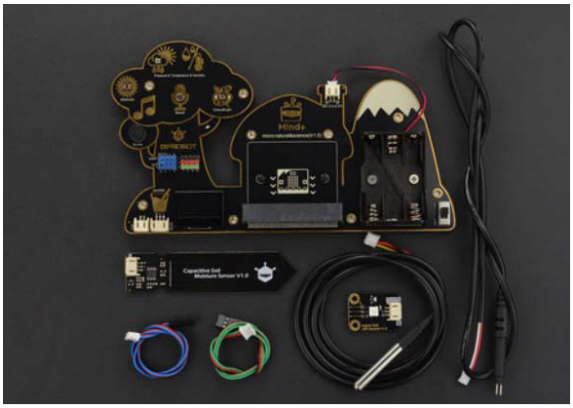
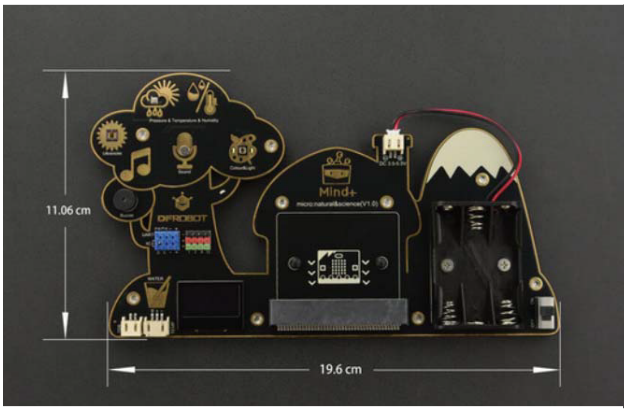
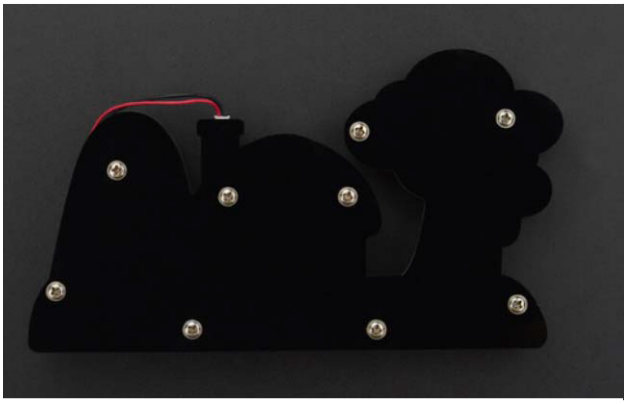






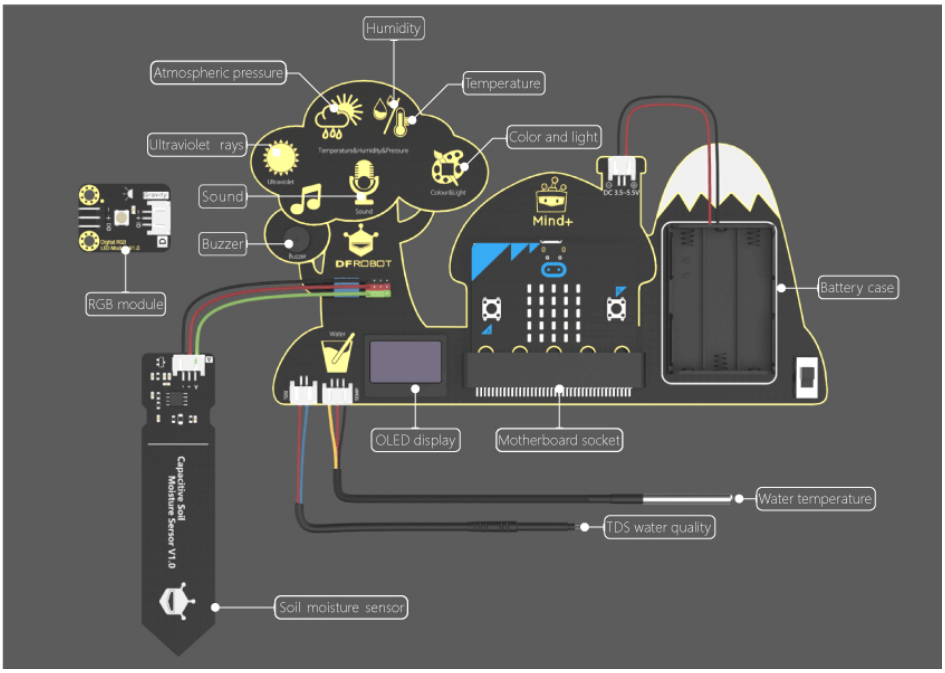
Environment Science Board for micro: bit (V1.0)

SKU:MBT0013

INTRODUCTION

Environment Science Board for micro: bit is designed with highly symbolic trees, houses, and snowy mountains. On a wide and easy-to-use PCB, it integrates many sensor modules of nature and science. Including UV sensor, temperature sensor, humidity sensor, air pressure sensor, sound sensor, color sensor, light sensor, water temperature sensor, TDS water quality sensor, buzzer, OLED display, etc.

This kit is rich in knowledge, including a wide range of applications. It is initial to observe and ease to play. Extended GPIOs are set and it supports gravity series sensors. The bottom is designed with PMMA (acrylic） to enhance the ease of use and durability.
It supports Makecode and Mind + platforms.



FEATURES

- Integrate 10 sensors (including UV sensor, temperature sensor, humidity sensor, air pressure sensor, sound sensor, color sensor, light sensor, water temperature sensor, TDS water quality sensor, soil humidity sensor)
- Integrate OLED display
- Rich in knowledge
- Initial to observe, and ease to play

SPECIFICATION

- Power supply: 3.5V~5V (AAA 1.5V Battery x3)
- GPIO: P1, P2, P8, P12, UART, I2C
- ML8511 UV sensor

- BME280 sensor
- TCS34725 color sensor
- DS18B20 waterproof temperature sensor
- TDS water quality sensor
- Capacitive soil moisture sensor
- WS2812-RGB-LED
- Dimension: 196mm×110.6mm
- Programming platform: Makecode and Mind+

DOCUMENTS

- Product wiki

SHIPPING LIST

- Environment Science Board for micro: bit (V1.0) x1

Introduction

Based on micro: bit, this environment expansion board is closely concerned with natural science. We hope through the natural subjects' combination, the maker education can be close-to-life.

Therefore, we integrated multiple sensors in this expansion board like atmospheric pressure, temperature, humidity, UV rays, light, color, sound, water quality, water temperature, soil moisture and so on. Which covers all basic aspects of natural science and daily life.

In the process of learning, students can learn the measurement principles of various natural data. And by programming their own graphical program to measure the relevant data, it deepens the understanding of knowledge, as well as the recognition of natural science.

