1. Introduction

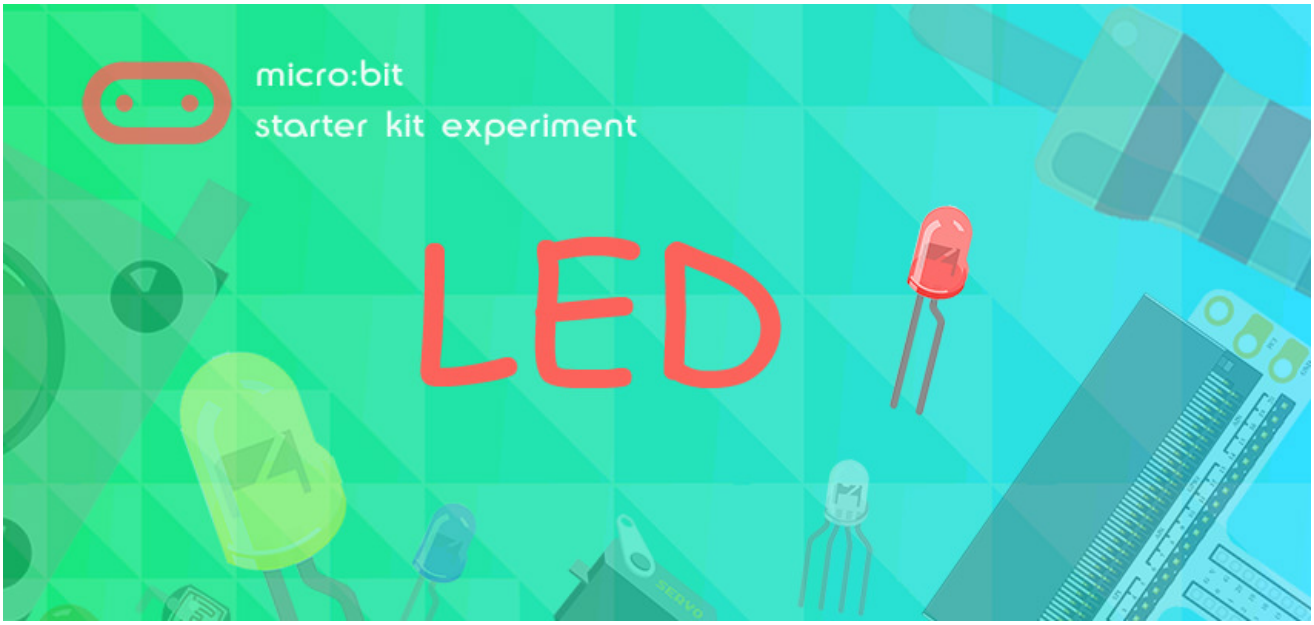
ElecFreaks Micro:bit Starter Kit is designed for people who is at the door step of learning electric circuit and programming knowledge. The kit has provided some basic electronic components like LED, button, buzzer, temperature sensor, steering engine and motor etc.. Micro:bit Starter kit can help you enter a wonderful of electronic world.

1.1. Components


100Ohm Resistance
Adapter
Breadboard
Battery holder
Servo
Temperature Sensor
Photocell
USB
Jumper Wire
RGB LED
Red LED
Blue LED
Yellow LED
10k Trimpot
Pushbutton Switch
Self-lock Switch
Mini Speaker
10K Resistance
Clip Wire
5V Motor
Transistor
Diode
LED Ring

1.2. FAQ

3. Lesson 01 LED



3.1. Introduction:

LED has wide applications. Most signal lights we saw in our daily life use LED as its major light source. In today's experiment, we are going to use Micro:bit to make 2 LED beads twinkle alternatively.

3.2. Components List:

Hardware:

- 1 x Micro:bit Board
- 1 x MicroB USB Cable
- 1 x Microbit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 2 x LED
- 2 x 100 Ohm Resistors
- n x Breadborad jumper wire 65pcs pack

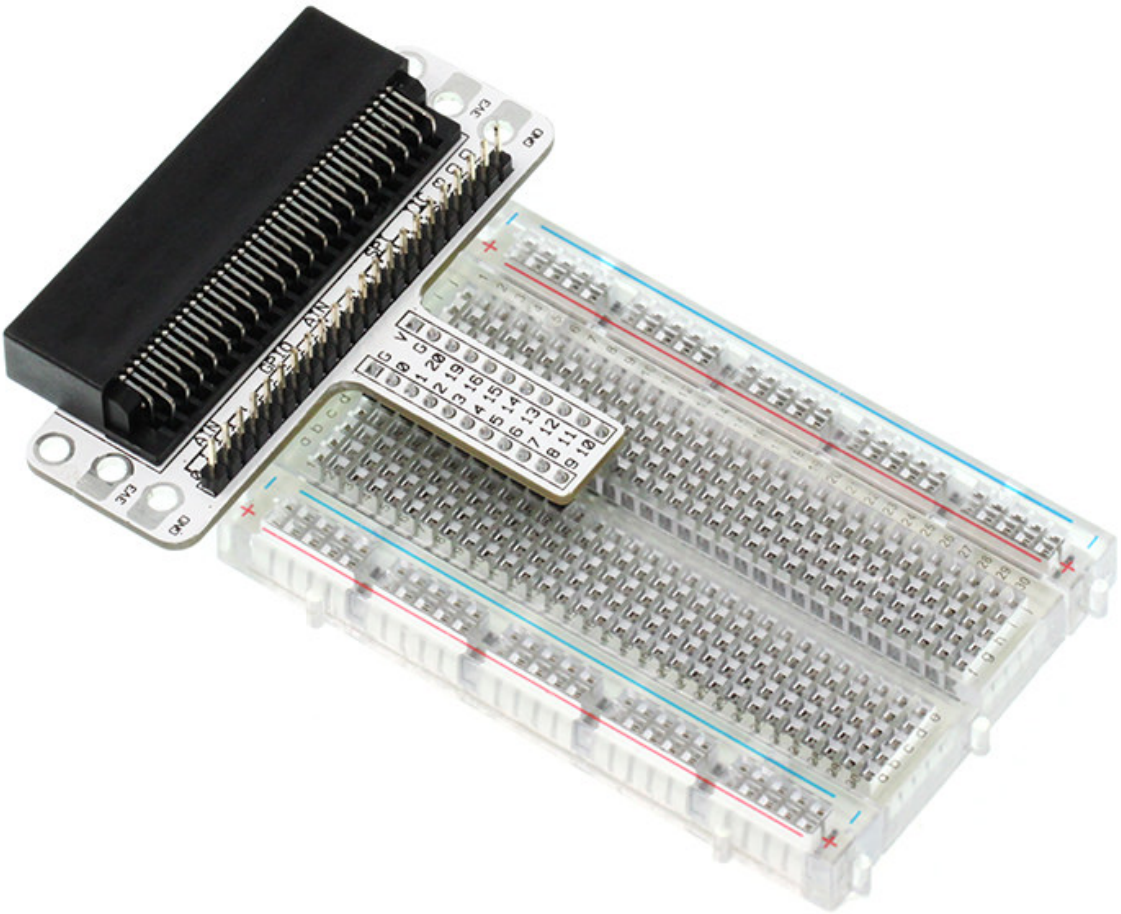
Tips: If you want all components above, you may need Elecfreaks Micro:bit Starter Kit.

3.3. Major Components Introduction

Micro:bit Breadboard Adapter

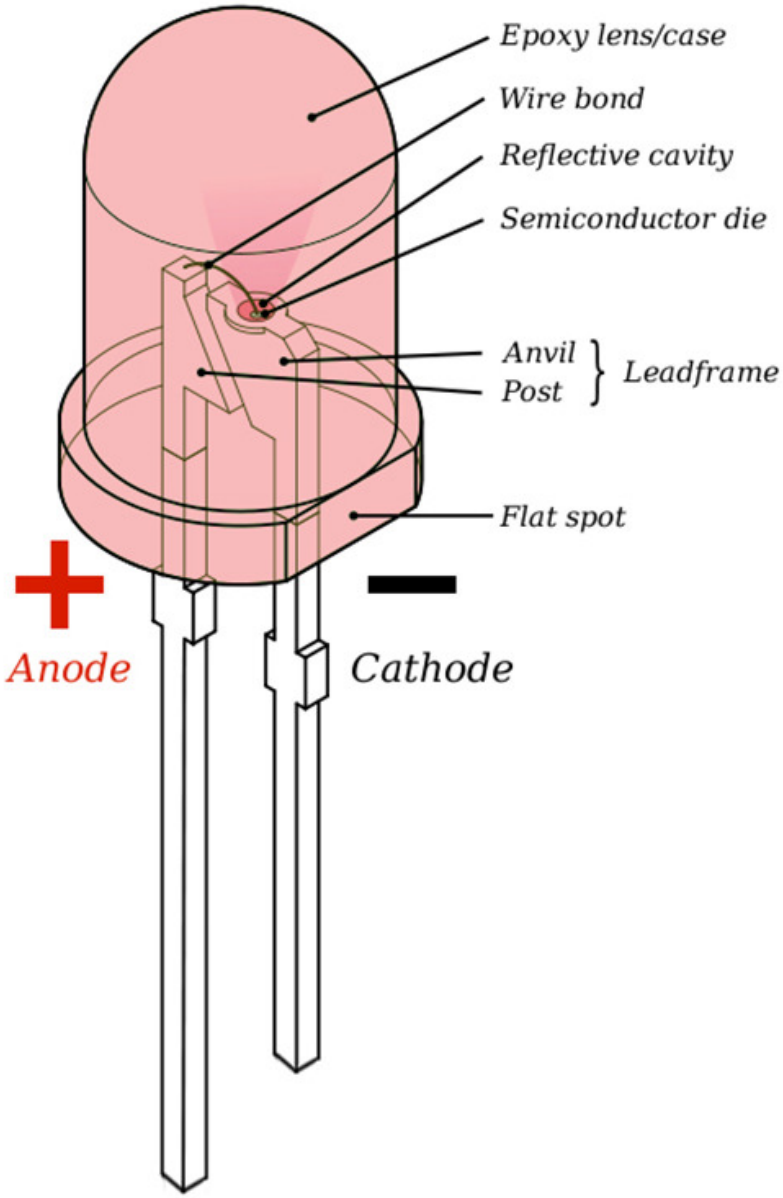
Micro: bit Breadboard Adapter can extend all pins of Micro: bit , so that we can create simple circuit on breadboard.

This picture shows how Micro: bit Breadboard Adapter is plugged into breadboard. It is suitable to all kinds of breadboards.



LED

LED is the abbreviation of Light Emitting Diode. It is a kind of semi-conductor diode and can convert electricity into light(When the current passes, it will light on)



If you check the LED with care you would notice the two features: one is that the legs are in different lengths , another is that on one side of the LED, instead of it being cylindrical, it is flattened. These are indicators to show which leg is the Anode (Positive) and which is the Cathode (Negative). The longer leg gets connected to the Positive Supply (3.3v) and the leg with the flattened side goes to Ground.

Resistor

Resistor is a component for current control. It can limit the current of the circuit connected. And in our experiment, we use 100Ω resistance, if there is no current limit, the LED might be damaged.

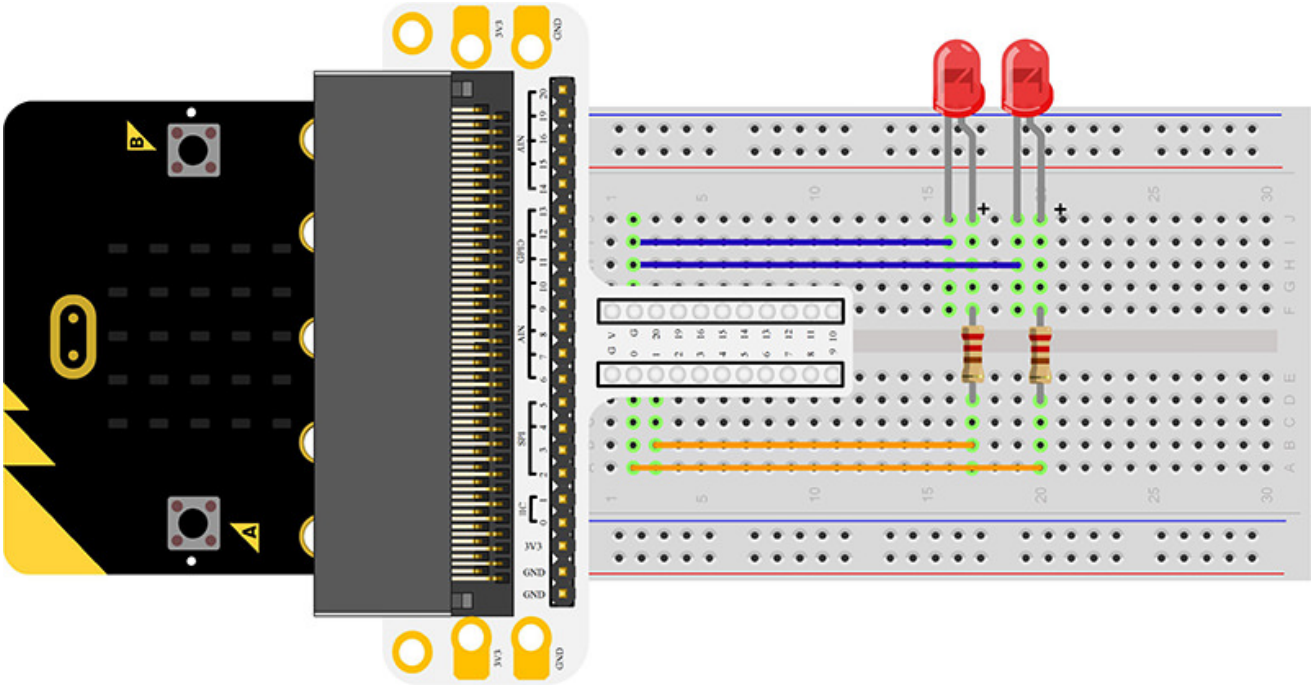
Want to know resistor value by color circles? You can read this article: How to Identify Color Circle Resistance Value.

3.4. Experimental Procedure

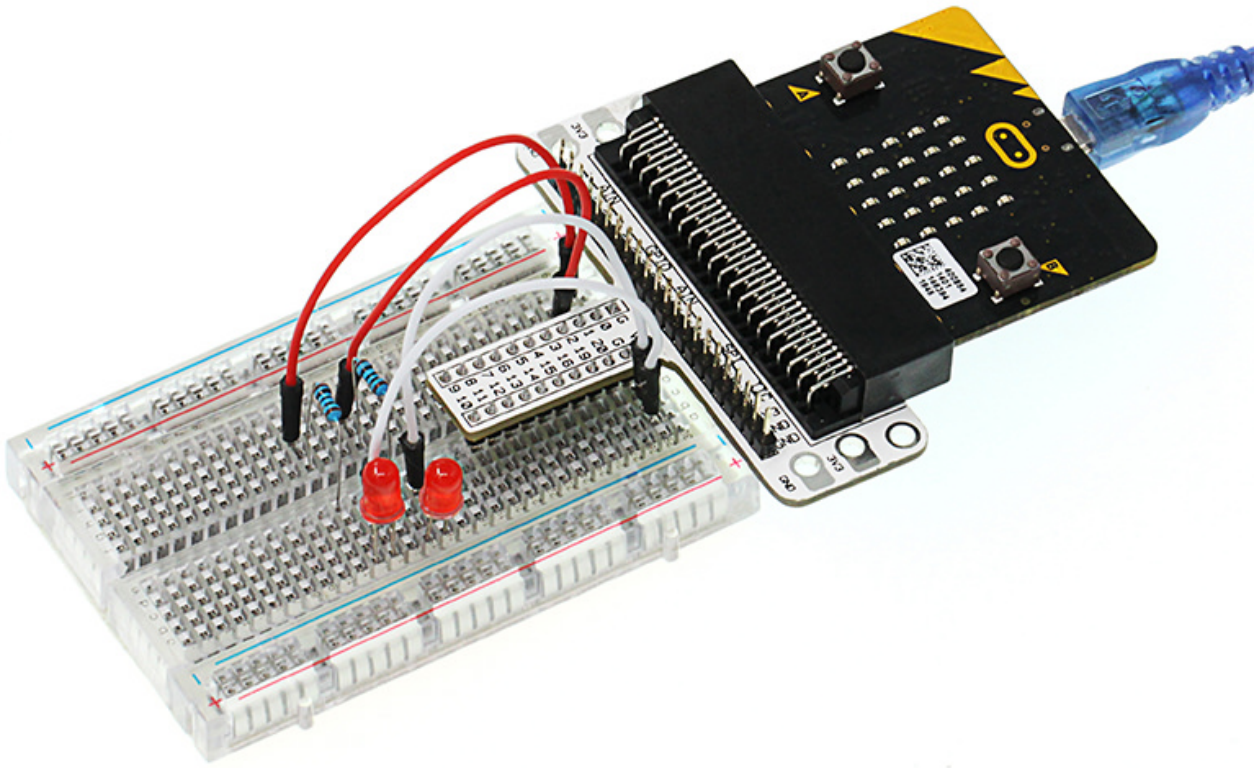
3.5. Hardware Connection

Connect your components according to the picture below:

- 1. Connect the shorter leg with the GND.
- 1. Connector the longer leg with the P0 and P1 ports through the Resistor.

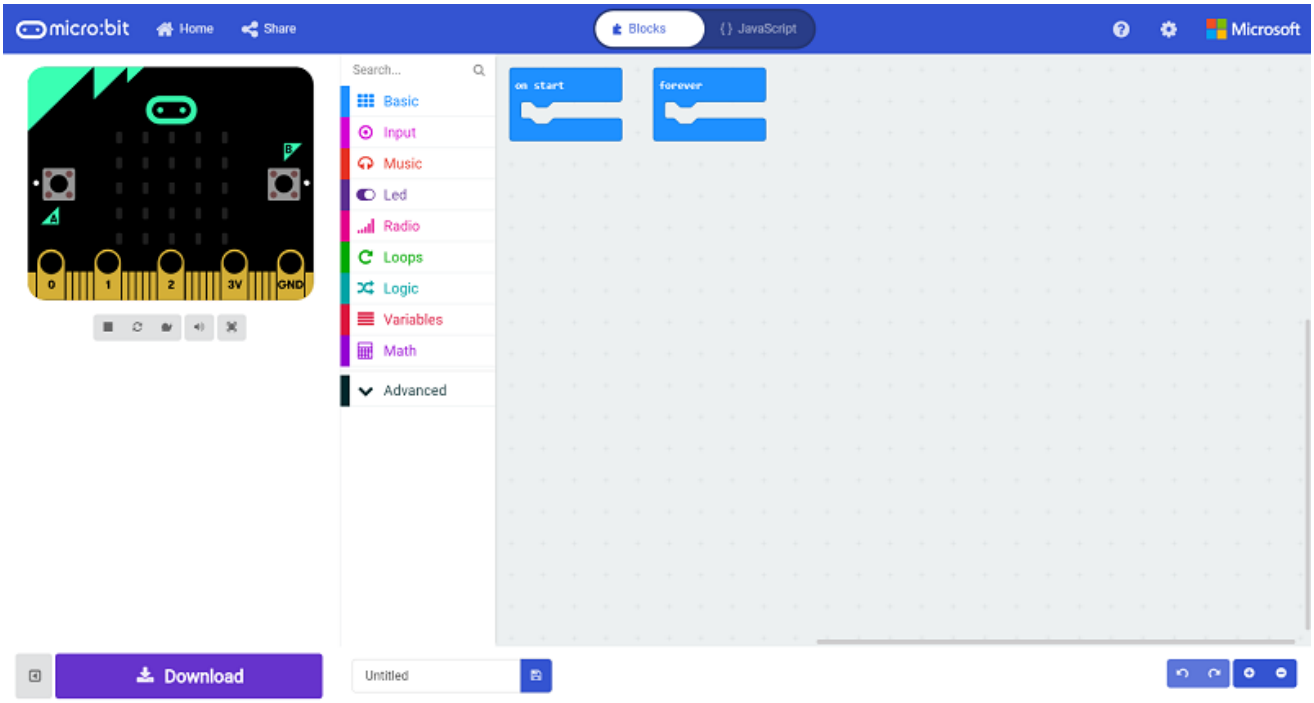


You would see as below after you finish the connection:

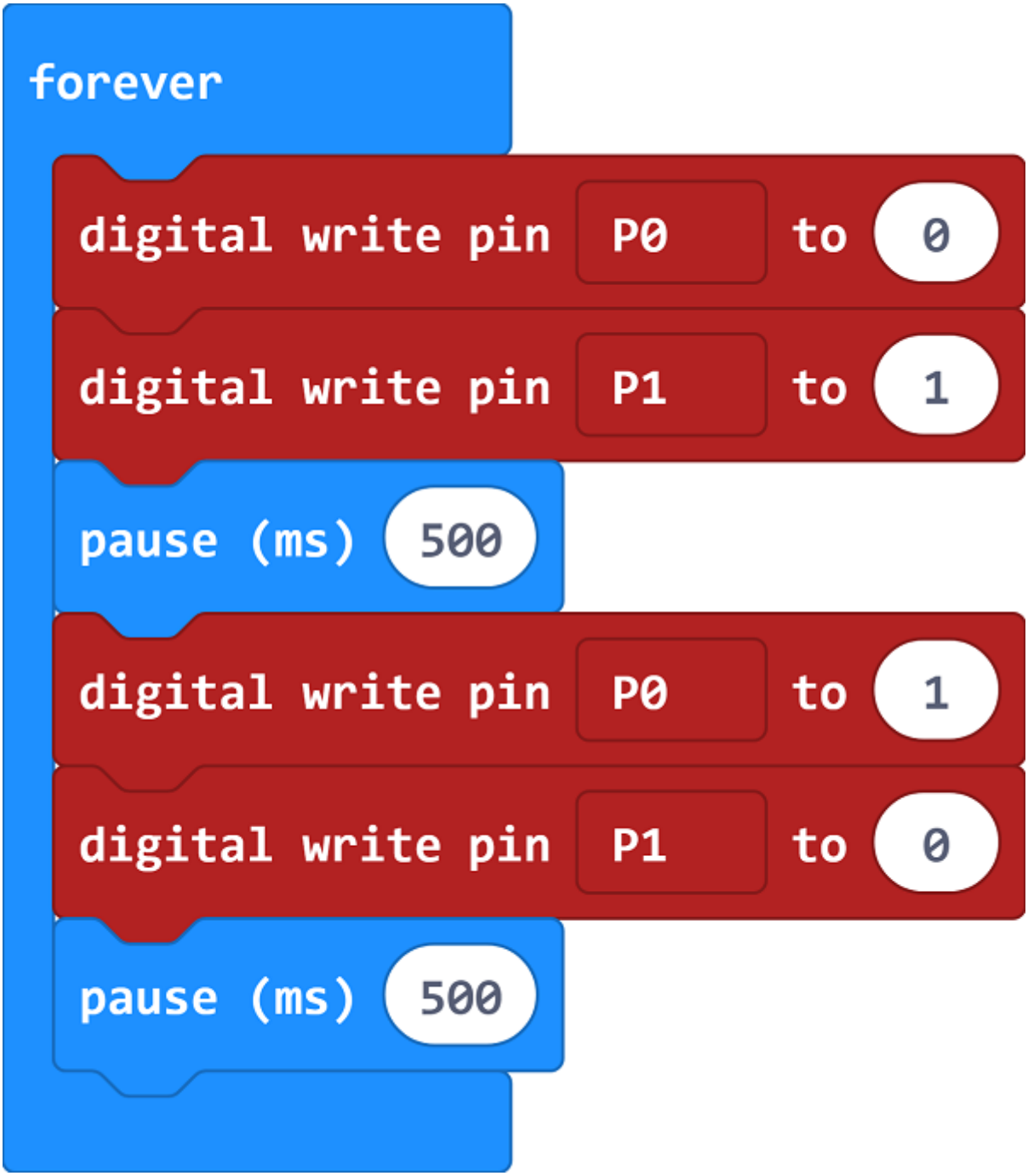


Software Programming

Click to open Microsoft Makecode, write the following code in the editor.

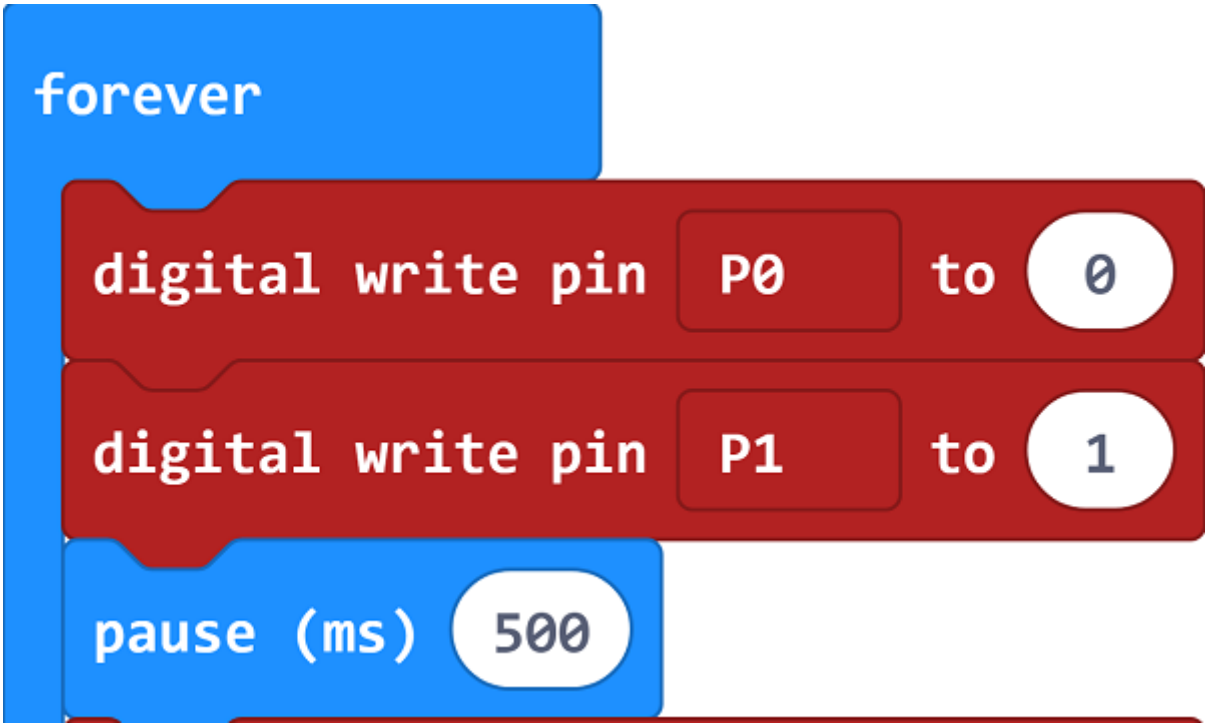


Program as the picture shows:



Details for the code:

- 1. Digital write signal 0 to P0 port to turn off the LED; digital write signal 1 to P1 port to turn on the LED, then set the pause in 500ms.

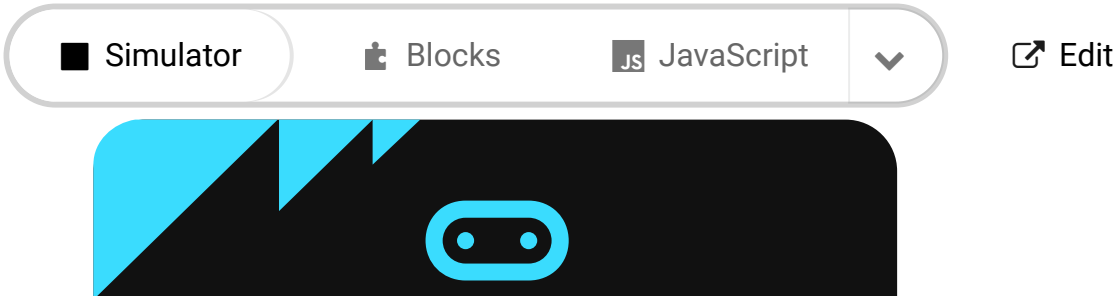


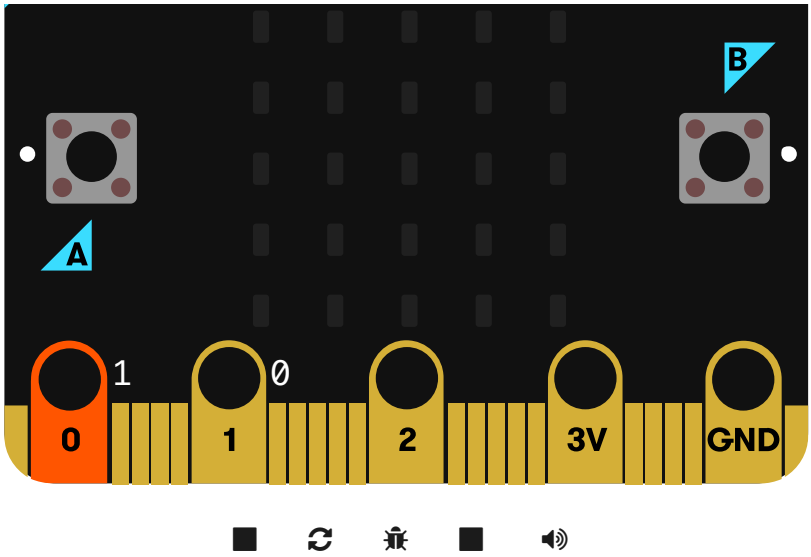
- 1. Digital write signal 1 to P0 port to turn on the LED; digital write signal 0 to P1 port to turn off the LED, then set the pause in 500ms.

Reference

Links: https://makecode.microbit.org/_LybdqfauX3TR

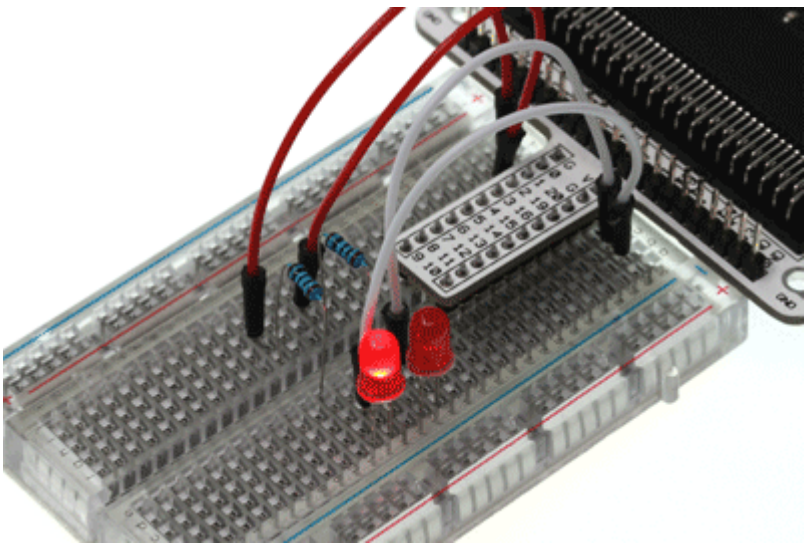
You can also download the links directly:





3.6. Result

You can see the 2 LEDs flashing alternatively. If not, you need to go back and check your operations.



3.7. Exploration

If we want to control 4 LEDs and make them illuminated in turns, how can we design the circuit and code? Welcome to have a further discussion with us!

3.8. FAQ

4. Lesson 02 Button

4.1. Introduction:

In our previous experiment , we have learned how to use Micro:bit to control 2 LEDs and make them twinkle alternatively. This time we are going to use a button to control LED flash. That means when we press down the button,the 2 LEDs flash in turns; when release the button, the LEDs stop flashing.

4.2. Components List:

Hardware:

- 1 x Micro:bit Board
- 1 x Micro-B USB Cable
- 1 x Microbit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 2 x LED
- 2 x 100 Ohm Resistors
- 1 x Momentary Pushbutton Switch
- n x Breadborad jumper wire 65pcs pack

Tips: If you want to buy all components above, you may need Elecfreaks Micro:bit Starter Kit.

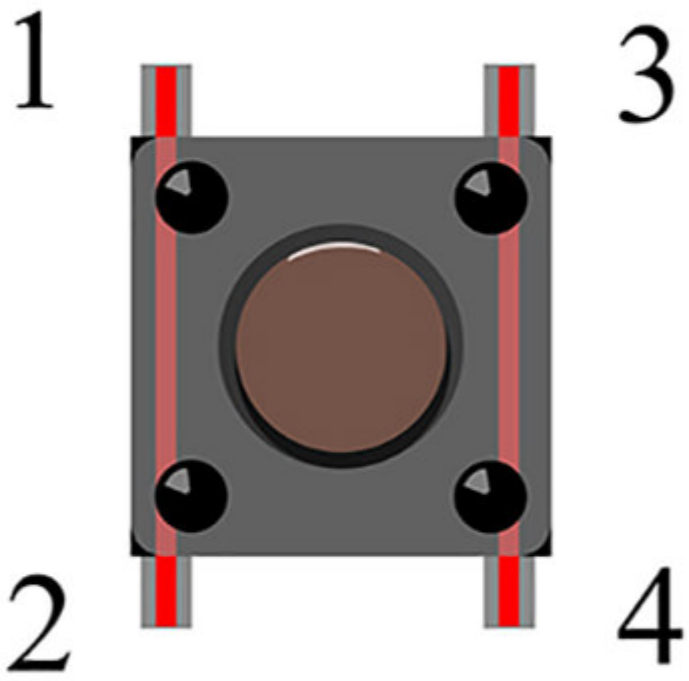
4.3. Major Components Introduction

Momentary Pushbutton Switch

This is a common component for controlling electronic devices. It is mostly used to connect or cut off the control circuit, it can achieve the control for motors or other electronic equipments.

Momentary Pushbutton Switch usually stays on. When it is pressed down, the circuit is connected; when it is released, it will bounce back to the status of disconnection.

Momentary Pushbutton Switch has 4 pins which can be divided into 2 groups: pin 1 short connects pin 2, pin 3 short connects pin 4.

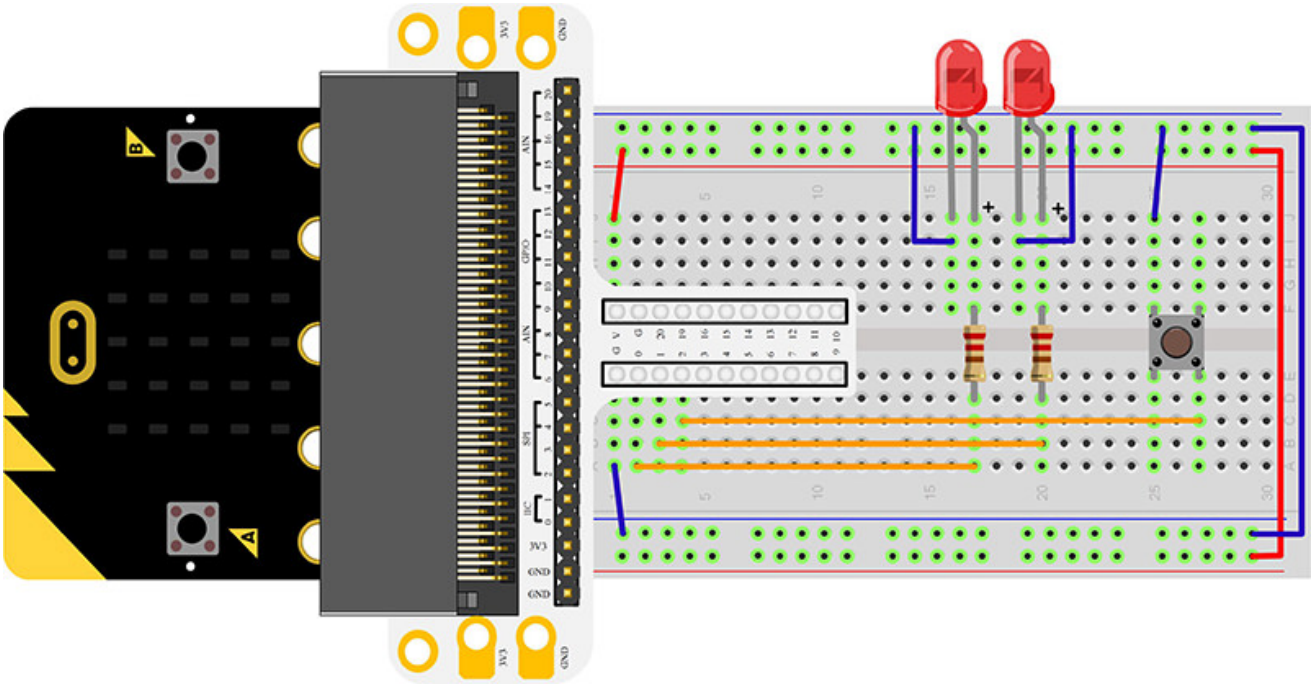


4.4. Experimental Procedure

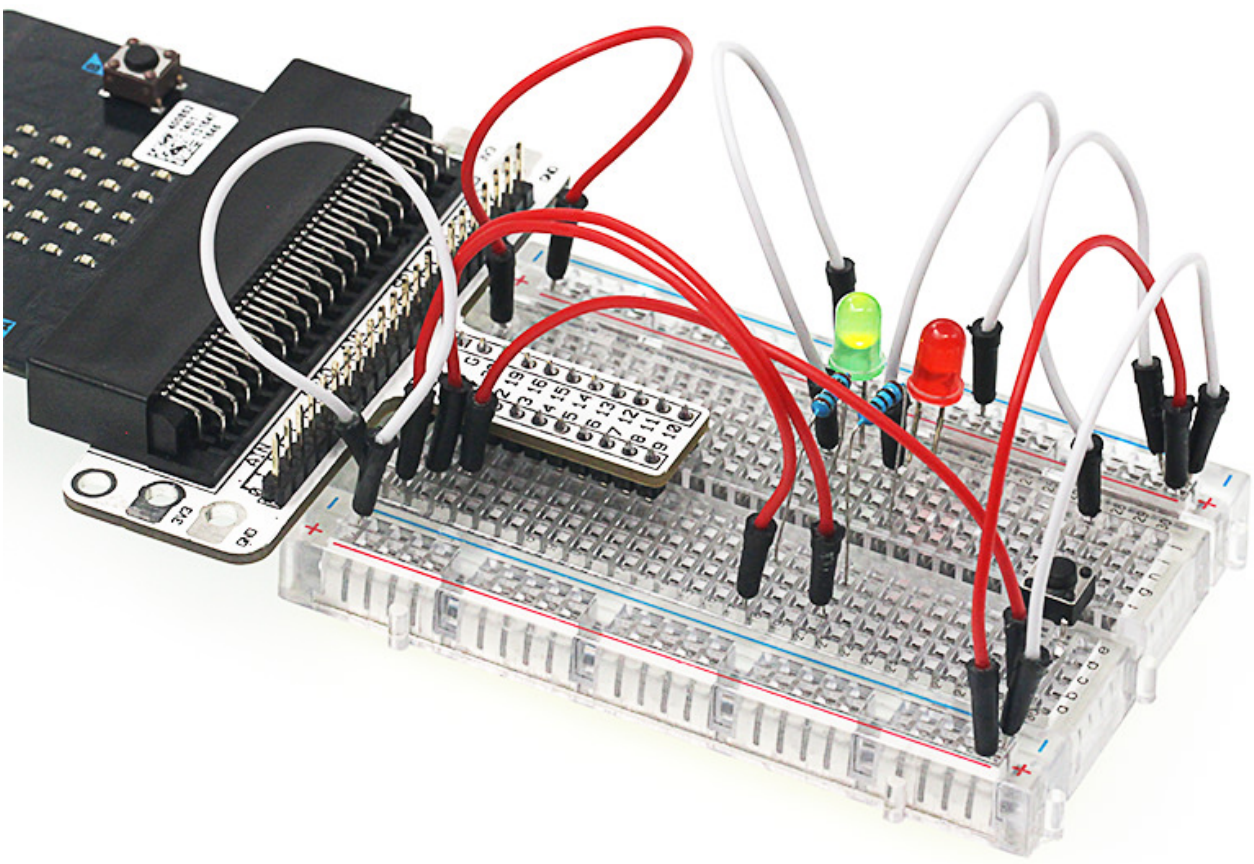
4.5. Hardware Connection

Connect your components according to the picture below:

- 1.Connect the shorter leg with the GND.
- 2.Connector the longer leg with the P0 and P1 ports through the Resistor.
- 3.Connect the Momentary Pushbutton to P2 port.

