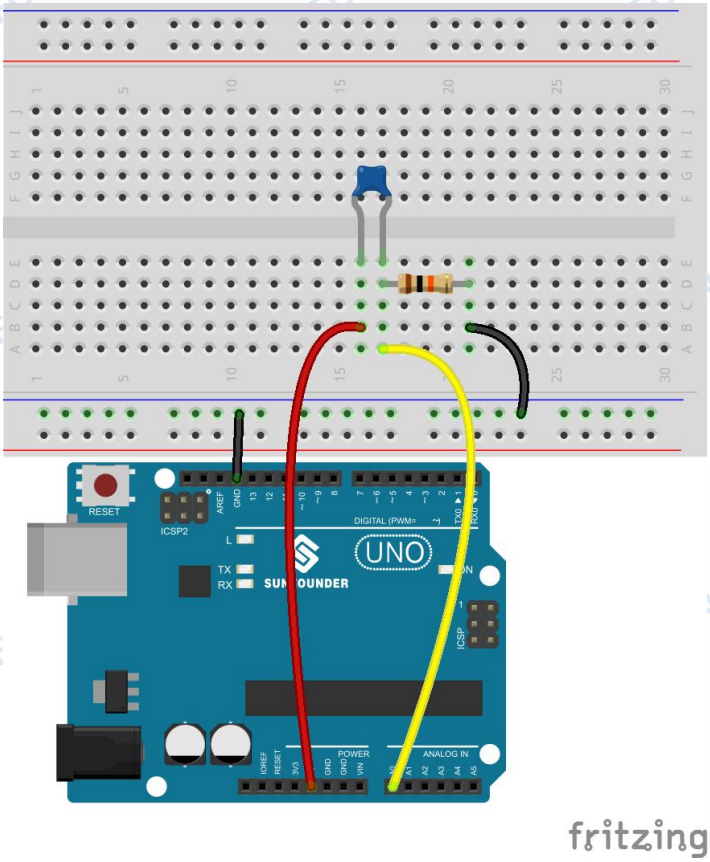
- 1 * SunFounder Uno board
- 1 * USB data cable
- 1 * Thermistor
- 1 * Resistor (10K)
- Several jumper wires

Experimental Principle

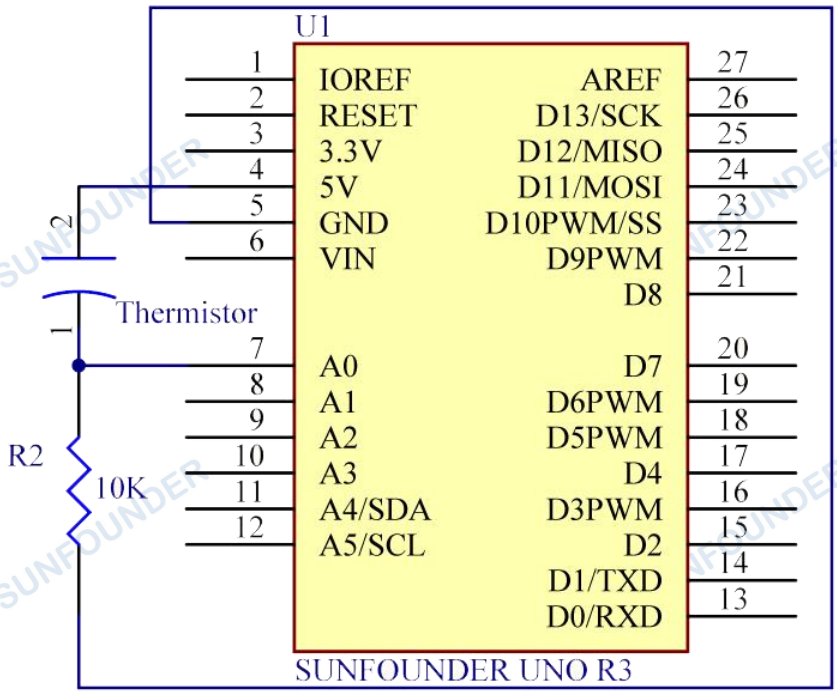
The resistance of the thermistor varies significantly with ambient temperature. It can detect surrounding temperature changes in real time. Send the temperature data to analog I/O port of SunFounder Uno board. Next we only need to convert sensor output to Celsius temperature by simple programming and display it on Serial Monitor.