Specification

- Power Supply: (3.5V~5V) 1.5V AAA Battery x3
- Digital Output Voltage: 0V/3.3V
- Analog Input Voltage: 0~3.3V DC
- Common Interfaces: IIC, UART, P1, P2, P8, P12
- ML8511 Ultraviolet Sensor
    - Operating Temperature: -20°C~ +70°C
    - Sensitive Range: UV-A, UV-B
    - Sensitive Wavelength: 280-390nm
- BME280 Environmental Sensor
    - Operating Current: 2mA
    - Operating Temperature: -40°C~+85°C
    - Temperature Inspection Range: -40°C ~ +85°C, resolution 0.1°C, error ±0.5°C
    - Humidity Inspection Range: 0~100%RH, resolution 0.1%RH, error ±2% RH
    - Pressure Inspection Range: 300~1100hPa
    - Response Time of Humidity Inspection: 1s
- TCS34725 Color Sensor
    - Operating Current: 65uA
    - Inspection Range: 3-10mm
    - Temperature Range: -30°C ~ +70°C
- Waterproof Temperature Sensor

    - Temperature Display Range: -10°C~+85°C (±0.5°C)
    - Temperature Range: -55°C to 125°C (-67°F to +257°F)
    - Query Time: ＜750ms
- TDS Water Quality Sensor

NOTE

- The probe cannot be used in water above 55°C.
- The probe cannot be left too close to the edge of the container, otherwise it will affect the reading.
- The head and the cable of the probe are waterproof, but the connector and the signal transmitter board are not. Please be careful!

- STM32 IIC Address: 0x1F
- Dimension: 196mm x 110.6mm
- Supportive Programming Platform: Makecode, Mind+

Board Overview

Basic makecode tutorial: click to enter the makecode online graphical tutorial.

Library Address: http://https://github.com/DFRobot/pxt-NaturalScience

Tutorial

Part1: Get to Know and Protect Nature

We live together on this beautiful blue planet: on Earth. On the earth, there are blue seas, green forests, clear streams, yellow deserts, colorful flowers, a variety of plants and animals; All this makes our home flourish and vibrant.

However, the population expansion, the acceleration of urbanization, the expansion of industry, deforestation, the air becomes cloudy, the streamlines no longer clear...

Environmental protection is not only the public welfare but also the responsibility of everyone, no matter what we do, as large as afforestation, as small as garbage classification. Everyone should make effort to protect the environment. But what kind of things are we capable of to protect the environment?

To begin with, let's get to know and understand nature itself. Through the learning, we can not only learn all kinds of nature knowledge, such as temperature, humidity, atmospheric pressure, ultraviolet light, color, light, water quality and so on... We can also learn how to use micro: bit to measure and use this data, so as to better protect nature and cherish our living environment.

Part2: The Comfortable Degree Evaluation of Environment: Temperature and Humidity

1.How Temp & Humidity affect the environmental comfort degree?

Among many meteorological elements, temperature and humidity are the biggest impacts on human health and comfort.

Generally, the human body feel comfortable when the temperature between 18-28 degrees and the humidity between 50%-60%. The ultra-low humidity will lead to excessive drying, one is easy to produce static electricity and increase the density of dust easily, so 50%-60% humidity is appropriate.

So, what affects the temperature and humidity of the environment? How can we measure temperature and humidity?

- Plants: Plants can evaporate water to improve the ambient air humidity, and absorb the sun's light energy to reduce the ambient temperature, so in the summer heat, dense forest temperature is relatively lower.
- Environment: Melting glaciers, air pollution all greatly affect and the environment temperature and humidity.

2.How to measure Temp & Humidity?

It’s too hard to control temp and humidity in the atmosphere, but it will not be hard to control the indoor temp and humidity with equipment such as air conditioners, humidifiers, electric fans and so on. Now, let’s get to know the units and measurements of temperature and humidity.

Unit and Measurement

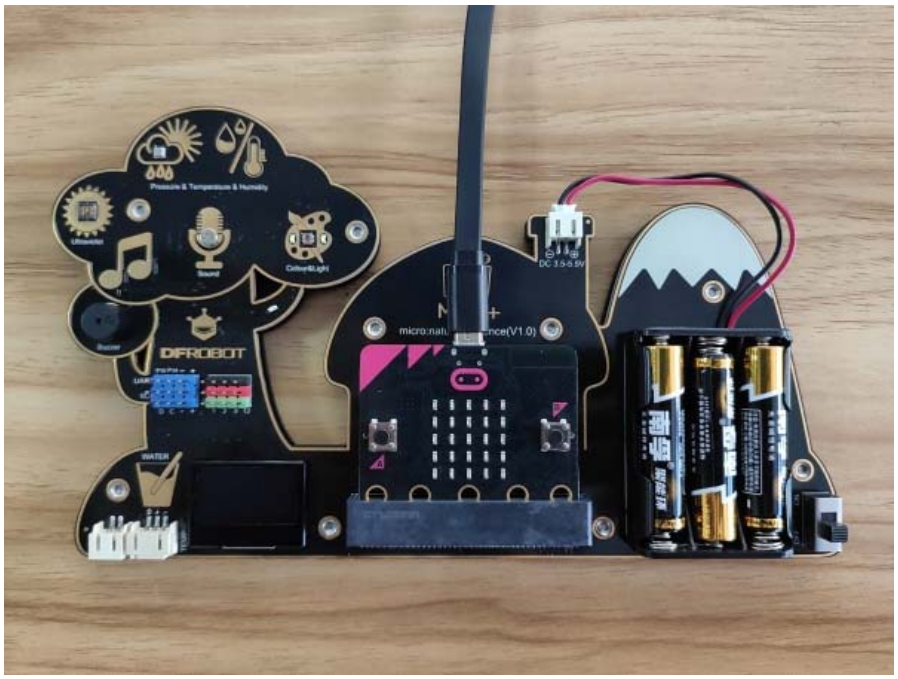
- Units: Currently the most common temperature units are: Celsius (C) and Fahrenheit (F), and humidity units are percentages (% RH)
- Measurement: The most common device for measuring temperature is a thermometer.

In the age of the Internet of Things, we also use a device called a "temperature sensor" and a "humidity sensor" to measure temperature and humidity, and can display the measured data on a screen or to a computer for analysis. Smaller and easier to use.