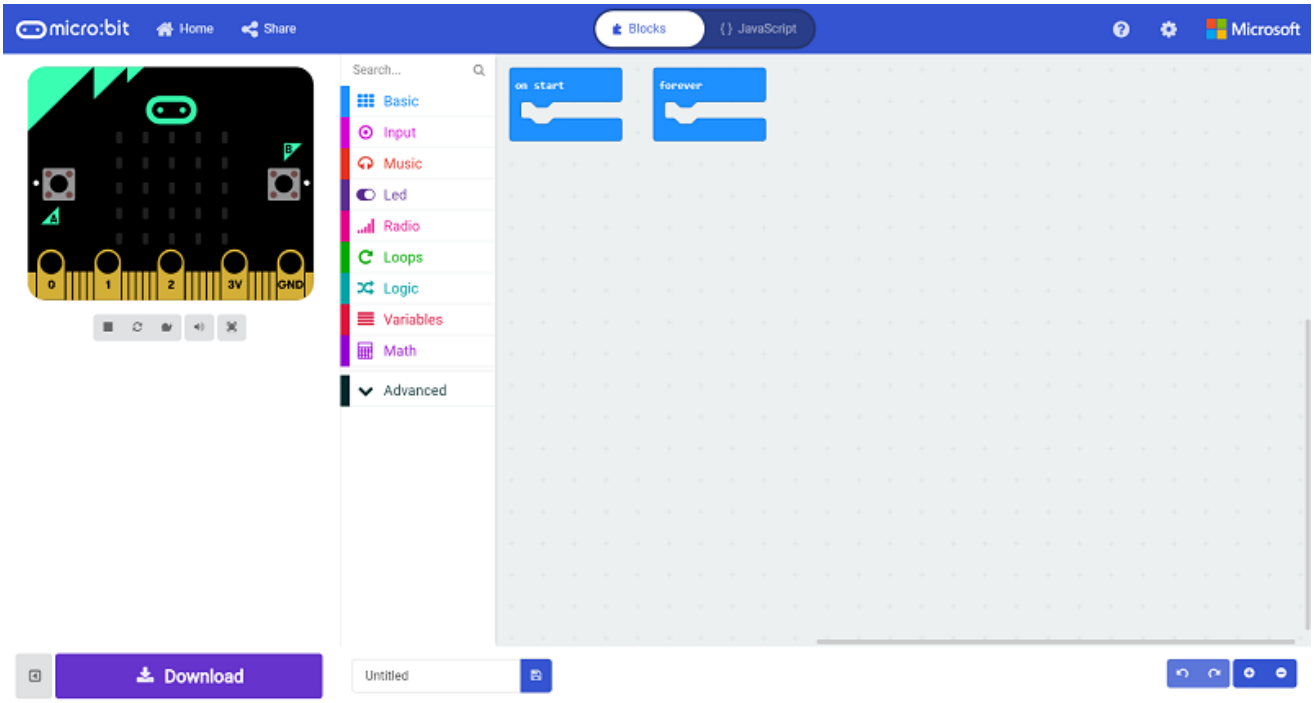


You would see as below after you finish the connection:

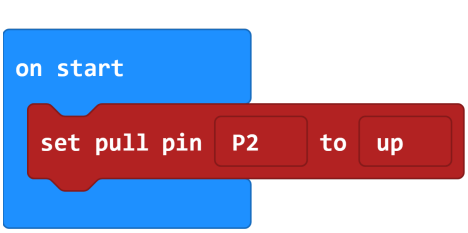


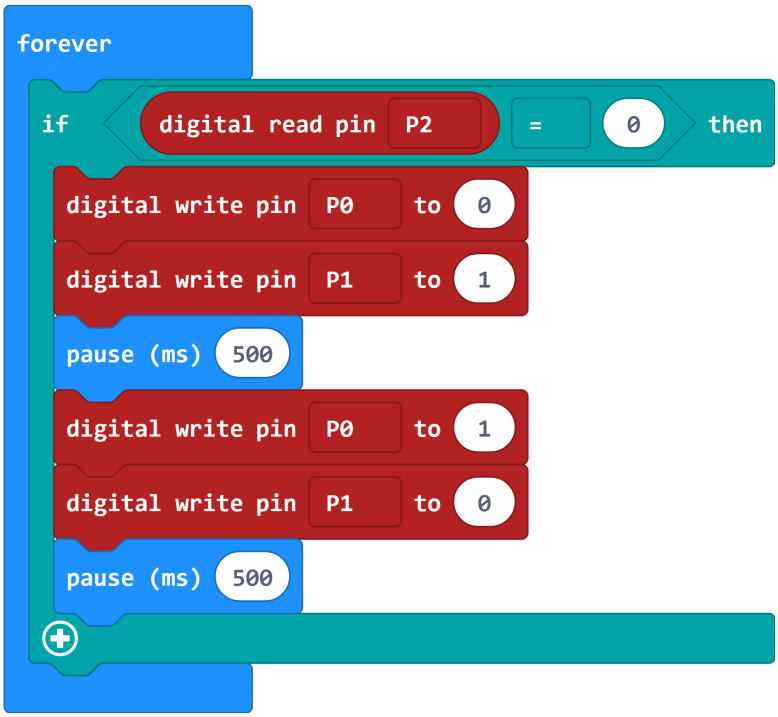
Software Programming

Click to open Microsoft Makecode, write the following code in the editor.



Program as the picture shows:



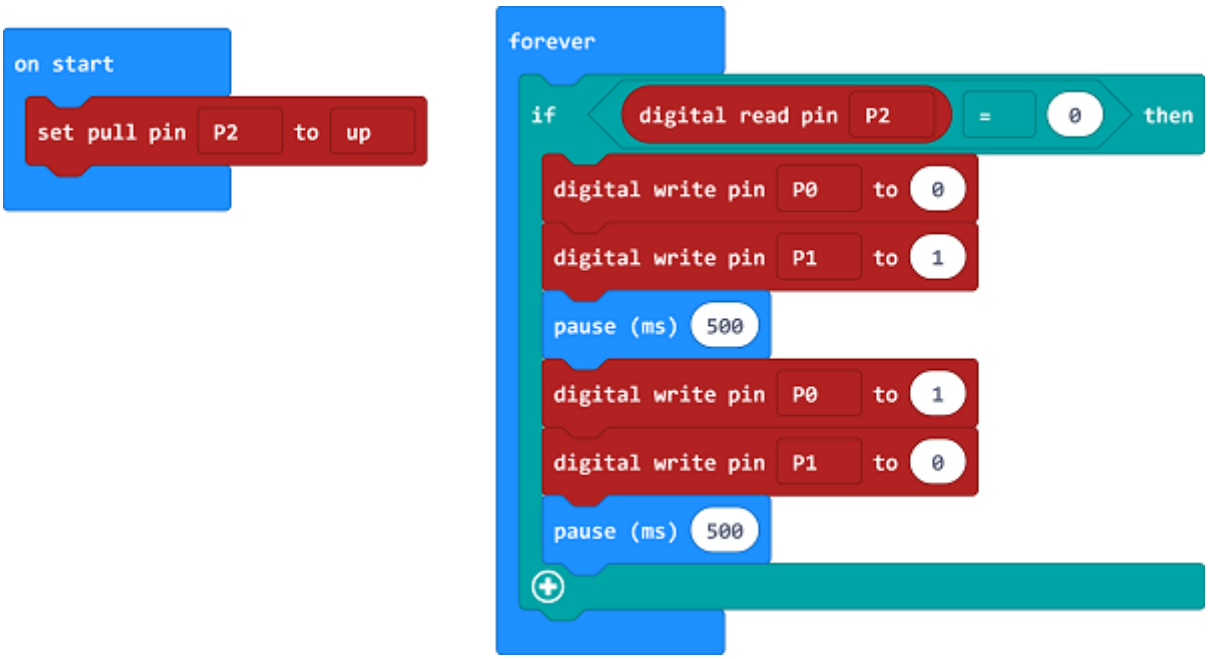


Details for the code:

- 1.Set pin P2 to the high potential in the bricks of “on start”.

- 2.Read the status from P2 to check if the button is pressed, if yes, digital write signal 0 to P0 port to turn off the LED; digital write signal 1 to P1 port to turn on the LED, then set the pause in 500ms; digital write signal 1 to P0 port to turn on the LED; digital write

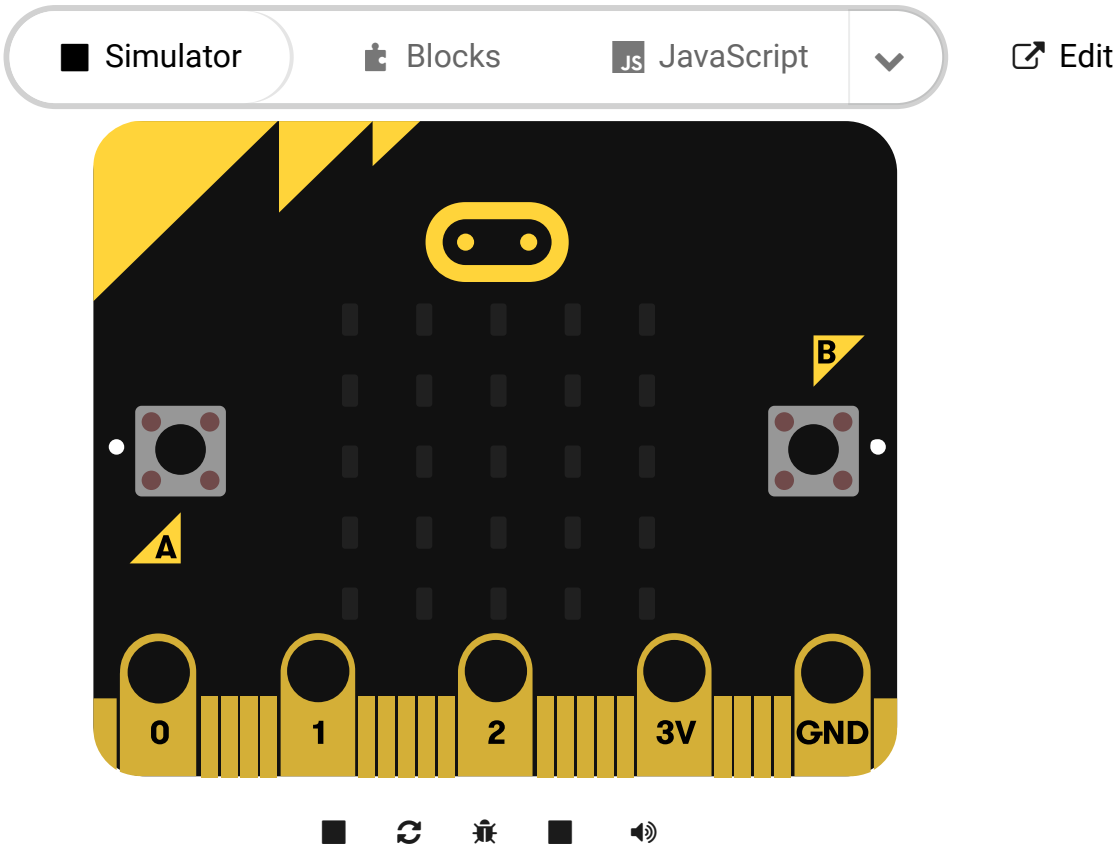
signal 0 to P1 port to turn off the LED, then set the pause in 500ms.



Reference

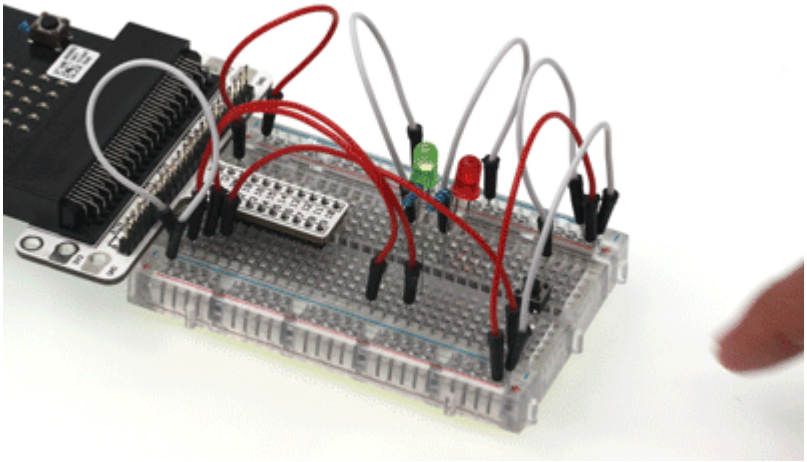
Links: https://makecode.microbit.org/_T585WeYwVWtv

You can also download the links directly:



4.6. Result

When the button is pressed, you can see the 2 LEDs flashing alternatively; When the button is released, they would stop flashing. If not, you need to go back and check your operations.

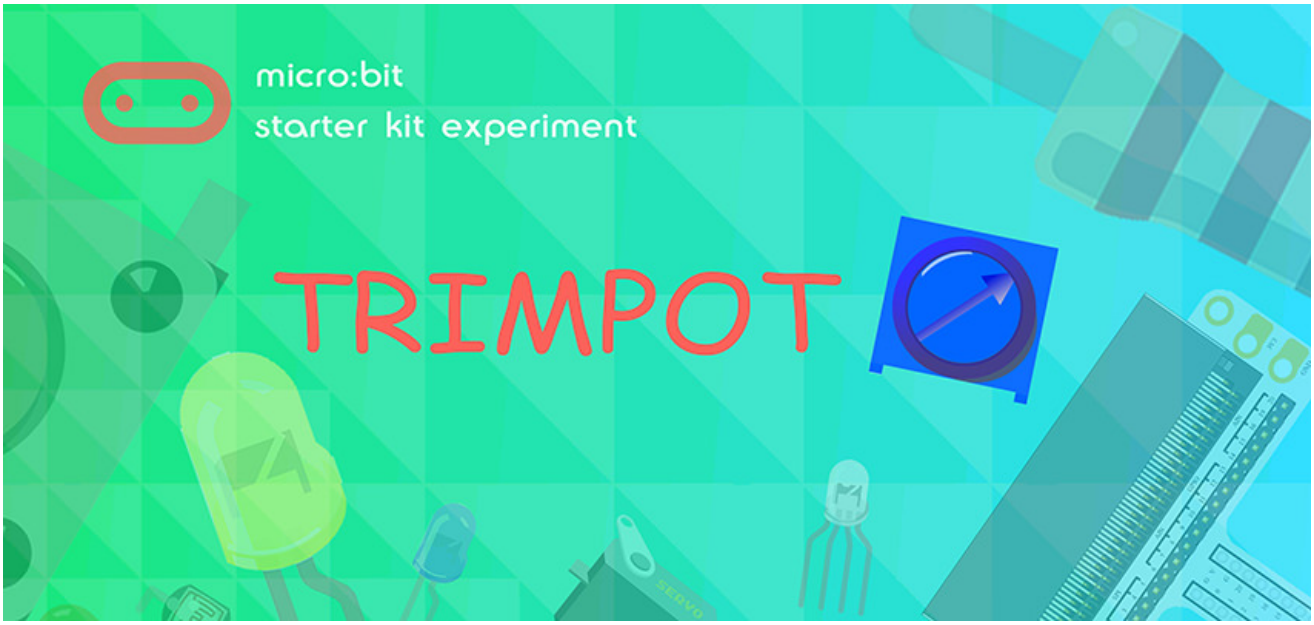


4.7. Exploration

If we want to light on the red LED when press the button and light on the green LED when release the button, how can we program?

4.8. 常见问题FAQ

5. Lesson 03 Trimpot



5.1. Introduction:

Trimpot （or potentiometer) is a kind of common pressure adjustment components. In the following experiment, we are going to read output voltage on trimpot and display it on the micro:bit 5*5 LED screen with bar graph.

5.2. Components List:

Hardware:

- 1 x Micro:bit Board
- 1 x Micro-B USB Cable
- 1 x Microbit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x 10K Trimpot
- n x Breadborad jumper wire 65pcs pack

Tips: If you want to buy all components above, you may need Elecfreaks Micro:bit Starter Kit.

5.3. Major Components Introduction

Trimpot

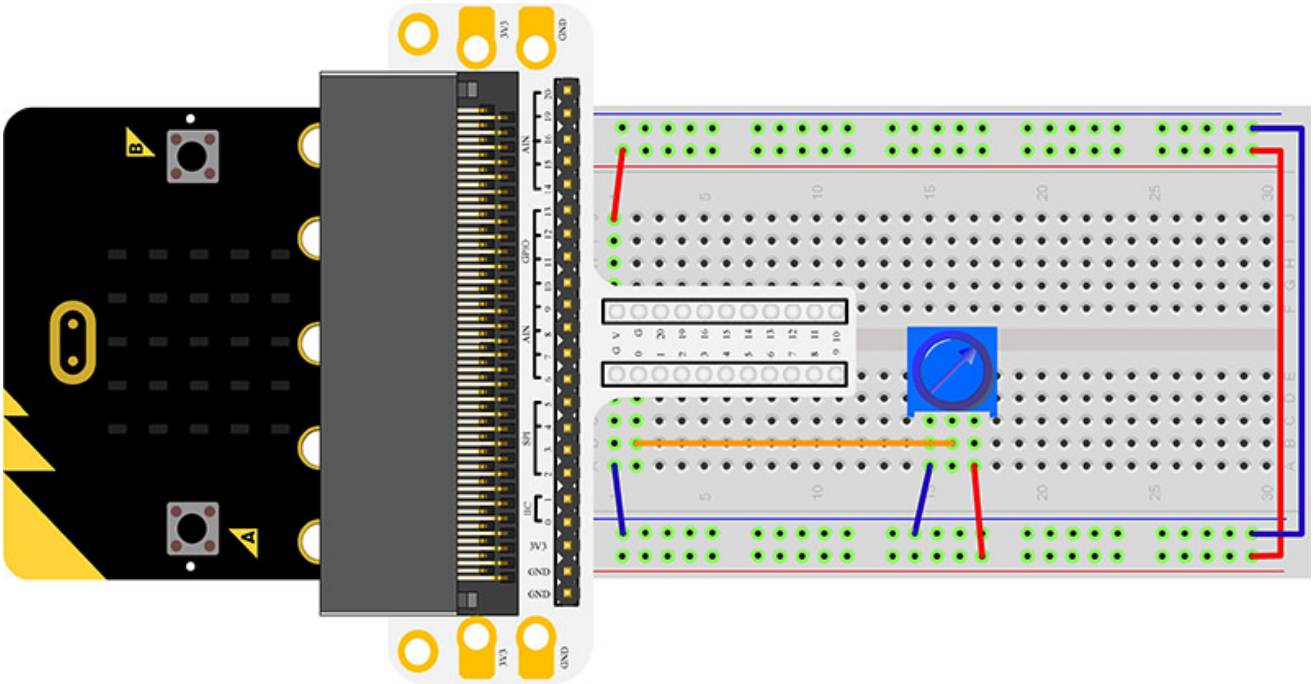
Trimpot is a kind of adjustable electronic components. It contains a resistor and a rotary or sliding system. When add an outer voltage on the two fixed contact spots of the resistor, the contact spot of the resistor can be changed by the rotary or the sliding system, a voltage with certain relationship with the place of movable contact spot is formed between movable contact spot and two fixed contact spots. Most of the time, it works as a voltage divider.

5.4. Experimental Procedure

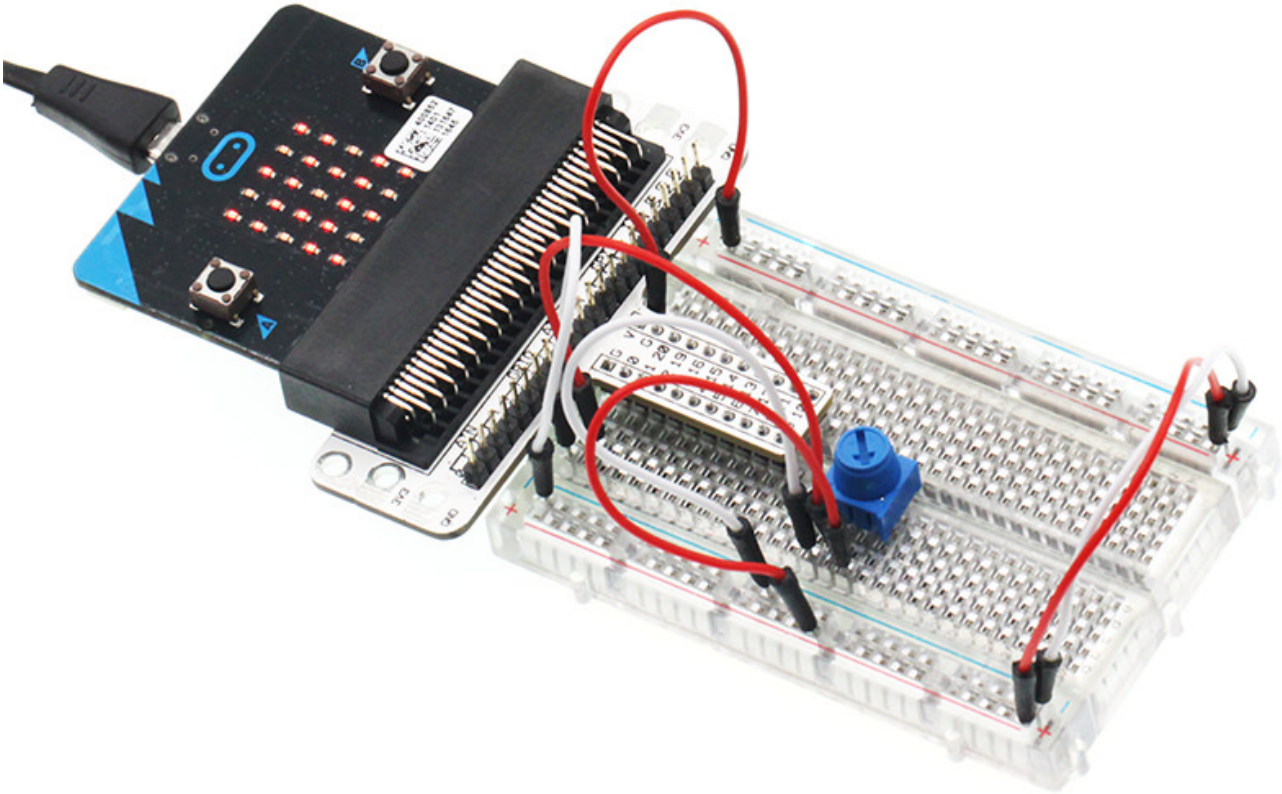
Hardware Connection

Connect your components according to the picture below:

- 1.Connect the P0 port of the breadboard adapter with the S port of the Trimpot.
- 2.Connect the other two ports with the GND and 3V power supply ports.

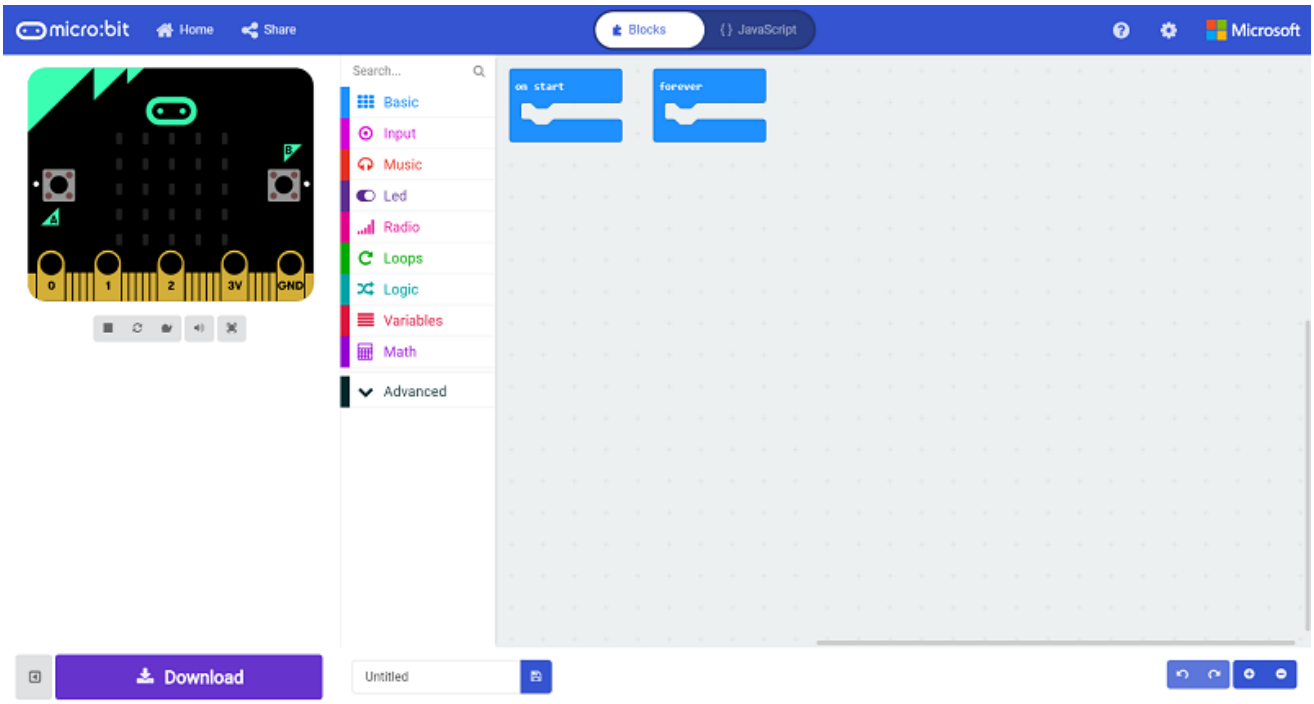


You would see as below after you finish the connection:

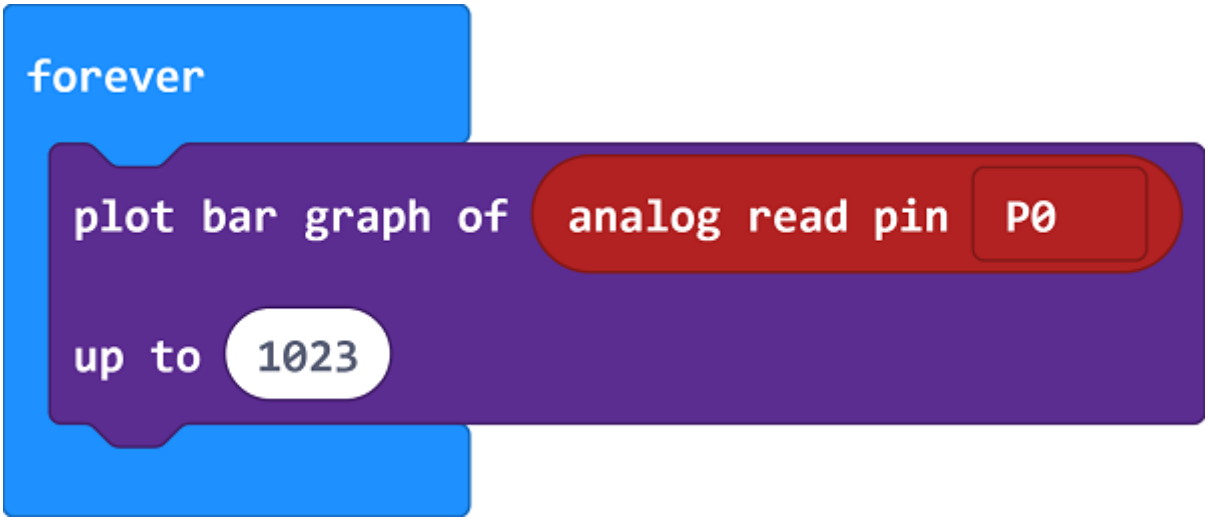


Software Programming

Click to open Microsoft Makecode, write the following code in the editor.

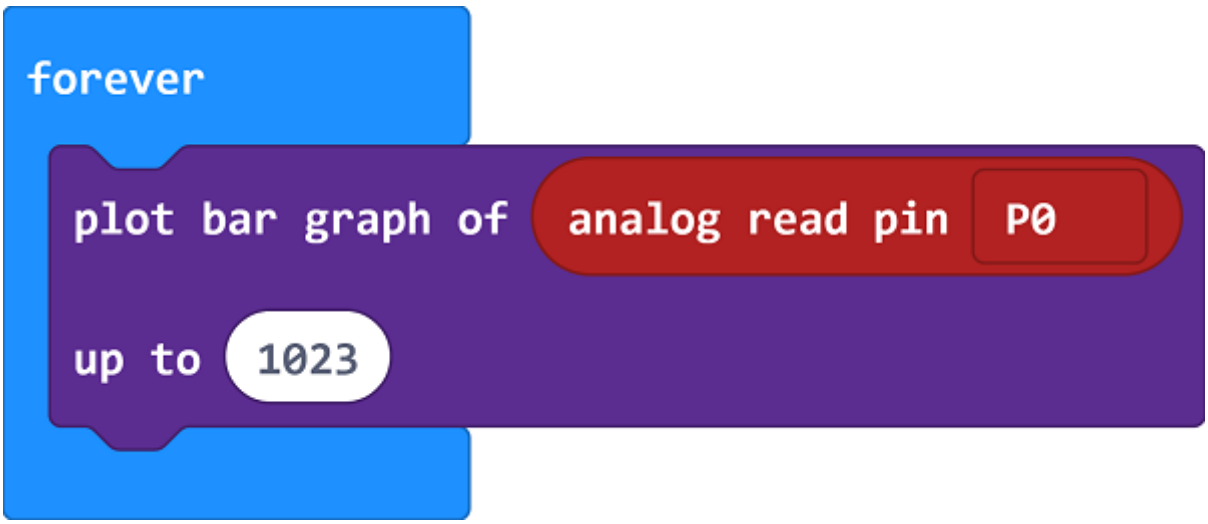


Program as the picture shows:



Details for the code:

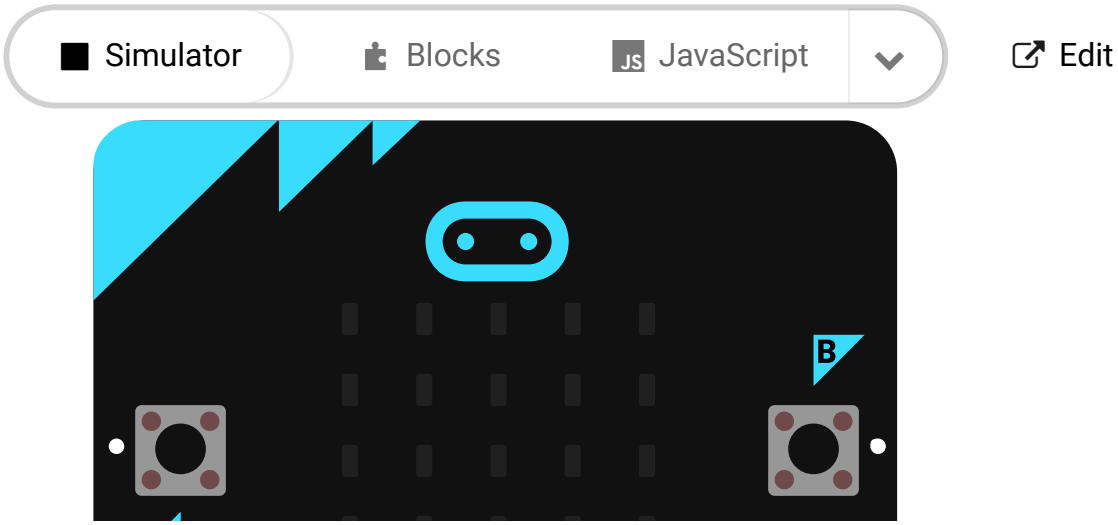
- Analog read the signal(0~1023) from P0 port and show it on the micro:bit in the form of bar graph.

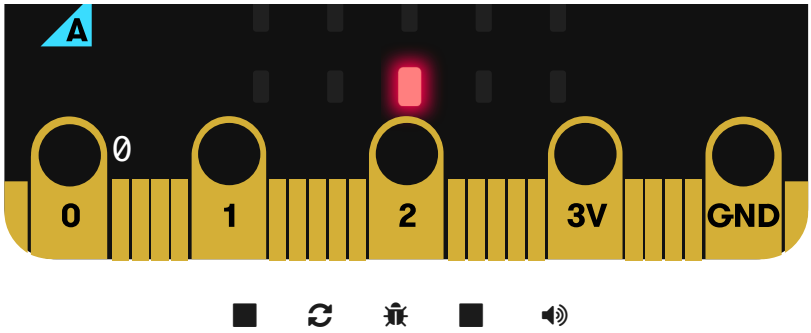


Reference

Links:https://makecode.microbit.org/_A2a4C65woMoc

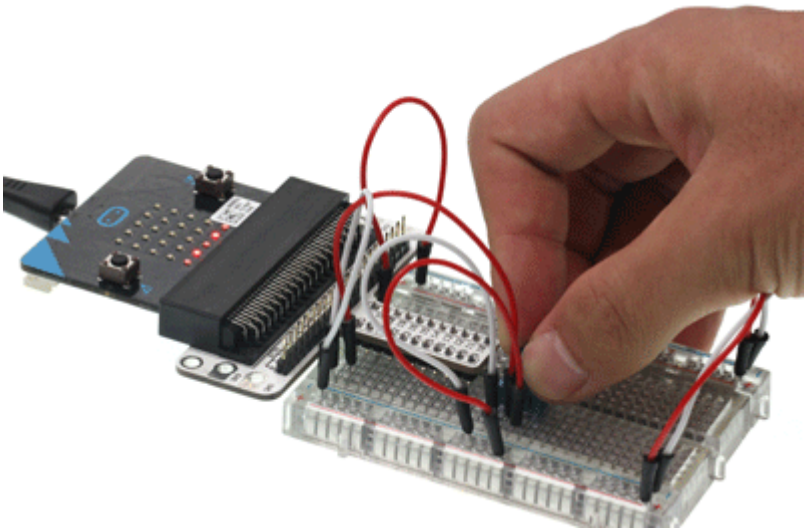
You can also download the links directly below:





5.5. Result

Rotate the Trimpot button, voltage value will be displayed on micro:bit in the form of bar graph. When voltage read is “0”, the LED screen display a pixel spot only. While the voltage becomes 3.3V, LED screen will be fully illuminated.



5.6. Exploration

If we want to use Trimpot to adjust the brightness of a LED, how can we design the circuit and program?

5.7. FAQ

6. Lesson 04 Photocell

6.1. Introduction:

Photocell is a kind of special resistor based on internal photoelectric effect. Its value of resistance is opposite to the brightness of the light, the brighter of the light is, the lower of the value of the resistance will be. Usually photocell is the core component of a photoswitch. In the following experiment, we are going to use photocell to control the brightness of 5*5 LED screen on micro:bit.

6.2. Components List:

Hardware:

- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x micro:bit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x Photocell
- 1 x 10k Ohm Resistors
- n x Breadborad jumper wire 65pcs pack

Tips: If you want to buy all components above, then you will need Elecfreaks micro:bit Starter Kit.

6.3. Major Components Introduction

Photocell

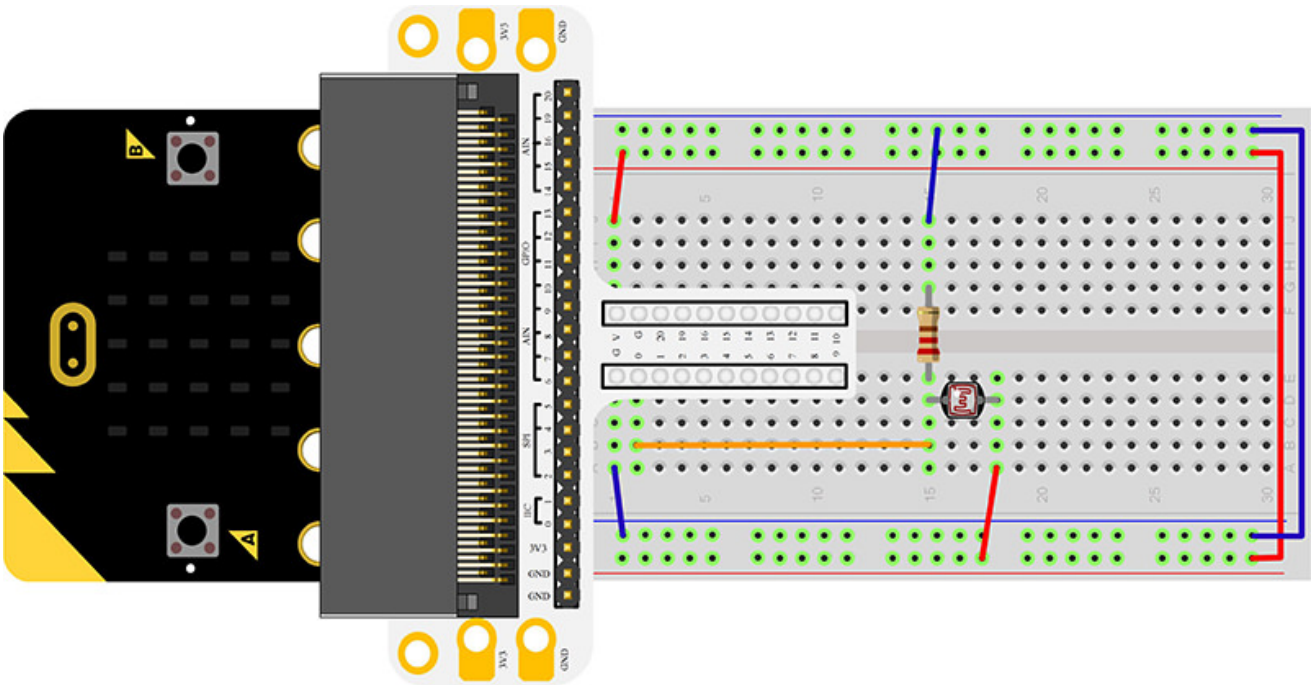
Photocell is a kind of special resistor made of semi-conductor materials like Cds or CdSe based on internal photoelectric effect. The brighter of the light is, the lower of the value of the resistance will be. with the intensity of light increasing, its resistant value decreased sharply, and the minimum light resistant value can drop down to below 1KΩ. Photocell is very sensitive to light. When there is no light, its resistant value arrives to its maximum and its dark resistant value usually can reach 1.5MΩ at max.

6.4. Experimental Procedure

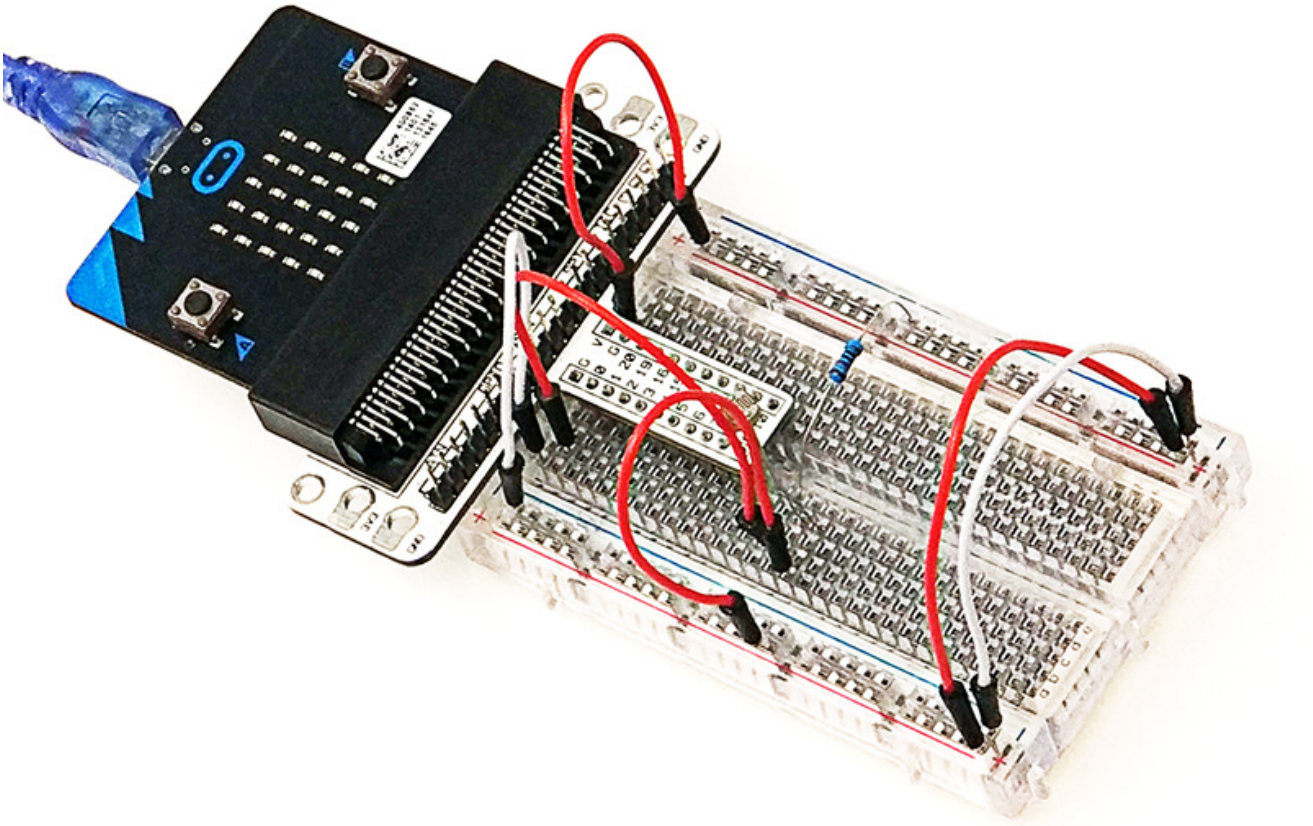
Hardware Connection

Connect your components according to the picture below:

- 1.Connect the Photocell to P0 port.
- 2.Connect the 10Ω resistor with the Photocell in parallel.