Experimental Procedures

Step 1: Build the circuit



The schematic diagram

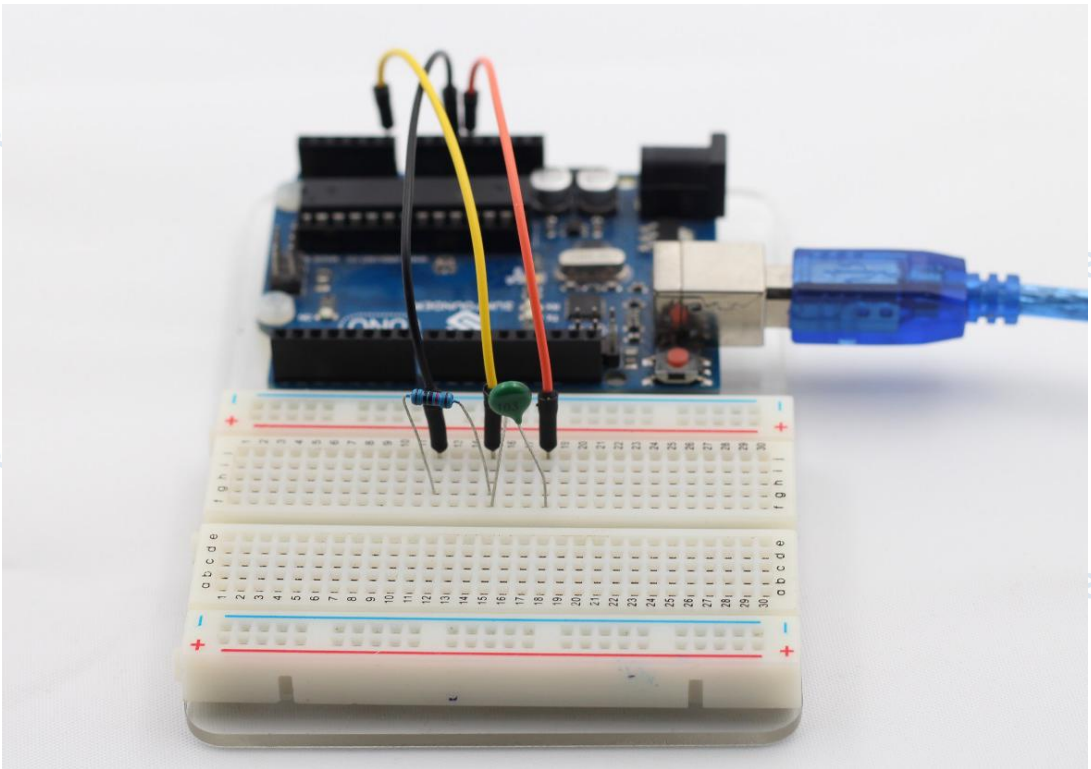


Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)

Step 3: Compile the code

Step 4: Upload the sketch to the SunFounder Uno board

Now, you can see the current temperature displayed on the Serial Monitor.



Lesson 9 Light Alarm

Introduction

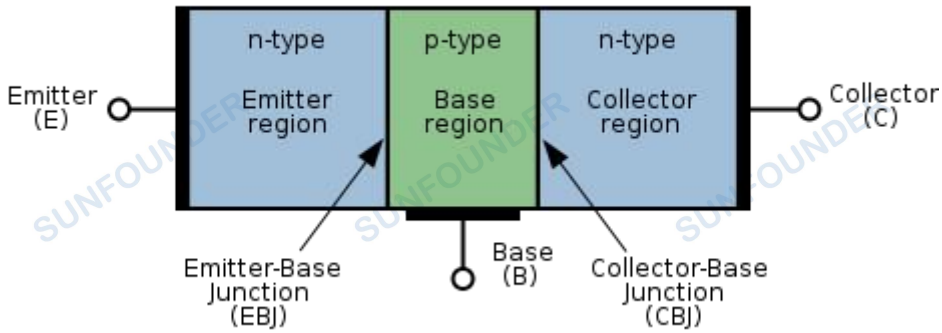
This experiment is a very interesting one – a DIY phototransistor. DIY phototransistors use the glow effect and photoelectric effect of LEDs. That is, LEDs will generate weak currents when some light is shined on it. And we use a transistor to amplify the currents generated, so the SunFounder Uno board can detect them.

