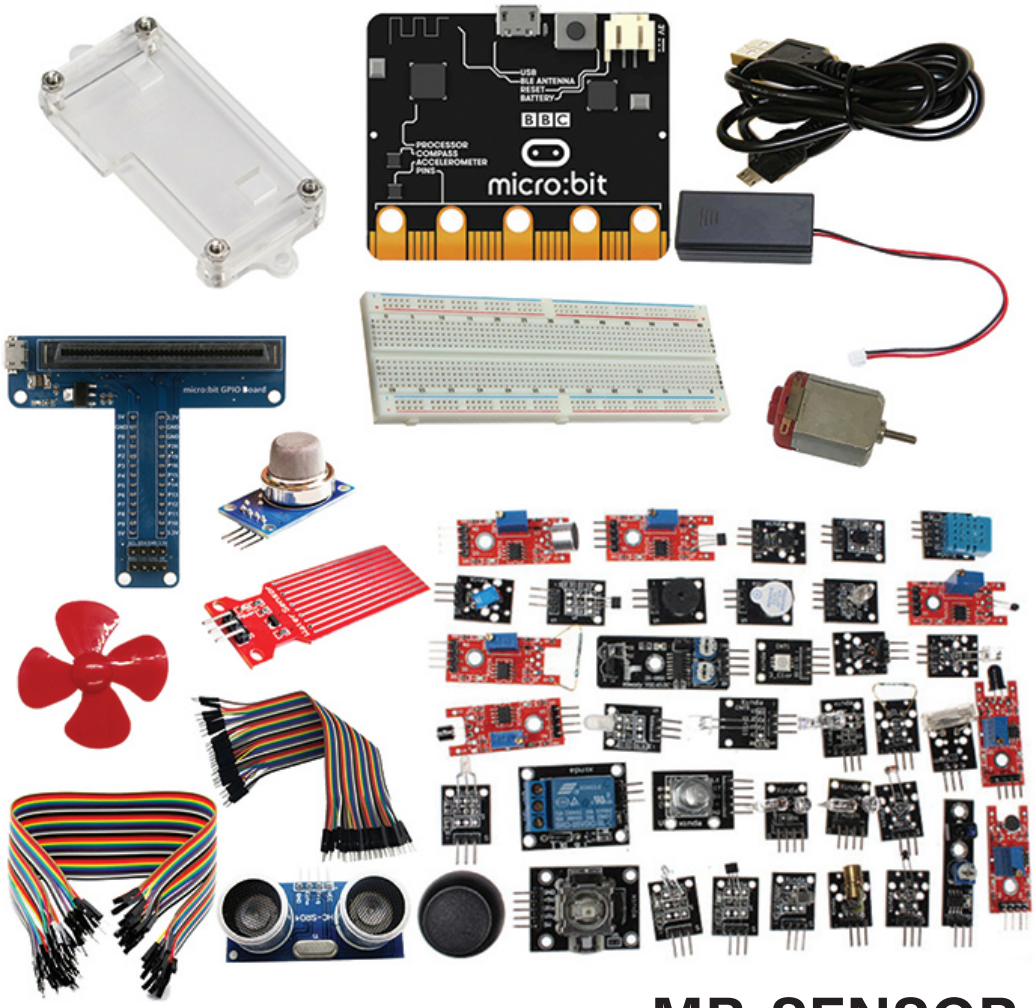
BBC micro:bit

ABRA ÉLECTRONIQUES • ELECTONICS CORP.

micro:bit Sensor Kit



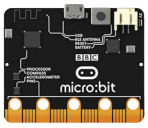
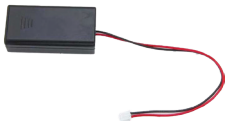
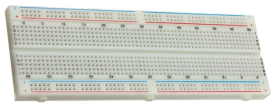
MB-SENSOR-KIT