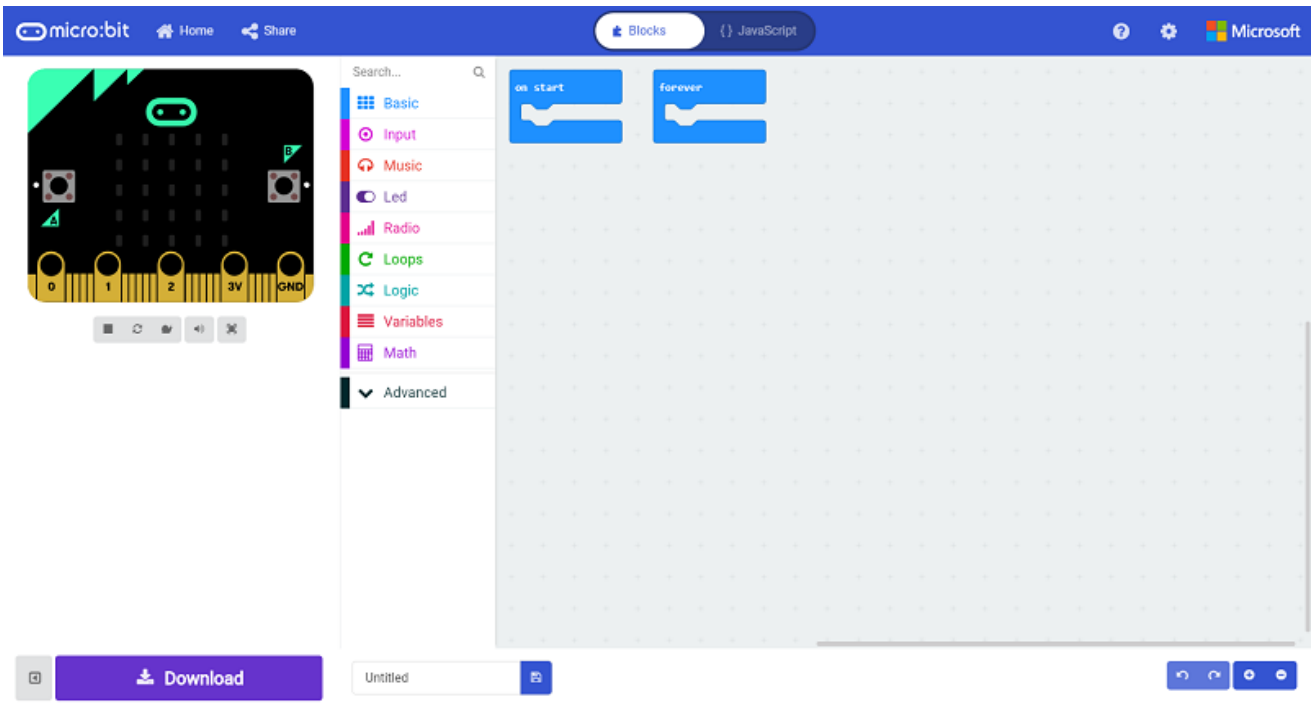


You would see as below after you finish the connection:

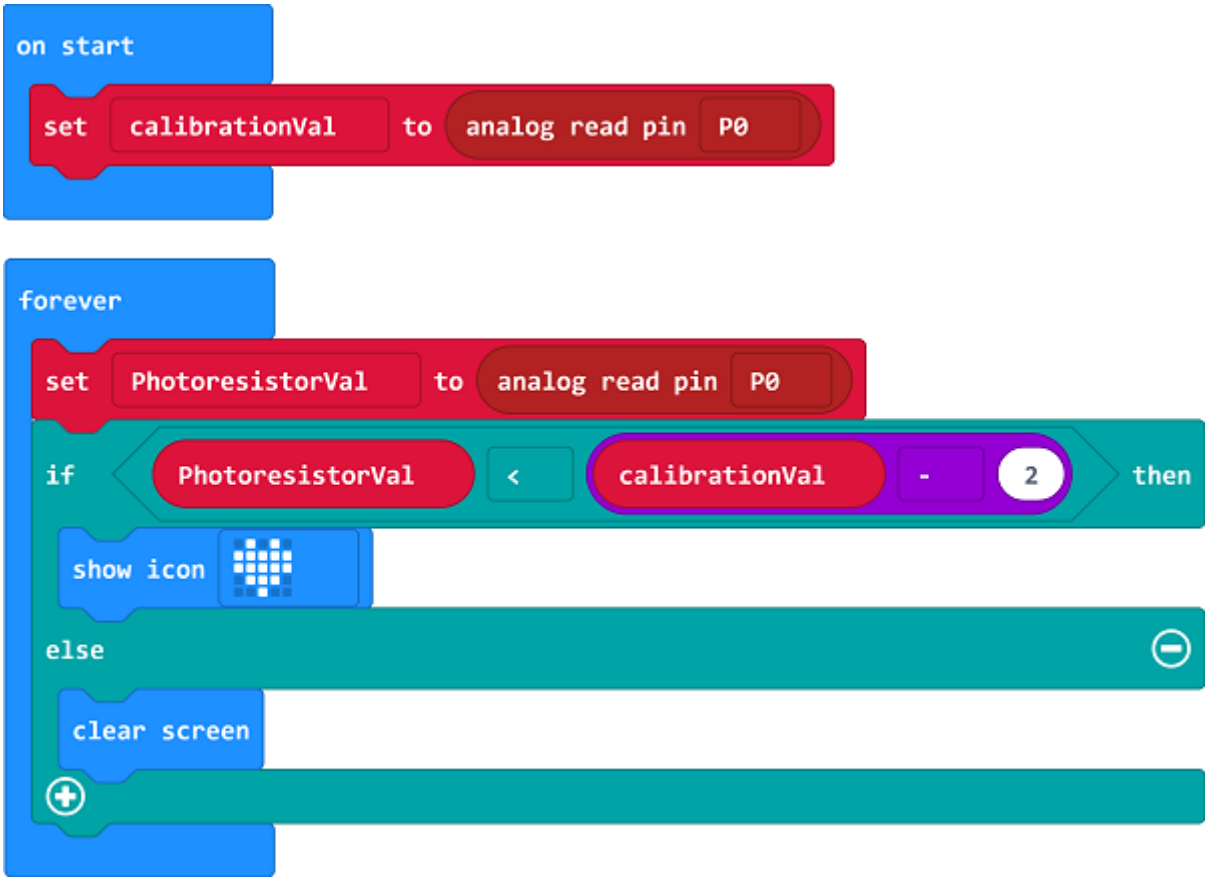


Software Programming

Click to open Microsoft Makecode, write the following code in the editor.



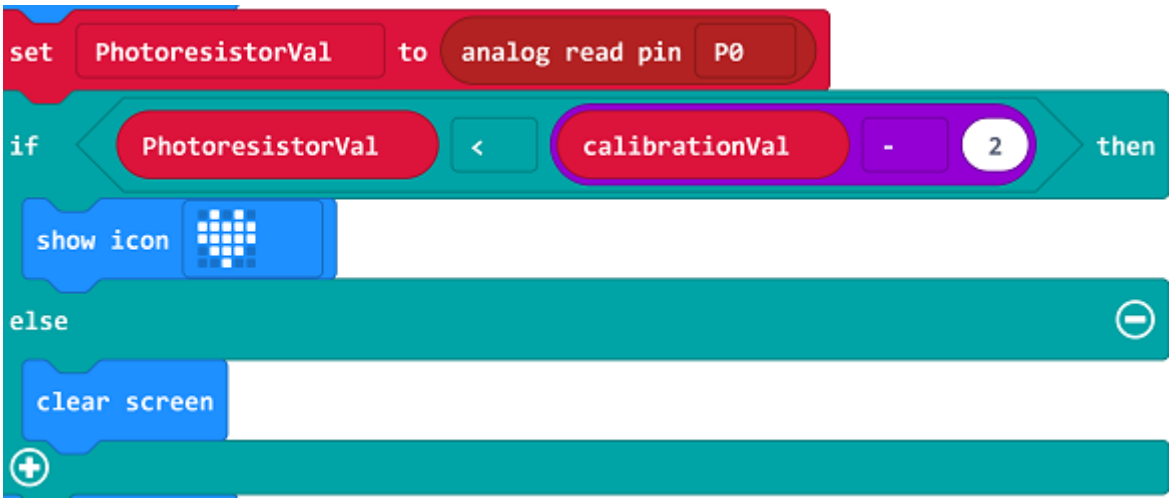
Program as the picture shows:



Details for the code:

- 1.Analog read the voltage as the reference value for the brightness in “on start”

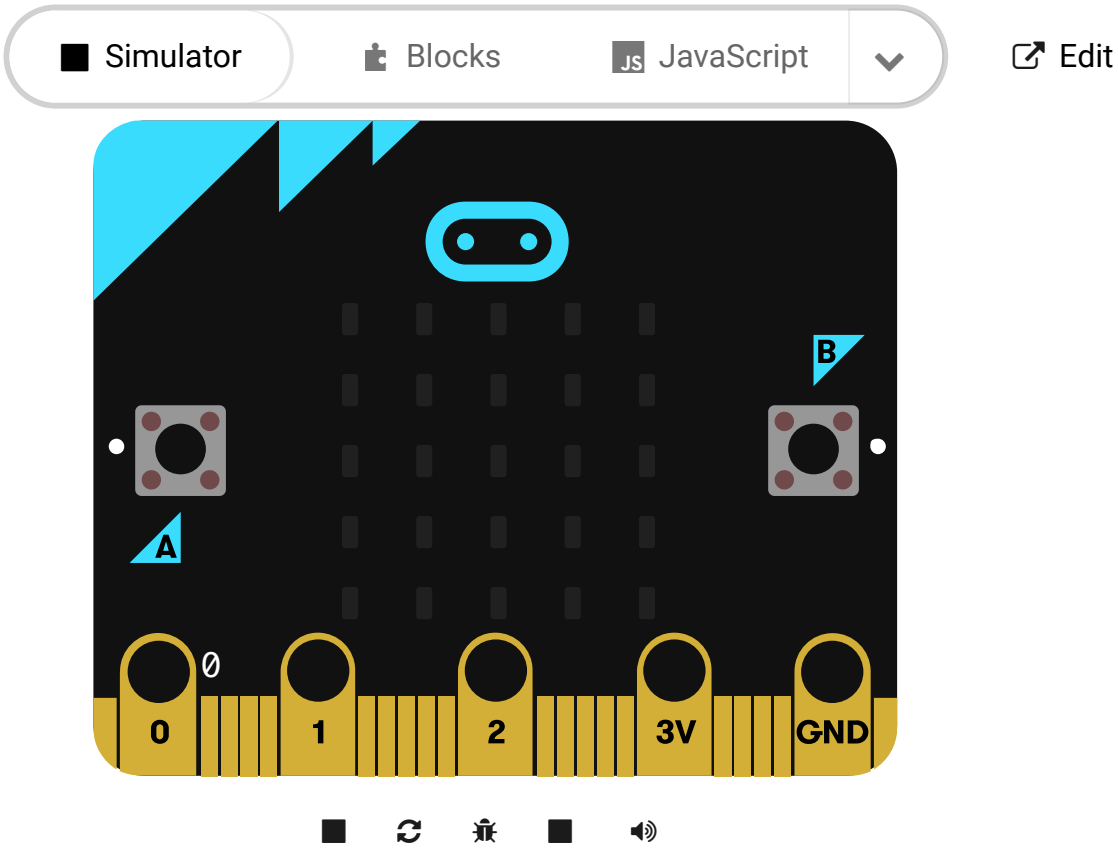
- 2.In the brick of “forever”, analog read the voltage from P0 port repeatedly. Once the voltage lower than reference value minus 2(it shows if the intensity of light increases, the resistant value of photocell would decrease), then it tells the light has been turned off. At the moment, an icon is showing on the micro:bit, the calibrationVal minus 2 is used to adjust the sensitivity, the lower value is, the higher of the sensitivity would be.



Reference

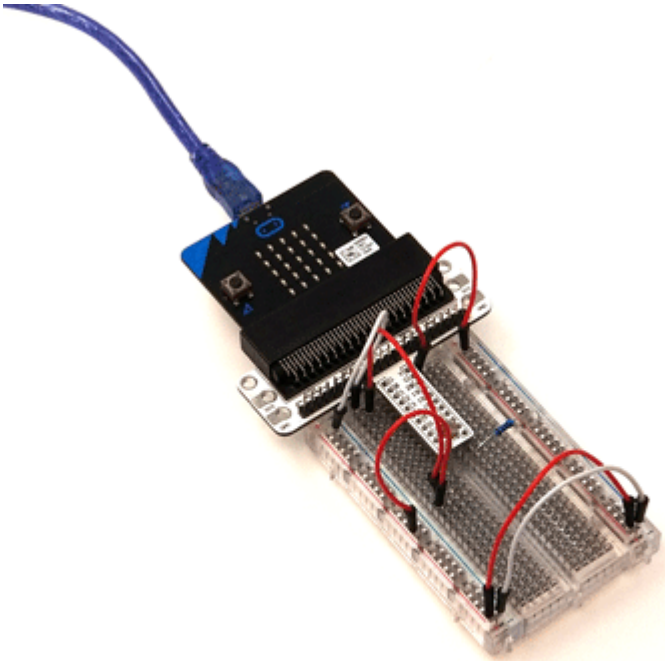
Links:https://makecode.microbit.org/_3tFFoPhLF7hX

You can also download the links directly:



6.5. Result

Turn on the light, the LED screen on micro:bit shows nothing. Turn off light, the LED screen displays an icon.

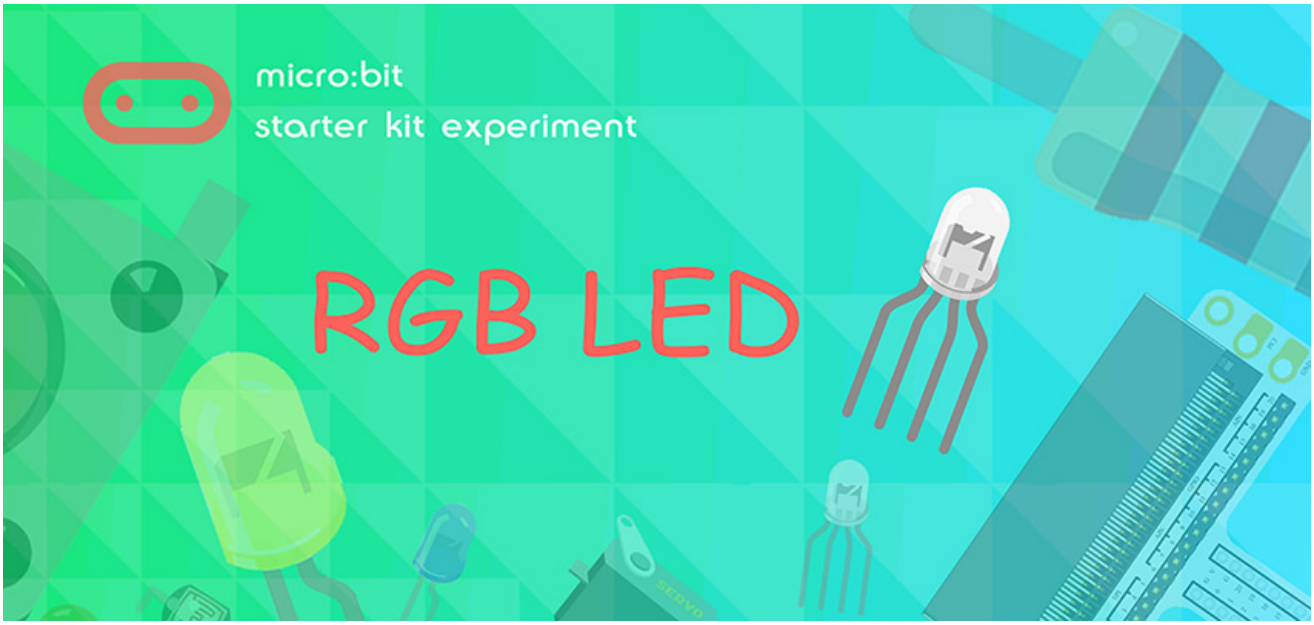


6.6. Elploration

If we want to use photocell to control a LED, how to design circuit and program?

6.7. FAQ

7. Lesson 05 RGB LED



7.1. Introduction:

RGB LED is a kind of LED that can emit light in three different colors: red, green and blue. In this experiment, we are going to make RGB LED shifts its light among the three different colors gradually.

7.2. Components List:

Hardware:

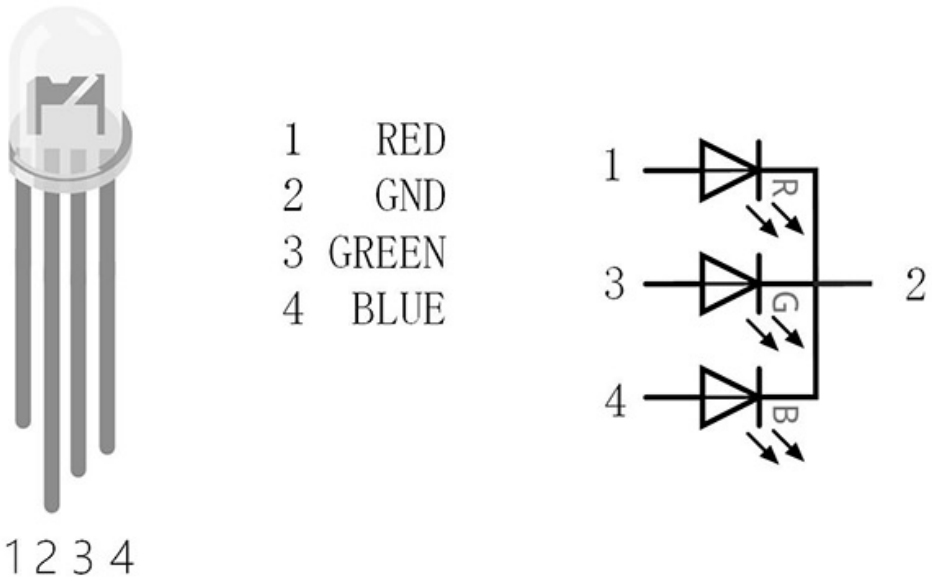
- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x microbit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x RGB LED
- 3 x 100 Ohm Resistors
- n x Breadborad jumper wire 65pcs pack

Tips: If you want to buy all components above, you may need Elecfreaks Micro:bit Starter Kit.

7.3. Major Components Introduction

RGB LED

RGB LED is a kind of LED that has integrated red LED, green LED, and blue LED into a component. We all knows that the three primary colors of light are red, green, and blue. With different groups of the three color lights, we can create all colors of the world. Similarly, if we use RGB LED to group lights with different brightness, then it can form various colors.



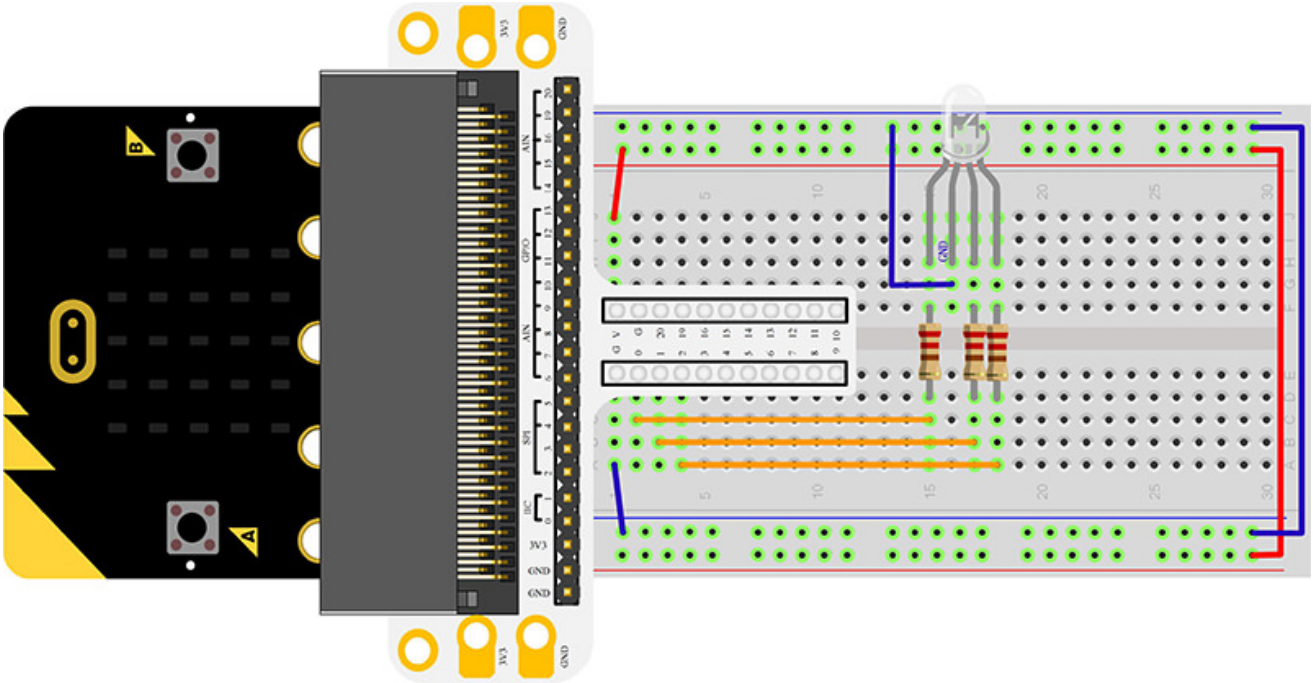
RGB LED can be divided into 2 types: common anode and common cathode. In common-cathode RGB LED, its common port usually connects GND, while in common-anode RGB LED, its common port connects VCC. In this experiment, we choose common-cathode RGB LED.

7.4. Experimental Procedure

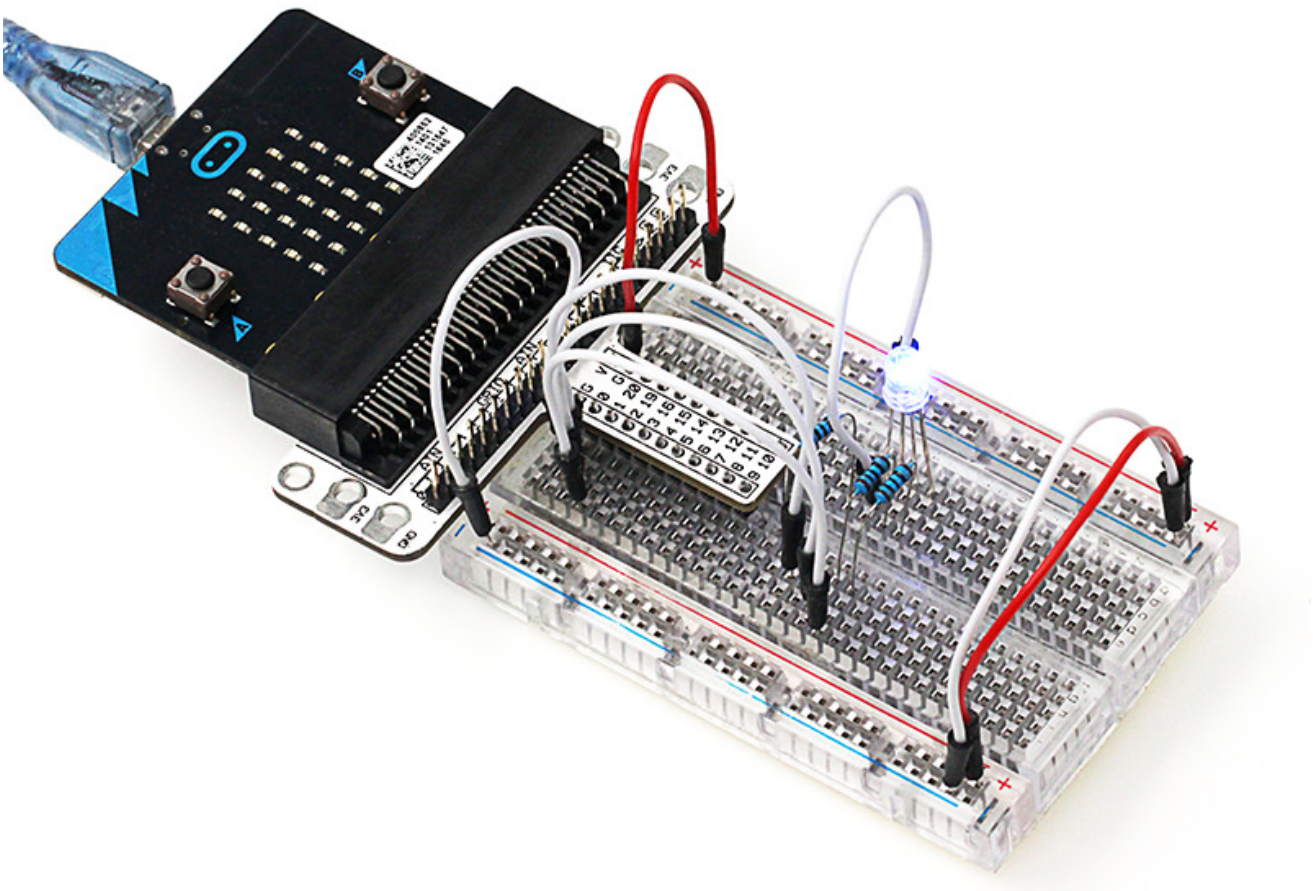
7.5. Hardware Connection

Connect your components according to the picture below:

- 1.Connect the three pins of the RGB led to the P0, P1 and P2 accordingly, then connect with a 100Ω resistor.
- 2.Connect the GND of the RGB led with the GND of the breadboard adapter through the breadboard.

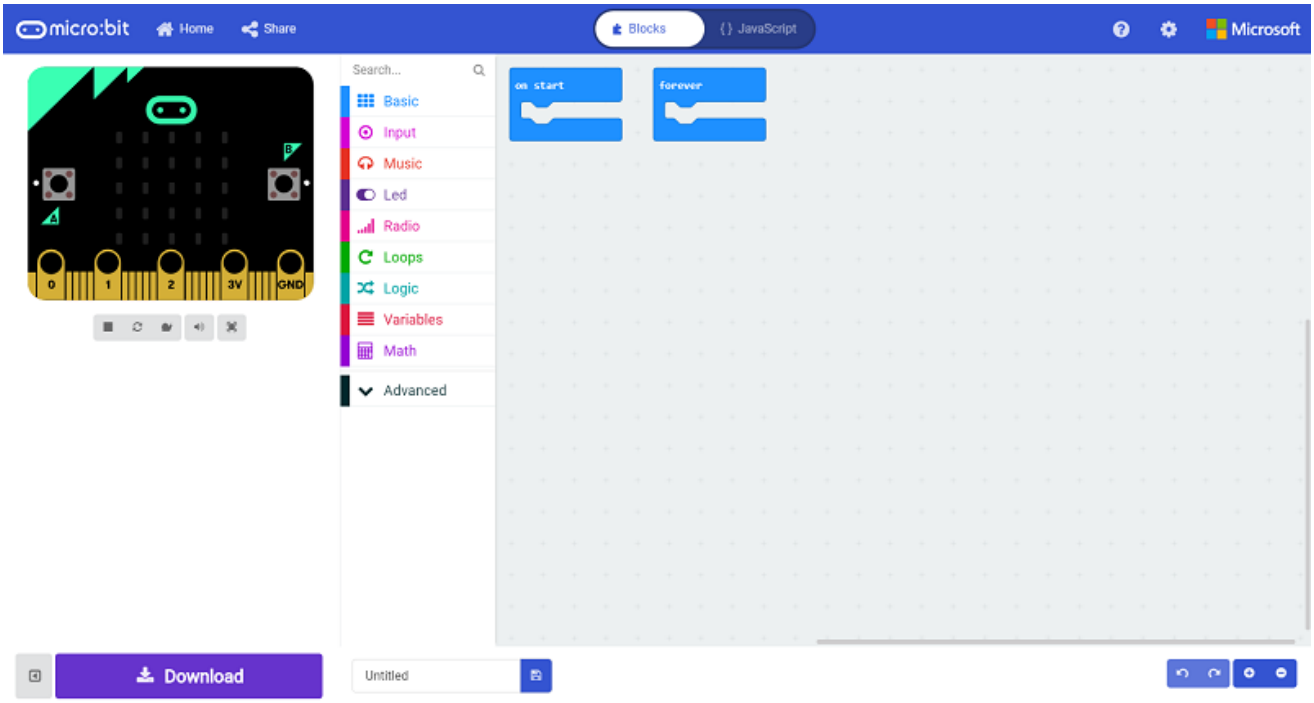


You would see as below after you finish the connection:

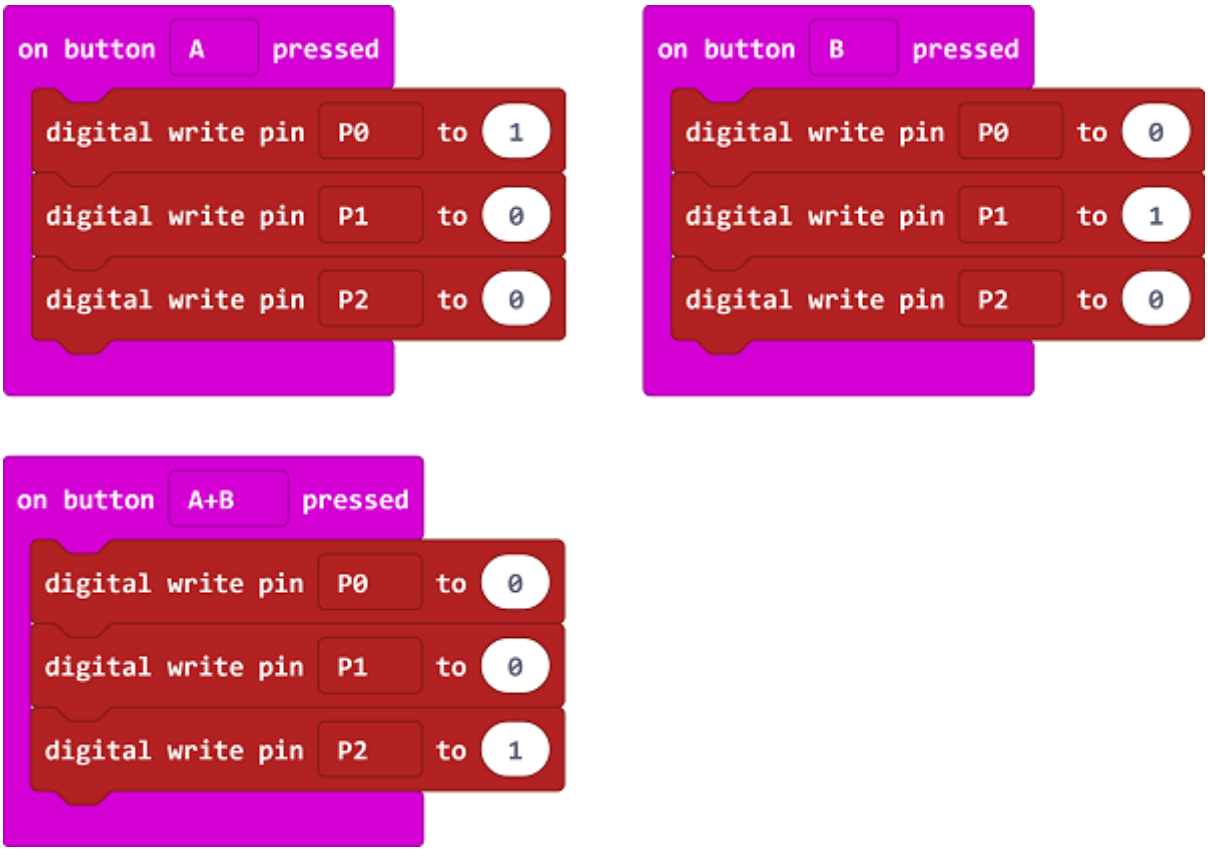


Software Programming

Click to open Microsoft Makecode, write the following code in the editor.

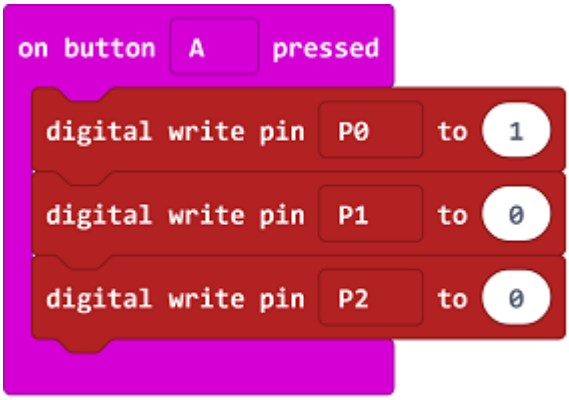


Program as the picture shows:



Details for the code:

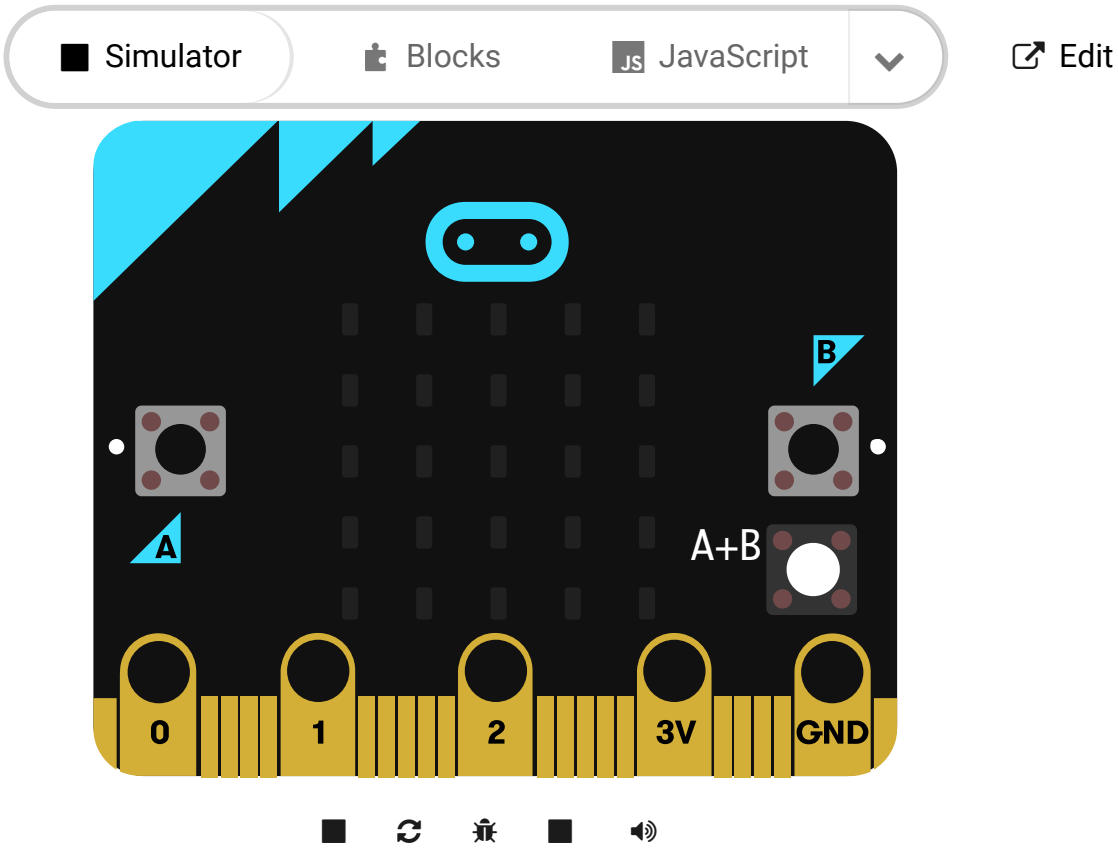
- When press the button A, set the R to 1, G, B to 0. When press the button B, and press the button A+B, set it in a similar way.



Reference

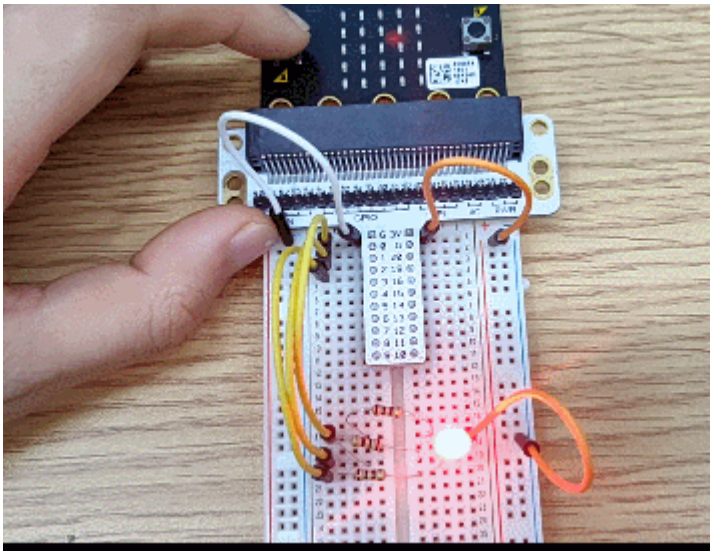
Links:https://makecode.microbit.org/_Th3Vum76F4Tr

You can also download the links directly:



7.6. Result

Press button A, LED turns red. Press button B, LED turns green. Press button A+B, LED turns blue.



7.7. Exploration

If we want to use RGB LED to emit cyan light, magenta light, yellow light, then how to design circuit and program?

7.8. FAQ

8. Lesson 06 Self-lock Switch

8.1. Introduction

Self-lock switch is a kind of common button switch. When we press the button for the first time, the switch is connected and remains that status, which is called “self-lock”. When we press the button for the second time, the switch is disconnected. At the same time, the button will bounce back to its initial place. In this experiment, we are going to use self-lock switch to control LED light.

8.2. Component List

Hardware：

- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x microbit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x Self-lock Switch
- 1 x LED
- 1 x 100 Ohm Resistors
- n x Breadborad jumper wire 65pcs pack

Tips: If you want all components above, you may need Elecfreaks micro:bit Starter Kit.

8.3. Major Components Introduction

Self-lock Switch

Self-lock switch normally means switch with built-in mechanical lock function. Press down the switch and then release, it will not fully bounce up because it is locked. You have to press it again, then it will be unlocked and fully bounce up. This is the so-called Self-lock Switch. It is widely used to earlier televisions and monitors with function of directly completely power off.

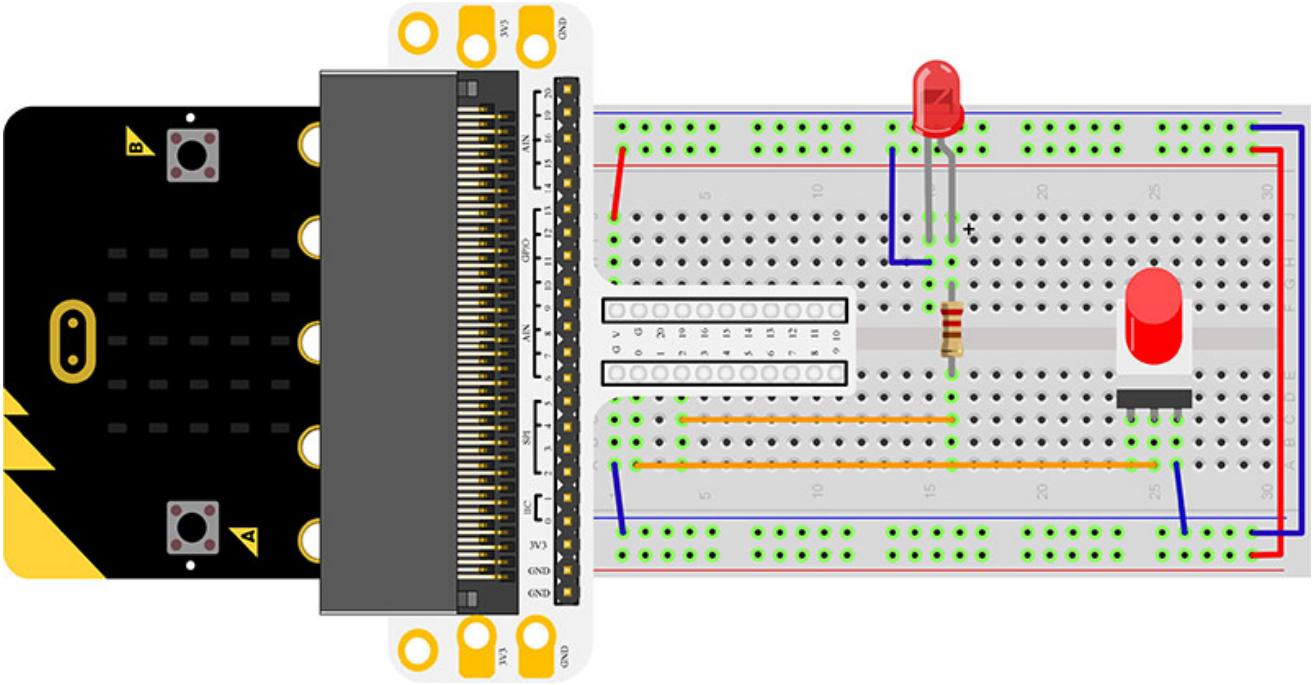
Note: This kind of self-lock switch contains two groups of double-throw switch. In this experiment, we use a group only. So we cut down the common footer of a group.

8.4. Experimental Procedure

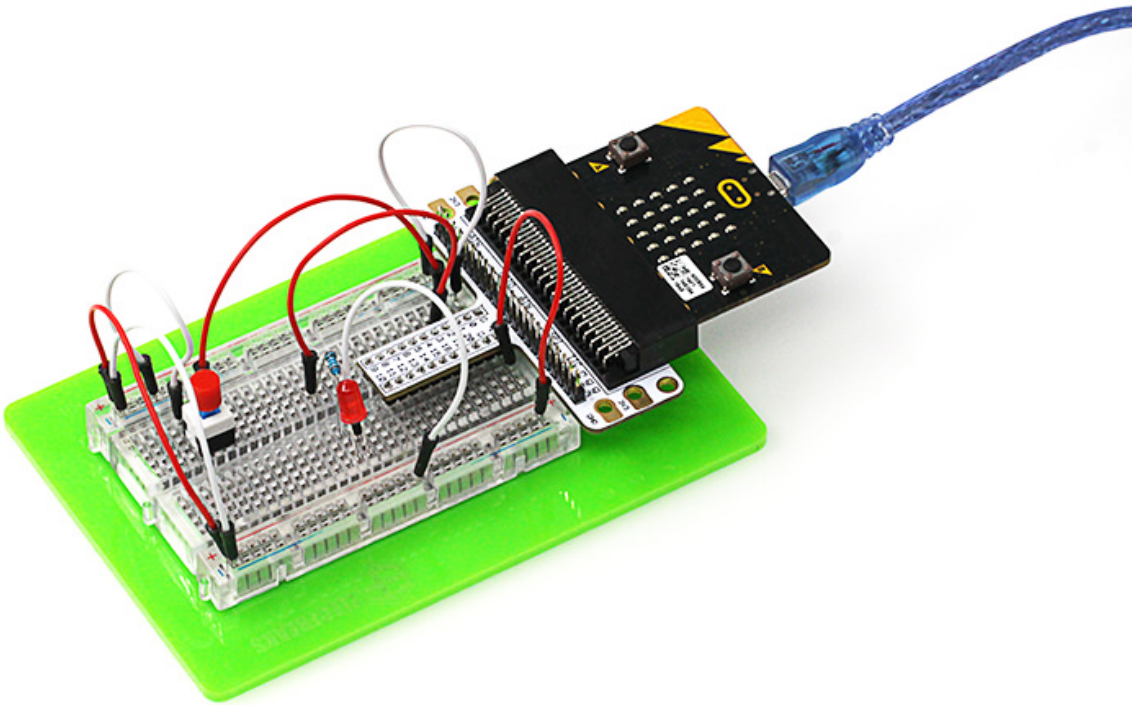
Hardware Connection

Connect them as the picture shows:

- 1. Connect the self-lock switch to the P0 port of the breadboard adapter.
  2. Connect the LED to P2 port of the breadboard through 100Ω resistor.