Components

- 1 * SunFounder Uno board
- 1 * Breadboard
- 1 * USB cable
- Jumper wires
- 1 * Passive buzzer
- 1 * Resistor (10KΩ)
- 1 * LED
- 1 * NPN Transistor S8050

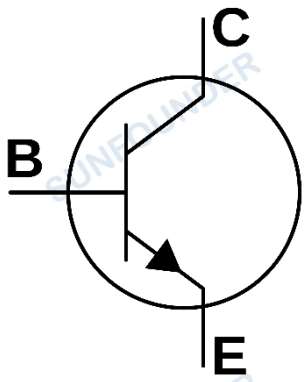
Principle

LEDs not only have a glow effect, but also a photoelectric effect. They will generate weak currents when exposed to light waves.



NPN consists of a layer of P-doped semiconductor (the "base") between two N-doped layers (see the picture above). A small current entering the base is amplified to produce a large collector and emitter current. That is, when there is a positive potential difference measured from the emitter of an NPN transistor to its base (i.e., when the base is high relative to the emitter) as well as positive potential difference measured from the base to the collector, the transistor becomes active. In this "on" state, current flows between the collector and emitter of the transistor.

There are three poles for the regions: base (b), emitter (e) and collector (c). They form two P-N junctions, namely the base-emitter junction and collector-base junction. The arrows in the NPN symbol (see the figure below) indicates the direction of the base-emitter junction.