3.Measure the environmental Temp & Humidity

- Tools in Need

1. micro: bit Environment Expansion Board x1
2. micro: bit x1
3. AAA Battery x1
4. USB Cable x1

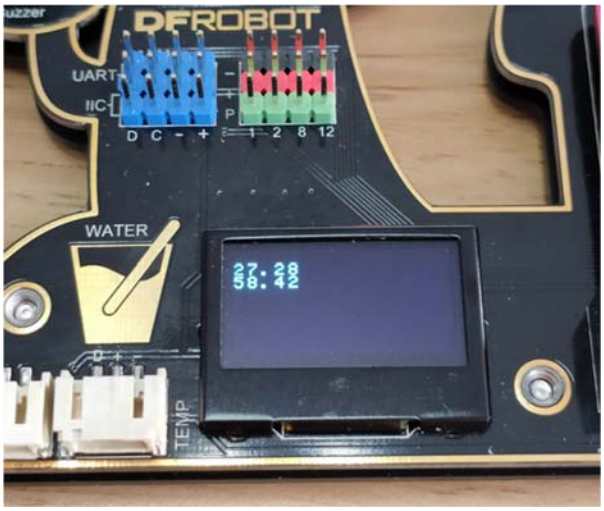


As the image above shows, we prepared the necessary tools. Then let's program the code to monitor temperature and humanity.

- Click to open the online Makecode programming https://makecode.microbit.org/
- Load the micro: bit natural science library https://github.com/DFRobot/pxt-NaturalScience
- According to the image below to program the code.

Download the code and check the result:

The first line of the OLED display shows the temperature is 27.28°C and the second line shows the humidity is 58.42%RH.



Hereafter, let’s check which hardware is designed to monitor temperature and humidity. In the top of the board, a tiny component in the center of the cloud and sun is the one that measures temperature, humidity and atmospheric pressure (what is the atmospheric pressure? We will introduce it in the next part)

Try holding our fingers down to this sensor, as shown in the figure:

We will find that two data changes, especially the temperature, the change is very obvious, the temperature is constantly rising, because our body temperature is higher than the ambient temperature, by holding down the sensor, the body temperature is transmitted to the sensor.

4.Extensions

Temperature Alarm: we'll do some functional extensions to the program, as shown in the figure. The buzzer starts to alert us when the temperature exceeds 30 degrees.

5.Conclusion

Through the learning above, we have learned the following: Learned the effects of temperature and humidity on human comfort. Mastered the current temperature and humidity measurement methods. We measured the temperature and humidity around us through programming, and actually experienced the sensor's measurement.

Part3: Get to Know and Measure the Pressure

1.Introduction

Air pressure is the atmospheric pressure acting on the unit area, i.e. the gravity of the vertical air column that is numerically equal to the vertical air column that extends upward in the upper boundary of the atmosphere. The famous Magdeburg hemispheric experiment proved its existence. The international unit of air pressure is Pascal, or Pa, and the symbol is Pa. In meteorology, people usually use kPa as a unit.

2.Atmospheric Pressure V.S. Altitude

The air pressure is related to altitude, atmospheric temperature, atmospheric density, etc. Generally, the atmospheric pressure will decrease as the altitude increases. And, during the year, winter is stronger than summer atmospheric pressure. E.g.

- Shanghai's altitude is about 0 meters, the atmospheric pressure is about 105kpa;
- Chengdu's altitude is about 520 meters, the atmospheric pressure is about 95kpa;
- The altitude of Mount Qomolangma is about 8848 meters, and the atmospheric pressure is about 30kpa.

From the data above, we can see that as the altitude increases, the greater the atmospheric pressure is lower. There is a formula that can roughly calculate the altitude, which can be done to understand.

The relationship between atmospheric pressure and altitude:

- **P=P0×(1-H/44300) ^5.256**

The calculation height formula is:

- **H=44300*(1- (P/P0) ^ (1/5.256))**

P.s. H- Altitude, P0-Atmospheric (0°C, 101.325kPa)

3.How to measure Atmospheric Pressure

In the previous section, we learned the basics of atmospheric pressure and the relationship with altitude, so how do we measure atmospheric pressure? There are three common ways to measure, mercury barometer, metal membrane barometer, and pressure sensor.

Mercury Barometer: the first mercury barometer was invented by Moreland in 1670. Then a German A. Sprung modified the original mercury barometer. The mercury barometer is a device to measure atmospheric pressure, the principle is based on the Torricelli experiment. Taking advantage of the principle that the mercury weight inverted in the glass tube column inside the mercury tank balances the surrounding atmospheric pressure, the height of the mercury column indicates atmospheric pressure. A standard atmospheric pressure (atm, standard atmosphere) is equal to the height of a 76 cm mercury column.

Metal Membrane Barometer: taking advantage of the difference between a standard atmospheric pressure filled internally and the air pressure of the outside world, which changes the metal form and reflected on the pointer.

Pressure Sensor: the air pressure sensor is an internal thin film that is sensitive to air pressure strength. When the pressure of the gas under test decreases or increases, the deformation of the film causes the internal resistance value to change, which causes the voltage to change. After an A/D conversion, it becomes a computer-readable air pressure data. The air pressure sensor is not only high-precision, but also small in size and easy to use. It is widely used in outdoor equipment, such as mountaineering watches, signal base stations, drones, etc.

4.Get to Know and Measure the Pressure

From the last part we know that the sensor in the center of the cloud and sun can measure the atmospheric pressure.

Now let's re-modify the program to test the local atmospheric pressure. Please write the following code and copy it to micro: bit. This program will automatically detect the local atmospheric pressure and display it on the display.

5.Conclusion

Through the learning above, we have learned the following:

- The basic concept of atmospheric pressure strength.

- The relationship between atmospheric pressure and altitude.
- Atmospheric pressure measurement method
- The way to program to measure the atmospheric pressure.

Part4: Sound

1.The principle of sound

Sound is a sound wave produced by the vibration of an object. It is a fluctuation that transmitted by a medium (air or solid, liquid) and is perceived by a person or animal's auditory organ. When playing an instrument, tapping a door or a tabletop, their vibration will lead to a rhythmic vibration of the air, causing the surrounding air to change dense, which will form a dense vertical wave, so sound waves produced and this phenomenon will continue until the vibration disappears.

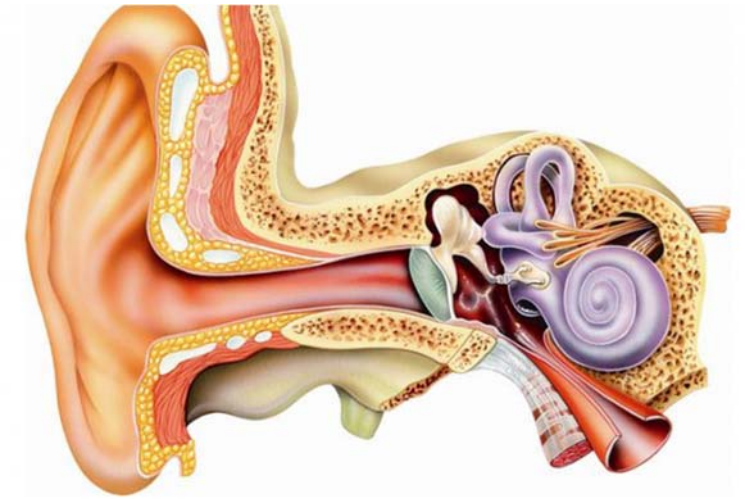
2.How could we hear sound?