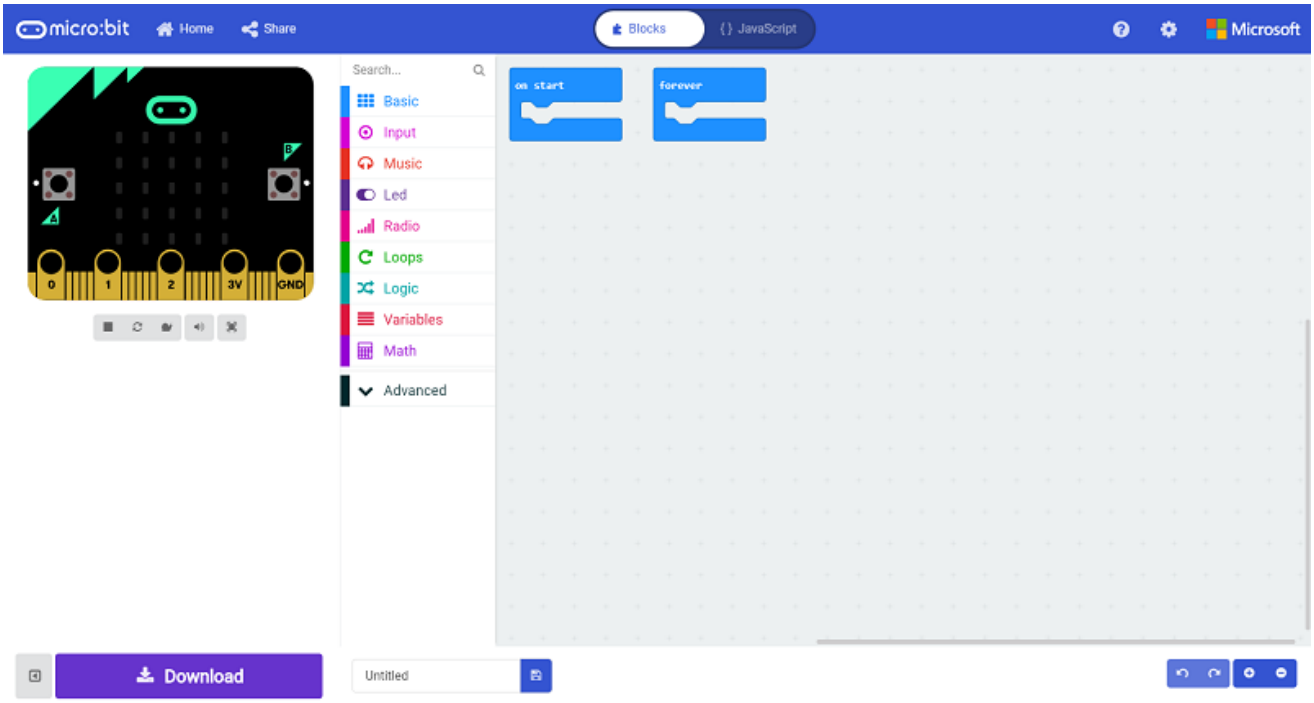


After connection, you will see:



Software

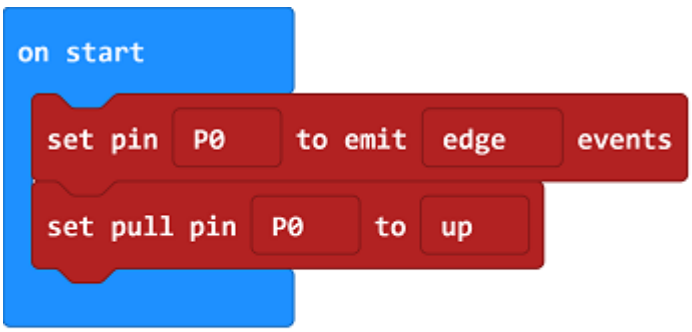
Please open makecode.microbit.org(https://makecode.microbit.org/) and write your code in the edit area.

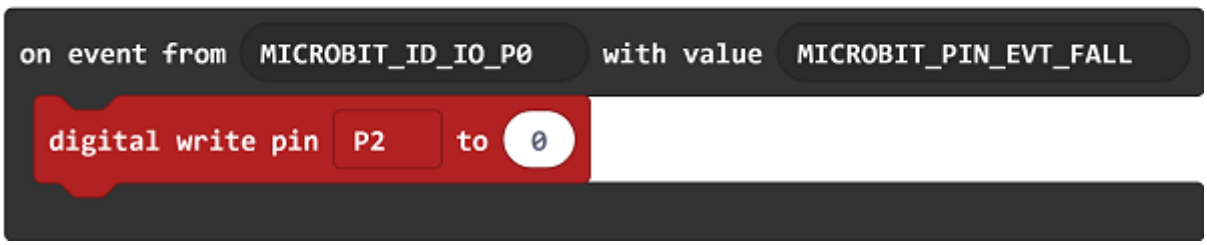


Add Package

- Not Required

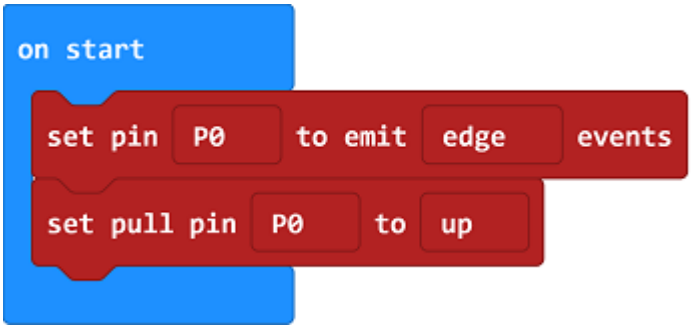
Program as the picture shows:



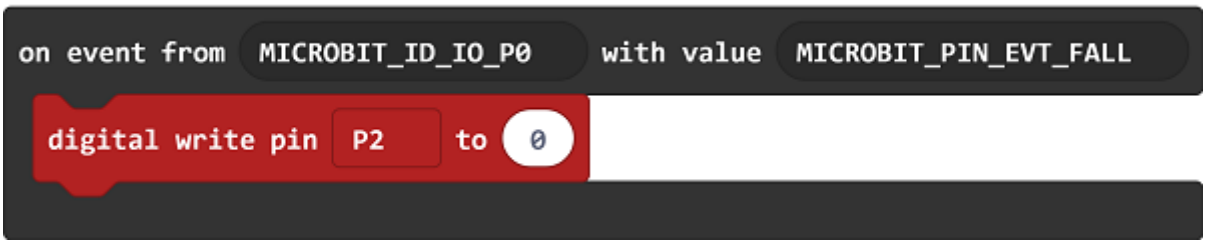


Details for the code:

- 1.Set events monitor to P0 port and set it to high level.



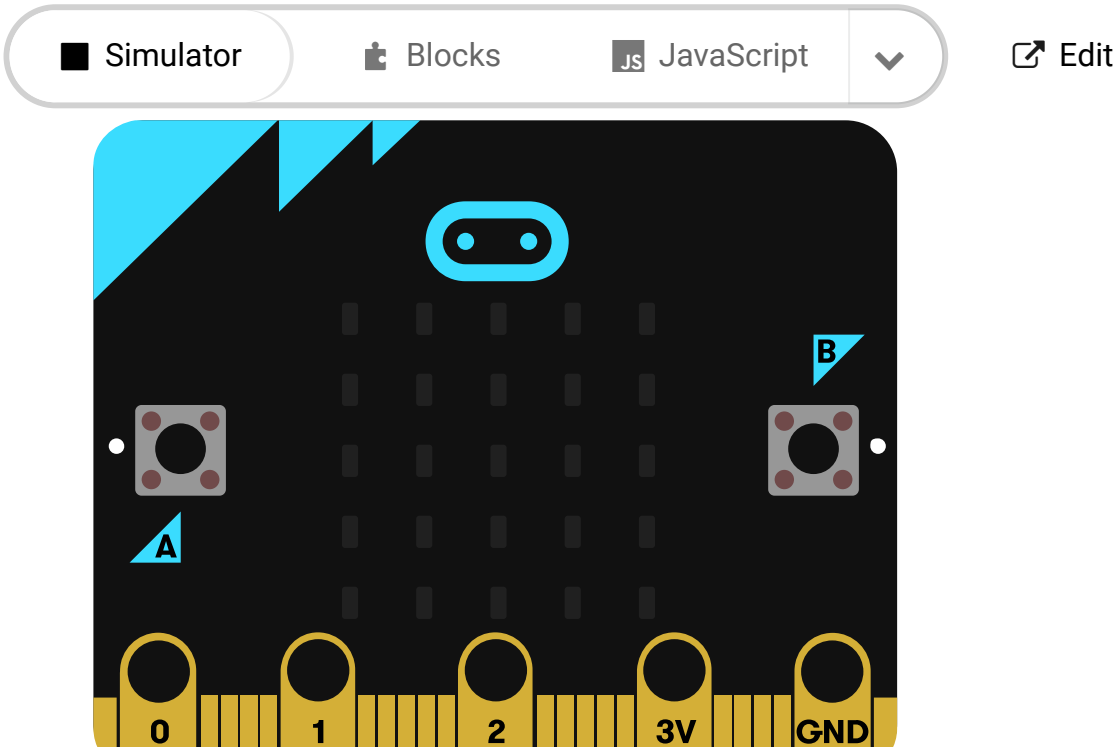
- 2.Set the trigger for the event, when the self-lock switch is pressed down, the electric potential changes and the led lights on; while being pressed again, the electric potential changes again and the led lights off.



Reference

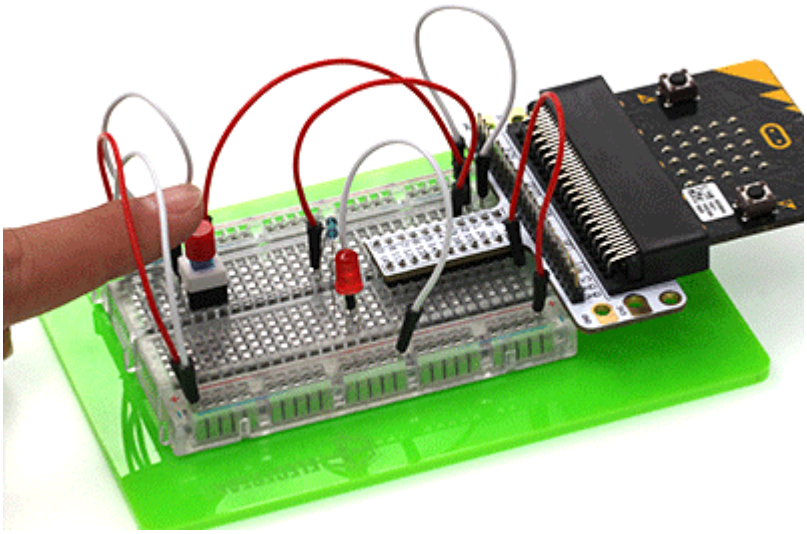
Links: https://makecode.microbit.org/_Dhy5i9KVeLAK

You can also download the links directly:



8.5. Result

Press down self-lock switch, LED lights on; press again, LED lights off.



8.6. Exploration

Usually stair light uses double-throw switch to realize this function. We can turn on the light upstairs and turn off it downstairs. Vice versa. Suppose if we want to use 2 self-lock switch to realize stair light function, then how to design circuit and program?

8.7. FAQ

9. Lesson 07 Temperature Sensor

9.1. Introduction

Temperature sensor is a kind of sensor that can detect temperature and transfer it into output data. Temperature sensor is the core component of temperature gauges and instruments with multiple categories. In this experiment, we are going to learn analog temperature sensor–TMP36 and display its data on micro:bit.

9.2. Components List

Hardware:

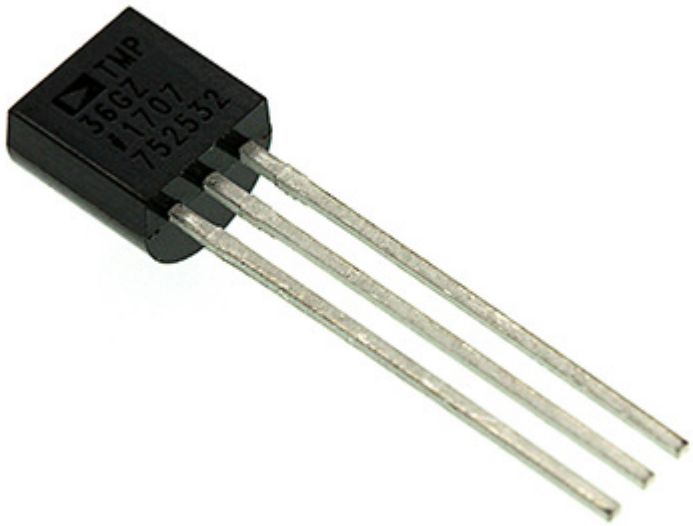
- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x microbit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x TMP36 Temperature Sensor
- n x Breadborad Jumper Wire 65pcs Pack

Tips: If you want all components above, you may need Elecfreaks Micro:bit Starter Kit.

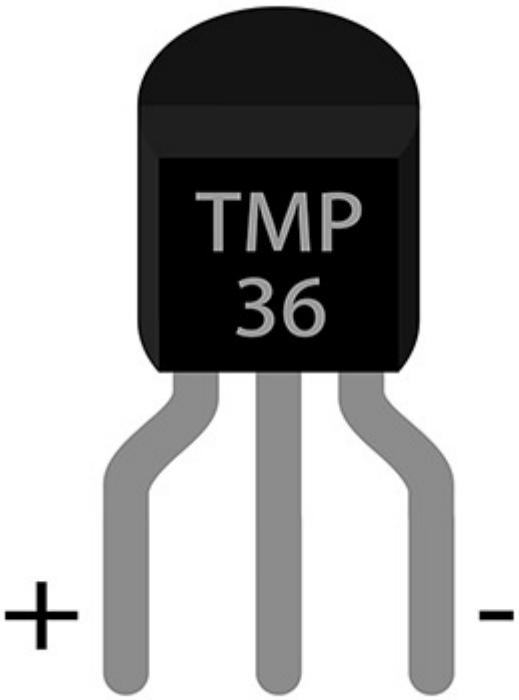
9.3. Major Components Introduction

TMP36

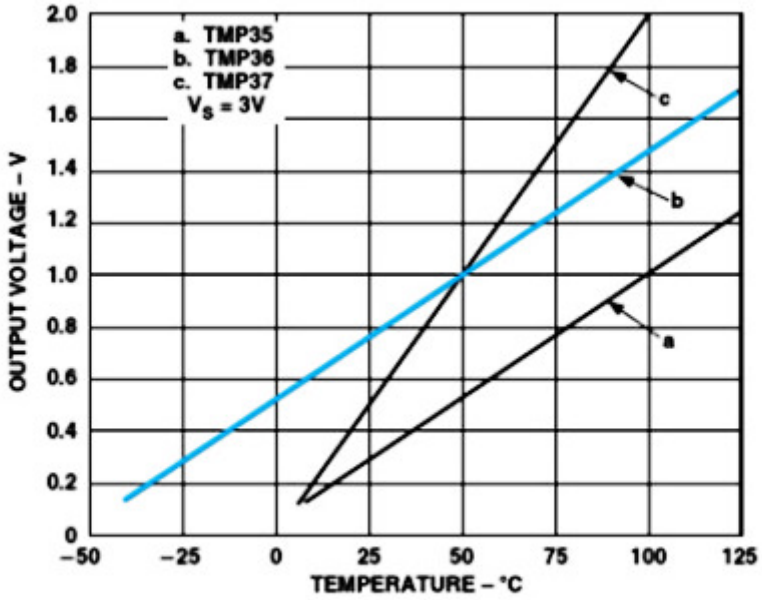
TMP36 is a kind of analog temperature sensor. Its output voltage and temperature forms a linear relationship. That means higher temperature will have bigger output voltage.



Note: When we look at the front side marked “TMP36”, the left side pin of the chip is VCC, middle is Vout, and the right side pin is GND. Do not connect it wrong or the components connected might be damaged.



Here’s the curve chart for output voltage of TMP36 changing with temperature:



Output Voltage vs. Temperature

TMP3x Output Characteristics

Sensor	Offset Voltage (V)	Output Voltage Scaling (mV/°C)	Output Voltage @ 25°C (mV)
TMP35	0	10	250
TMP36	0.5	10	750
TMP37	0	20	500

We can know from the above chart that the temperature formula is:

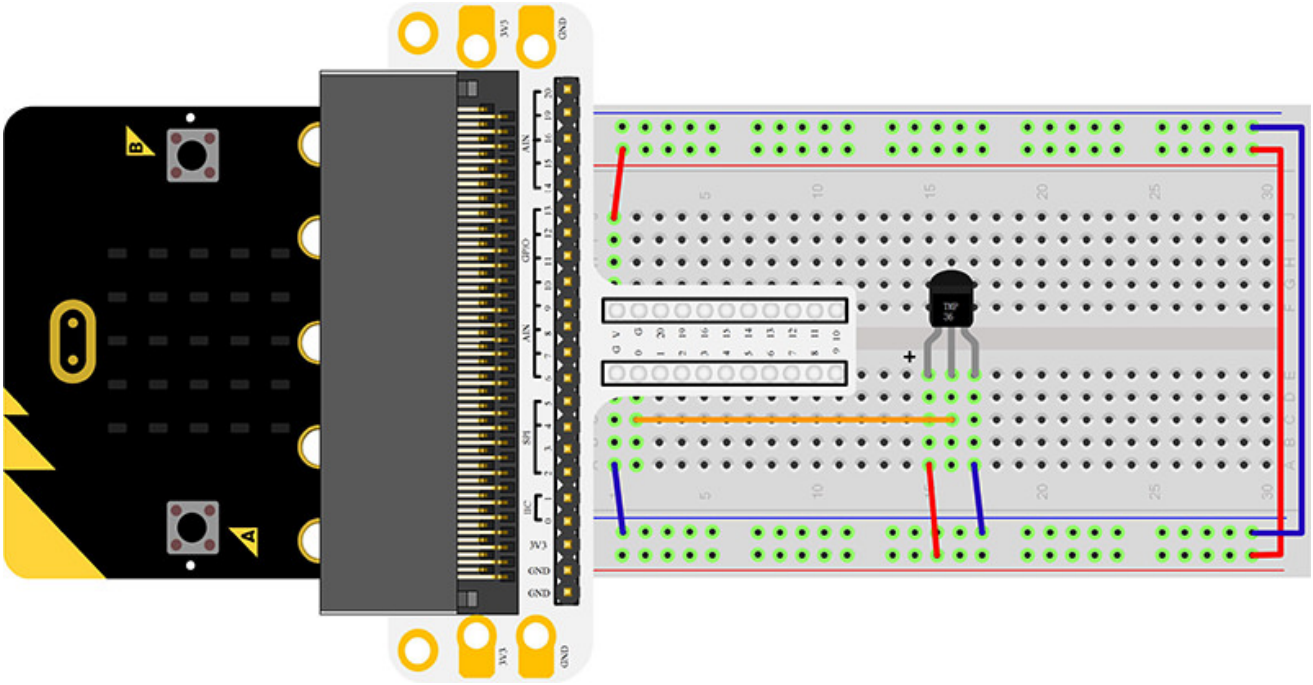
Temperature（°C）=(Output Voltage（mV）-500)/10

9.4. Experimental Procedure

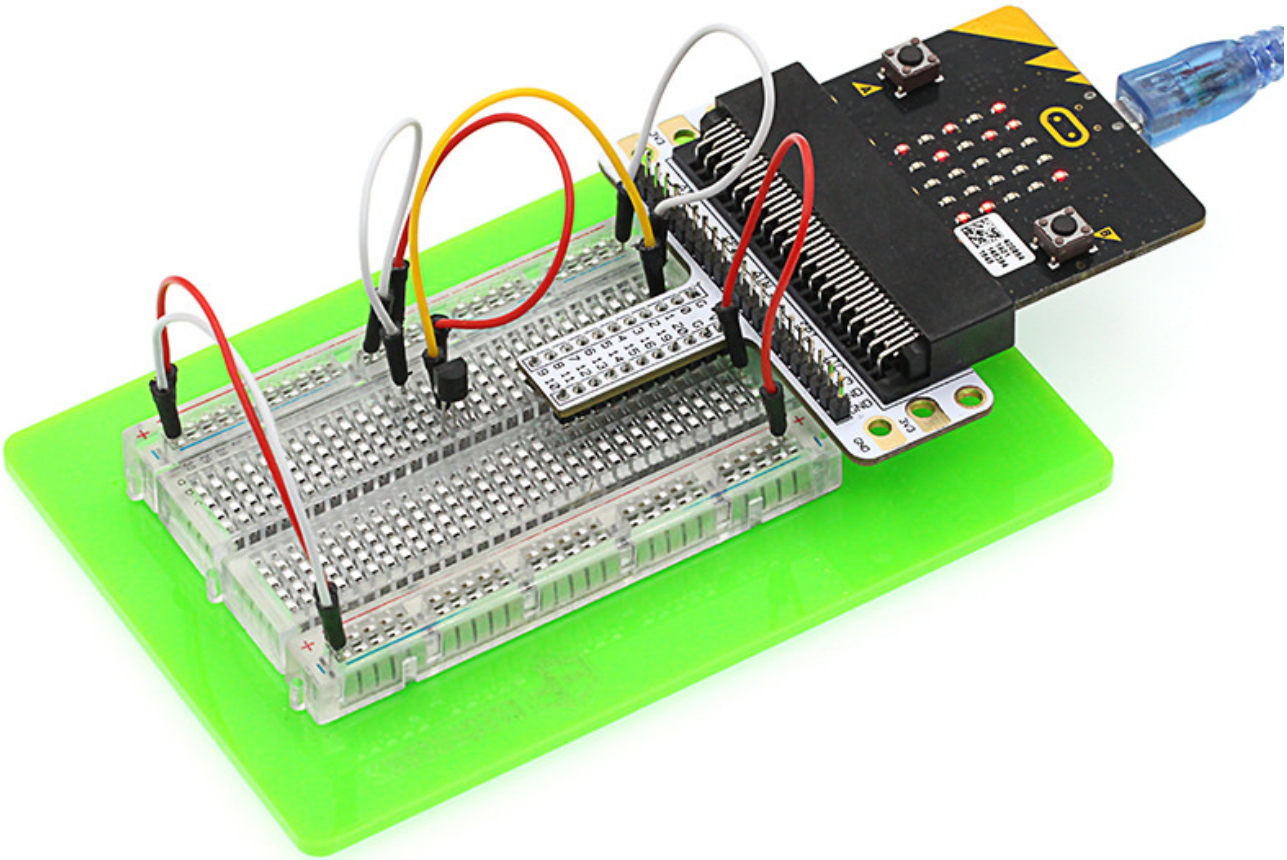
Hardware Connection

Connect your components according to the picture below:

- 1.Connect the sensor to P0 port of the breadboard adapter.

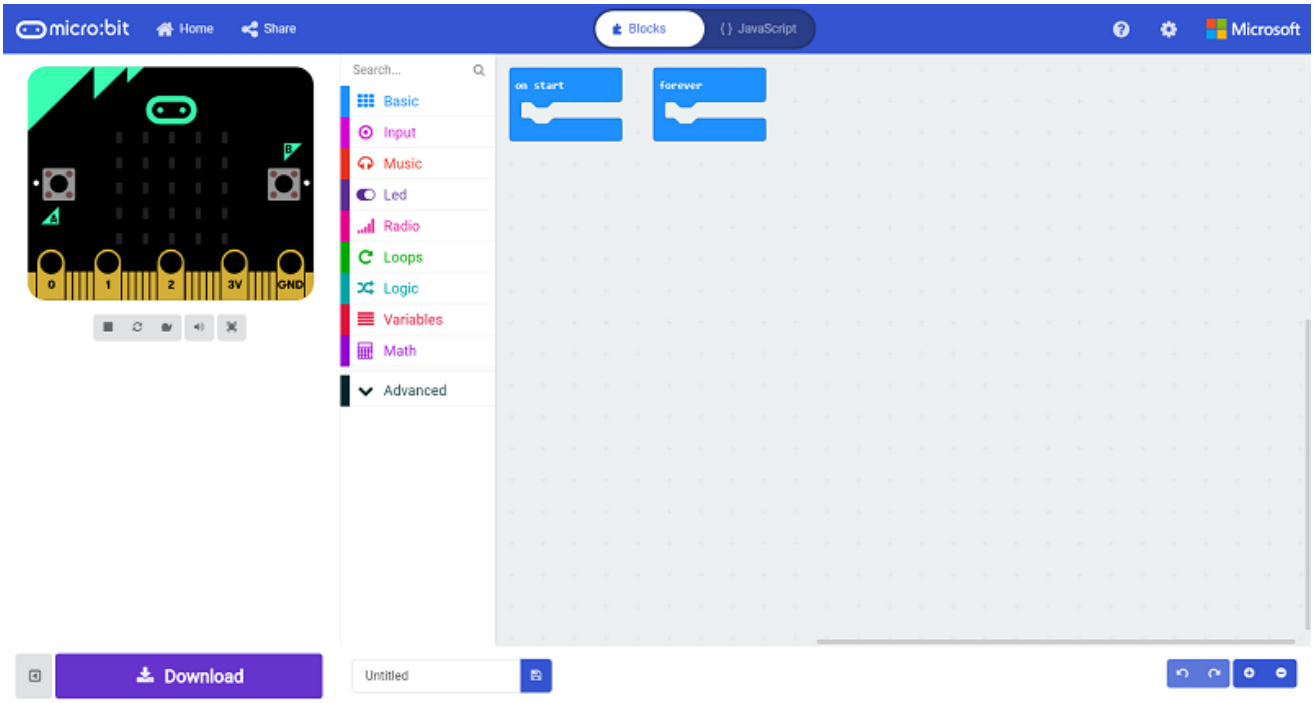


You would see as below after you finish the connection:

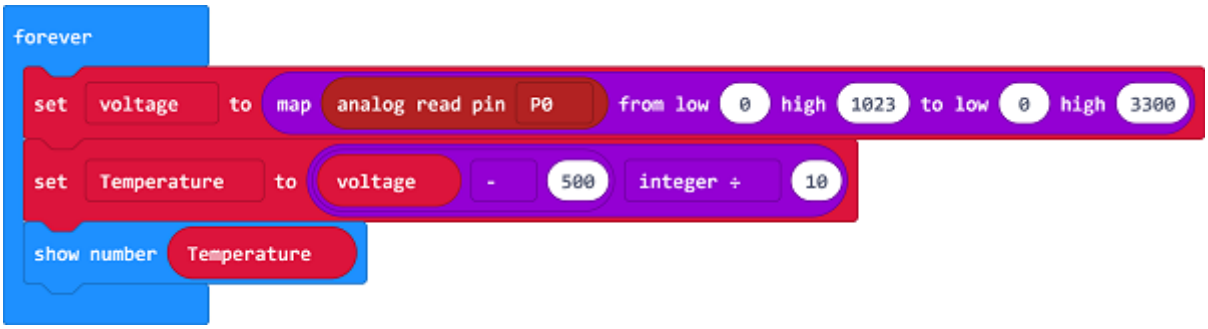


Software Programming

Click to open Microsoft Makecode, write the following code in the editor.

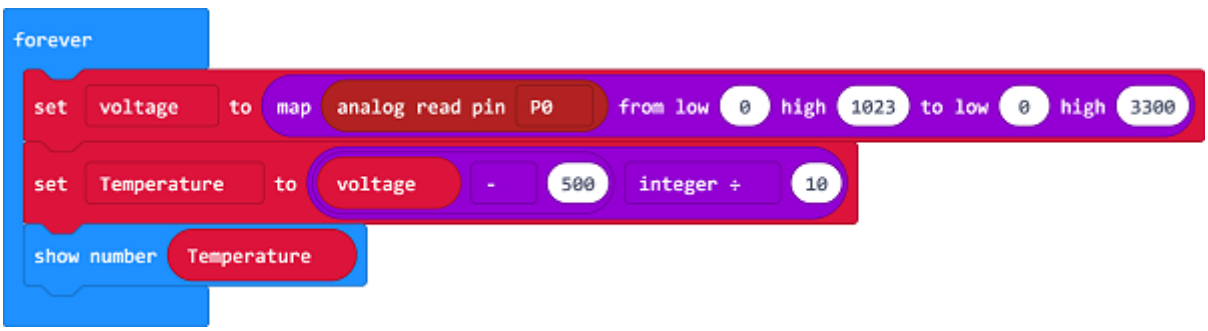


Program as the picture shows:



Details for the code:

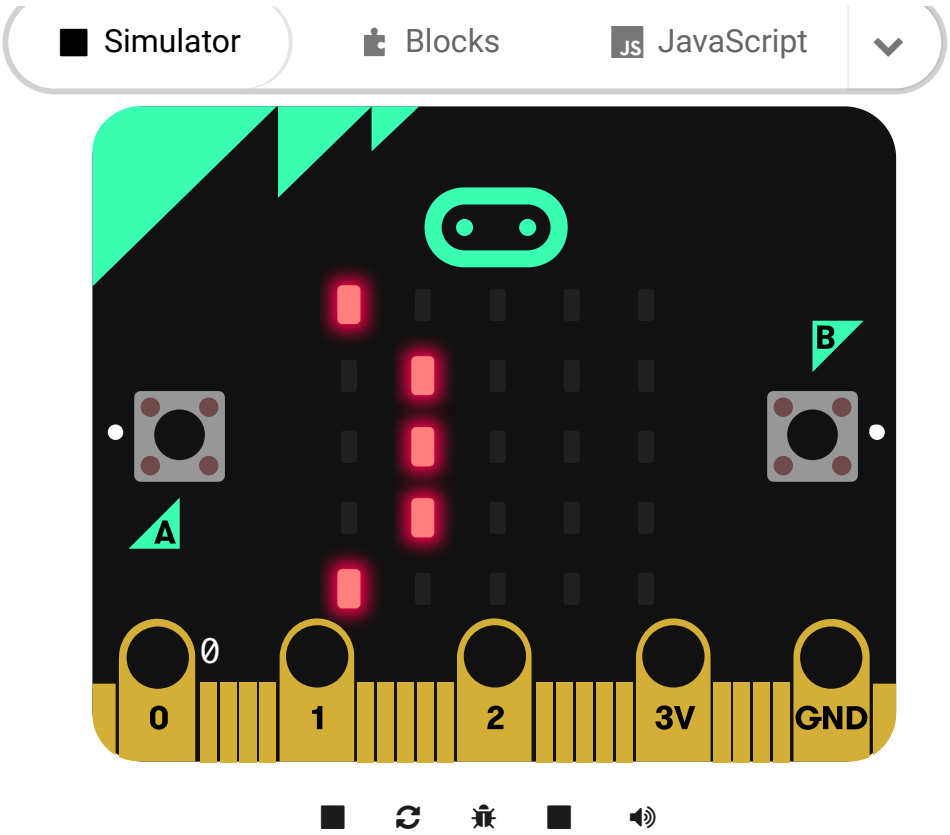
- 1.Use the “map” function to confirm a value between 0~1023 with the value detected by the sensor through P0 port, then save it in voltage.
- 2.Transforming the value saved in voltage into temperature and show it on the micro:bit.



Reference

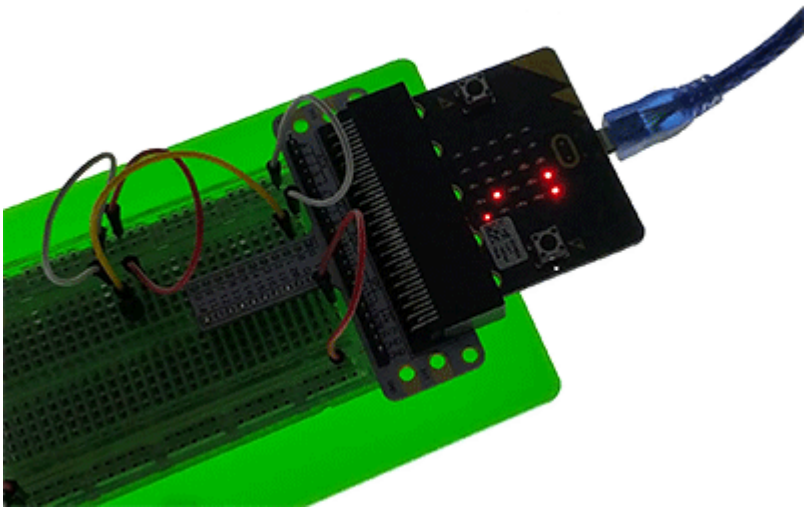
Links:https://makecode.microbit.org/_AKuYFoDsLJ7D

You can also download the links directly:



9.5. Result

The current temperature is showing on the micro:bit.



9.6. Exploration

9.7. FAQ

10. Lesson 08 Servo

10.1. Introduction

Servo is a kind of driver for position (angle) servo. It is suitable to control system with constant angle change and can remain its status. In this experiment, we are going to use micro:bit to make a servo rotate circularly within a travel range.

10.2. Component List

Hardware：

- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x microbit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x TowerPro SG-90 Mini Servo(1.6kg)
- n x Breadborad Jumper Wire 65pcs Pack

Tips: If you want all components above, you may need Elecfreaks Micro:bit Starter Kit.

10.3. Major Component Introduction

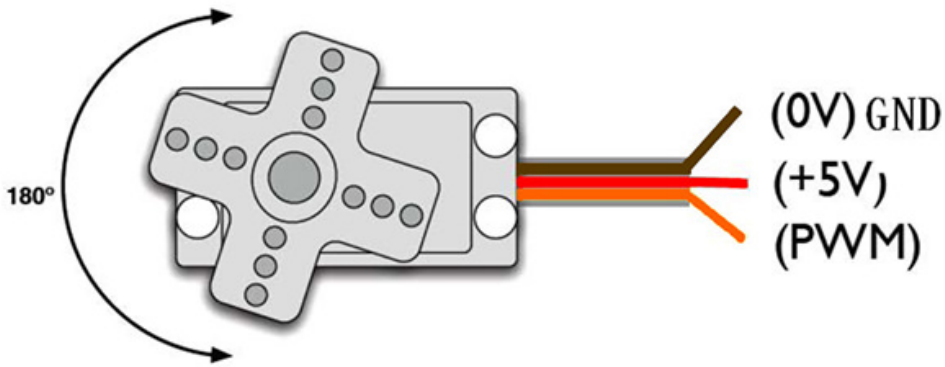
Servo

Servo is a set of automatic control system, which consists of DC motor, reduction gear unit, potentiometer and control circuit. It can define rotate angle of output shaft by sending signals. Usually, a servo has a maximum rotate angle(e.g. 180 degrees). Compared with ordinary DC motor, servo rotates within a certain angle range only while ordinary DC motor rotates in circle. This is the major difference between ordinary DC motor and servo. Servo can not rotate in circle. (Note: digital servo do not have this problem because it can switch between servo mode and motor mode.) Ordinary DC motor can not give us feedback about rotate angle but servo can do it. Their usage are different too. Ordinary DC motor use a whole circle rotation as power while servo use certain angle of an object it controlled such as robot joint. The servo system can be controlled by impulse, which can change its width. We use control cable to transmit impulse. The parameter of impulse has maximum value,

minimum value and frequency. Generally speaking, the cycle of servo reference signal is 20ms and the width is 1.5ms. The position defined by servo reference signal is middle position. Since servo has a maximum rotate angle, the definition of middle position is from this position the maximum value and the minimum value are the same. Most importantly, different servo may have different maximum rotate angle but the impulse width of middle position is the same and that is 1.5ms.

Note: Micro:bit official has loaded servo control code into bricks. When using Makecode to program, you don't have to take some complex information (e.g. the width of impulse) into consideration.

Servo has many categories. However, all of servos have three cables connected externally. These cables usually have three different colors(brown, red, orange) to differentiate each other. (Different servos brand may have different cable colors.) The brown cable is for connecting GND, red cable is for positive power cable and orange cable is for signal cable.

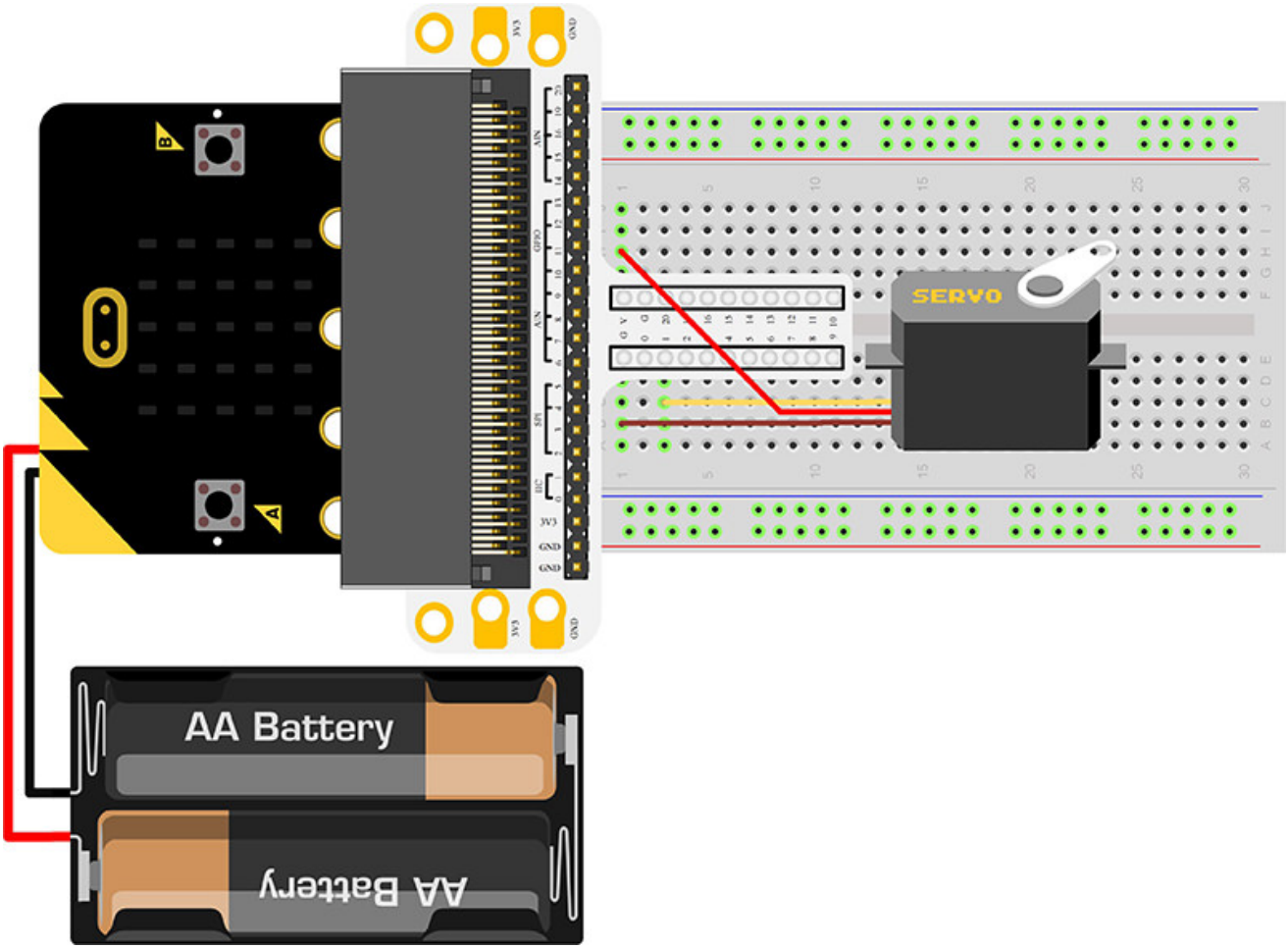


10.4. Experimental Procedure

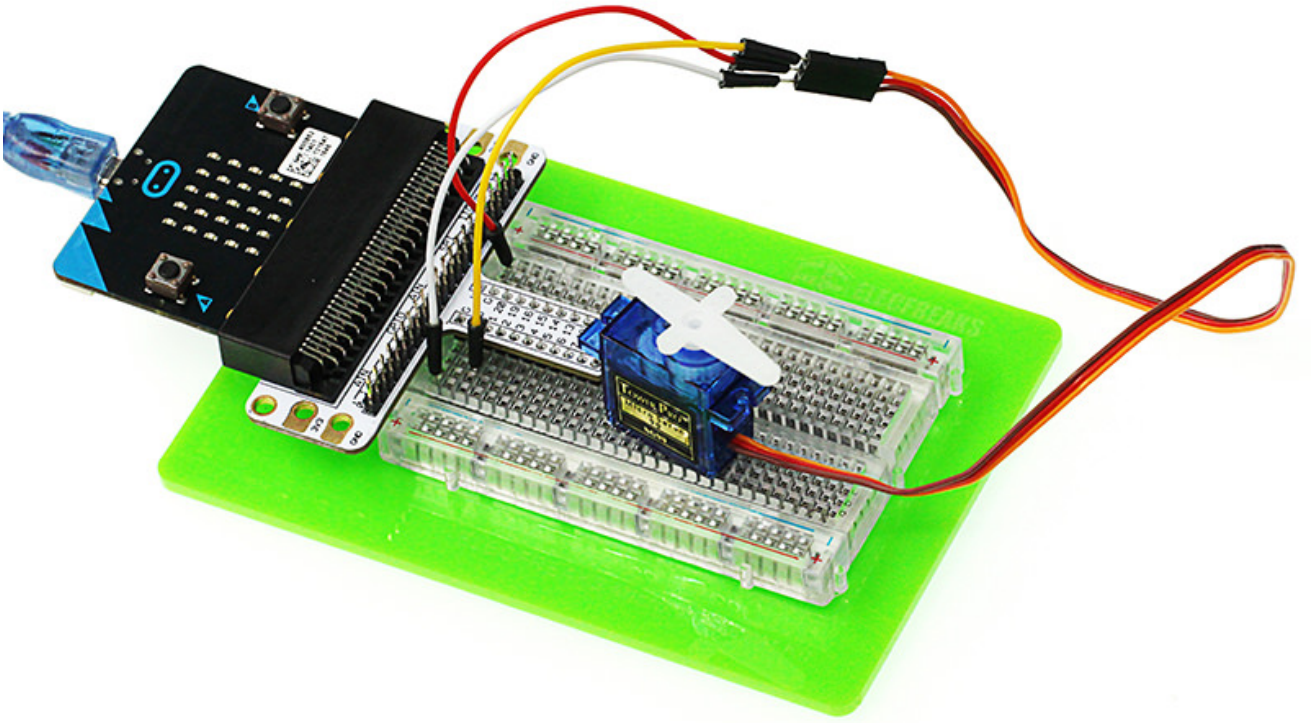
Hardware Connection

Connect your components according to the picture below:

- 1.Connect the servo to P1 port of the breadboard adapter.