Table of Contents

Introduction

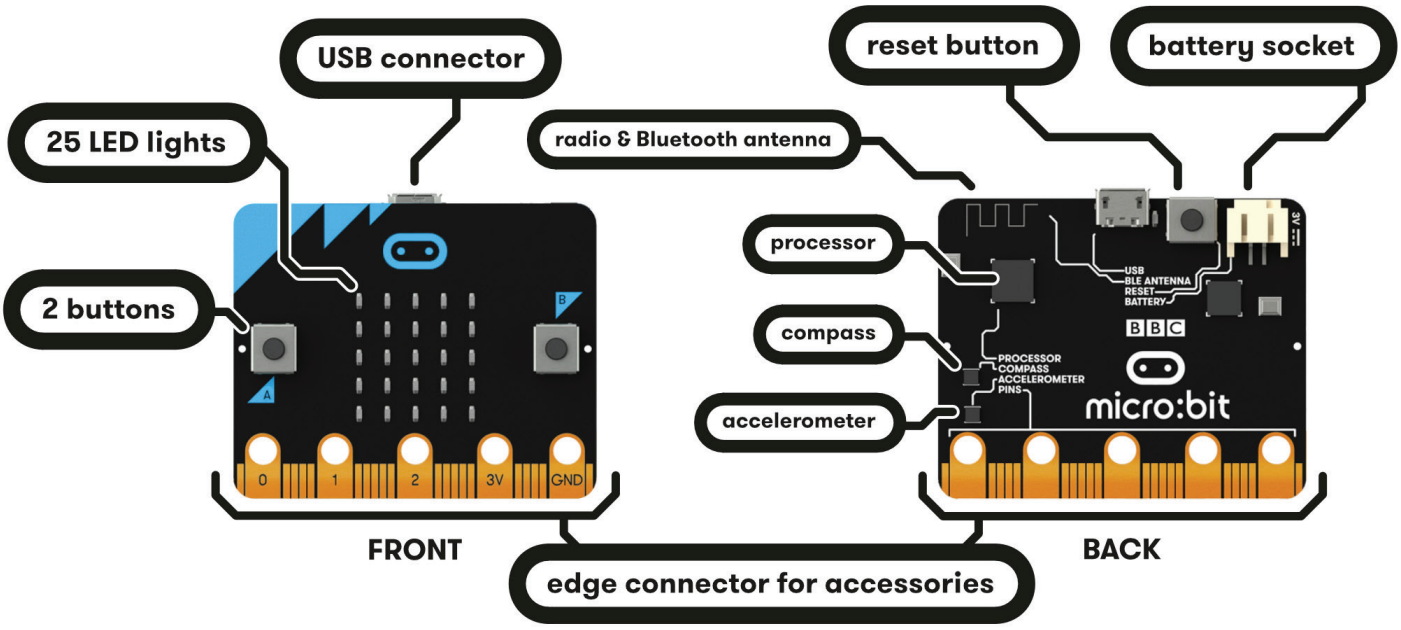
The micro:bit is a powerful hand-held, fully programmable, ARM-based computer designed by BBC. It is only half the size of a credit card, and is suitable for children's programming education. This board consists of a Bluetooth module, accelerometer, compass, three buttons, 5 x 5 LED matrix, USB interface and I/O pins.
To help you gain better knowledge on how to use the micro:bit, we have devised the micro:bit sensor kit which includes various learning projects with wiring diagrams, source codes and more. This kits includes everything you need to get started such as a GPIO expension board which is fully compatible with the micro:bit, and many commonly used sensors.

List of Components

Component	QTY	Part Number	Image
micro:bit	1	MICROBIT	
USB-A to Micro-USB Cable	1	CAB-600-R	
2xAAA Battery Holder	1	BAT-H-2AAA	
MicroBit Protective Acrylic Case	1	MB-CASE	
micro:bit GPIO Expansion Board	1	MB-GPIO	
Breadboard	1	ABRA-12-LC	
Male-to-Male Jumper Wires	40	758-ADA	
Male-to-Female Jumper Wires	40	826-ADA	
DC Motor	1	MOT-500	
Propeller	1	MOT-PROP-L	
Sensors	40		