The occurrence and transmission of sound in nature is a kind of vibrational sound wave. The vibrational sound wave received through the outer ear, passed through the ear canal to the eardrum. The vibration of the eardrum causes the hammer bone, the shin bone, the tibia three listening bone in the inside of the ear to vibrate one by one, and the sound wave turns into a solid vibration.

Then, the "inner ear" cochlear receives vibrations from the middle ear and activate the body's most important auditory receptor the Corti’sorgan to turn vibration into nerve impulses.

Neural impulses along the "listening nerve" to the brain's auditory center, the auditory center to complete the tasks of auditory information, analyzing, processing, integration, processing, hereafter the auditory produced.

Sound sources → sound waves (gas vibrations) → ear profiles (collect sound waves) → outer ear canals (sound wave conduction) → the eardrum (convert sound waves into solid vibrations) → cochlear (convert vibrations into nerve impulses) → listening nerves (pass nerve impulses) → the auditory center of the brain (integrate information and produce hearing).



3.Principle and Applications of Sound Sensor

We have already known the principle of sound and how the ear hears sound. But how does sound sensors work? Where will sensors be used?

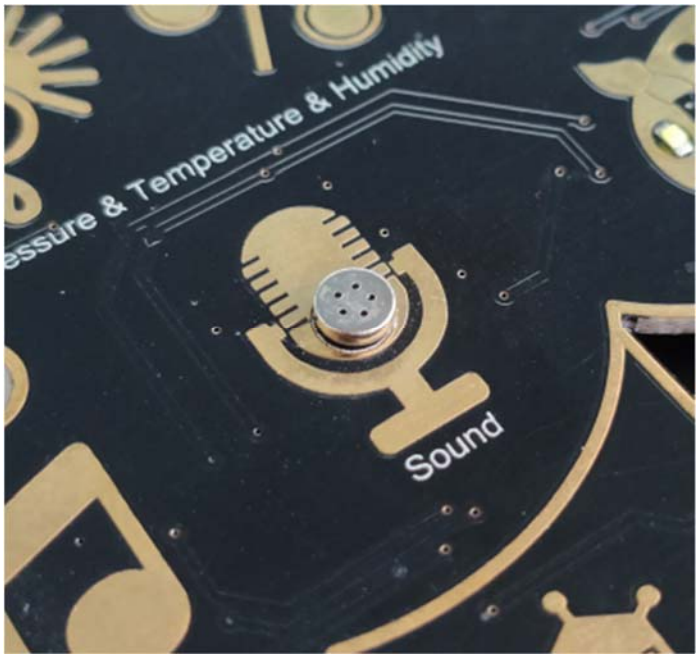
Introduction and Principle

A sound sensor is a sensor that detects the size and frequency of a sound by the vibration of the vibratory membrane and converts the vibration into an electrical signal. Through a series of conversions and analysis of electrical signals by chip, the strength of sound can be detected intuitively.

Application

Sound sensors are widely used in daily life, industrial agriculture and military. E.g. KTV, command traffic shouters, mobile phones, walkie-talkies...

So, which is the sound sensor on the natural science board? Let's see.



Here we can see a small sound sensor in the board which with a logo speaker. Small but sensitive, it can grasp the clapping, speaking sound and input the sound to micro: bit to calculate. Let's program to get the sound strength.

In the above program, we convert the sound to the moving position of the micro: bit dot matrix, the louder the sound, the more the dot matrix lighting up scrolls to the right.

4.Extensions

Programming as follows, record the number of 1 to 9 pat times and display the corresponding number on the dot matrix, and display the current sound strength in real time on the OLED screen. In this program, you will learn how to use the multithreaded programs as well as to judge and use sound strength.

5.Conclusion

Through the learning above, we have learned the following:

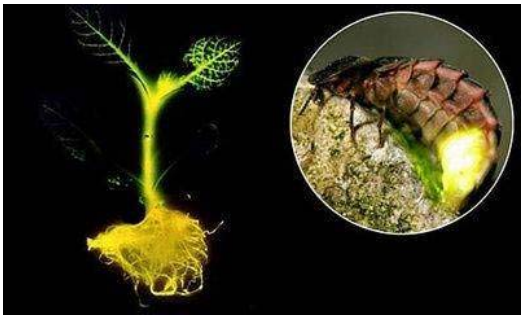
- The definition and principle of sound.
- How people hear sound.
- The principle and application of sound sensors.
- Programming to dynamic display the sound strength on the dot matrix screen.
- Programming to make an interesting applause number recorder.

Part5 Get to know light and Its Application

1.Light

- First let's share some interesting little things about "light": The speed of light in a vacuum is about 300,000 kilometers per second, which is the largest speed in the universe.

- People will transplant bacteria that cause fireflies luminescent, infect tobacco, tobacco can grow to glow. Scientists have boldly envisioned to plant luminescent plants on both sides of the road, so that could they be used as streetlights?



- Some of the bacteria on land emit colorful light at night, and so far, the mystery of their glow has not been completely figured out.

- Shadow less lamp, is an advanced light source, its shape is a large light plate, which contains a lot of fluorescent lamps that shoot into all directions, and all the shadows of the operating table are illuminated, so there is no shadow under the shadow less lamp.

2.How do we see light?

Living in this world, we can see the sunlight, moonlight, lamp light, movies, television, the fundamental reason is the light. Eyes, a sophisticated camera. The eye, like the camera, can also be divided into two parts according to its function, the front cornea, lens and glass equivalent to the camera lens, which belong to the refractive system.

The retina at the back equals to the film of the camera and belongs to the photosensitive system. The refractive system is actually like a lens that brings images of the vast world to converge into a tiny retina.

3.How to measure the light strength?

Light has different strength, strong or weak. Light strength is not the same in the morning, noon, evening and night. So, how do we measure the intensity of light? Typically, we use something called a "light sensor" to measure the intensity of light. A light sensor is a device that uses the size of the light value to change the output resister or output voltage. The following image is one of the light sensors:

The device in the red circle below is the on-board light sensor: it is a mini high-sensitivity optics hardware that not only can detect the intensity of the light, but also distinguish colors.

Let's write a program to detect the ambient light values, as follows: This is a simple program that detects the intensity of light and displays the light intensity data obtained on the OLED screen.