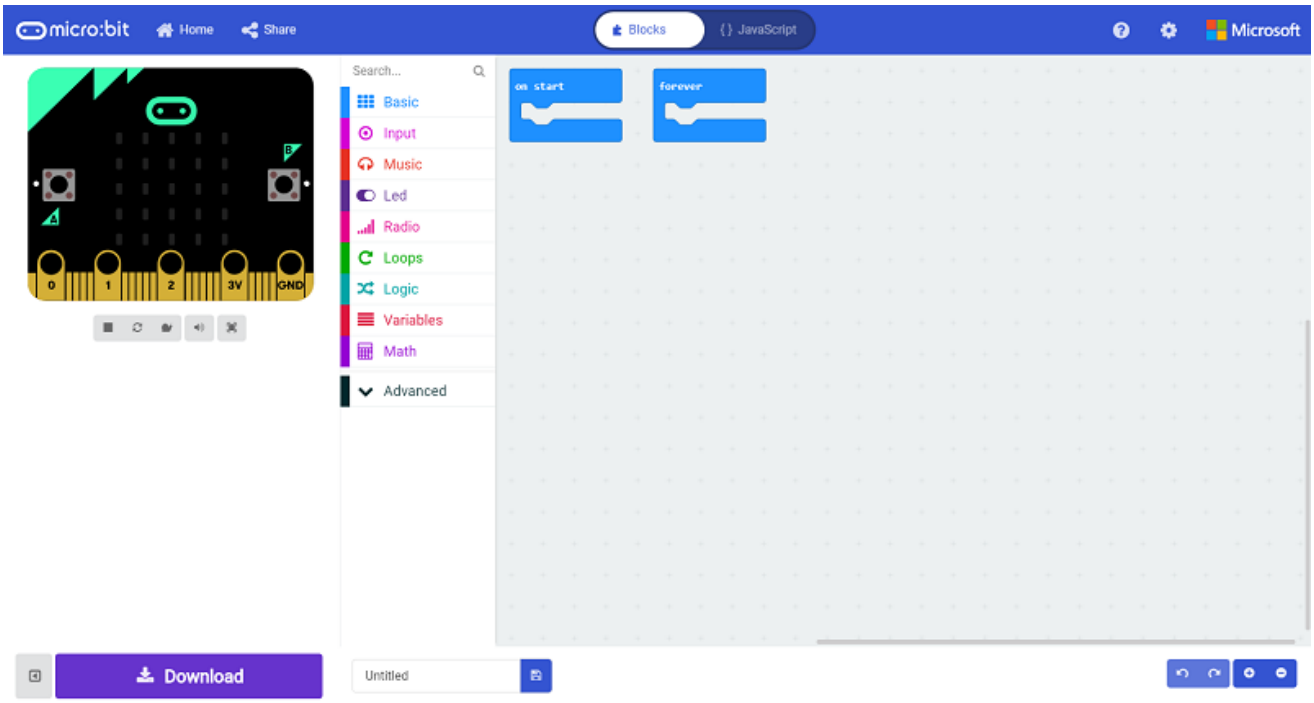


You would see as below after you finish the connection:

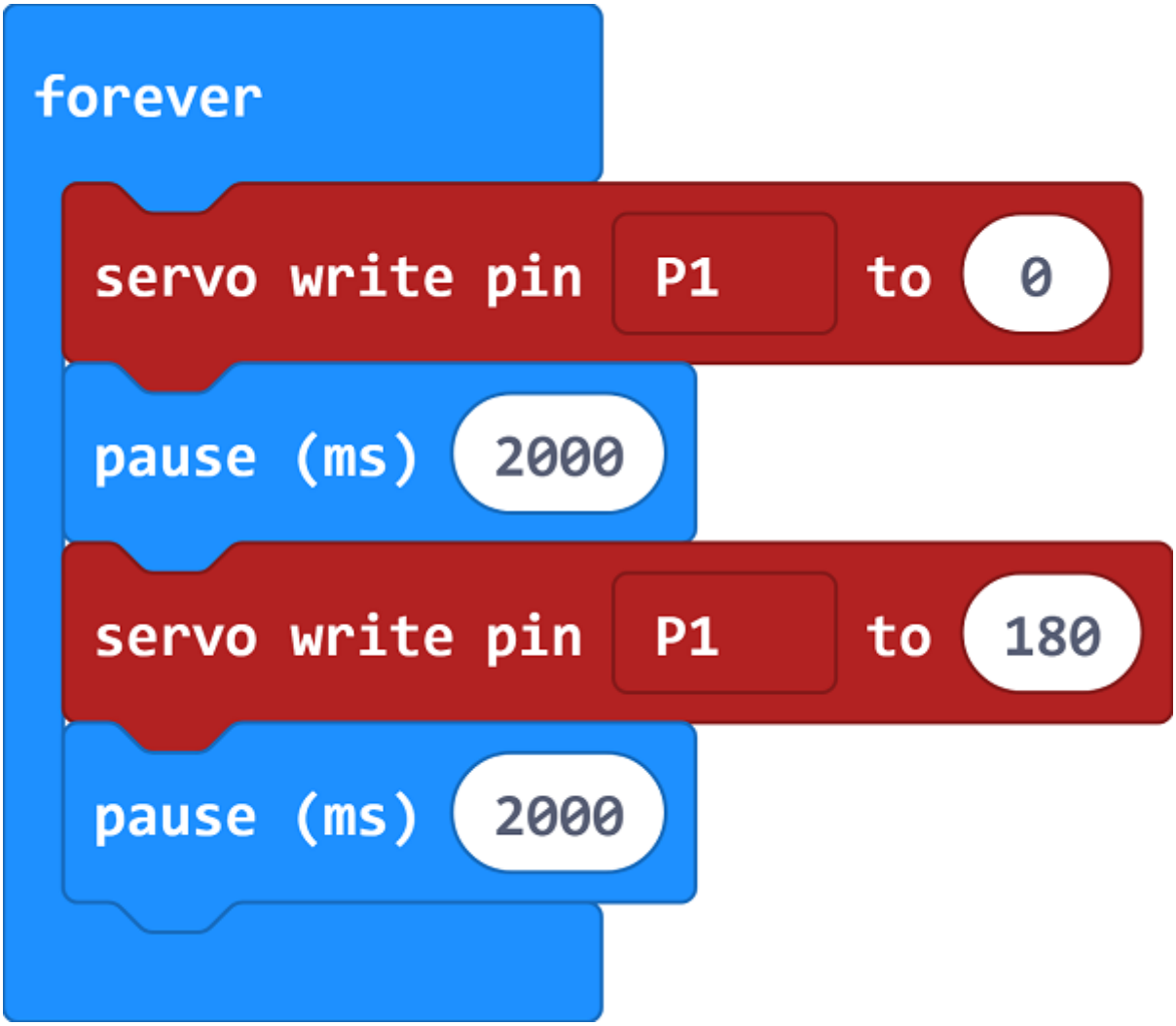


Software Programming

Click to open Microsoft Makecode, write the following code in the editor.

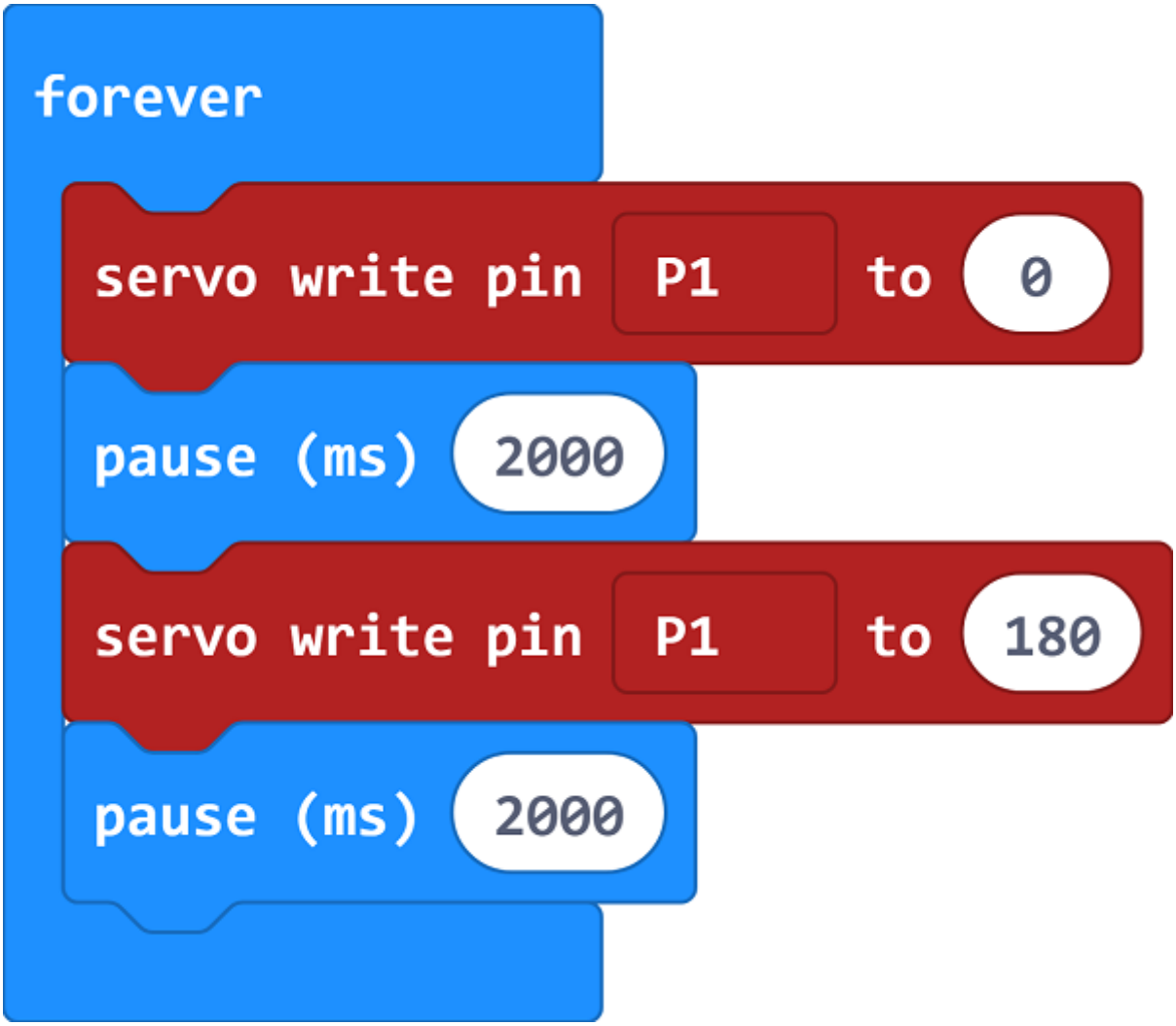


Program as the picture shows:



Details for the code:

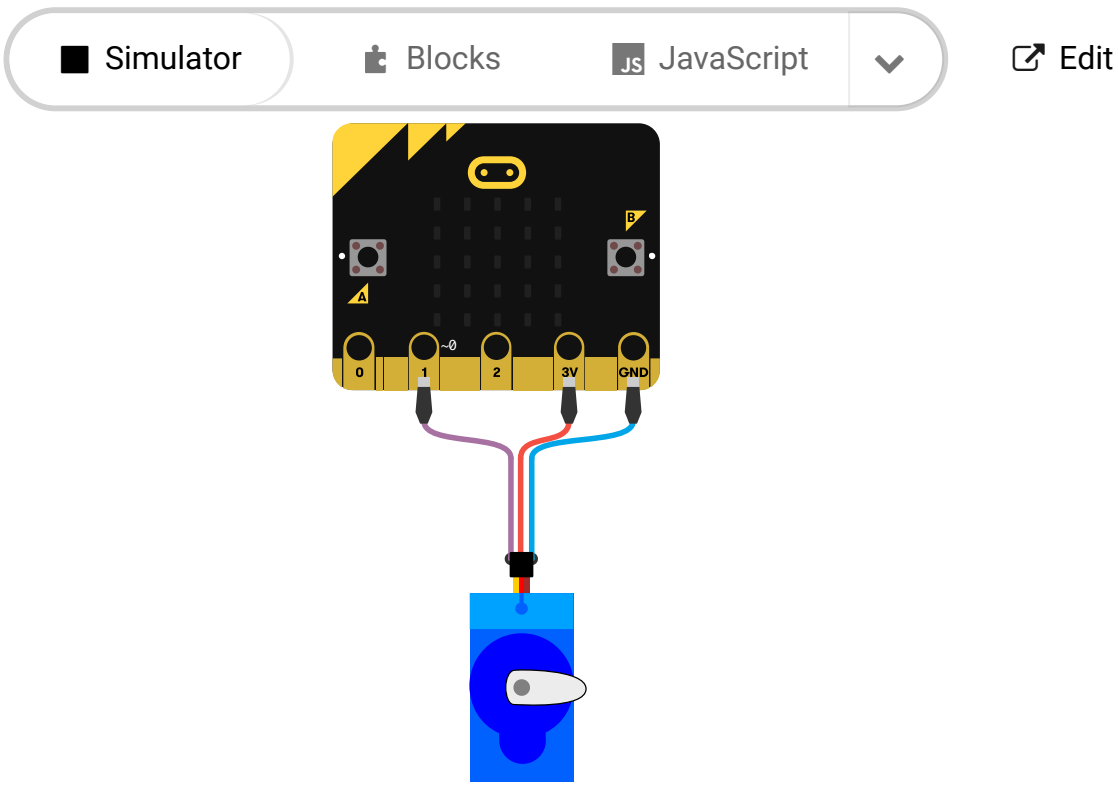
- 1.Analog write pin P1 to 0 in PWM, then pause 2s.
- 2.Analog write pin P1 to 1 in PWM, then pause 2s.
- 3.Show the PWM value repeatedly.



Reference

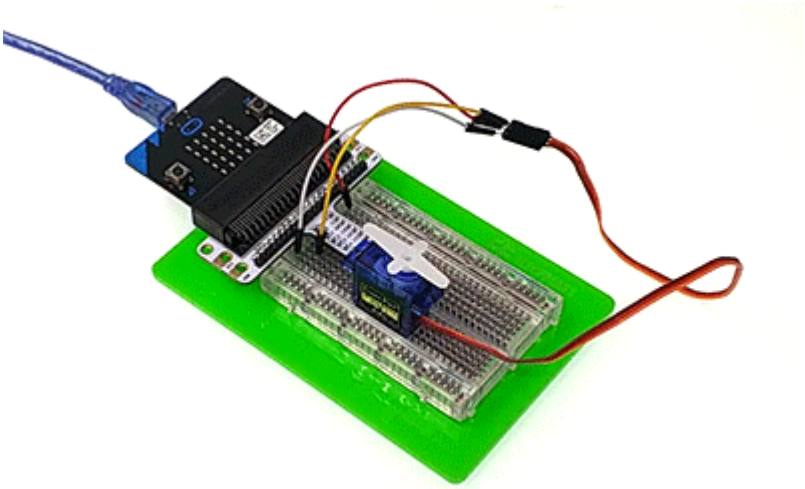
Links:https://makecode.microbit.org/_52MVspRmRWjc

You can also download the links directly:



10.5. Result

We can see the servo rotates with angle range from 0 degree to 180 degree.



10.6. Exploration

If we want to use temperature sensors and servos to make a dial thermometer, then how to design circuit and program?

10.7. FAQ

11. Lesson 09 Buzzer

11.1. Introduction

Buzzer is a kind of electronic sound receiver with integrated structure. It is widely used as a voice device in electronic products like computers, printers, copying machines, alarm apparatus, electronic toys, auto electronic devices, telephones, etc..In this experiment, we are going to use micro:bit to drive buzzer and make its sound circulate between high frequency and low frequency just like alarm song. And we will present its sound frequency on micro:bit with bar chart format.

11.2. Components List:

Hardware:

- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x microbit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x Mini Speaker (Buzzer)
- 1 x TIP 120 NPN Transistor
- 1 x 100 Ohm Resistors
- 1 x Breadborad Jumper Wire 65pcs Pack

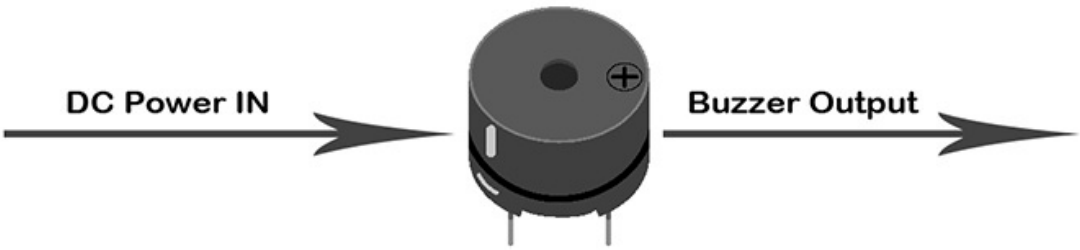
Tips: If you want all components above, you will need Elecfreaks micro:bit Starter Kit.

11.3. Major Component Introduction

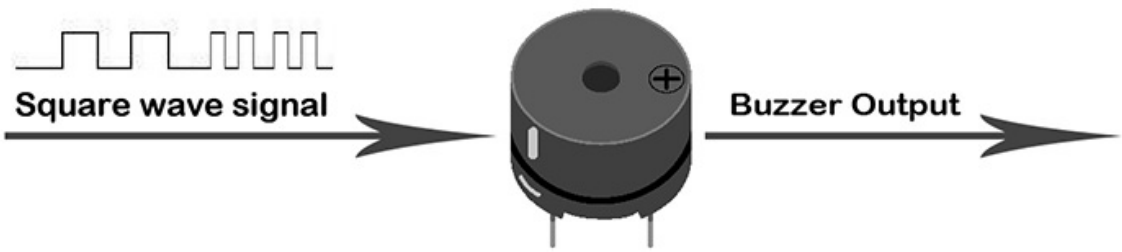
Buzzer

Buzzer is a kind of voice device. It is made of vibration and resonance device. According to the difference of control method, we can divide buzzer into active type and passive type.

Here's the working principle of active buzzer: Because active buzzer has integrated amplify sampling circuit and resonance system, when DC power input passes through active buzzer, it will make resonance device generate sound signal. We can see the schematic diagram below for the working principle of active buzzer:



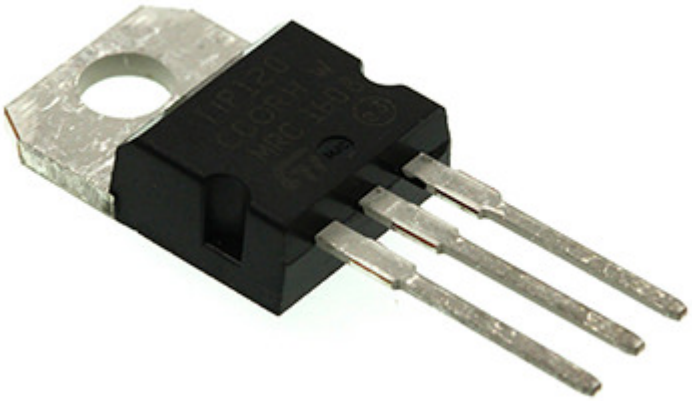
The working principle of passive buzzer is: When square wave signal passes through the buzzer, its resonance device will transform the square wave signal input into sound signal output. Below is the schematic diagram for the working principle of passive buzzer:



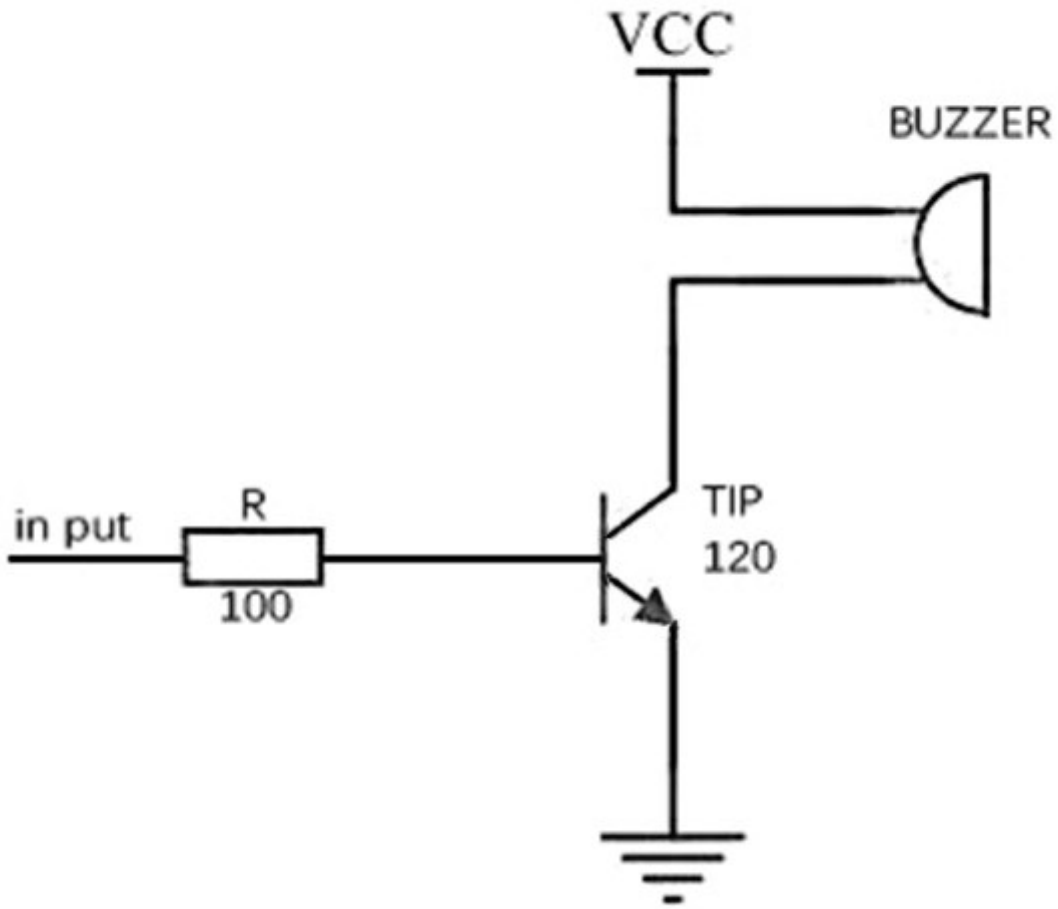
Note: In this experiment, we use passive buzzer only.

Transistor

Transistor is a kind of semi-conductor component for current control. It is used to amplify the weak signal to signal with larger frequency.



If we input PWM signal produced by micro:bit into buzzer directly, the buzzer will send out feeble voice. This is because the drive current of I/O port is usually too weak to directly drive components like buzzer. At this time, we have to use transistor to amplify the current of PMW signal so that the buzzer can alarm properly. Here is the circuit diagram for a typical application of using transistor to drive buzzer:

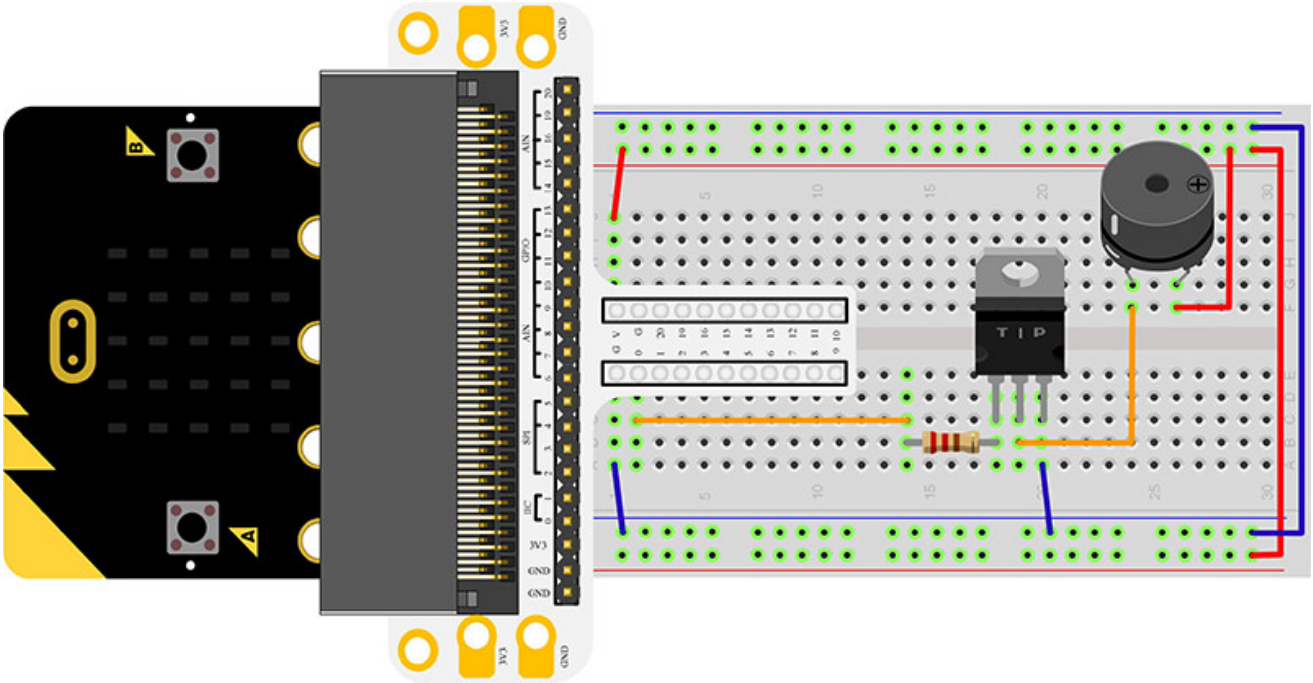


11.4. Experimental Procedure

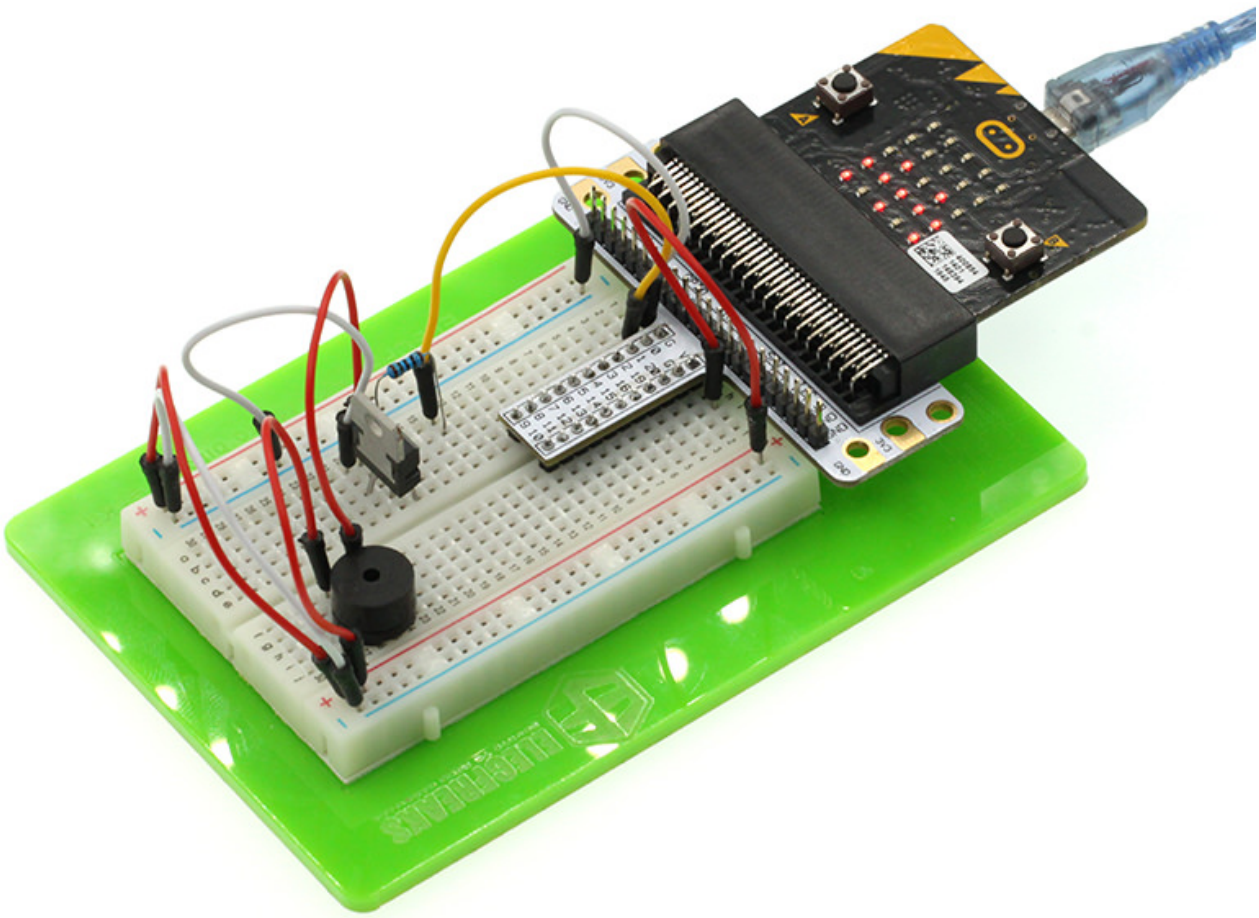
Hardware Connection

Connect your components according to the picture below:

- 1.Connect the buzzer, the 100Ω resistor and the transistor in series, then connect to P0 port.

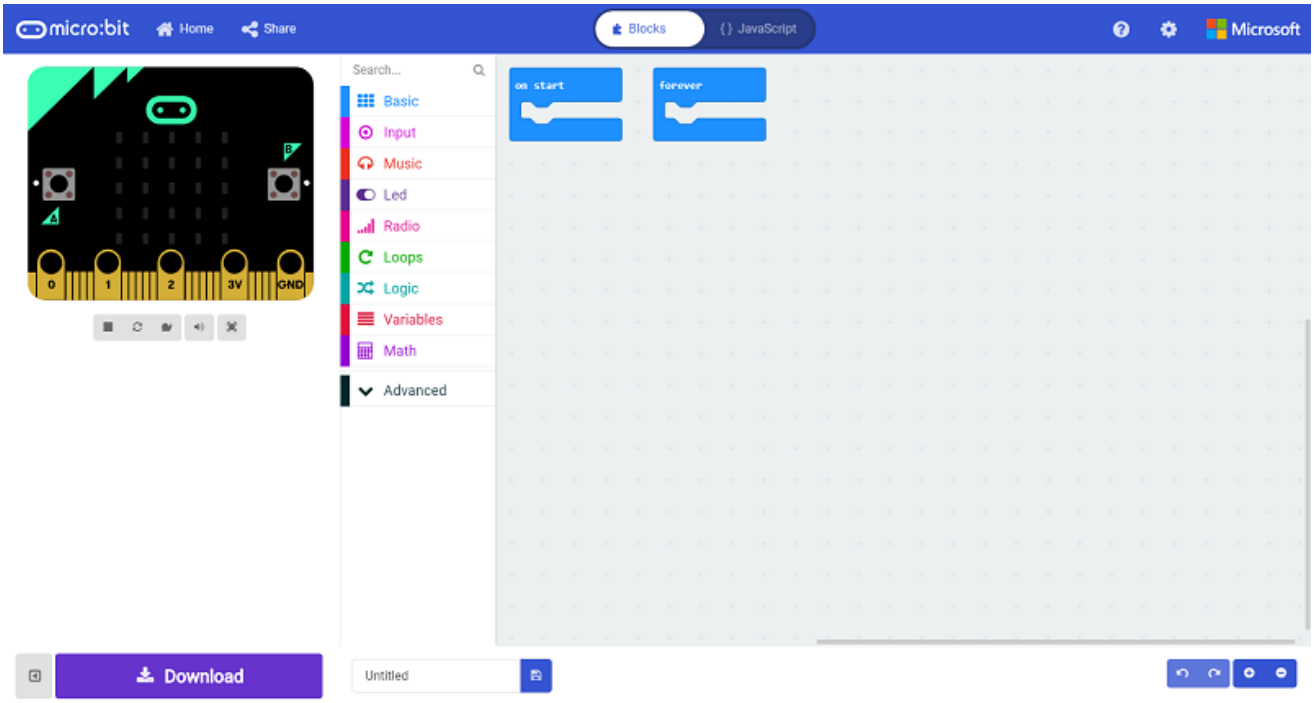


You would see as below after you finish the connection:

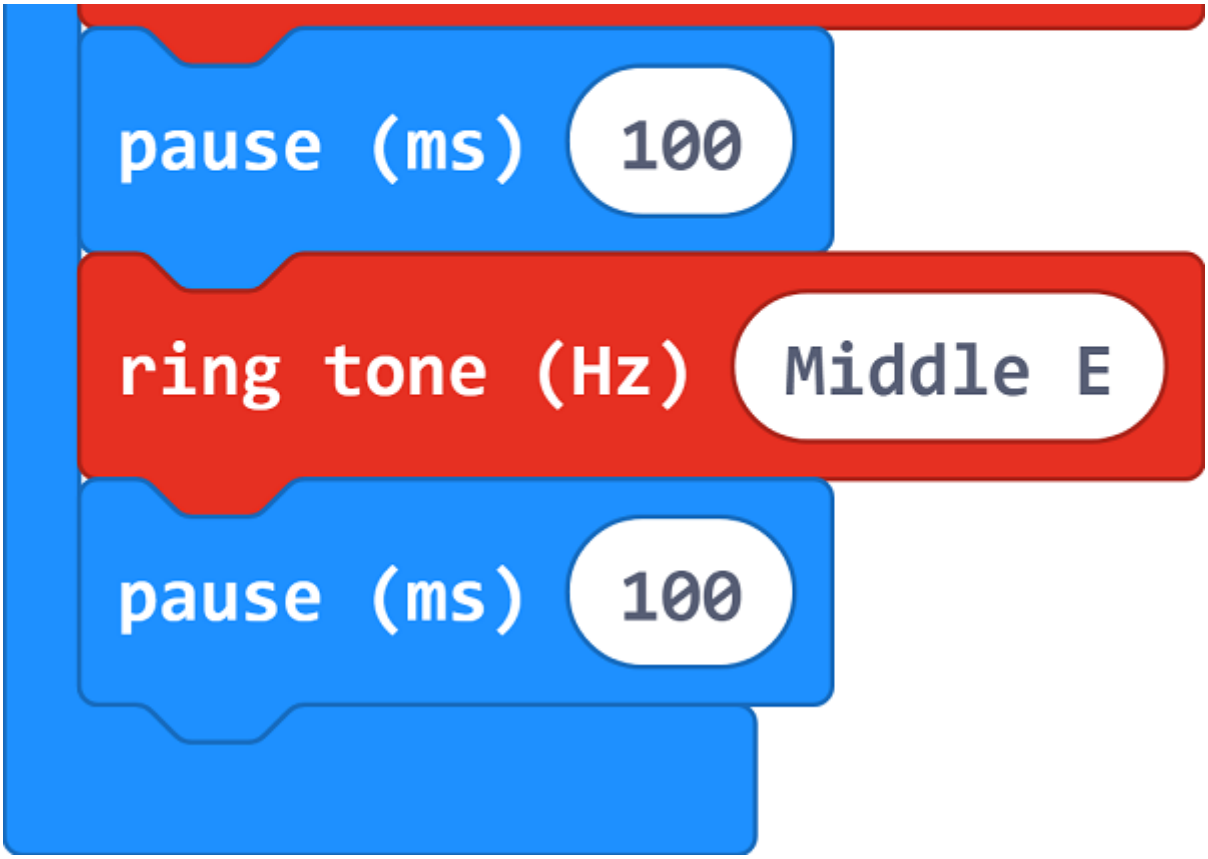


Software Programming

Click to open Microsoft Makecode, write the following code in the editor.

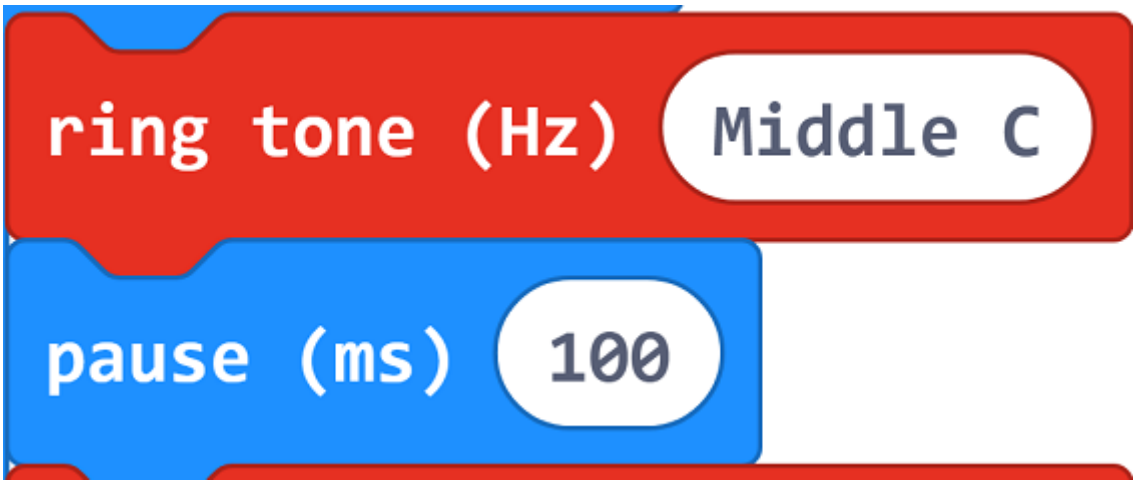


Program as the picture shows:



Details for the code:

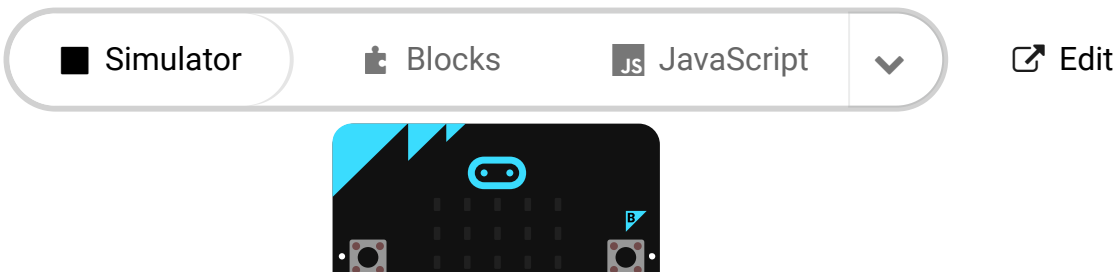
- 1.Make a middle C sound in the code and pause 100s; Programme EGE in a similar way.

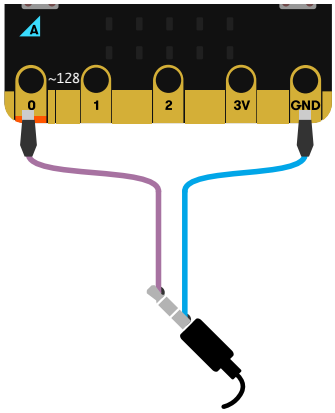


Reference

Links:https://makecode.microbit.org/_DdPPjDCdmM1a

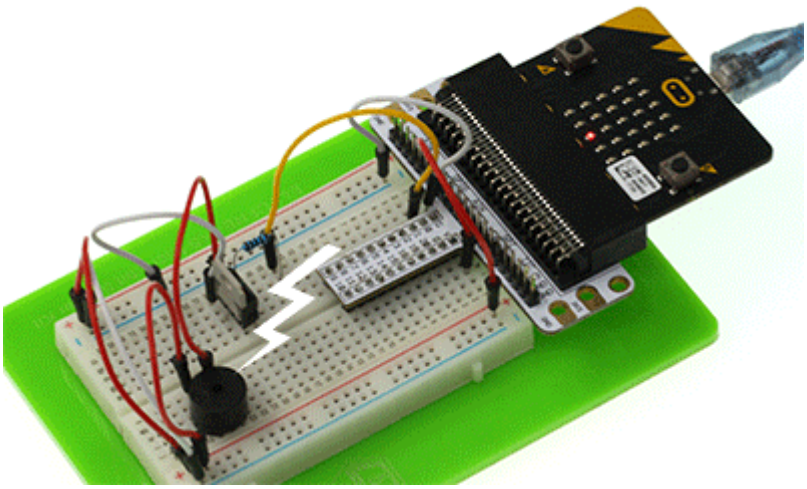
You can also download the links directly:





11.5. Result

The sound sent out by buzzer changes between high frequency and low frequency. And we can see the bar chart of frequency on the micro:bit.