**AA batteries are not included

micro:bit Specifications



- Size: approx. 5 x 4cm
- Weight: 8g
- Hardware:
  - 32-bit ARM® Cortex™ M0 Microcontroller
  - A 5x5 LED matrix with 25 surface-mount red LEDs which can light up and display animated patterns, scrolling text and alphanumeric characters.
  - Two programmable buttons.
  - On-board motion detector or 3-axis digital accelerometer that can detect movement (e.g. shake, tilt or free-fall)
  - A built-in compass and 3D magnetometer to sense direction and movement in degrees as well as the presence of certain metals and magnets.
  - Bluetooth® Smart Technology used to connect the micro:bit to other micro:bits, phones, tablets, cameras and other smart devices.
  - Five Ring Input and Output (I/O) including power (PWR), ground (GND) and three I/Os to read values from sensors and control peripheral devices.
  - 20 pin edge-connectors that allow the micro:bit to be connected to other devices such as Raspberry Pi, Arduino, Galileo and Kano.
  - Micro-USB connector allows you to connect the micro:bit to your computer via a micro-USB cable, which will power the device and allow you to transmit programs onto the micro:bit.
  - System LED x 1 yellow.
  - System push button switch x 2

micro:bit Driver Installation

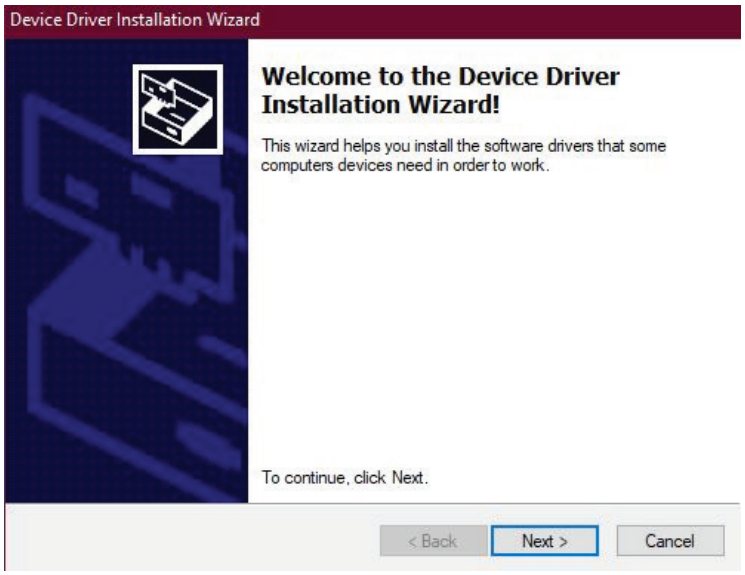
In order to connect your micro:bit to Windows, MAC, or Linux, you will need to download and install the drivers.
Please follow the easy quick start guide at https://microbit.org/guide/quick/ , for this kit you will use the MakeCode editor not the Python editor.
You may also follow the instructions below which will show you how to setup your micro:bit on a Windows PC.
Let's install the driver for micro:bit:.

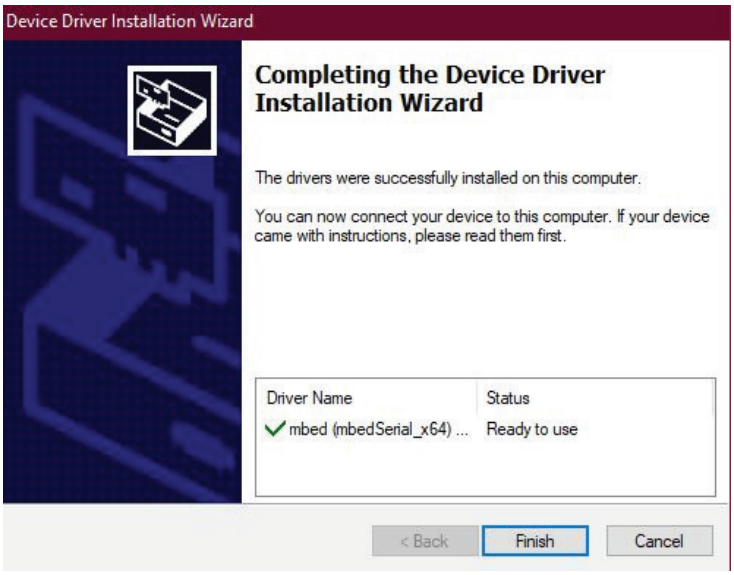
1) First connect the micro:bit to your computer using the USB cable provided in the kit.