4.Extensions

We get the intensity of the light, but how could we use this data? In real life, where might light sensors be used? For example, street lamps does not light in the daytime, but at night, the street lights on both sides of the road will automatically light. Here it may use two principles. One is to light ON and extinguish automatically at the fixed time. The other is to use light sensors to detect ambient light, when the light is dim, turn on the street lights automatically. Let's use this principle to make a funny day-lighting auto wake-up service program.

The program simulates a scenario. When the light from the window hits the sensor in the morning, the horn makes a musical sound to remind you that it's time to get up. So, you press the A key, the music stops playing, and the bedside light lights up. When you

are dressed, press the B key, the bedside lamp goes out and the program enters the next waiting state.

5.Conclusion

Through the learning above, we have learned the following:

- Learned knowledge of light.
- Learned how people see light.
- Learned the measurement method of light.
- Through the programming of dawn wake-up service device, we understand the principles and applications of light sensors more deeply.

Part6: Color principle and color recognition

In this beautiful and colorful world, we can see a variety of colors: green trees, blue sky, rainbows, cartoons, different clothing colors and so on, then how these colors are formed? How do people's eyes see all kinds of colors?

1.The principle of color formation

Light has a variety of color spectra. When visible light projected onto objects, different objects absorb different colors of the spectrum, a part of the wavelength of light is absorbed, a part of the wavelength of light is reflected to stimulate the human eye, forming a different color.

People's retina has three photosensitive pigments red, green, blue. They are not only sensitive to light, but also very sensitive to color. Light into the retina can cause the three cells to change in different degrees. Along different neural channels, the transformed cells transport into the visual center of the cerebral cortex, resulting in the corresponding color perception.

White colors are displayed when the three photosensitive pigments are stimulated equally. When they are stimulated by mixture with different proportions, they can form a variety of color perceptions, and that's how people recognize and perceive this colorful world.

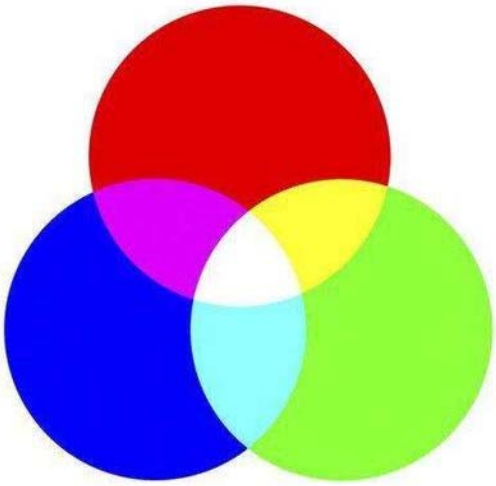
2.Three-color principle

In nature, there are many colors, such as: red, orange, yellow, green, green, blue, purple, white and so on.

Later, it was found that almost all colors of light in nature are obtainable by mixing the colors red, green and blue, that is the principle of tri-color.

Three-base colors refer to red, green and blue, abbreviated as RGB. As shown in the following image we can see:

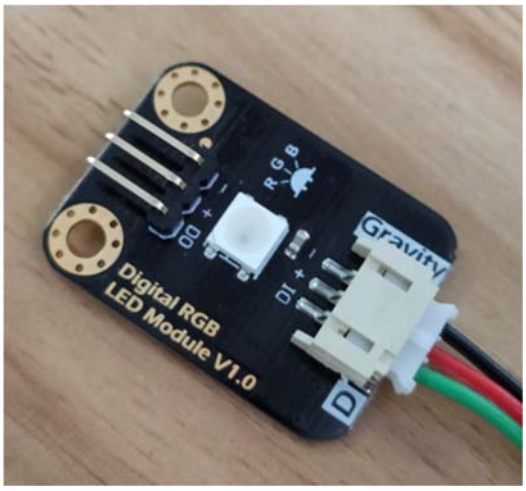
- When red and blue are superimposed, purple is displayed.
- When the red and green are superimposed, yellow is shown.
- When the green and blue superimposed, it shows cyan.
- When red, green and blue are superimposed together, they show pure white.



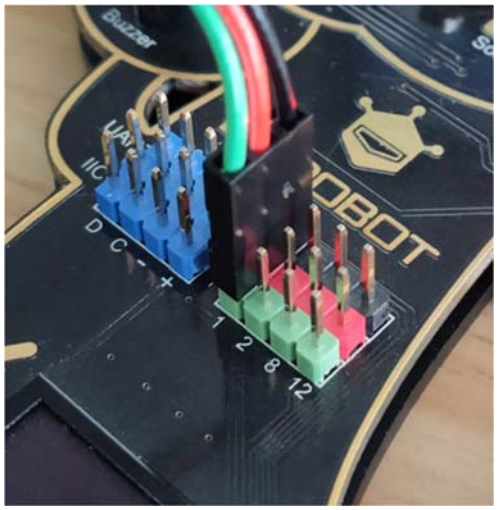
3.The principle of RGB LED and applications

According to the principle of color formation and the principle of eye recognition of color, people invented colorful lamps, cameras, color recognition sensors and other scientific and technological products. In this section, let's learn about RGB lamps and color sensors.

(1) First, we prepare an RGB lamp module, as follows:



(2) Connect the module to the P1 port, as follows:



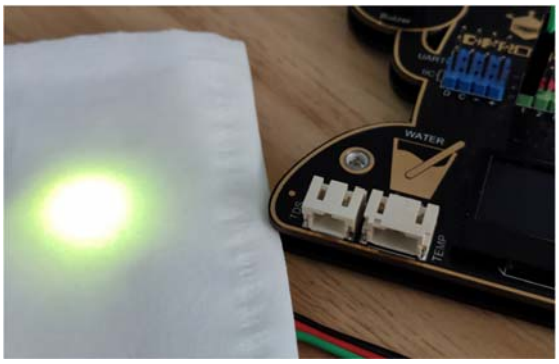
(3) Let's write a program to intuitively feel the RGB tricolor blending principle: In the program, we called the RGB lamp library. And set the RGB led connected to the P1, the number is 1.

- First of all, set the value of Red to 255, Green and Blue to 0, displayed in Red.
- After a one-second delay, set the value of Red to 255, Green and Blue to 0, displayed as Green.
- After a delay of one second, set the Blue value to 255, Red and Green to 0, displayed in Blue.
- After a one-second delay, set the value of Red and Blue to 255, Green value to 0, displayed as Purple.
- After a delay of one second, set the value of Red and Green to 255, Blue value to 0, displayed as Yellow.

- After a one-second delay, set the value of Green and Blue to 255, Red value to 0, displayed as Cyan.
- The final execution result of the program: RGB led shows red, green, blue, purple, yellow, green 6 colors in turn.

In the program, we found that the range of RGB tricolor is: 0 to 255. You can try changing the values of the three parameters of the RGB to see what color will show with different values.