11.6. Exploration

If we want to make a high temperature alarming device with a temperature sensor and a buzzer, then how can we design circuit and program?

11.7. FAQ

12. Lesson 10 Motor

12.1. Introduction

Motor is a kind of device which can transfer electric energy into kinetic energy according to the law in electromagnetic induction. In this experiment, we are going to use a switch to control the start and stop of a motor.

12.2. Component List

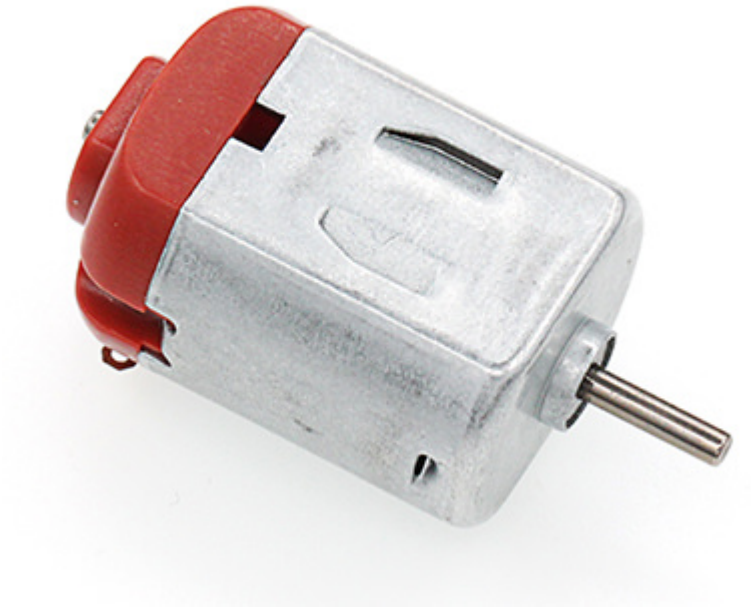
Hardware:

- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x micro:bit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x 5V Miniature Motors
- 1 x TIP 120 NPN Transistor
- 1 x 1N4007 Diodes
- 1 x 100 Ohm Resistors
- n x Breadborad Jumper Wire 65pcs Pack
- 2 x Alligator Clip Wires
- **Tips: If you want all components above, you may need Elecfreaks Micro:bit Starter Kit.**

12.3. Major Component Introduction

Motor

Motor is a kind of device that can transfer electric energy into kinetic energy according to the law of electromagnetic induction. Motor has a lot of categories. In our experiment, the motor we use is DC motor. When we supply DC voltage to the two terminals of motor, it will rotate. The higher the voltage, the faster it rotates.



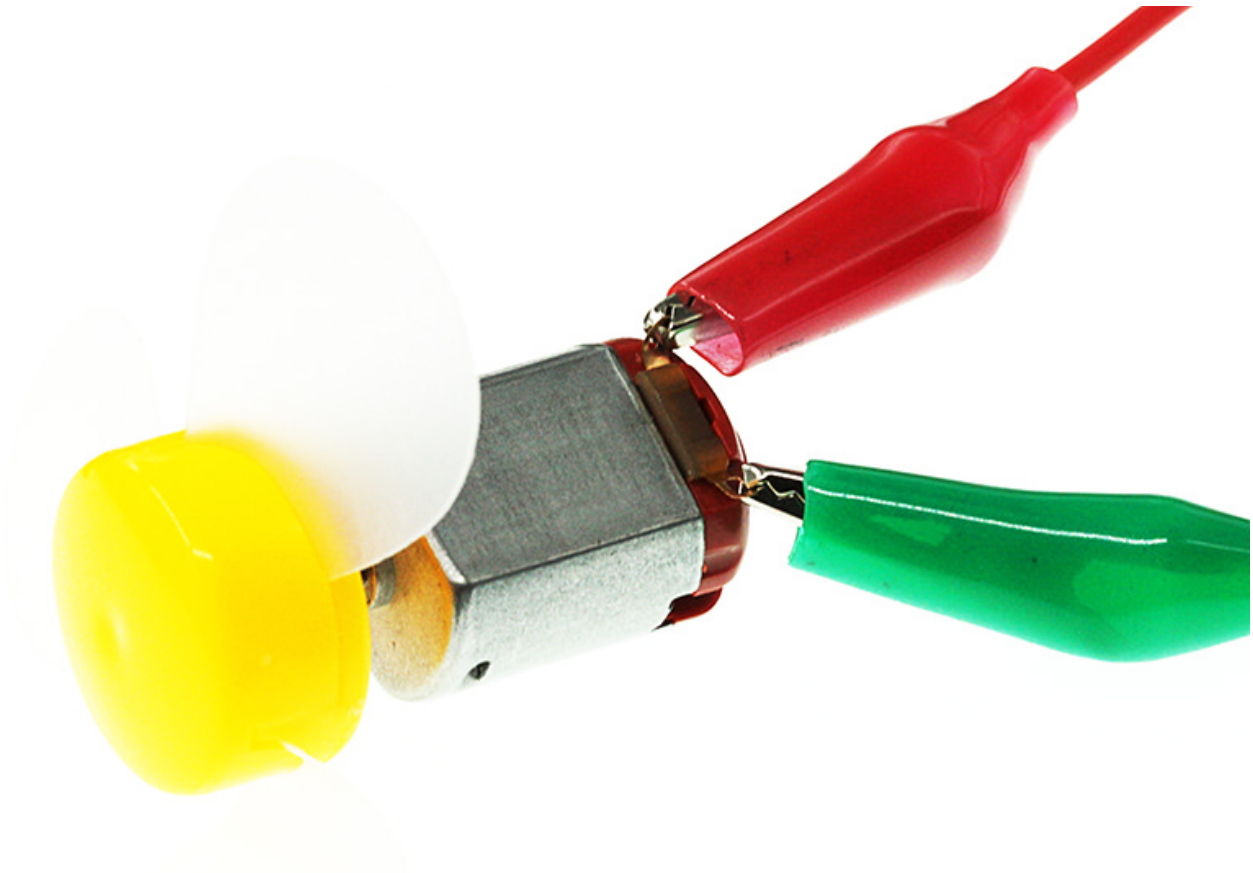
Diodes

Diode is a kind of component with two polarities: one is for positive and the other is negative. It allows current move from the positive end to the negative end only. We can regard it as an electronic check valve. For common diode, we can judge from the color of tube for its polarity. The terminal with white color is negative polar.

Alligator Clip Wires

Similar to the usage of jumper cable, alligator clip wire is used when some components are not suitable to use jumper cable for connection.

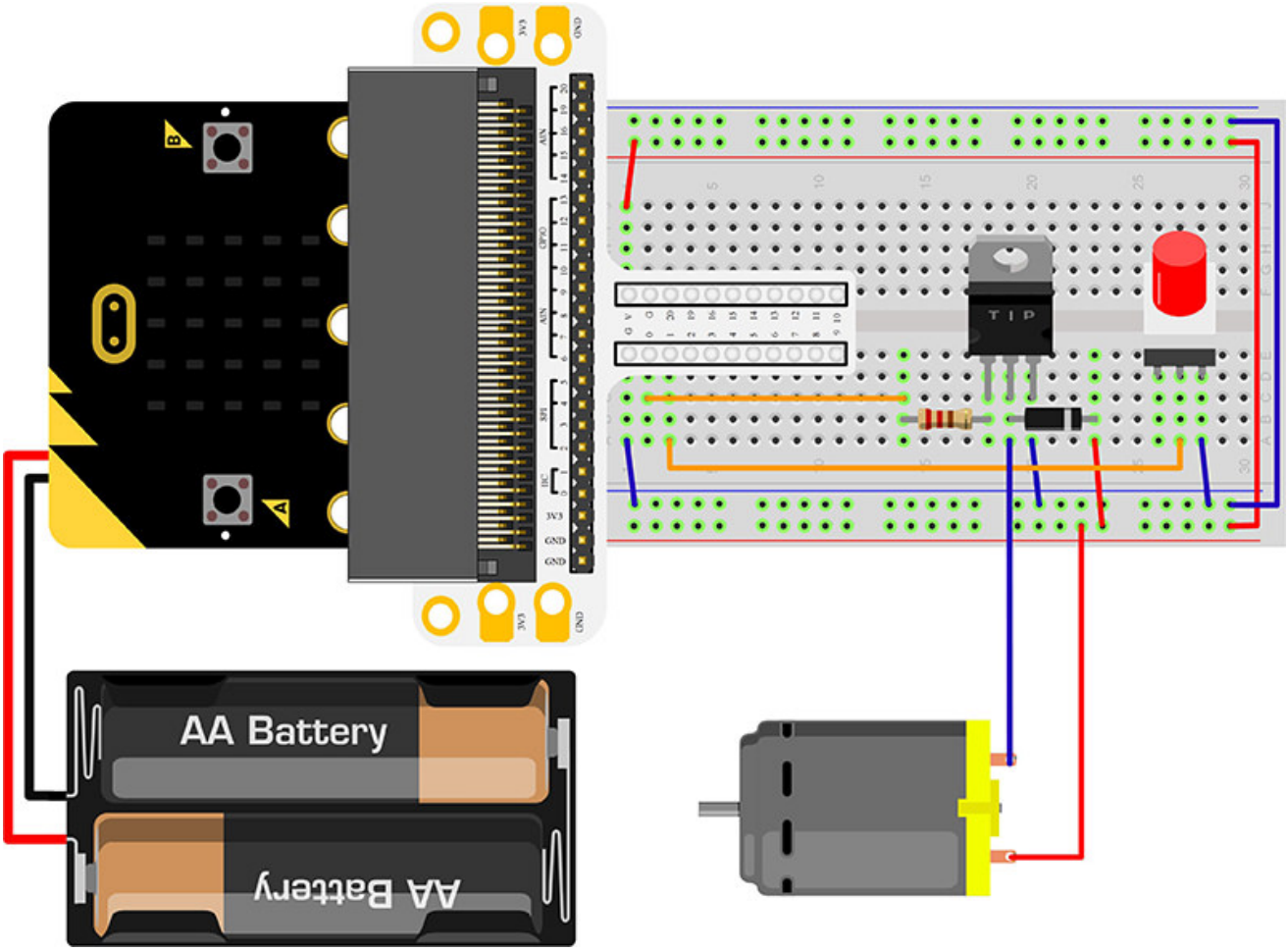
In this experiment, we use alligator clip wire to connect our motor.



12.4. Experimental Procedure

12.5. Hardware Connection

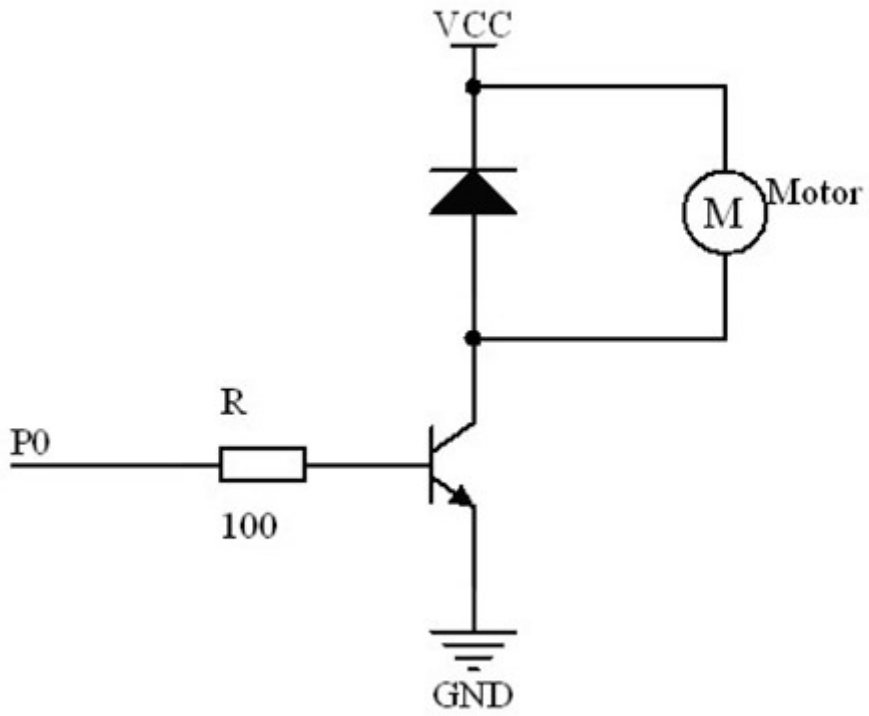
Connect your components according to the picture below:



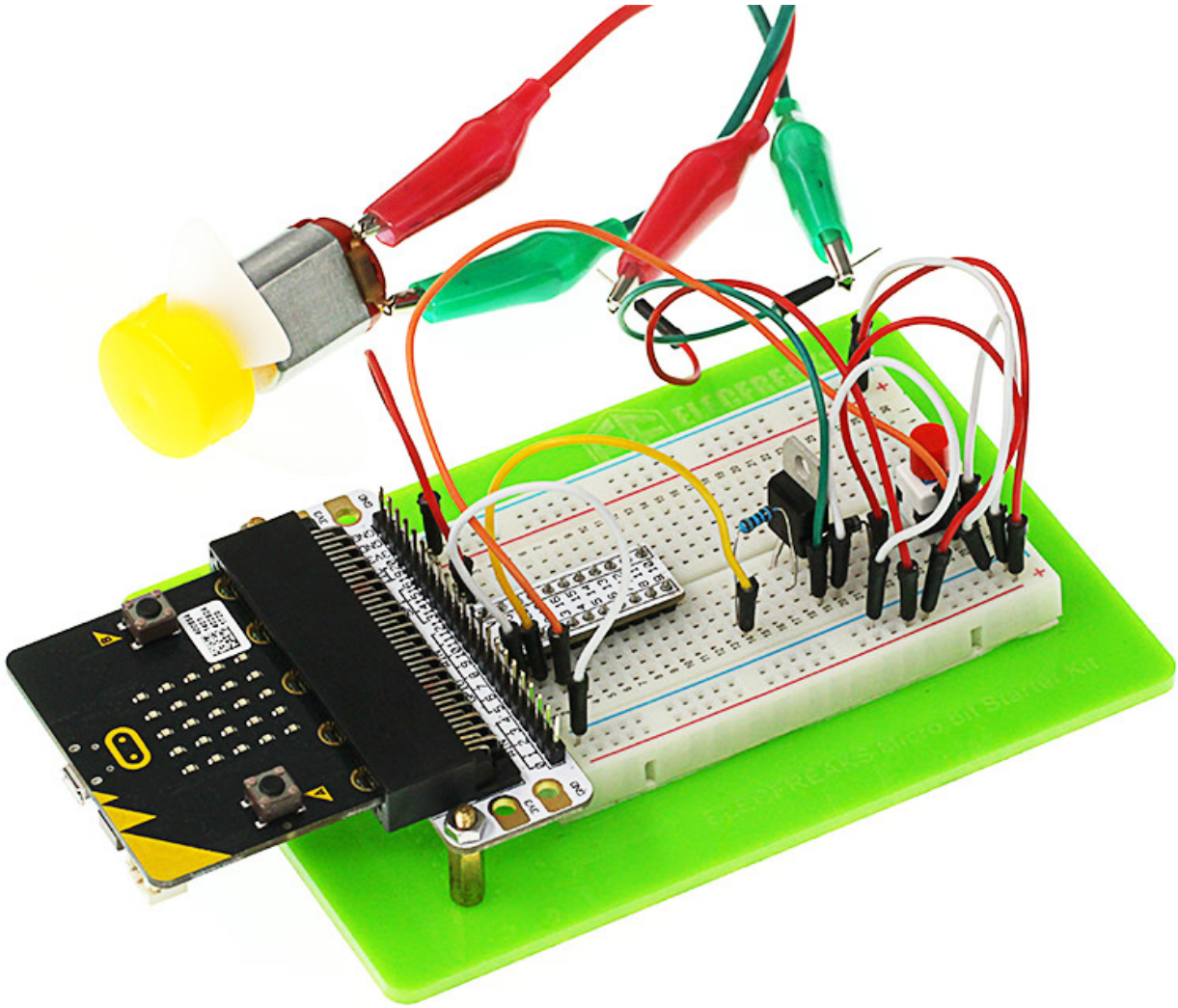
The drive current on micro:bit IO port is too feeble to connect motor directly. At this time, we have to use a triode to amplify the current of IO port. The circuit diagram of using triode to amplify current on IO port is very similar to the circuit diagram of our last chapter “micro:bit Experiment 09:Buzzer —— Elecfreaks mirco: bit Starter Kit Course”. The only difference is the motor has two diodes on its both terminals. And the diode in this circuit is called Freewheel Diode.

Within the motor, there has a coil. When current flow passes through the coil, it will produce induced electromotive force on the both terminals. When current disappears, the induced electromotive force will generate backward voltage to the components in the circuit. It might damage these components. Freewheel diode connects the two terminals of the coil in anti-parallel. When we cut off the power supply of the inductance coil, the induced electromotive force will not disappear immediately. And the residual force will release by diode. This is a typical design of protection.

Below is the partial circuit diagram of the usage of triode in amplifying the IO port current:

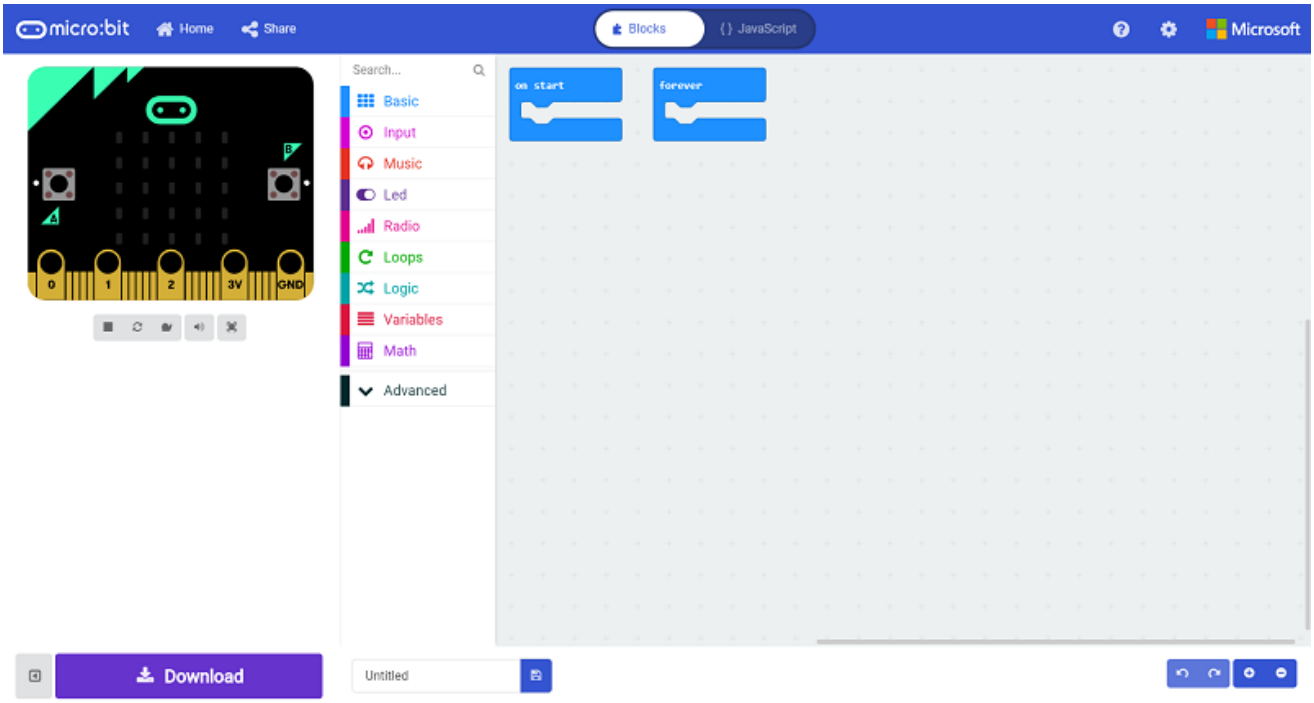


You would see as below after you finish the connection:

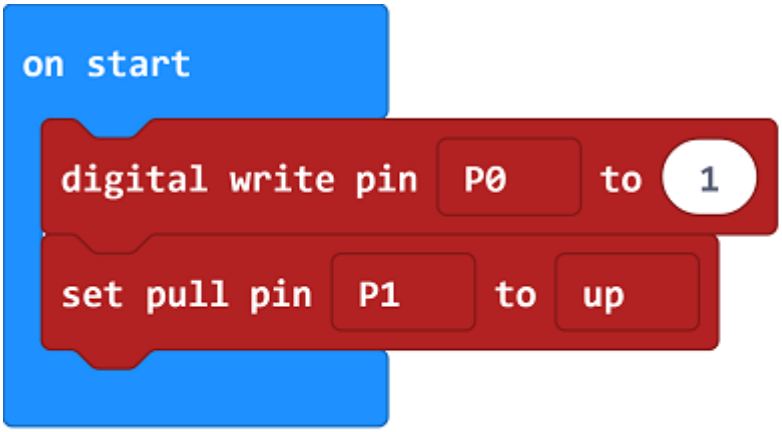


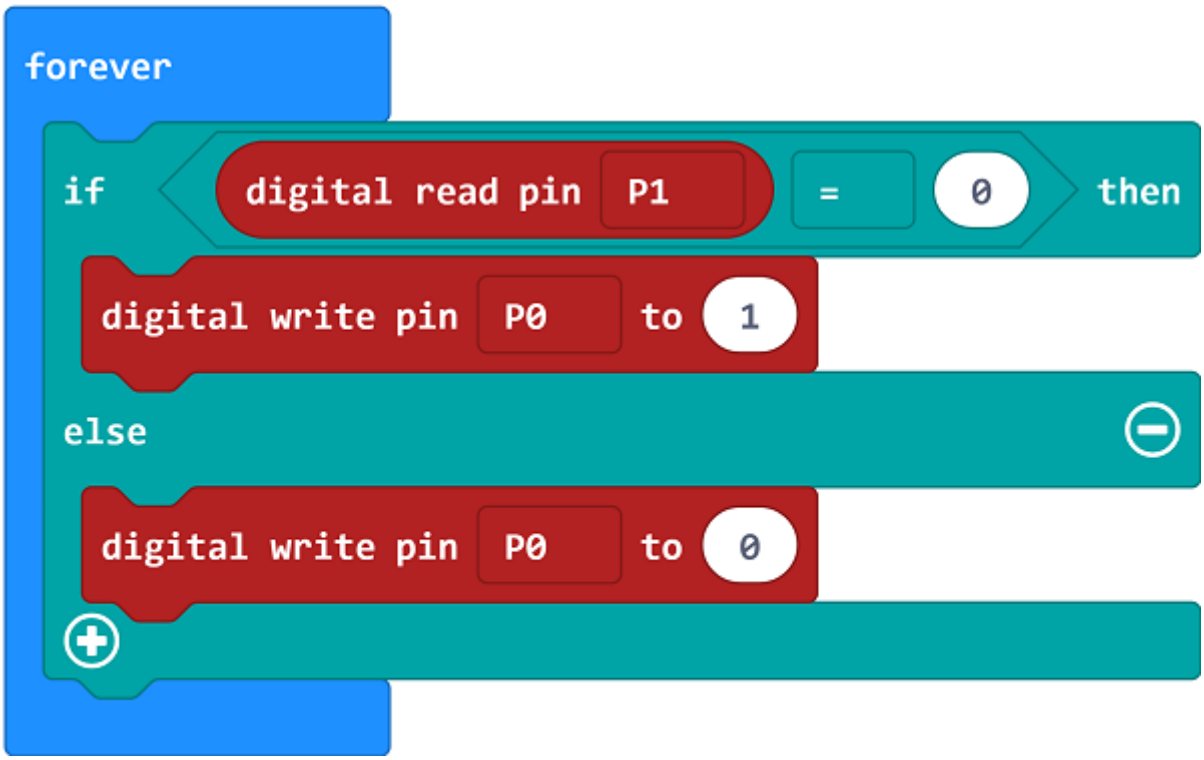
Software Programming

Click to open Microsoft Makecode, write the following code in the editor.
(https://makecode.microbit.org/)



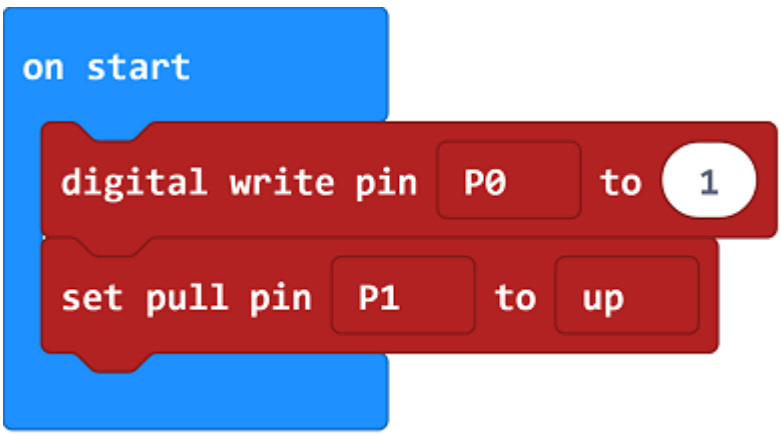
Program as the picture shows:



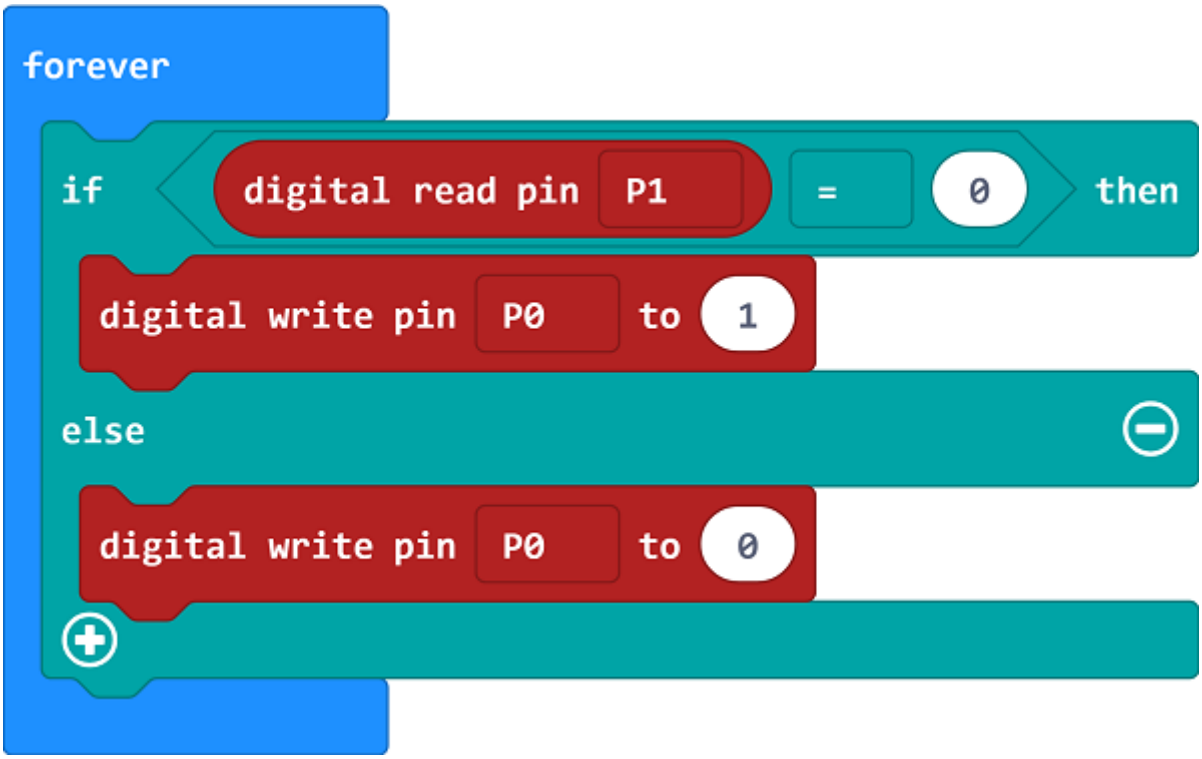


Details for the code:

- 1.Digital write pin P0 to 1 and set the P0 port in a high level to recognize the signal of the button normally.



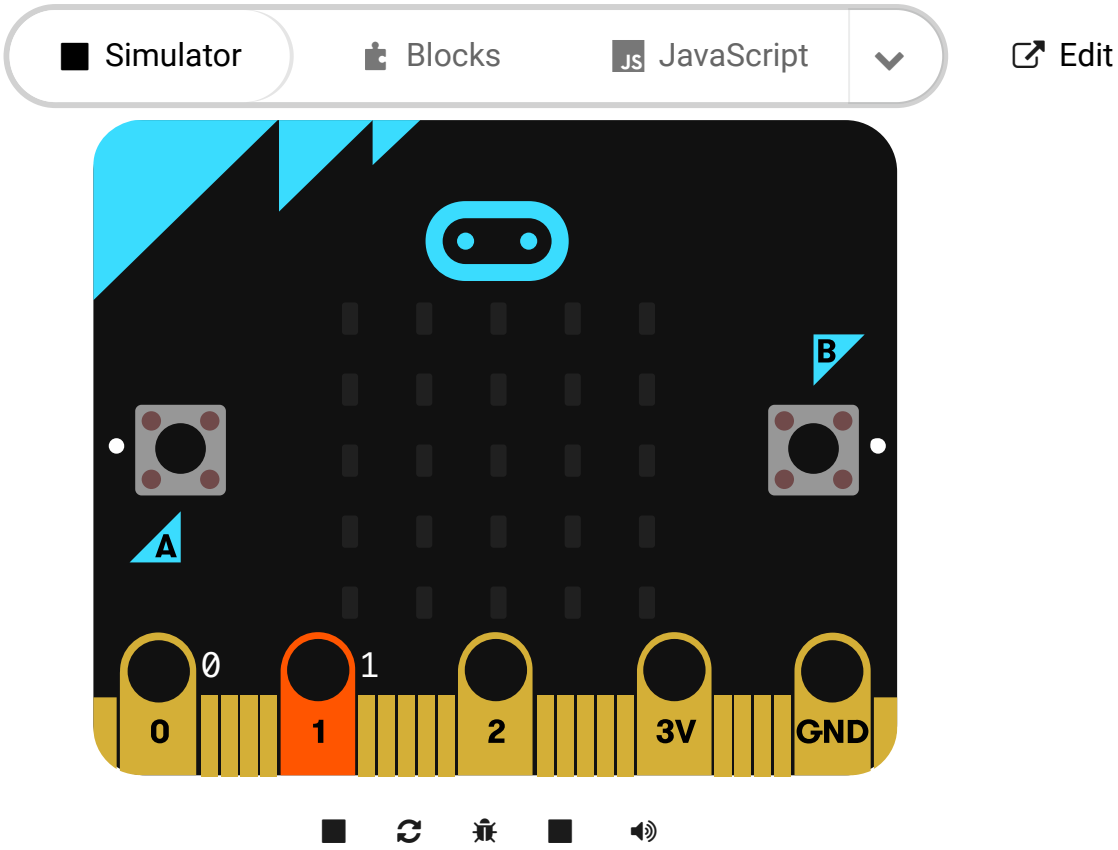
- 2.When the button is pressed, set P0 to 1; while released, set it to 0.



Reference

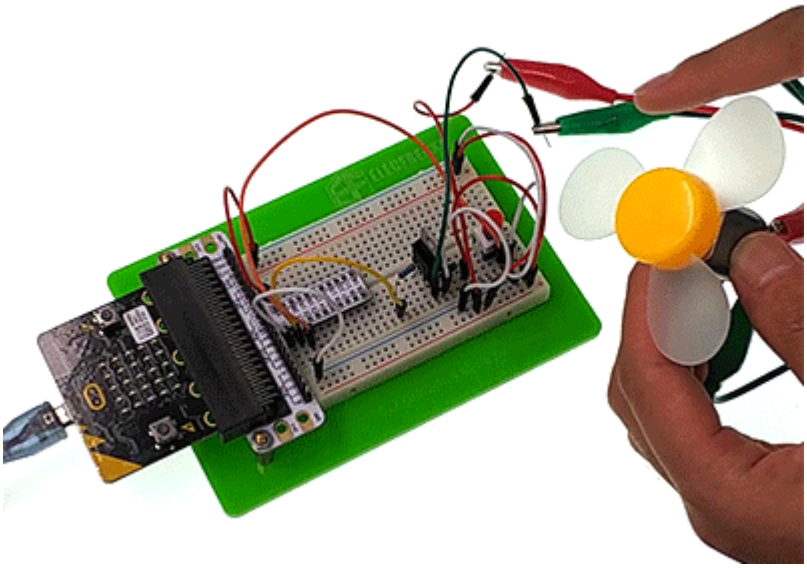
Links:https://makecode.microbit.org/_CAUDezEJrVtc

You can also download the links directly:



12.6. Result

Press down the button, the motor starts rotating. Press again, it will stop moving. Attention: The voltage of micro:bit power source is low. It is 3V only. Press down the button, the motor may not start. If this happens, please stir the fan blade of the motor so that it can move properly.

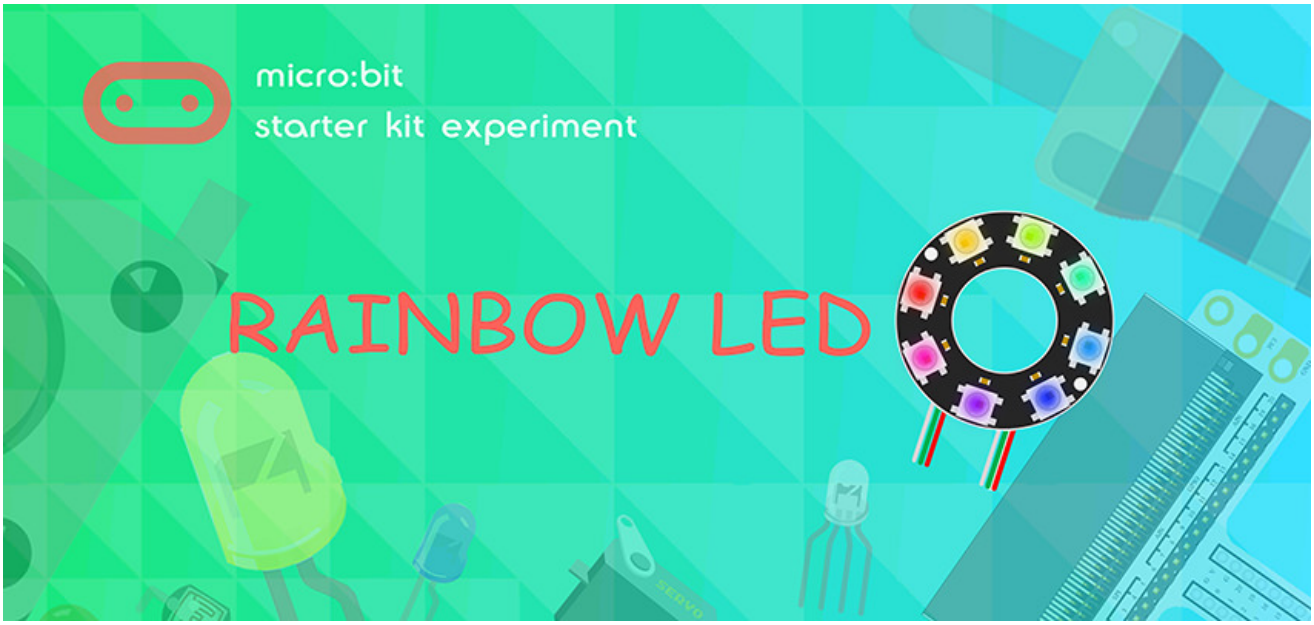


12.7. Exploration

If we want to use a potentiometer to control the motor speed, then how to design circuit and program.

12.8. FAQ

13. Lesson 11 Rainbow LED



13.1. Introduction

8 RGB Rainbow LED Ring is based on ws2812b bead. Its biggest characteristic is single IO control and infinite cascade connection. In this experiment, we are going to use micro:bit to drive 8 RGB Rainbow LED Ring and realize rainbow color gradual change.

13.2. Component List

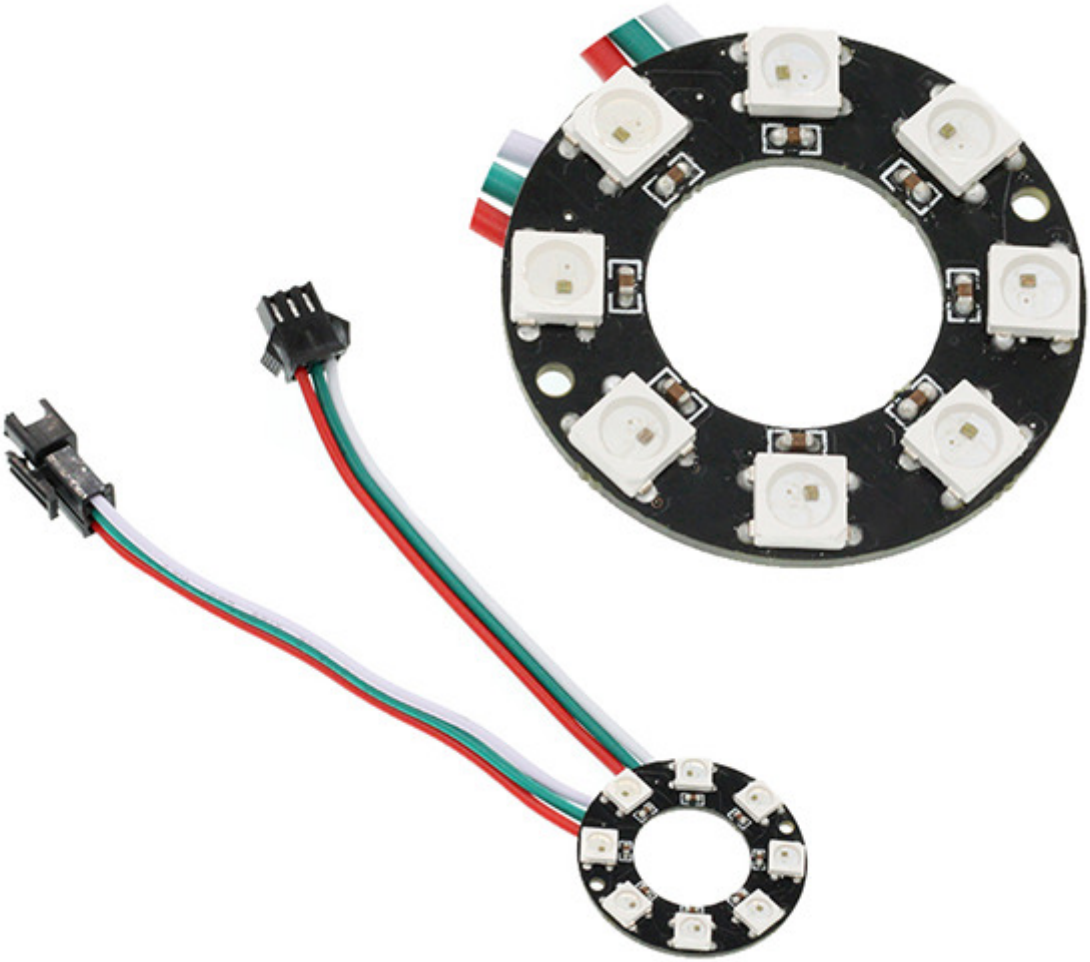
Hardware:

- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x micro:bit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x 8 RGB Rainbow LED Ring
- n x Breadborad Jumper Wire 65pcs Pack

Tips: If you want all components above, you may need Elecfreaks Micro:bit Starter Kit.

13.3. Major Component Introduction

8 RGB Rainbow LED Ring



8 RGB Rainbow LED Ring is an LED ring made of 8 ws2812b beads in cascade connection. Ws2812b is an intelligent outer control LED source, which has integrated control circuit and light emitting circuit. It has same appearance with 5050LED bead.

The digital protocol adopts communication method of single line goes to zero. After pixel point restoration, DIN will receive the data sent from the controller. Once the first 24-bit data received was extracted by the first pixel point, it will be sent to the internal digital lock storage device of pixel point and the rest data amplified through the inner transformation processing circuit will be sent to the next pixel point from DO port. Every time it passes through a pixel point transmission, the signal will decrease 24bit. The pixel point uses automatic transformation forwarding technique, thus the pixel cascade connection quantity do not limited by signal transmission but the speed of transmission only.