2) Then click/copy the link below and download the driver software.

   https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

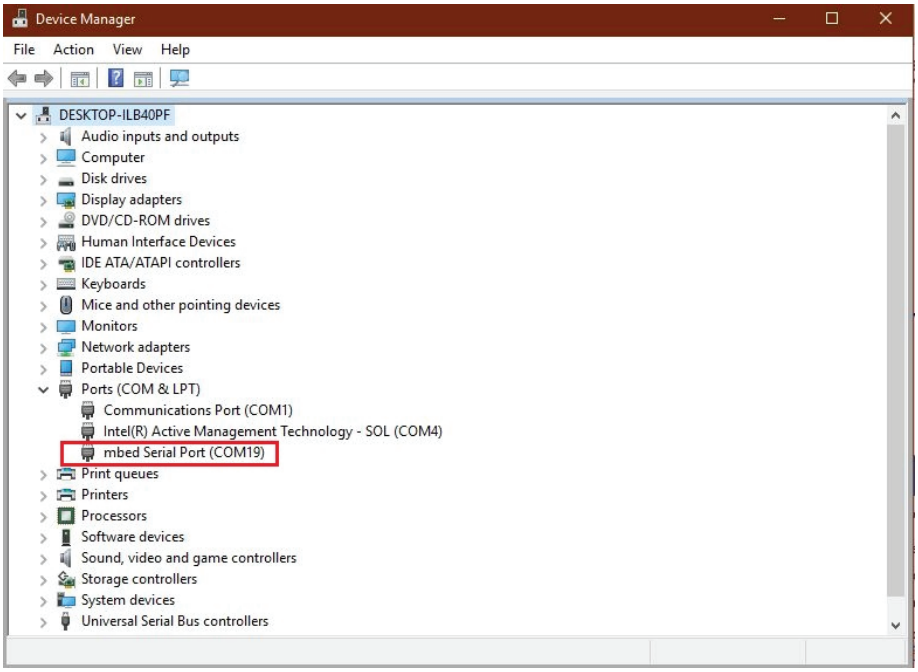
3) Install the software. (Click NEXT all the way to the end)



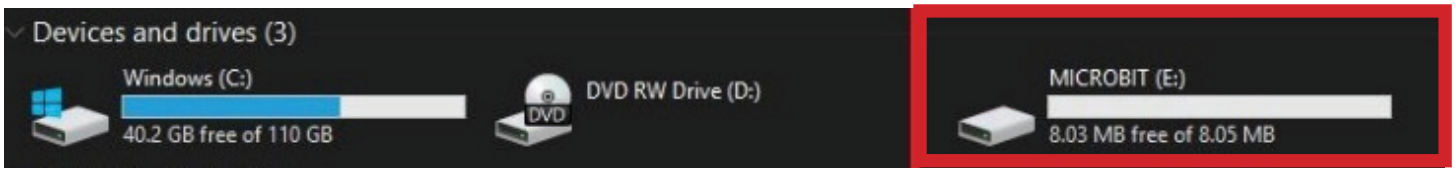


4) When the driver installation is completed, you can right click on "Computer"→ "Properties"→ "Device Manager". (You can also type "Device Manager" in the search bar on the start menu)

5) You can check the presence of the installed driver and its information as shown below.



6) Your micro:bit will show up on your computer as a drive called ‘MICROBIT’ as shown below.

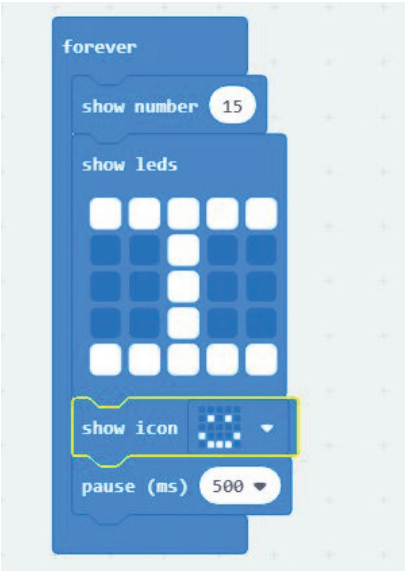


The driver installation is now complete, the micro:bit is setup on your computer.
Next you will learn how to program and do various projects.