Try covering a piece of paper on the RGB lamp and you'll find that the color blends better, as follows:

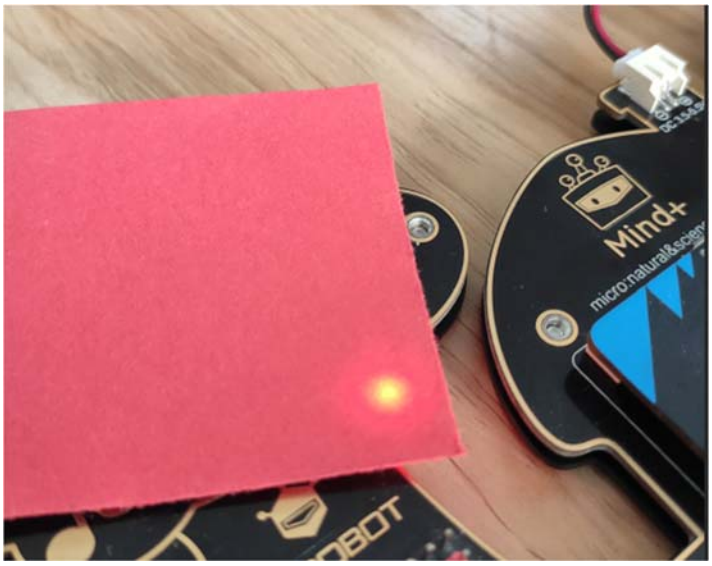


4.Color recognition sensor

First, let's look at what a color recognition sensor looks like, as follows: Maybe you'll ask: Isn't this a light sensor? Yes, this sensor can detect light intensity and different color values.

Let's use this sensor to actually test the values of the various colors in daily life. First, we write a detection program:

Download the program and let's find some objects with bright colors to put above the sensor in about 5mm height, this time, the display can show the current RGB values. Of course, because the influences like light, distance and others, this value may not be as accurate as we think, the accurate data need to be modified by various algorithms. But in this way, we can understand how colors are read. And we can also try recording the color values we read, then light the RGB led in the program, and see what colors the color sensor will sees.



5.Conclusion

Through the learning above, we have learned the following:

- The principle of color formation.
- The principle of three-base color.
- The principle of RGB lamp and its application.
- The principle and measurement of color recognition sensors.

Part7 Ultraviolet light affection

1.What is UV? Where did it come from?

Ultraviolet light is the general term for radiation in the electromagnetic spectrum with wavelengths ranging from 10nm to 400nm, and our eyes cannot see ultraviolet light directly.

In 1801, German physicist Ritter discovered the presence of ultraviolet light by discovering the presence of ultraviolet light in a section of the purple-end section of the solar spectrum that can sense light from photographic negatives containing silver bromide, hereafter the ultraviolet light is discovered.

Divide according to wavelength, the ultraviolet light can be divided to near UVA, far UV UVB and ultra-short UV UVC. The penetration of ultraviolet rays in human skin is different. The shorter the wavelength of ultraviolet light, the greater the harm to human skin. Short-wave UV rays can pass through the leather, and medium-wave can enter the leather.

2.Advantages and disadvantages of ultraviolet rays to the human body

Advantages

- Sterilization: A base cell in the human epidermis contains a tyrosine substance called melanin. Under the action of ultraviolet light, the "melanin" turns black, calming the surface of the sun-drenched skin, making the skin evenly black-brown. This is an important reason for sun-tanned skin. This pigment can absorb more light energy, and quickly transforms it into heat, and stimulates the secretion of the sweat glands to dissipate heat. Solar energy kills bacteria on the skin and prevents skin diseases such as scabies and folliculitis. More sunshine indoor, shining bed and cloth can reduce the spread of disease spreading.

- Promotes calcium phosphorus metabolism substance containing sterols in human skin. This substance can be changed to vitamin D by ultraviolet radiation from sunlight. Vitamin D can improve the metabolism of calcium and phosphorus when it enters the bloodstream. It has the effect of anti-rickets, resist bone softening and osteoporosis in old age.

- Enhance the body's immunity: Ultraviolet radiation in the sun can stimulate the body's hematopoietic function, so that the number of red blood cells increased, hemoglobin increased, improve red blood cell quality, improve muscle activity. It also can reduce blood pressure, blood sugar, cholesterol, increase the body's immune capacity, promote the body's cellular oxygen absorption capacity and metabolism, comfort asthma and joint pain, relax the muscles and stimulate the blood circulation, enhances physical fitness.

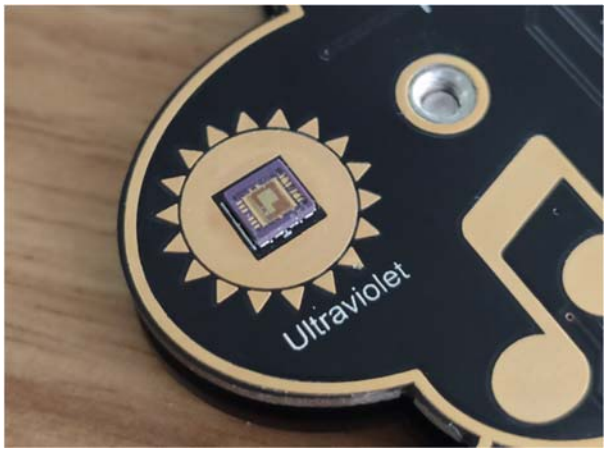
Disadvantages

Ultraviolet rays have a certain bactericidal effect, but excessive exposure to ultraviolet light is harmful to the human body.

- Damage to the eyes: when exposed to ultraviolet light, the degree of eye injury is proportional to the time, inversely proportional to the distance from the source of the exposure, and is related to the angle of projection of light.
- Damage to the skin: when UV rays strongly in the skin, it can lead to light dermatitis, red spots on the skin, itching, blisters, edema, eye pain, tears, etc. Severe skin cancer can also be caused.
- Damage to the nervous central system: when UV light acts on the central nervous system, it may lead to headache, dizziness, elevated body temperature and other symptoms.

3.Get to know ultraviolet sensor and its application

Moderate exposure to UV rays is good for the human body, but excessive exposure is harmful to the human body. So, we need to measure UV light to serve humans and avoid excessive UV rays harm. Let's take a look at the device for UV measurement The UV sensor shown below:



Ultraviolet sensor uses photosensitive elements to convert UV signals into electrical signals. It is only sensitive to ultraviolet light, insensitive to other lights like the usual sunlight, lamp light. So, we can measure the intensity of UV light more accurately. With the knowledge of UV sensors, let's measure the intensity of UV rays by programming.

4.Measure the intensity of UV rays in different environments

First, we prepare a table like this:

We recorded data from tests at different locations and time, and tried measuring ambient temperature, light intensity at that time, and then tried to understand the relationship between temperature, light intensity and UV intensity by comparing and summarizing.