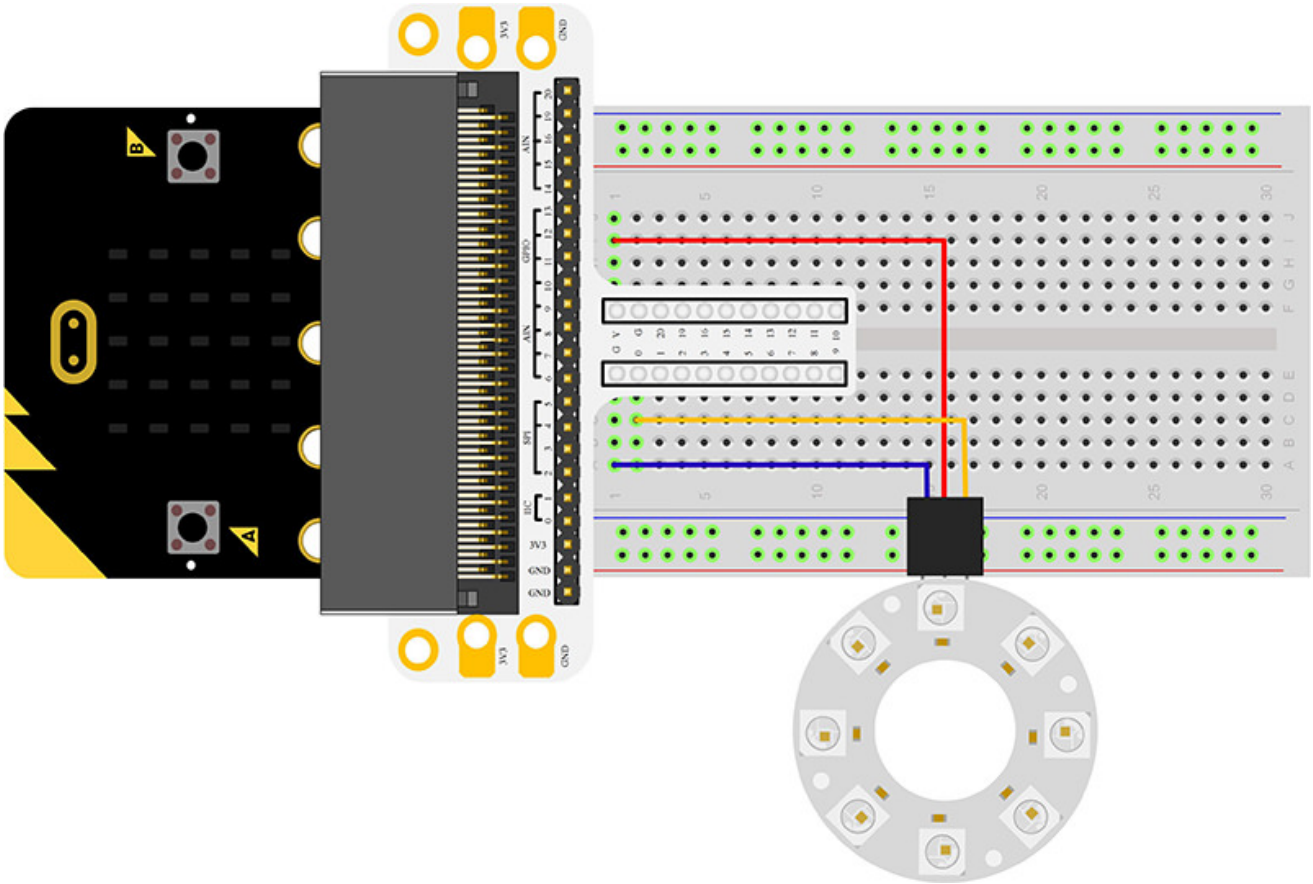
LED has advantages of low voltage drive, energy-saving and environment protect, wide scattering angle, good consistency, ultra-long life, etc.. To integrate control circuit onto LED, the circuit will become more simple, easier to install and have smaller volume.

13.4. Experimental Procedure

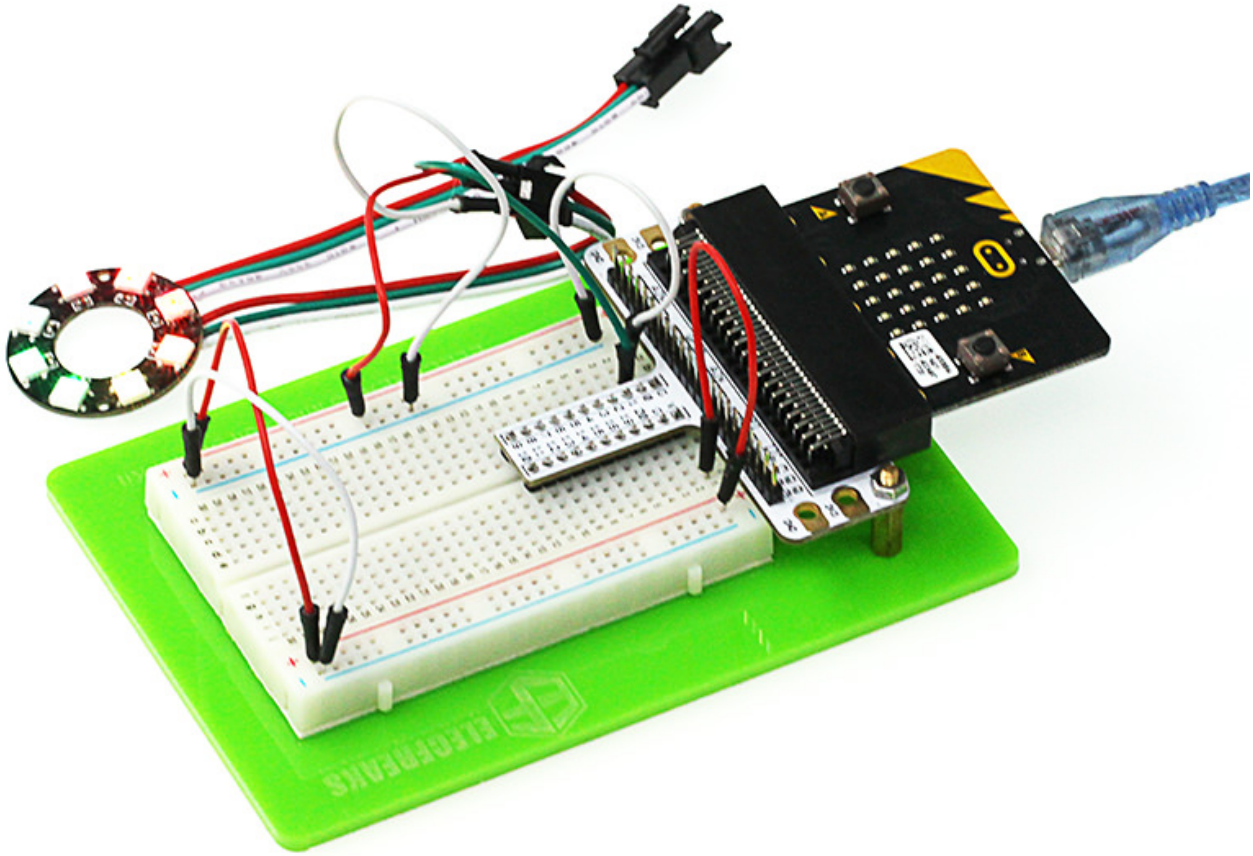
13.5. Hardware Connection

Connect your components according to the picture below:

- 1. Connect the signal wire of the LED ring to the P0 port of the breadboard adapter.

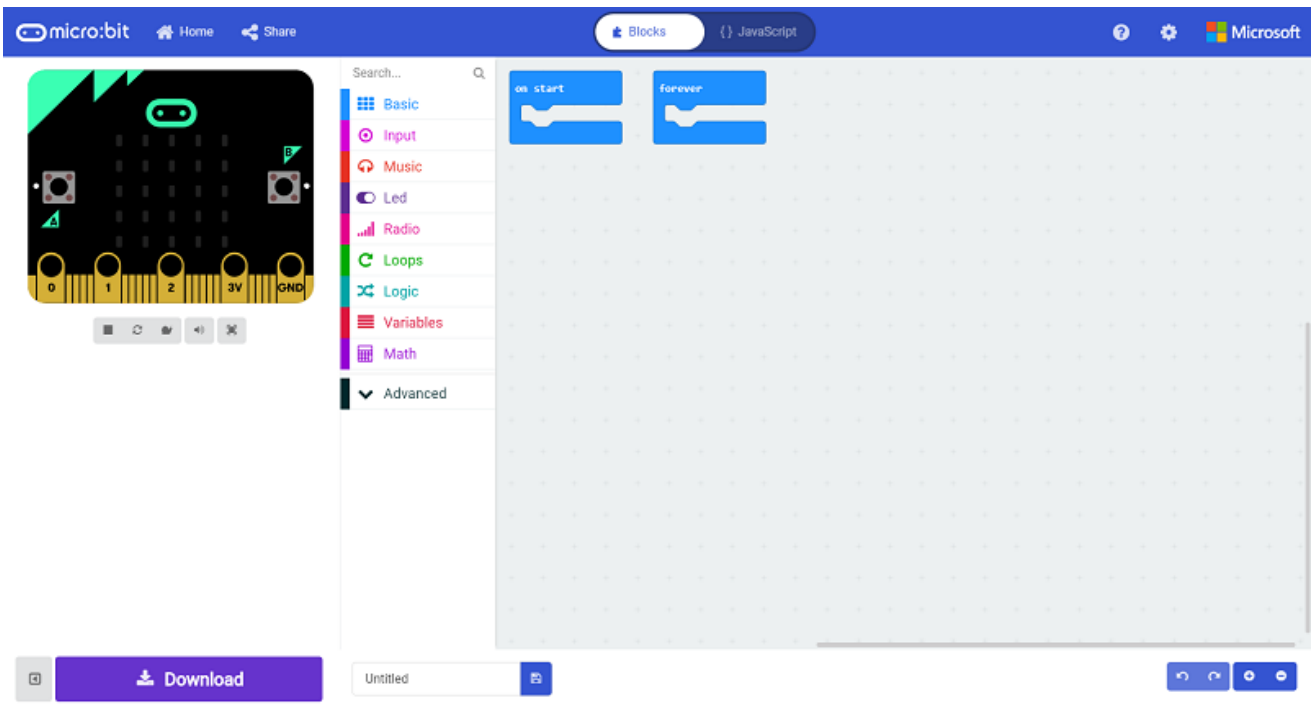


Note: There are two cables led out by the ring. One is DI and the other is DO. We should connect DI. After connection, we can see:



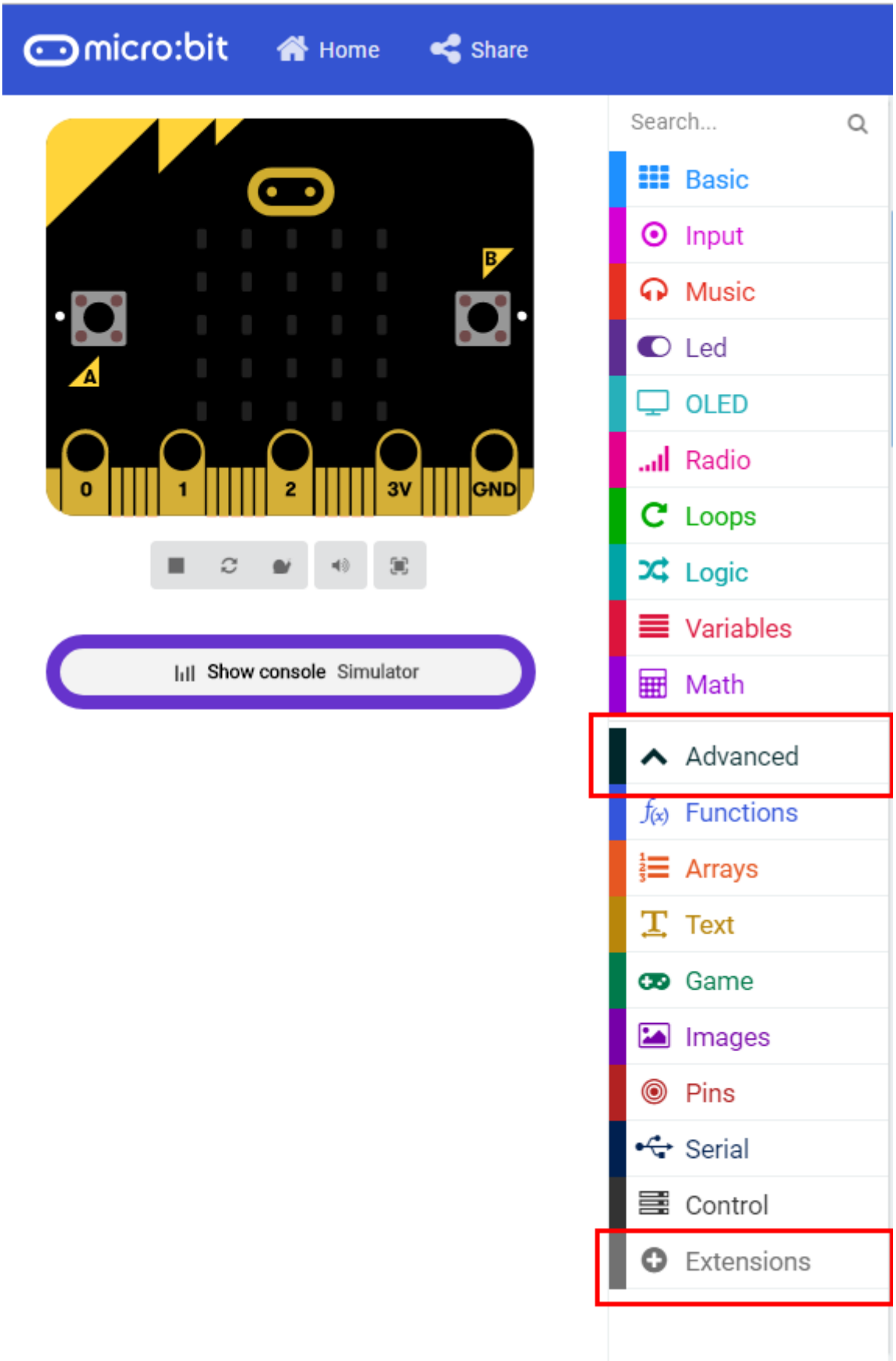
Software Programming

Click to open Microsoft Makecode, write the following code in the editor.
(https://makecode.microbit.org/)

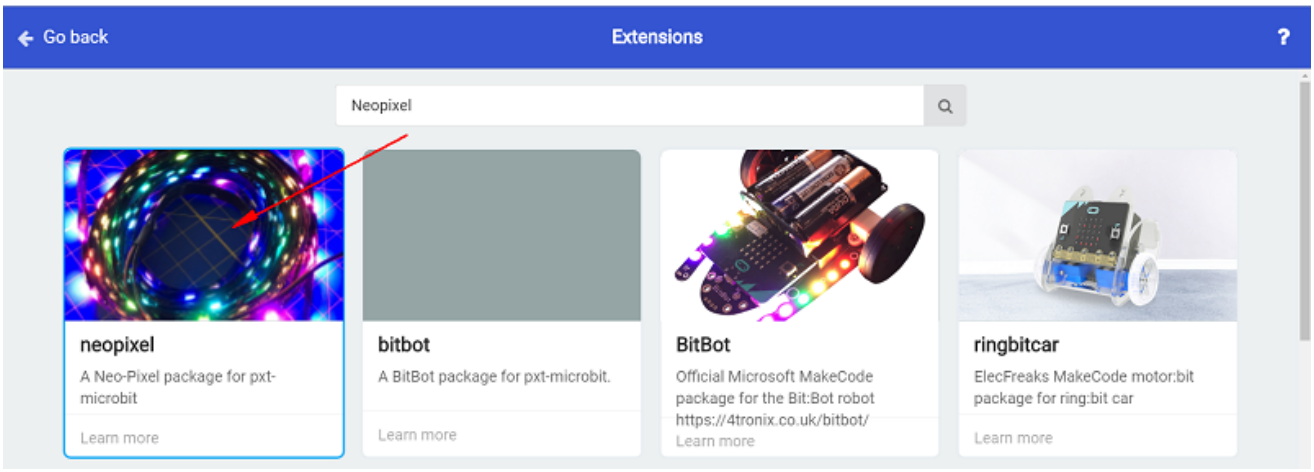


Add Package

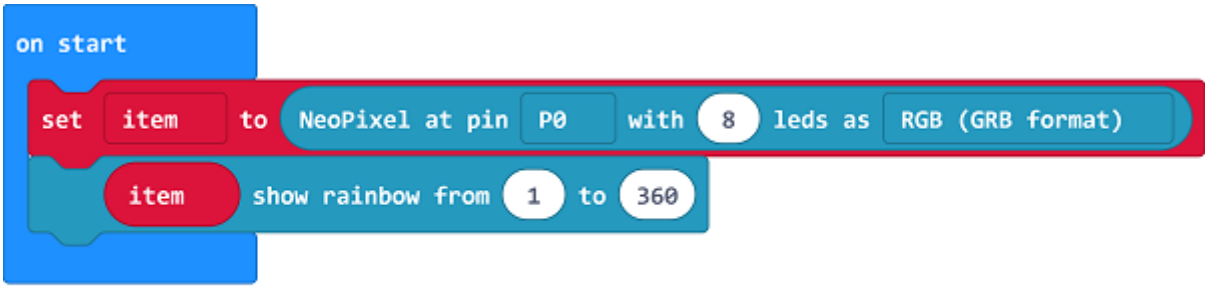
- Click “Advanced”in the choice of the MakeCode to find more choices.

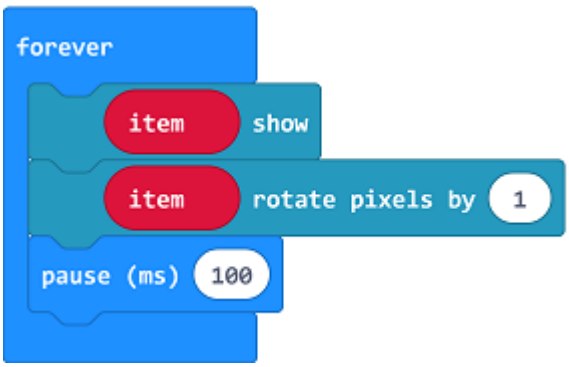


Click “Extensions”, search “neopixel”in the dialog box and then download the “neopixel”.



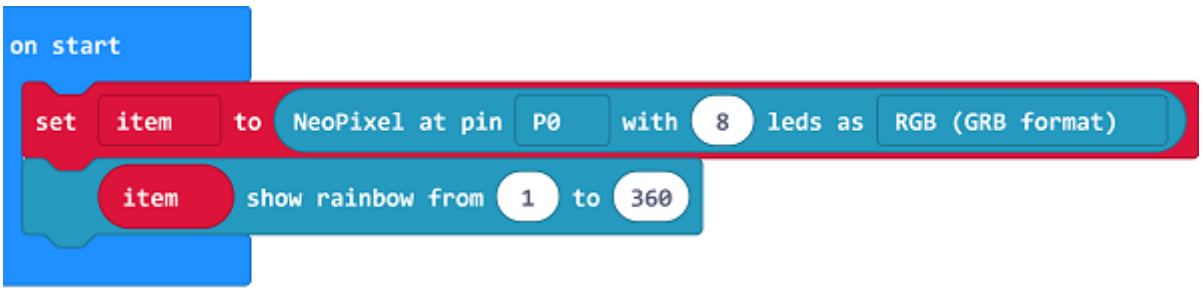
Program as the picture shows:



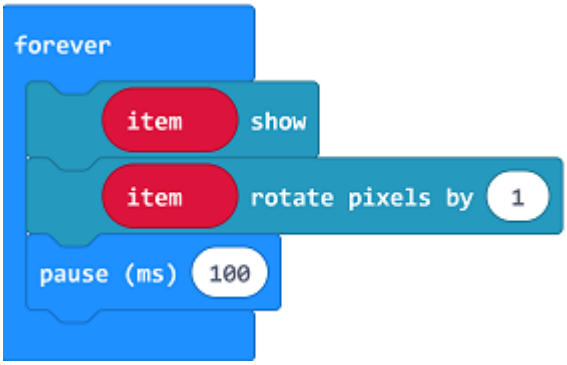


Details for the code:

- Set the 8 led to RGB mode and set the pins to P0 port.



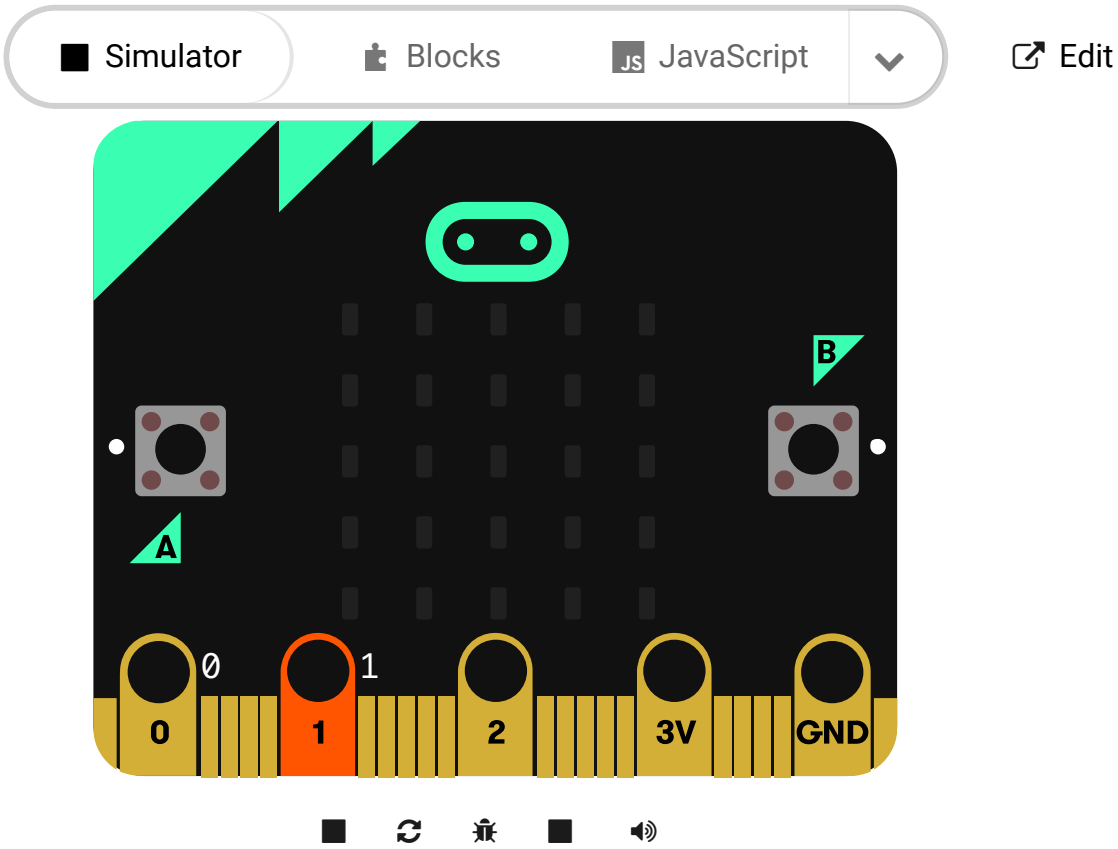
- 2.Show the color of RGB and set color gradient.



Reference

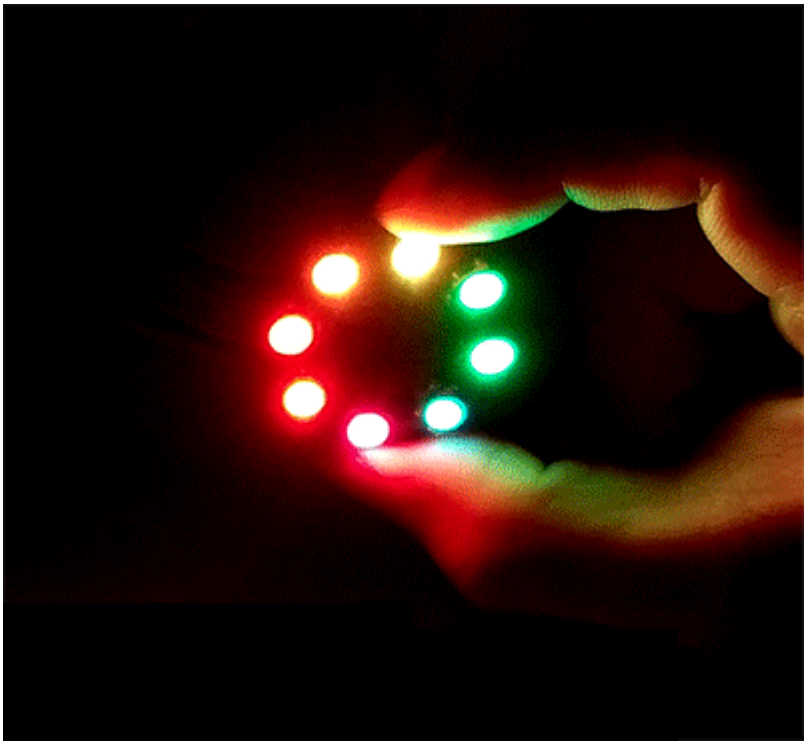
Links:https://makecode.microbit.org/_LybdqfauX3TR

You can also download the links directly:



13.6. Result

We can see the light of 8 RGB Rainbow LED Ring is rotating with rainbow color.

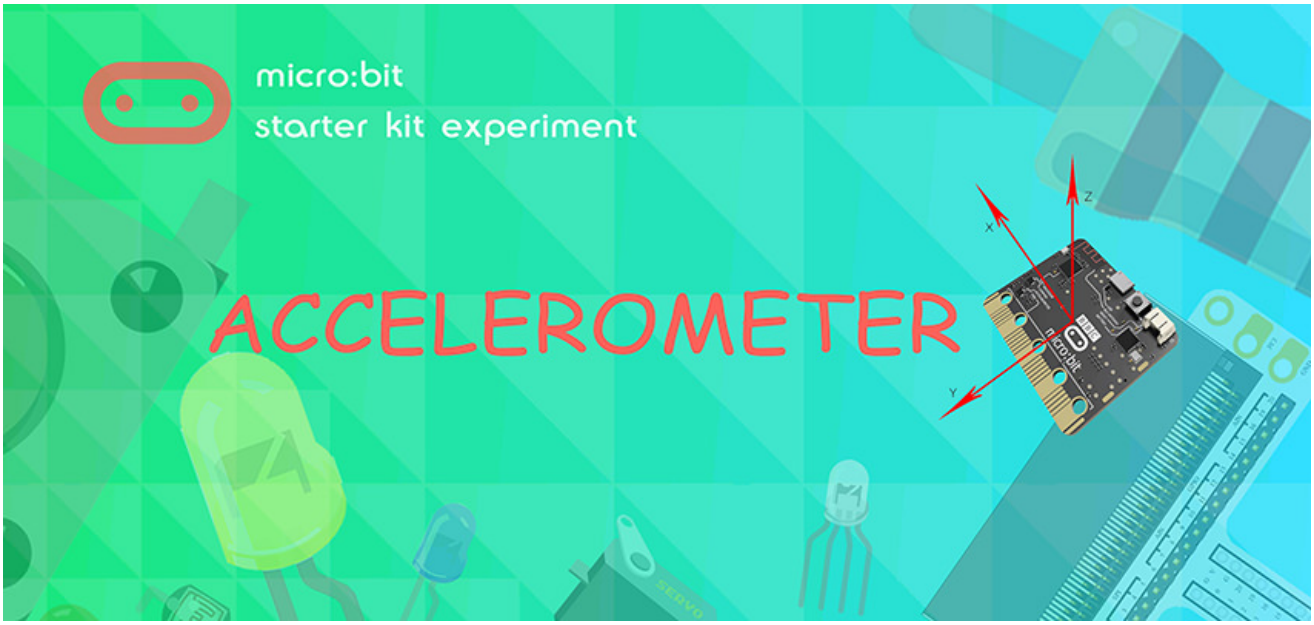


13.7. Exploration

Imagine the ring is a big eye, in order to make it twinkle, then how to design circuit and program?

13.8. FAQ

14. Lesson 12 Accelerometer



14.1. Introduction

micro:bit has integrated multiple sensors including accelerometer. Today, we are going to use accelerometer to make a level device and display the inclination on NeoPixel ring in bar chart format.

14.2. Component List

Hardware:

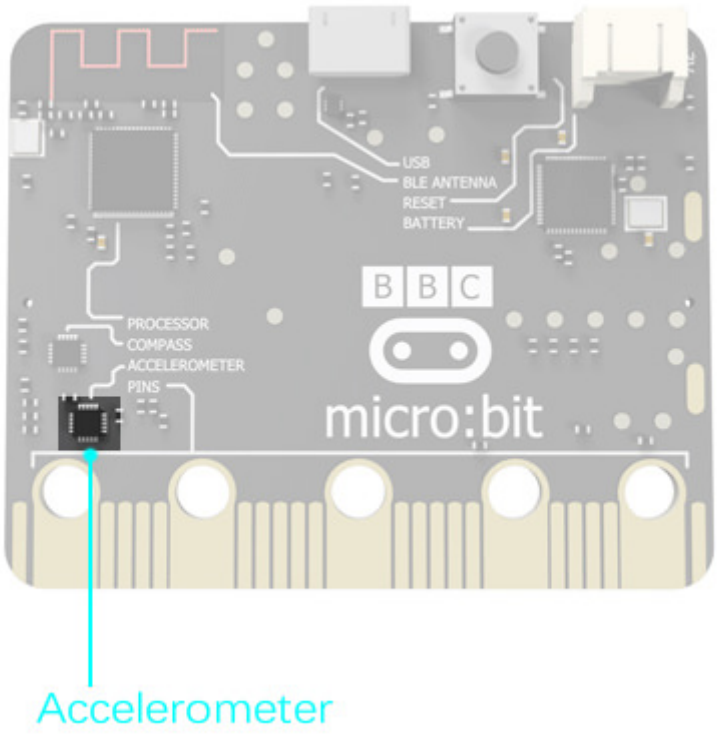
- 1 x micro:bit Board
- 1 x USB Cable
- 1 x micro:bit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x 8 RGB LED NeoPixel Ring
- n x Breadborad Jumper Wire 65pcs Pack

Tips: If you want all components above, you may need Elecfreaks Micro:bit Starter Kit.

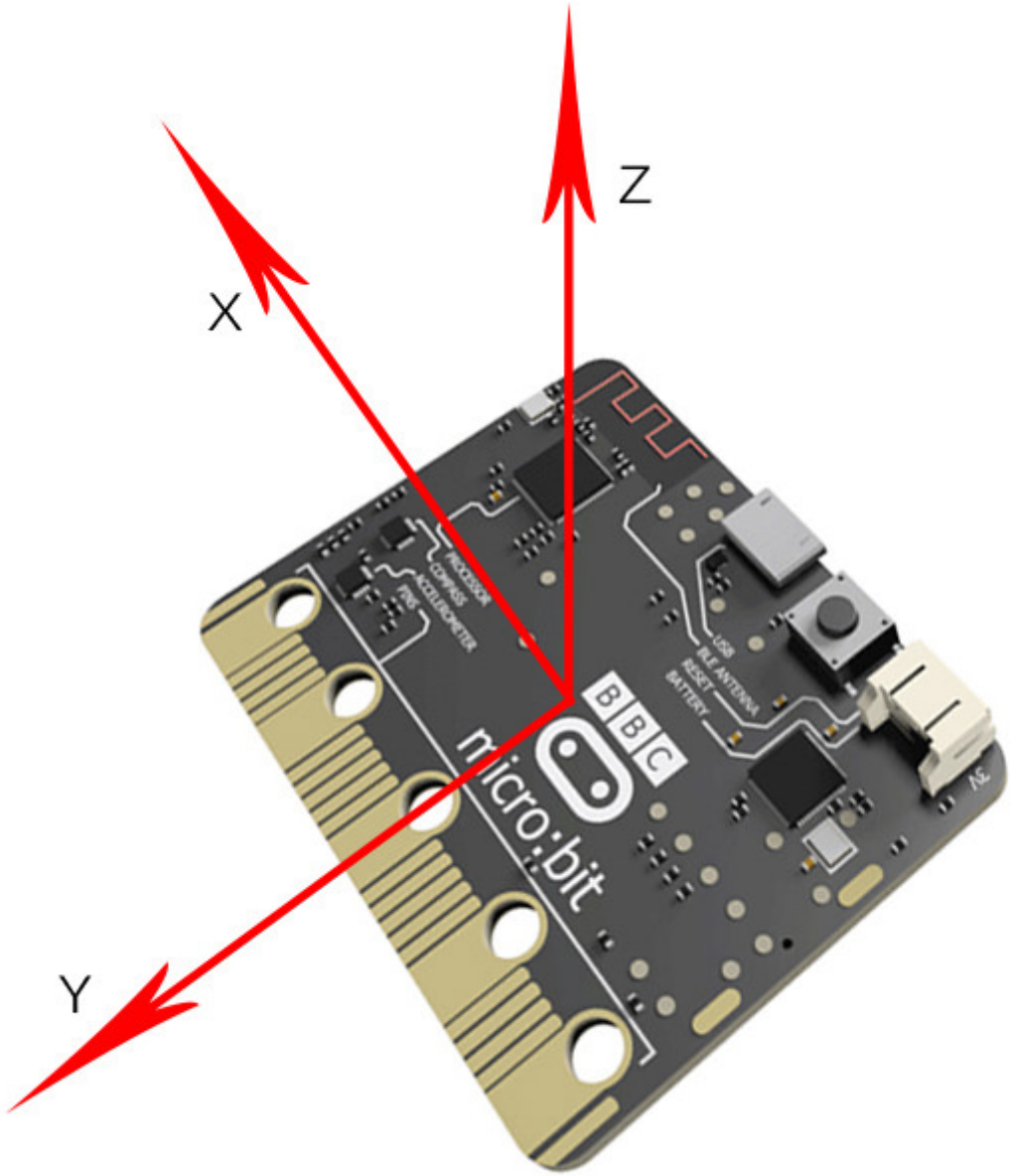
14.3. Major Component Introduction

Accelerometer

There is an accelerometer on your micro:bit which detects the speed change of micro:bit. It converts analog information into digital form that can be used in micro:bit programs. Output is in milli-g. The device will also detect a small number of standard actions, e.g. shake, tilt and free-fall.



The corresponding X, Y, Z axle direction of accelerometer are showed below:

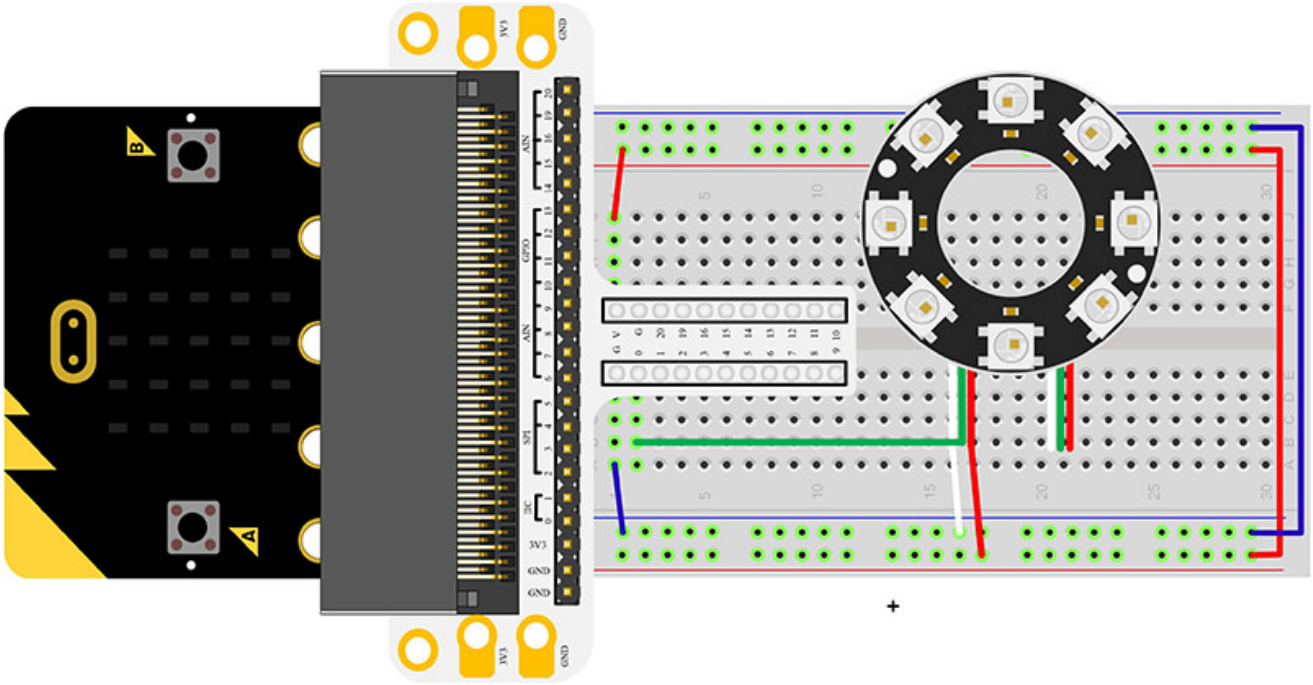


14.4. Experimental Procedure

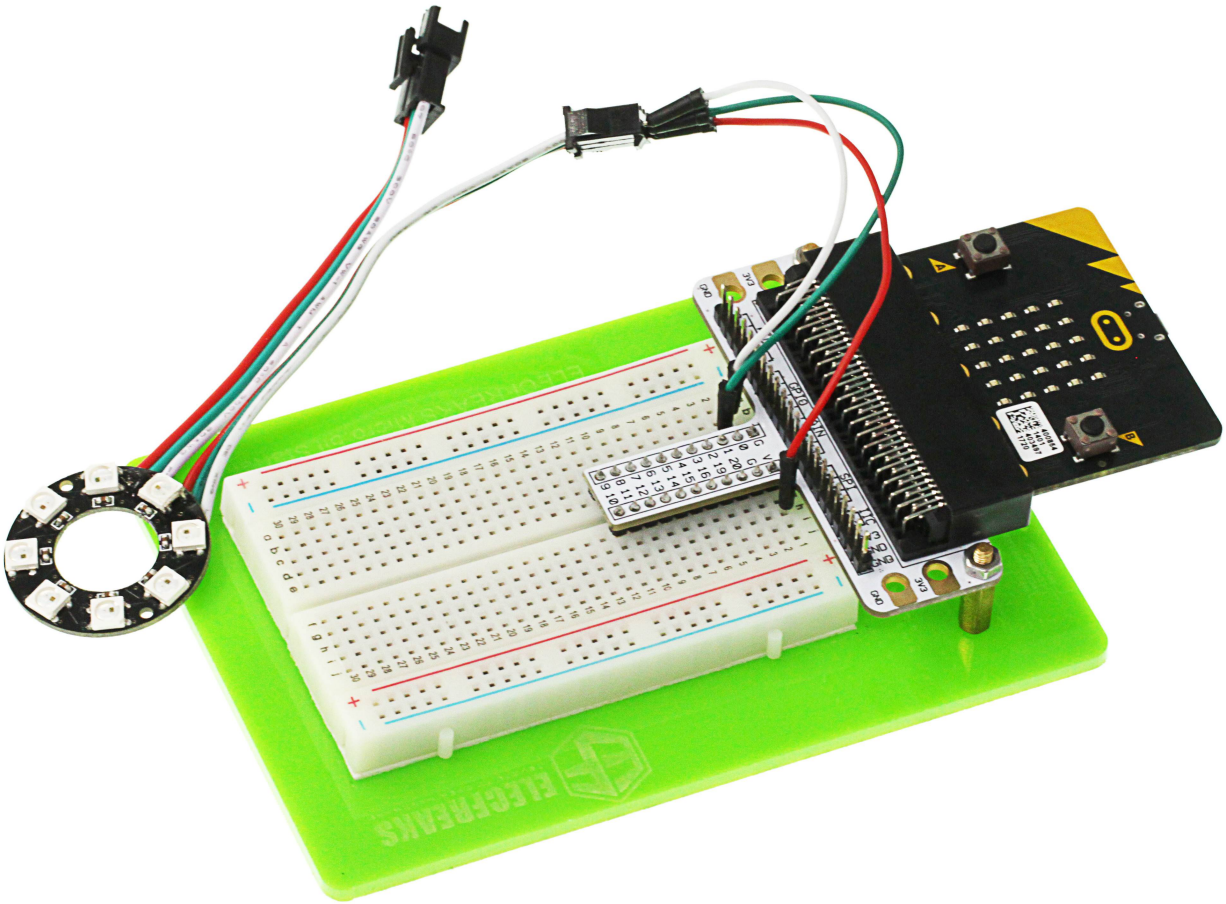
Hardware Connection

Connect your components according to the picture below:

- Connect the signal wire of the LED ring to the P0 port of the breadboard adapter.