How to Program?

Step 1: Connect the micro:bit to your computer via the micro-USB cable. Your micro:bit will show up on your computer as a drive called ‘MICROBIT’.

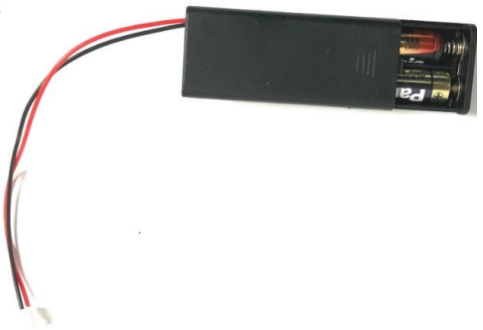
Step 2: Using Microsoft MakeCode Block Editor https://makecode.microbit.org/ , write your first micro:bit code. You can drag and drop some example blocks and try your program on the simulator in the JavaScript Block Editor, as shown below.



Step 3: Download the code block you created by clicking the download button in the editor. This will download a “hex” (.h) file, which is a compact format of your program that your micro:bit can read and execute. Here you can name the project as “TEST”, then click “Save”.

Once the hex file is downloaded, copy it to your micro:bit drive just like copying a file to a USB drive.
On Windows you can right click on the hex file and choose “Send to → MICROBIT”.

Step 4: Power-up and play. The micro:bit can be powered-up using the Micro-USB cable or two 1.5V AA batteries. Disconnect the micro:bit from the PC, insert the batteries into the provided battery holder and connect it to the micro:bit. It will start executing the program you created



Please note: Running the micro:bit on two AA batteries will provide sufficient power when your project only contains the micro:bit itself and not any external peripherals.

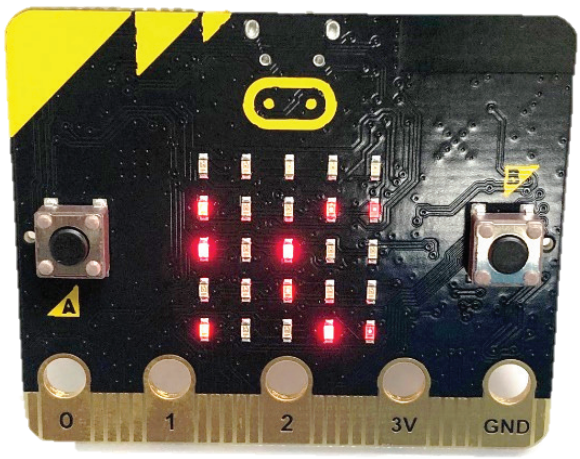
The GPIO extension has an onboard AMS1117 linear voltage regulator that converts any given DC voltage up to 15V to 5V. In order to provide enough current/amperage to the micro:bit as well as the sensor modules, an external DC power supply that provides 9-12V might be needed.

Project 1: Hello World!

Let's start with a basic example of displaying Hello world! On the 5x5 LED matrix.

Go to https://makecode.microbit.org/ and click on "New Project".

The picture below is the "Hello World!" code. You can either copy it from the picture or head over to our GitHub to access the hex files (https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT). We have provided different hex example files on our GitHub. After downloading the hex file to your PC from MakeCode or GitHub, you can copy and paste the completed file to the micro:bit drive as guided in the previous page. For more information on coding, please refer to https://makecode.microbit.org/reference.



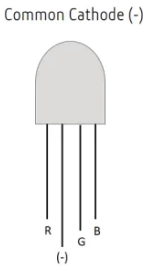
Project 2: RGB LED

In this project, you will use the RGB LED module and the micro:bit to control the colors on the LED (i.e. Red, Green and Blue).