5.Conclusion

Through the learning above, we have learned the following:

- Ultraviolet light is an electromagnetic wave.
- Ultraviolet light can be sterilized.
- Long-term excessive exposure to UV rays is harmful to the human body
- Ultraviolet sensors can accurately detect ultraviolet rays, but are not sensitive to ordinary light.
- Mastered the method of measuring ultraviolet rays through programming, and made comparison and summary.

Part8 Source of Life: Water

1.Basic knowledge of water

Water is the source of life. But how much do you know about water? Let's look at some little knowledge together.

1. Water (H_2O) is an inorganic substance consisting of hydrogen and oxygen, a transparent liquid that is colorless and odorless at room temperature and normal pressure.
2. Water has three states: liquid, solid, and gas.
3. Seventy-two percent of the earth's surface is covered with water.
4. There are about 1.5 billion cubic kilometers of water on earth.

5. Ninety-seven percent of the earth's water is salty, and 2.1 percent of the water is still frozen in the polar ice sheet, so the fresh water that we can drink directly is less than 1 percent.
6. 60% to 70% of our bodies are made up of water, i.e. about 42 kg of water in a 70 kg human body.
7. Where there is water on earth, there is life. Whether in almost boiling water or in strong acid.

2.Protecting water resources

We have just learned that we can drink less than 1% of the fresh water directly, and our drinking water resources are very limited.

Despite the limited freshwater resources, there is still a large amount of water that is polluted and wasted.

There are garbage and plastic bags floating in the river, industrial waste water sneaking into the river, etc....

What can we do to protect water resources? To protect water resources, what we can do is to start with the little things, save water, turn off the tap, and not pollute the water source.

3.Water Quality Measurement and Analysis

Introduction of TDS Water Quality

In the last section, we learned that our drinking water resources are very limited, we understand water pollution, we know how to save water, protect water resources and so on. So now let's learn about water quality measurements. To begin with, let's look at a noun: TDS. TDS is an important parameter that affects water quality.

(1) What is the TDS value?

The TDS value refers to the total dissolved solid, also known as the total amount of soluble solids, measured in mg/L. It shows how many milligrams of soluble solids are dissolved in 1L of water. The higher the TDS value, the more dissolved matter is contained in the water.

Simply put, the TDS value partly reflects the purity of the water. The lower the TDS value, the higher the water quality, the higher the TDS value, the more soluble solids contained in the water, but water with high TDS values is not equal to harmful.

For example, the water inside the river, TDS value is about 400. And tap water is about 100, bottled pure water is about 10, while the TDS value of juice is 500. From the values above, the purity of bottled pure water is very high, impurities are very small. The TDS value of fruit juice is 500, but it is harmless to humans.

But TDS is not the only criterion for determining water quality. TDS can only measure conductive substances in water, but cannot detect bacteria, viruses and other substances. We also need to comprehensively test the pH of water, acidity, bacterial content and so on project comprehensive assessment of whether water can be directly consumed. We also need to comprehensively test the pH of water, acidity, bacterial content and other projects to assess whether water can be directly consumed.

(2) Measurement and application scenarios for TDS values

The following image shows us the application scenario of TDS detection in actual production and life, such as water quality testing pen, water purifier, swimming pool, water treatment plant, etc. will do TDS value testing.

Although TDS value is not the only indicator to determine water quality, it is an important indicator to determine water quality.

4.Measure and analyze TDS values for different water sources

Here we programming a water quality testing program to test different water sources and record the corresponding TDS values. The program is as follows:

- Programming as shown in the image above and download the code to micro: bit.
- Plugin TDS probe to TDS socket.
- Put the probe to different water resources and shake it lightly, read and record data shown in the OLED display. The table form is shown as below:

By selecting different water sources in different locations for testing and recording, we will come up with a set of TDS data that can intuitively understand the pollution of different water sources in different regions.

5.Conclusion

Through the learning above, we have learned the following:

- The basic knowledge of water, and learned a little knowledge of water.
- Knew the importance of water to human beings, and knew that water should be saved.
- Understood the application scenario of water quality testing and the concept of TDS values.
- Learned to use TDS probe to test the TDS values of different water sources, and make a record table.

Part9: Measurement and application of water temperature

1.What occasions do we need to measure and control water temperature?

In our daily life, we can come into contact with water at many different temperatures. For example, tea, coffee, bath, swimming and so on, involving equipment including heaters, water dispensers, water heaters, temperature controllers and so on. So how do we detect and control the water temperature? First of all, let's get to know the water temperature sensor.

2.Get to know the water temperature sensor

The water temperature sensor consists of a sealed metal housing and an internal temperature sensor, as shown below: when we put the water temperature sensor in the water, the temperature of the water is transmitted to the internal temperature sensor through the metal thermal conductor, which causes the sensor value to change. That’s how the water temperature sensor works.

3.Programming the water temperature control

Like the projects above, we can also write a program in a very simple way to measure the temperature of water:

4.Extensions

In the first chapter, we measured the temperature at a Celsius, and there is a "Fahrenheit" that is also a widely used unit of temperature measurement. Let's take a look and make the corresponding conversion. First, look at the definition of two units of temperature measurement.

Celsius: the temperature of the ice water mixture is set to 0 degrees C, the temperature of boiling water is set to 100 degrees C, and the two are divided into 100 equal parts, each of which is a unit of Celsius, called 1 degree Celsius.

Fahrenheit: at standard atmospheric pressure, the melting point of ice is 32 degrees F, the boiling point of water is 212 degrees F, the middle is 180 equal points, each equal unit is 1-degree Fahrenheit.

Formula to convert °C to °F: **Fahrenheit = Celsius x 1.8 + 32°C**

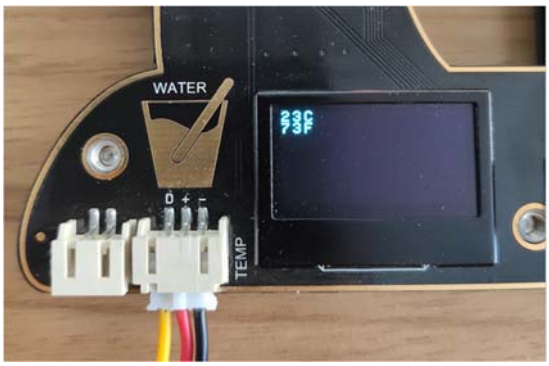
Use the conversion formula to convert the measured temperature value to Fahrenheit:

In this program, we use mathematical operators to convert the value of Celsius to a value of Fahrenheit, and we use two new program modules: truncation and combining strings.

Truncation: truncate the fraction already obtained values, only leaving integers.

Combining strings: combining two strings to show on one line.