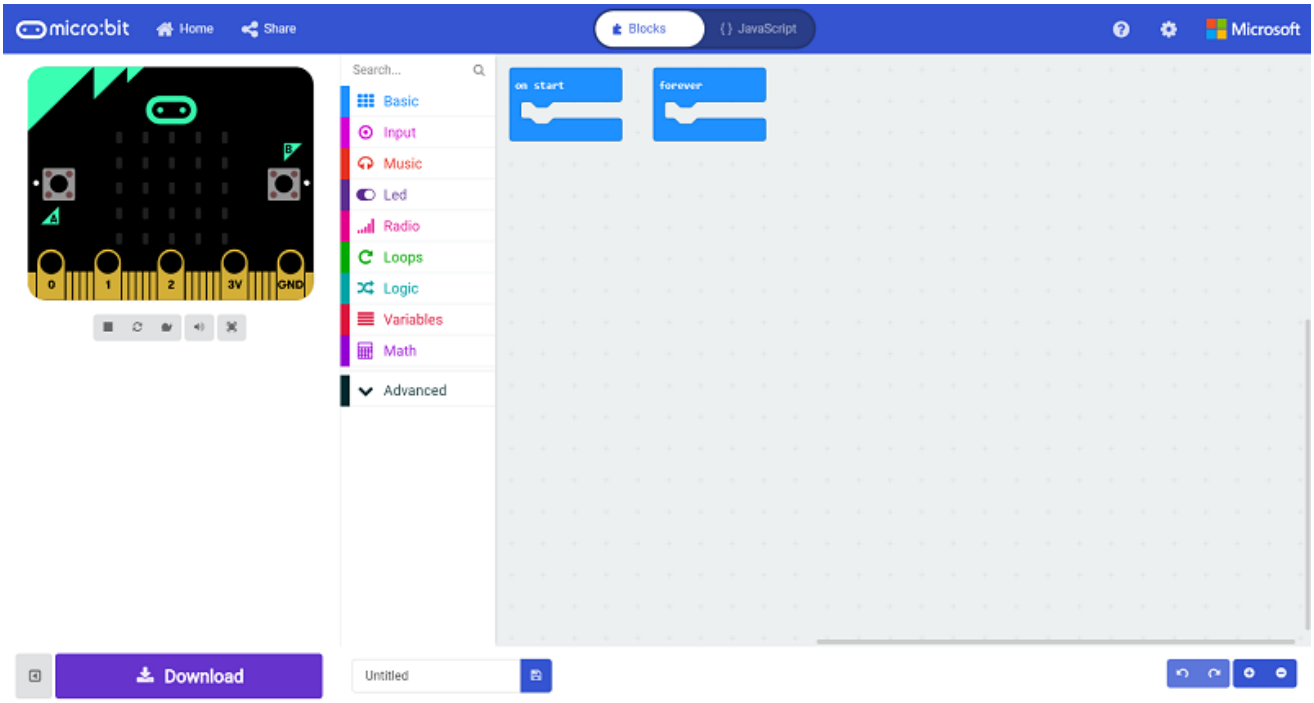


After connection, we can see:



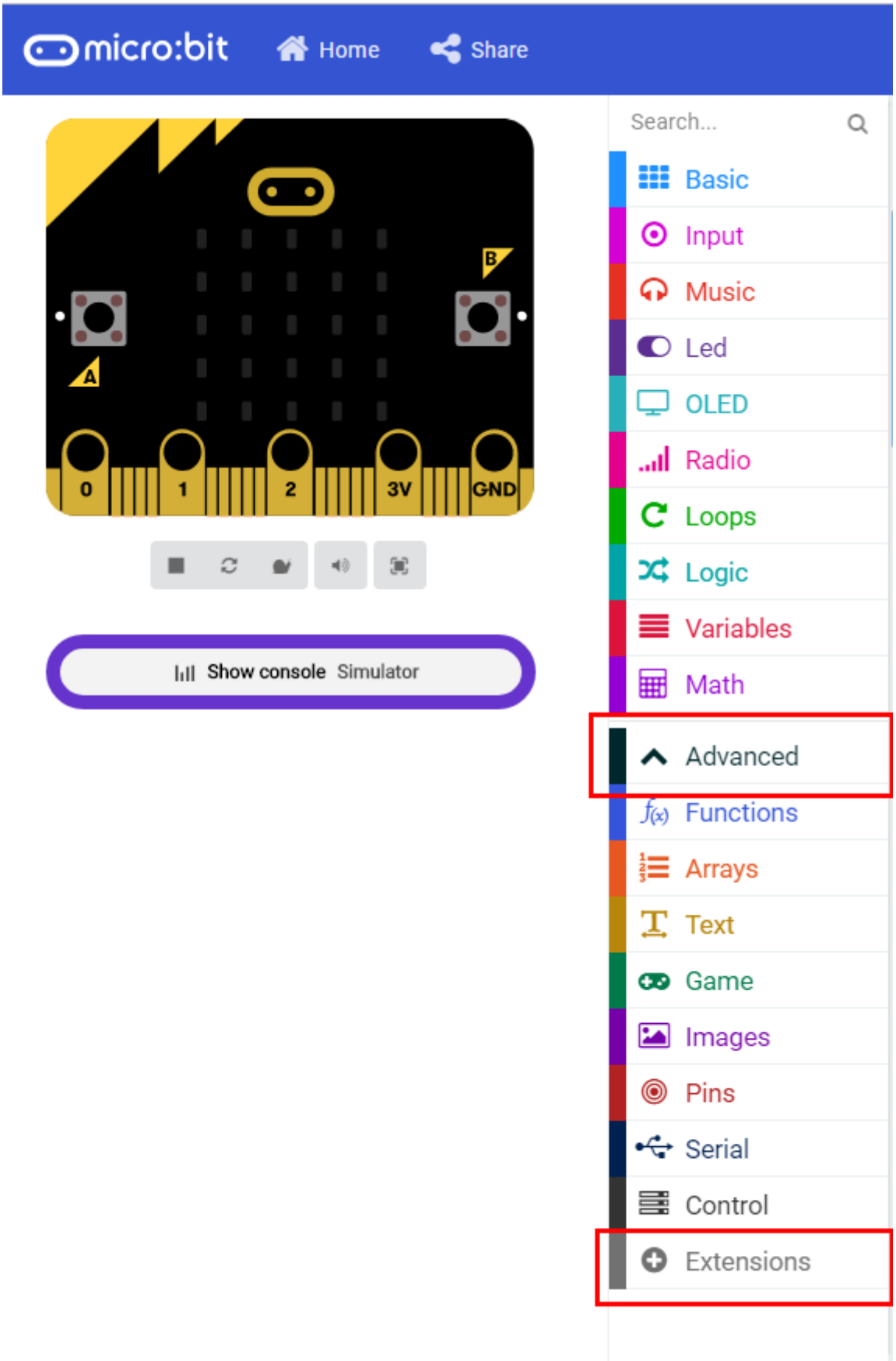
Software Programming

Click to open Microsoft Makecode, write the following code in the editor.
(https://makecode.microbit.org/)

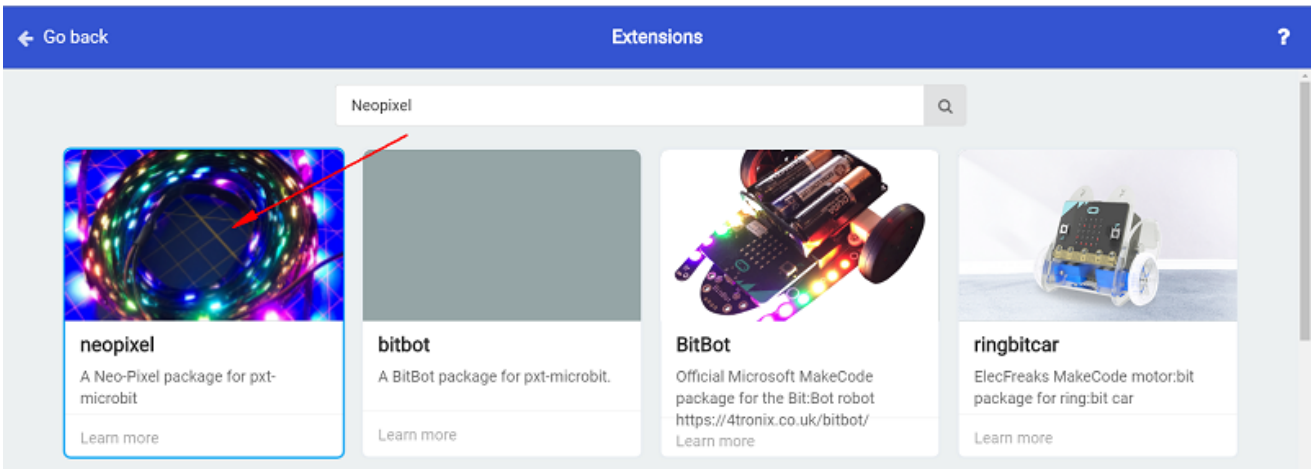


Add Package

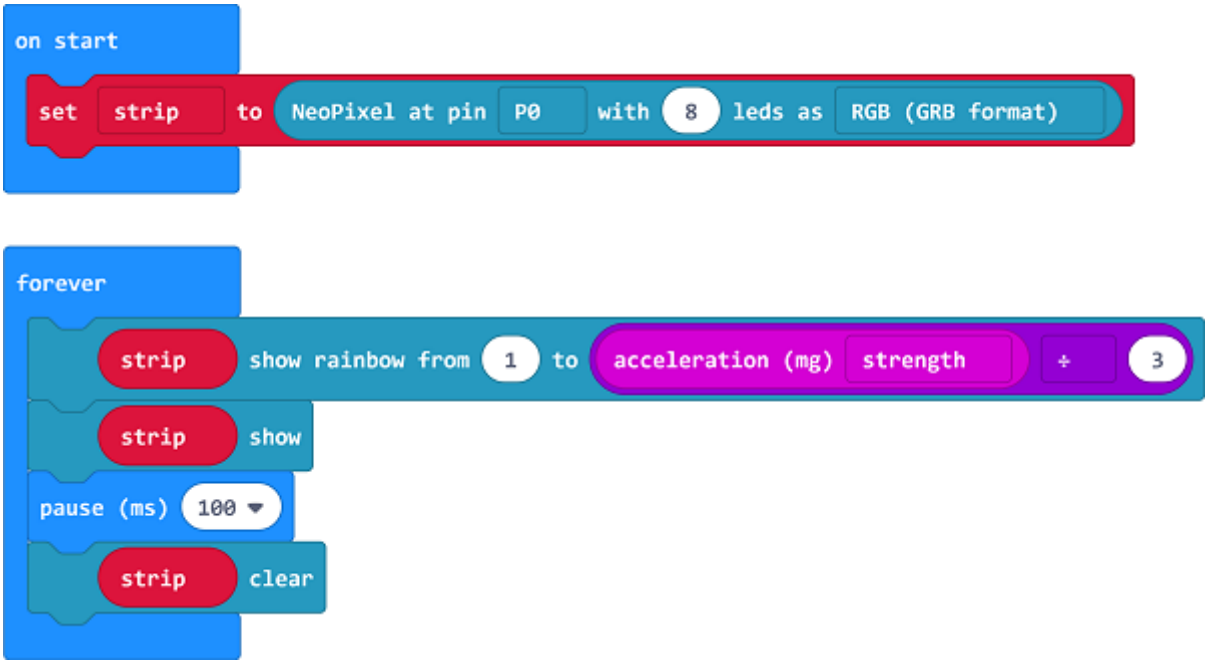
Click “Advanced”in the choice of the MakeCode to find more choices.



Click “Extensions”, search “neopixel”in the dialog box and then download the “neopixel”.



Program as the picture shows:



Details for the code:

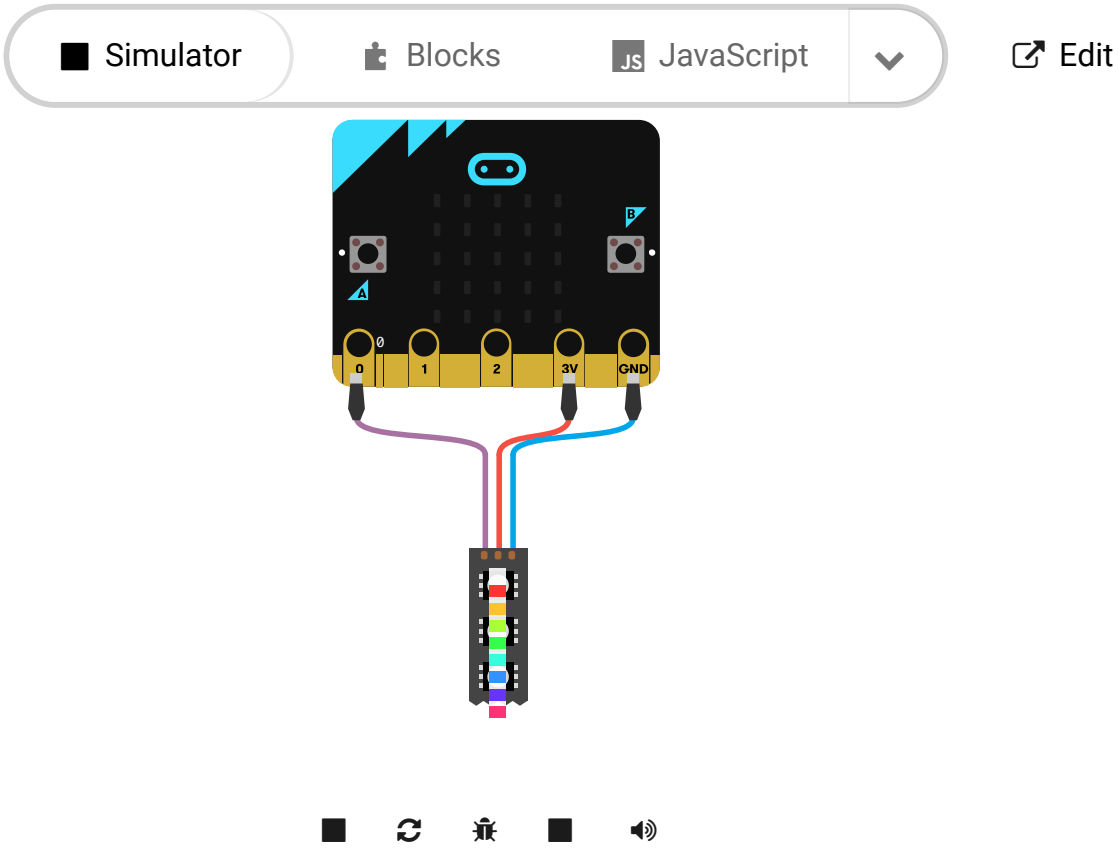
- Set P0 port as the pin for LED beads and set it in RGB mode, then light on all the LED.

- Set the color of the light is changed with the accelerated speed.

Reference

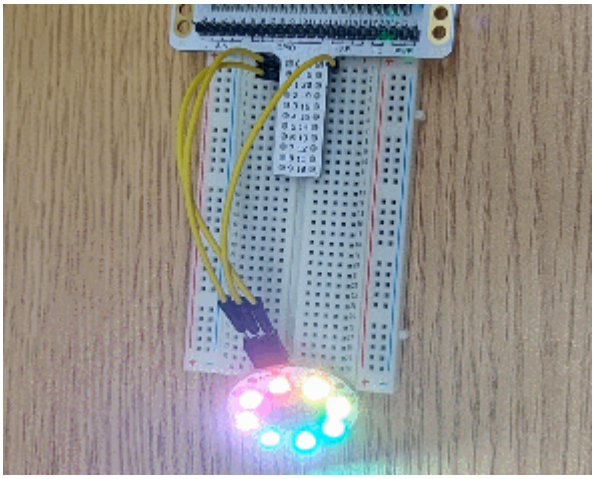
Links:https://makecode.microbit.org/_0Y07f36Y77sa

You can also download the links directly:



14.5. Result

The RGB LED ring lights on in different color with the movement of the micro:bit.

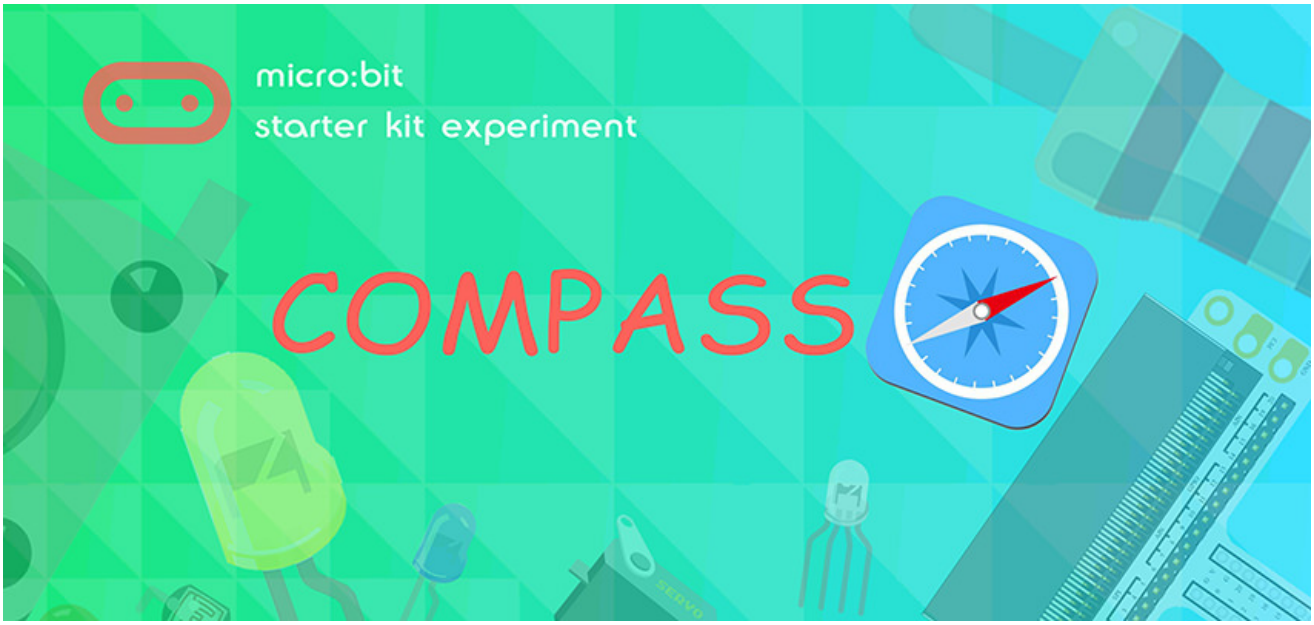


14.6. Exploration

If we want to set 4 of the LEDs to light on in turns, how can we design the circuit and program?

14.7. FAQ

15. Lesson 13 Compass



15.1. Introduction

Do you know compass? I believe most of you have played it ever. Today I am going to use micro:bit to create a compass and display its direction on NeoPixels ring. Want to know how I do it? Just read the article below and follow my steps. Let's go!

15.2. Component List

Hardware:

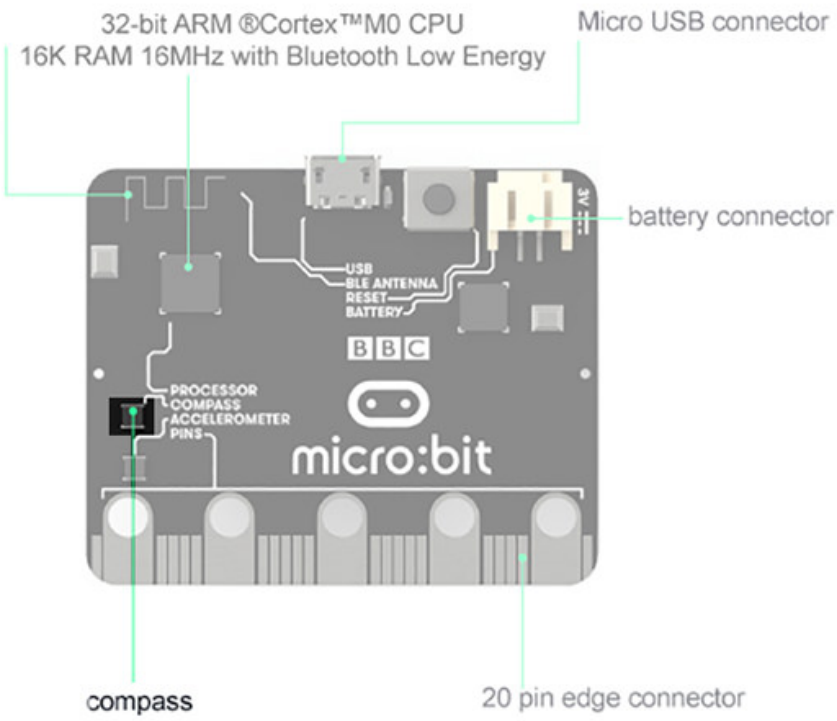
- 1 x micro:bit Board
- 1 x Micro-B USB Cable
- 1 x micro:bit Breadboard Adapter
- 1 x Transparent Breadboard - 83 * 55 mm
- 1 x 8 RGB Rainbow LED Ring
- n x Breadborad Jumper Wire 65pcs Pack

Tips: If you want all components above, you may need Elecfreaks Micro:bit Starter Kit.

15.3. Major Component Introduction

Compass

Here, compass in reality is a magnetometer. The magnetometer is a separate chip that provides magnetic field strength sensing. A software algorithm in the standard runtime uses the on board accelerometer to turn these readings into a board orientation independent compass reading. The compass must be calibrated before use, and the calibration process is automatically initiated by the runtime software. This device is connected to the application processor via the I2C bus.

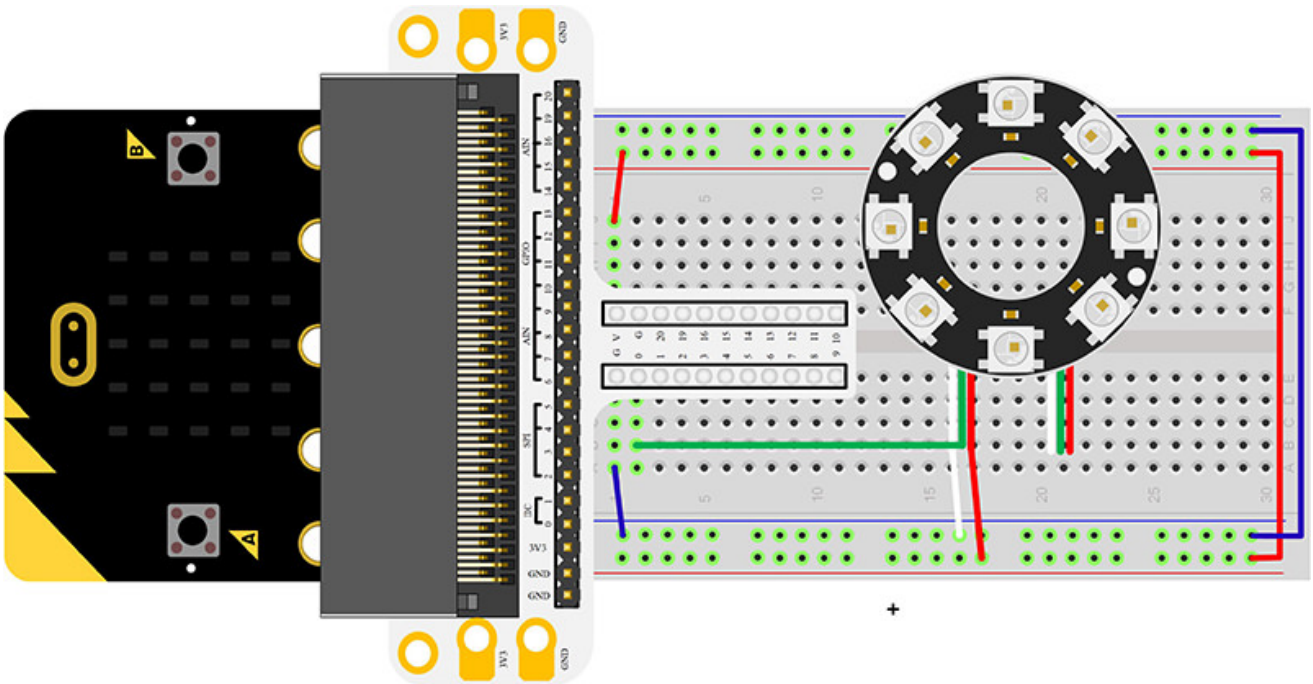


15.4. Experimental Procedure

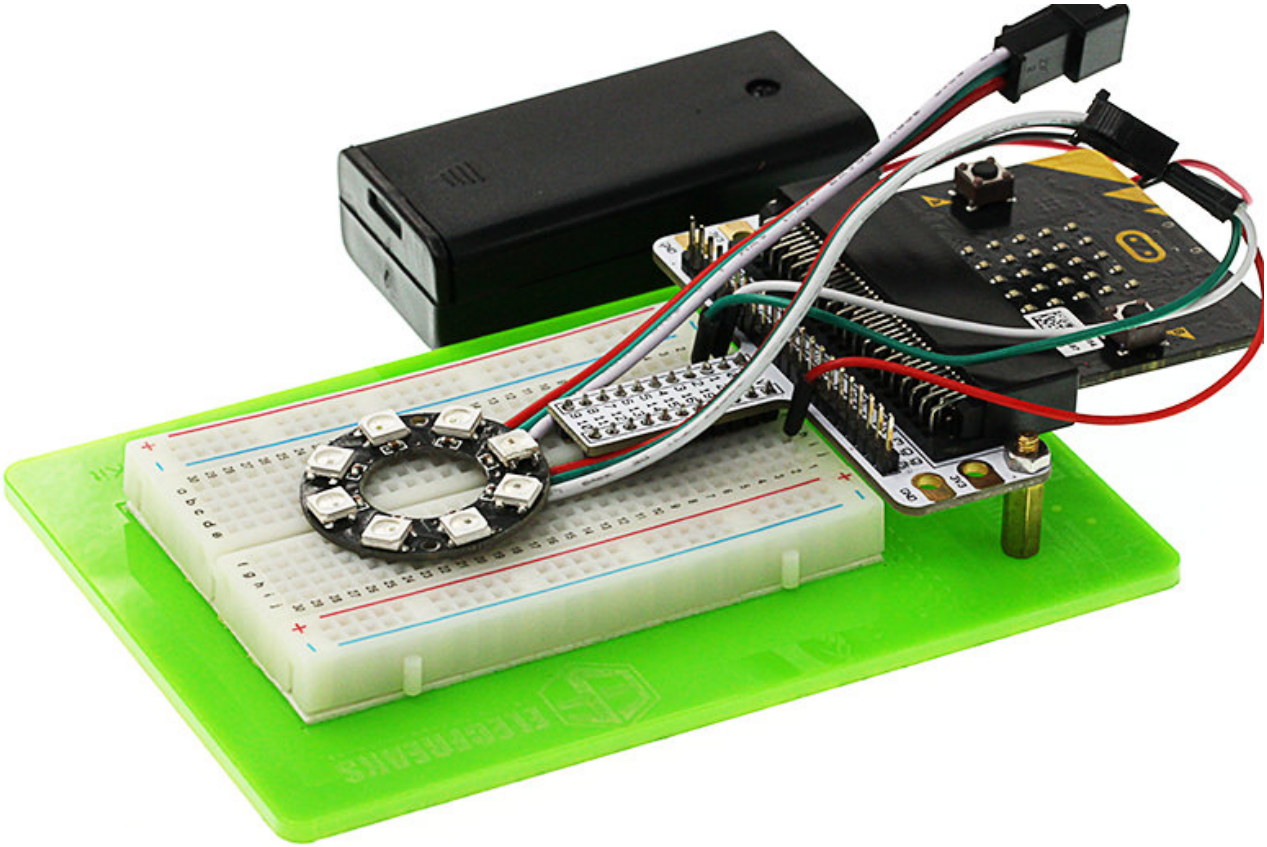
Hardware Connection

Connect your components according to the picture below:

- Connect the signal wire of the LED ring to the P0 port of the breadboard adapter.

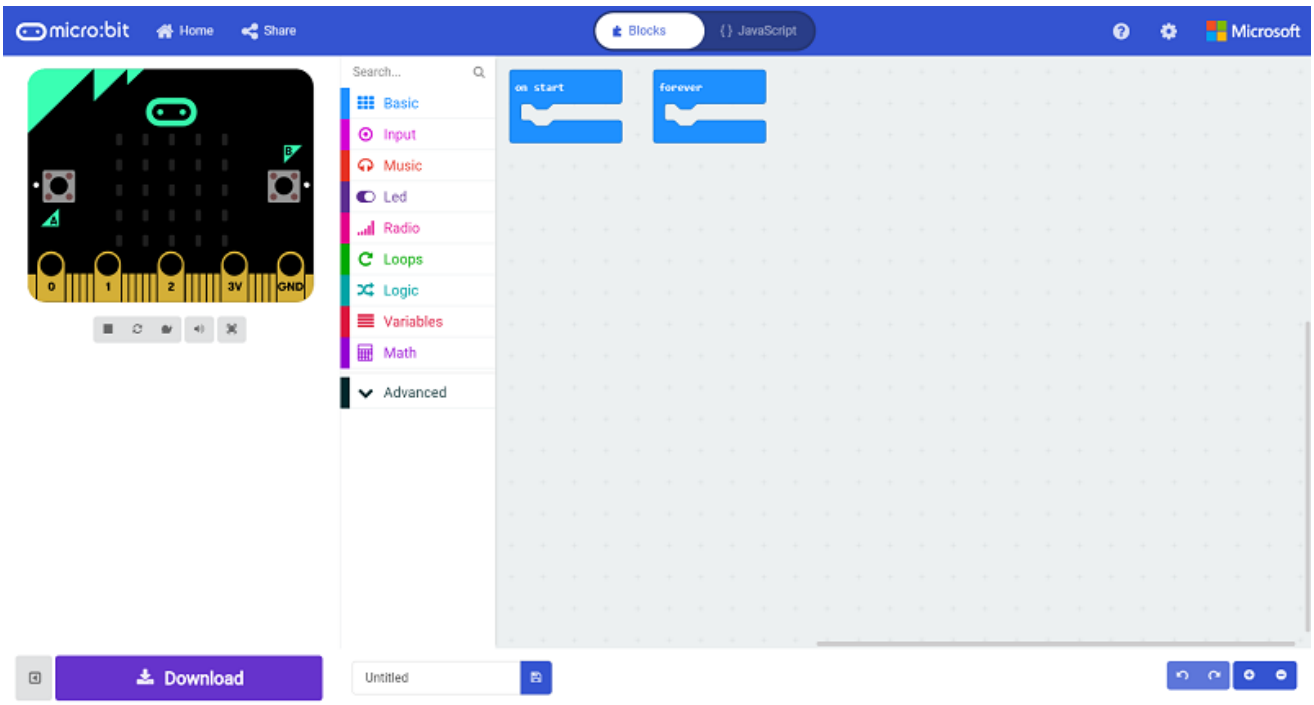


After connection, we can see:



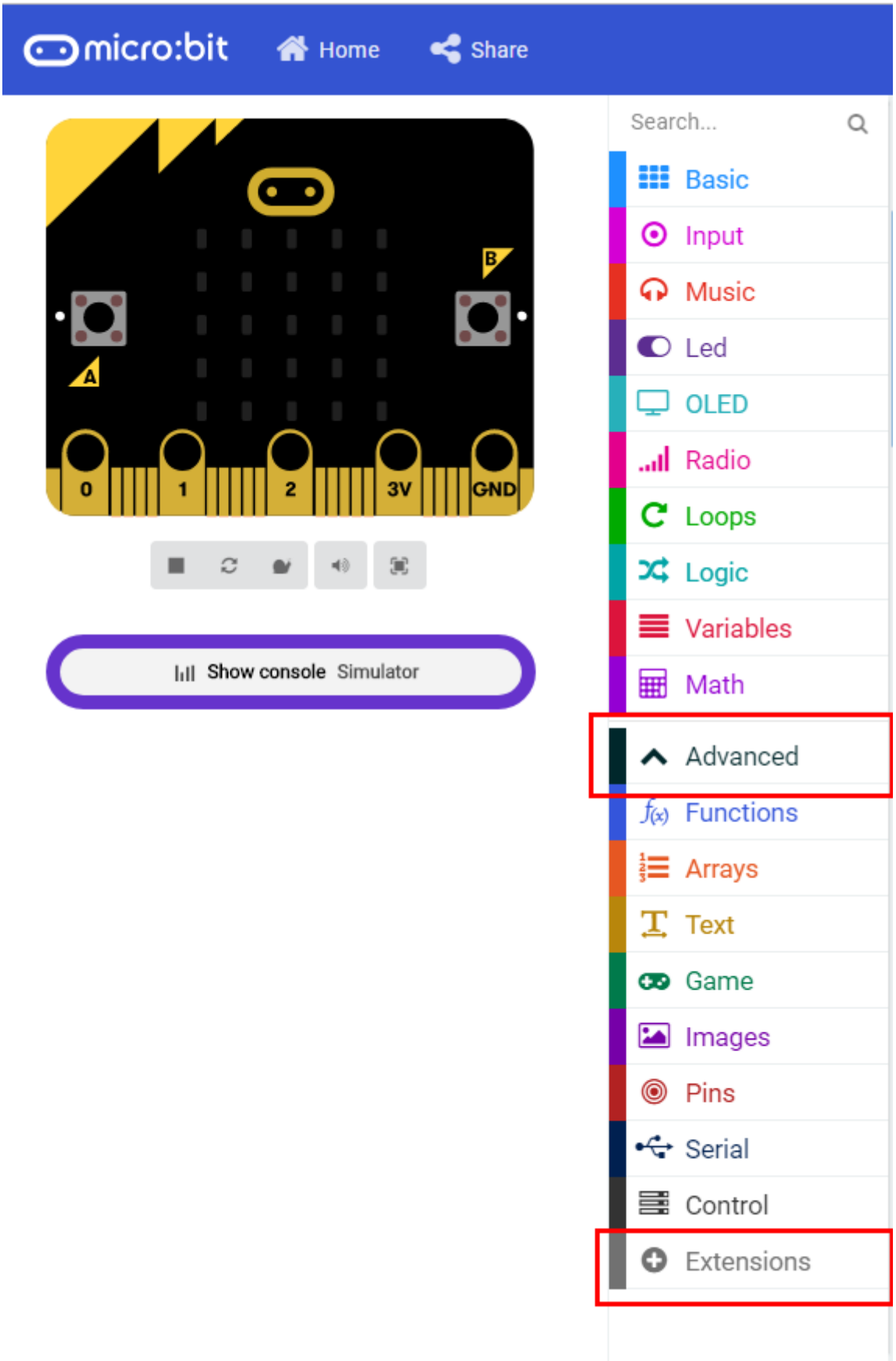
Software Programming

Click to open Microsoft Makecode, write the following code in the editor. (https://makecode.microbit.org/)

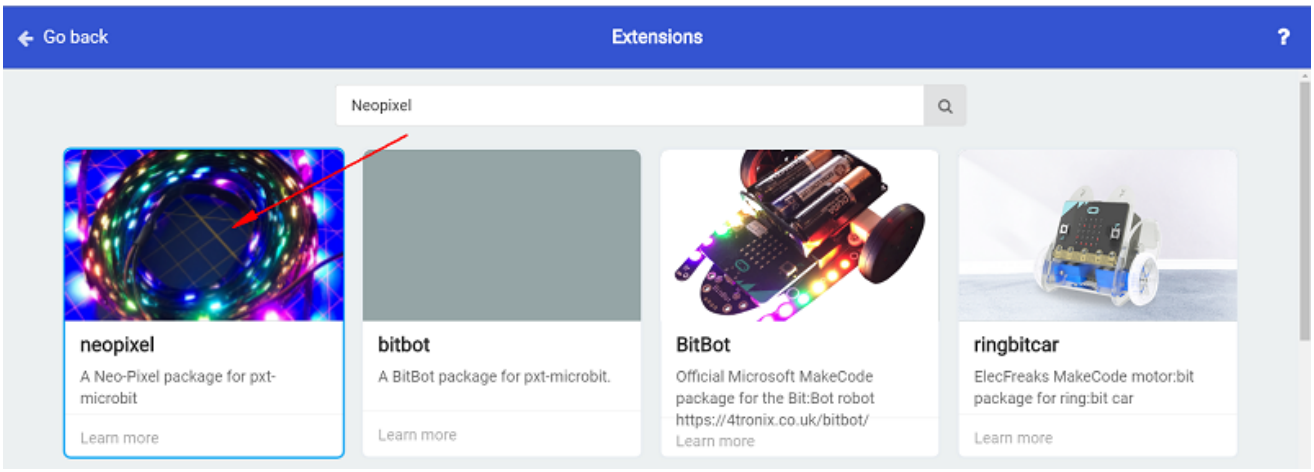


Add Package

Click “Advanced”in the choice of the MakeCode to find more choices.



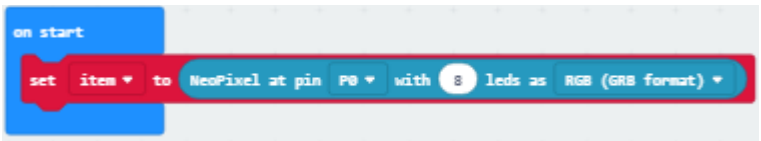
Click “Extensions”, search “neopixel”in the dialog box and then download the “neopixel”.



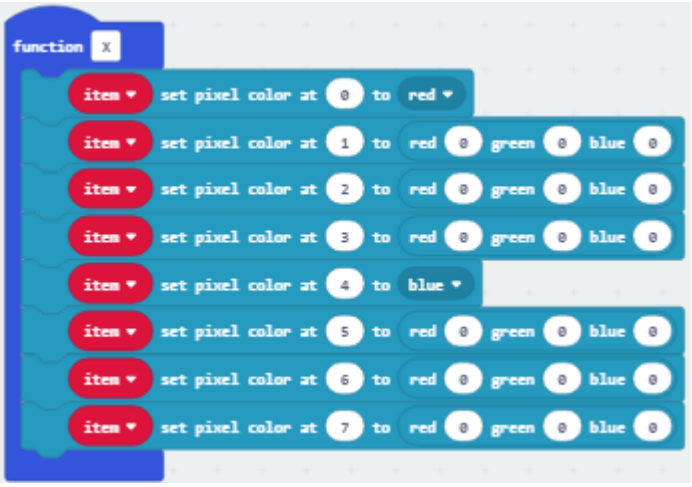
Program as the picture shows:

Details for the code:

- 1.Set P0 port as the pin to control the ring and set its color mode to RGB.



- 2.Set a function to make the 1st and 5th LED light on with red and blue.

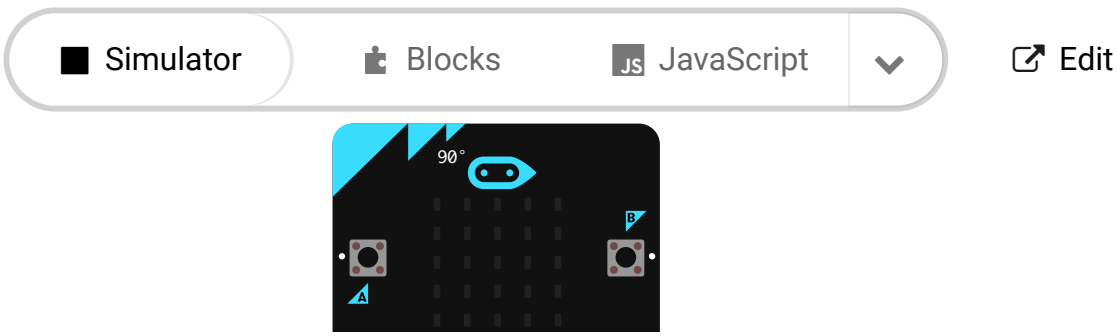


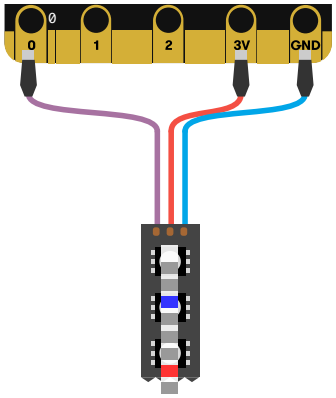
- 3.Read the value detected by the compass, change the color of the LEDs according to them.

Reference

Links:https://makecode.microbit.org/_L88UK5VdmR9A

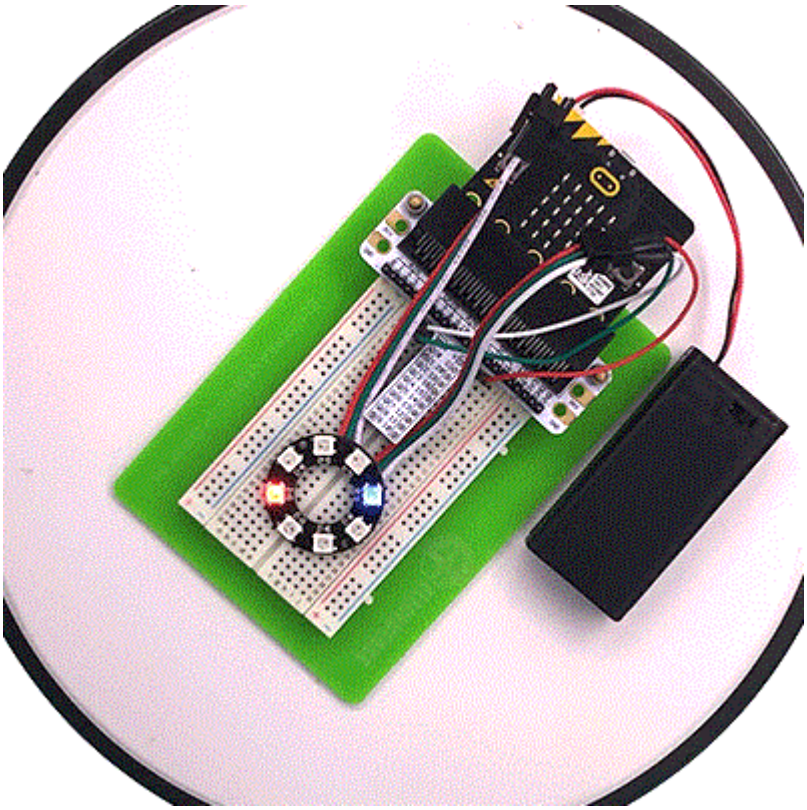
You can also download the links directly:





15.5. Result

Rotate the whole device, you can see the Rainbow LED Ring always point at the same direction. Note: Every time you start to use the compass (for example, if you have just turned the micro:bit on), the micro:bit will start to calibrate compass (adjust itself). It will ask you to draw a circle by tilting the micro:bit. If you are calibrating or using the compass near metal, it might confuse the micro:bit.



15.6. Exploration

If this experiment does not use Rainbow LED Ring but use the arrow displayed on micro:bit as indicator, then how to design circuit and program?

15.7. FAQ