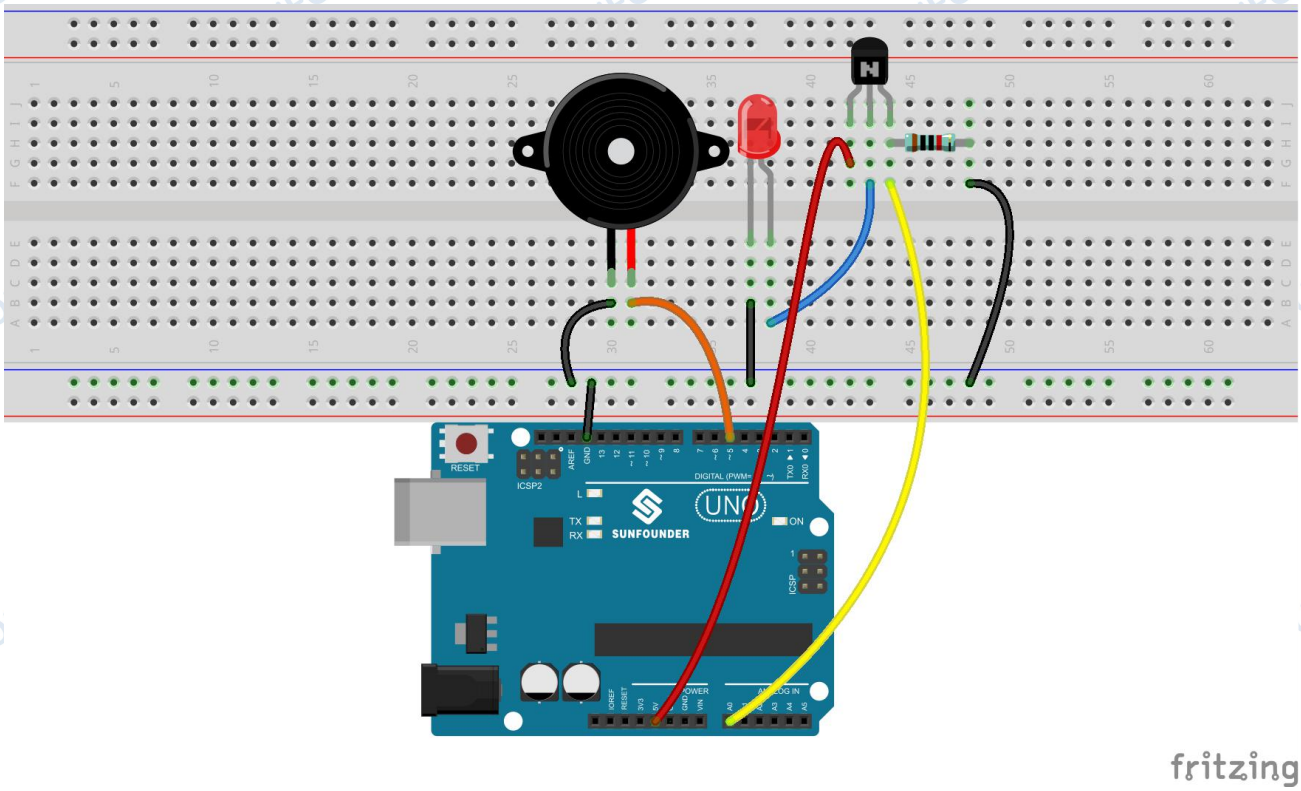


The symbol of NPN is shown here. We can see the two PN junctions with unilateral conductivity inside, which enables it a switch component.

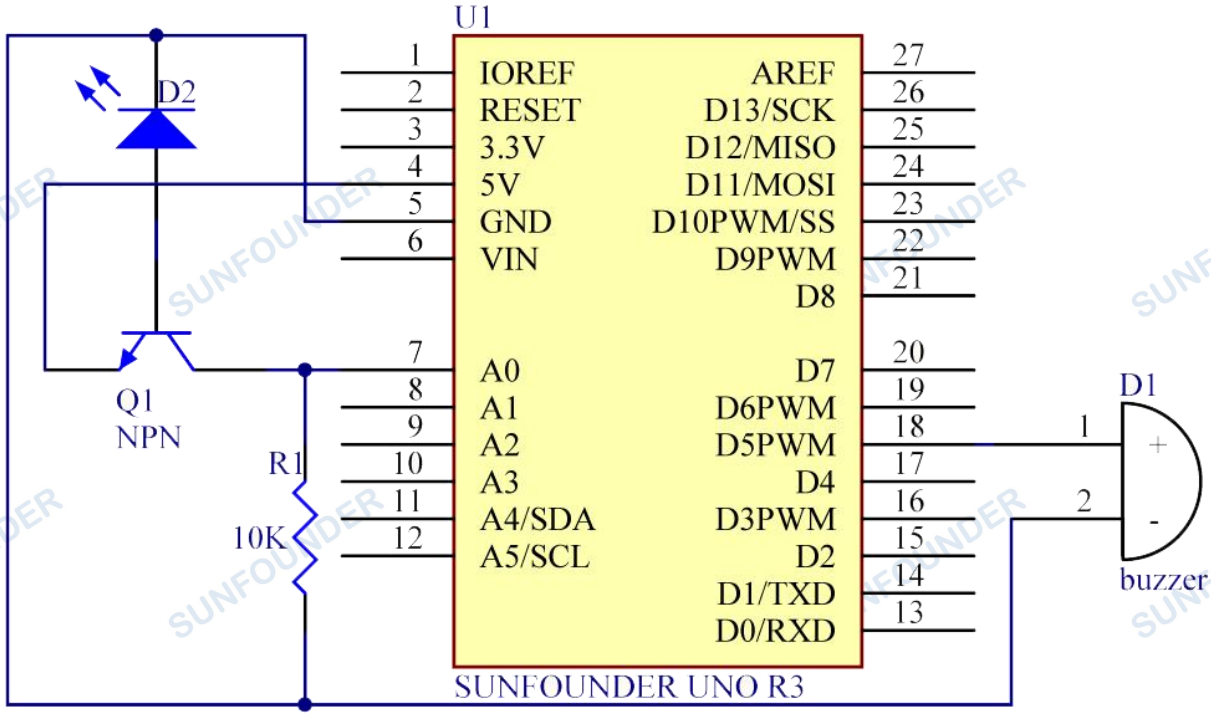
A 10kΩ pull-down resistor is attached to the transistor output stage in order to avoid analog port suspending to interfere with signals and cause misjudgment.