In the end, the display shown the result as below:



5.Conclusion

Through the learning above, we have learned the following:

- Water heaters, smart water cups, water dispensers and other occasions need to measure water temperature and control water temperature.
- Knew about the water temperature sensor and the principle.
- The water temperature was measured by graphical programming.
- Learned the conversion of degrees Celsius Fahrenheit.

Part10: Plant a tree

1.Forest Knowledge

On earth, there are a lot of forests. Global forests are concentrated in South America, Russia, Central Africa and Southeast Asia. These four regions take up 60% of the world's forests, with Russia, Brazil, Indonesia and Congo’s accounting for 40% of the world's forests.

Total global forest cover is 32%, among them, North America takes 34%, South America and Europe are around 30%, Asia 15%, the Pacific 10% and Africa only 6%. The continent with the largest forests is Latin America, which accounts for 24% of the world's forest edified area and reaches 44% of forest cover. These forests play an important role in regulating the climate, preventing desert invasion and protect the natural ecology.

The United Nations Environment Office reports that global forests have been halved in history, mainly due to human activity. According to a report in 2001 by the United Nations Food and Agriculture Organization, global forests fell from 3.96 billion hectares

in 1990 to 3.87 billion hectares in 2000. Nearly 10 million hectares of forest are lost each year worldwide. The role of plants in protecting the living environment of human beings.

- Beautifying the environment Many plants have high aesthetic value, especially garden plants. The graceful posture and rich colors of garden plants beautify the city's landscape and play a good role in beautifying the environment.
- Protecting and improving the environment Plant leaves can be photosynthesis, absorbing carbon dioxide in the air, releasing oxygen, so that the air turns fresher. Tall plant canopy can effectively block dust in the air, hairy leaf surface can absorb dust and absorb harmful substances in the air, such as sulfur dioxide, hydrogen fluoride, chlorine gas and so on. Regulating and improving the environmental microclimate Tall plants have good shade effect, plant leaves can increase the humidity in the air, and reduce the air temperature by heat absorption, effective regulate and improve the environment microclimate. Some plants can also secrete a large amount of fungicides, effectively killing harmful bacteria in the air. Plants can also be effective in blocking noise. The root system of plants can effectively fix the soil and prevent soil erosion.
- Photosynthesis of plants The process by which green plants use the sun's light energy to assimilate carbon dioxide (CO_2) and water (H_2O) to make organic matter and release oxygen, called photosynthesis. The organic matter produced by photosynthesis is mainly carbohydrates and releases energy.

2.Effects of the environment on plants

Water, sunlight, temperature, humidity, atmospheric pressure will have an impact on the shape and survival of plants, of which the water content has the greatest impact.

Moisture is an important part of plants. The average plant contains 60% to 80% water, or even more than 90%. Without water, the plants cannot take actions like absorption, transportation, as well as photosynthesis and breathing.

For example, the main characteristics of plants that can survive in desert environments are drought-resistant. The general desert plant leaves are relatively small in order to reduce the water loss caused by the role of steaming, mainly represented by the fairy ball, stick tree, aloe vera and so on.

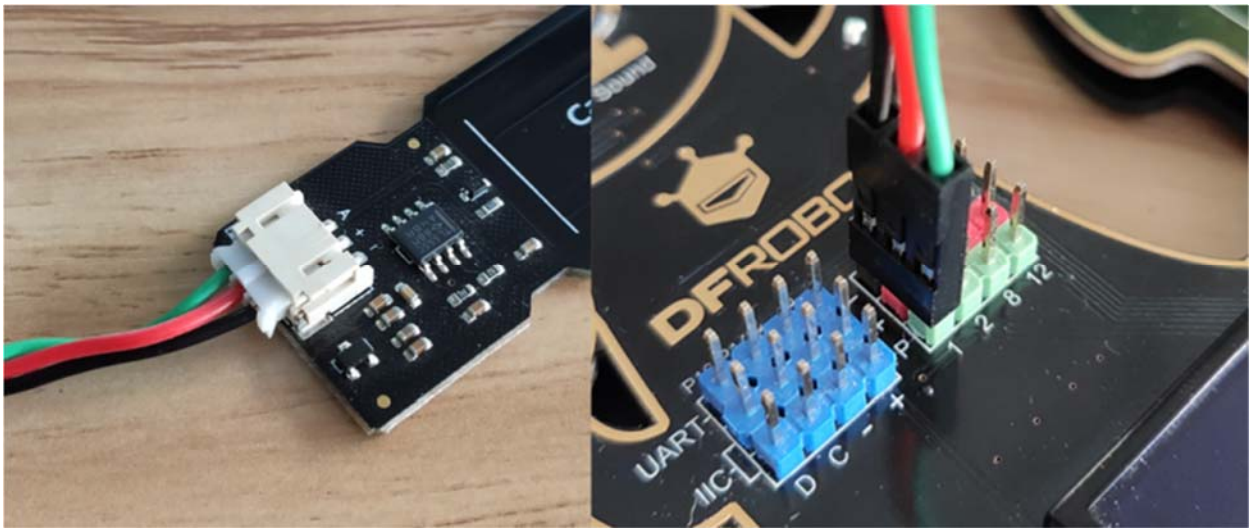
In the rainforest, due to the abundance of rain, abundant water, a large number of broad-leaved plants, such as banana, eucalyptus and so on.

3.Plant moisture measurement

Through learning, we knew the importance of water to plants. Then, in the process of farming, we need to pay attention to the water situation of plants to prevent water shortage nor too much water which will cause plant roots to be flooded.

Let's use the soil moisture sensor in the kit to learn how to measure soil moisture. The soil moisture sensor is shown below:

Connecting the soil sensor:



Programming to calibrate the soil sensor Download the program to micro: bit, according to the figure shown as below to obtain and record the reading in dry and in water. My data is 841 in dry, 543 in the water.

Then modify the program and put the two calibration values in the previous dry and water to the program. In the program, we map 543 to 10, 841 to 0. In the actual test, the humidity is 0 when reaches the lowest, and the highest humidity is 10.

After downloading the program, insert the soil moisture sensor to the flower pot soil to be tested, it shows that the humidity value of the current soil is between 0 and 10. According to the water requirements of different plants, we can make a preliminary judgment on the suitability of humidity.

4.Conclusion

Through the learning above, we have learned the following:

- We learned about the forest cover in different regions and the importance of plants to the environment.
- Learned about the photosynthesis of plants.
- Understand the environmental factors required for plant growth.
- Learned how to use soil moisture sensors to detect soil moisture.

FAQ

Q&A	**Some general Arduino Problems/FAQ/Tips**
Q	I have a question!
A	Please click the topic link on DFRobot Forum.
A	For any questions, advice or cool ideas to share, please visit the **DFRobot Forum**.