Experimental Procedures

Step 1: Build the circuit



The schematic diagram

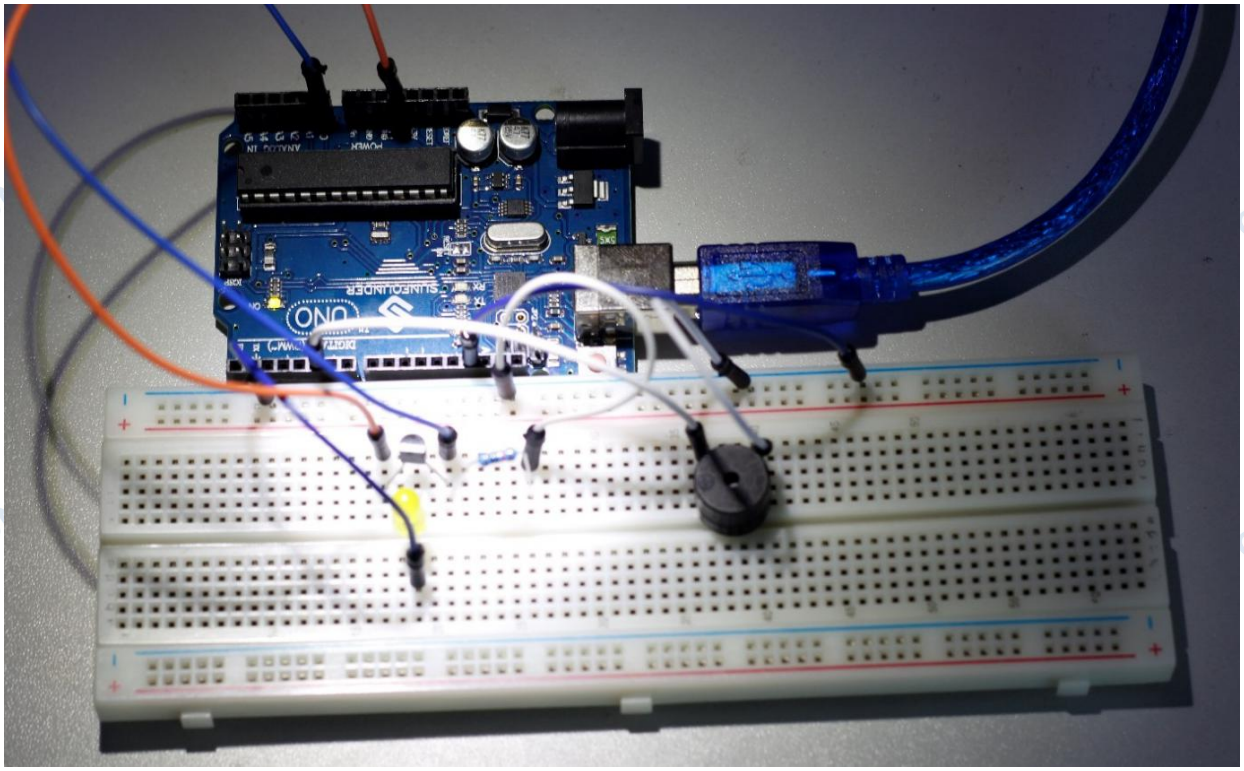


Step 2: Program (Please refer to the example code in LEARN -> Get Tutorial on our website)

Step 3: Compile the code

Step 4: Upload the sketch to the SunFounder Uno board

Now, you can hear the buzzer beep when shining a flashlight on the LED.



For Safe Use

All parts and devices in this kit should be powered appropriately in compliance with relevant regulations and standards applicable in the country of intended use.

The connection of unapproved external devices to the modules/boards in this kit may affect compliance or result in damage to the unit, for which we will not be responsible.

To avoid malfunction or damage to your circuit boards, please observe the following:

DO NOT expose it to water/moisture or place it on a conductive surface whilst in operation.

DO NOT expose it to heat from any source; the product is designed for reliable operation at normal ambient room temperatures.

Take care whilst handling to avoid mechanical or electrical damage to the printed circuit board and connectors.

PLEASE perform the connection or wiring based on the instructions in the manual or our website if you are not clear of the results.

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