Components Required

- 1 x micro:bit
- 1 x T-type GPIO Expansion Board
- 1 x Micro-USB Cable
- 1 x RGB LED Module
- 1 x Breadboard
- 3 x Male-to-Male Jumper Wires

RGB Led Module



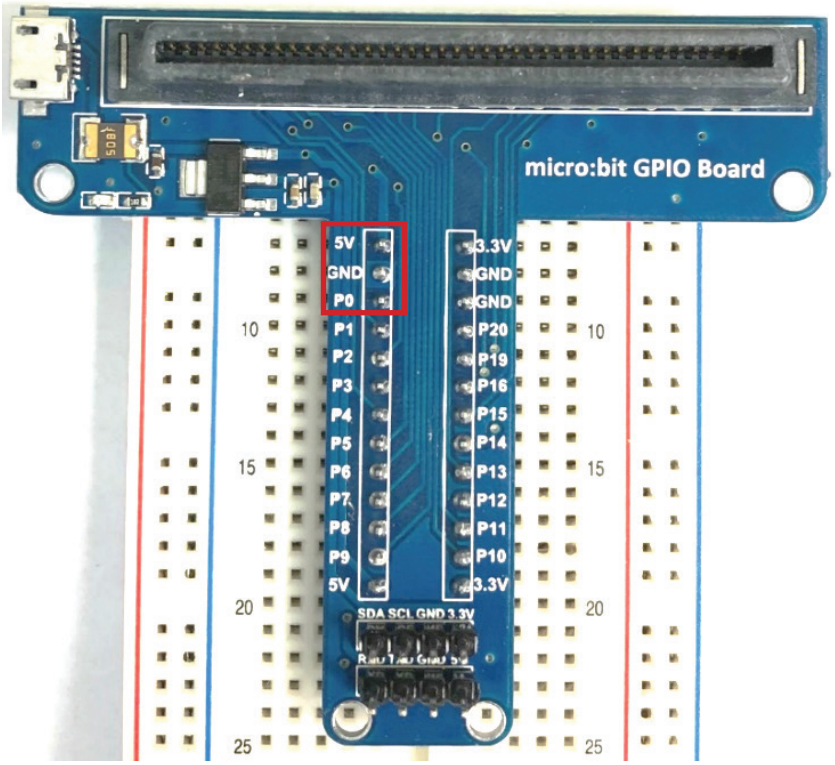
RGB comes from the initials of three additive primary colors, Red, Green, and Blue. RGB LEDs are like 3 regular LEDs in one, using them is not much different. They come mostly in two variations: common anode or common cathode. The longer lead/pin of a common anode LED is connected to " + ", while a common cathode has it's longer lead/pin grounded. This module uses a super bright common cathode RGB LED.

Specifications

- Light Color: Red, Green and blue
- Operating Voltage: 5VDC

Connections

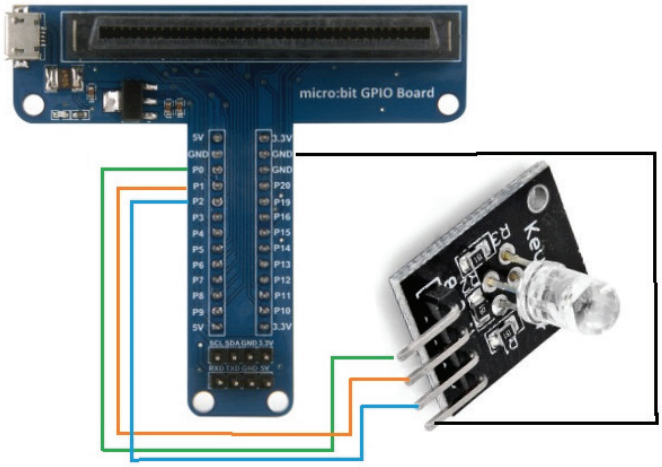
The T-type GPIO expansion board (shield) is an very useful for micro:bit wiring. It breaks out the input/output ports and power sources for connecting sensor modules. This board should be placed on the uppermost section of the provided breadboard. You can power the shield through the micro-USB connector on the micro:bit, or the GPIO expansion board by using the provided micro-USB cable, or you can use the extended 5V and ground pins as shown below.



Now let's connect the RGB LED module as shown in the figure below

Important Note

Place the micro:bit as shown below with the 5x5 LED matrix facing down towards the GPIO expansion pins.



Pin connections

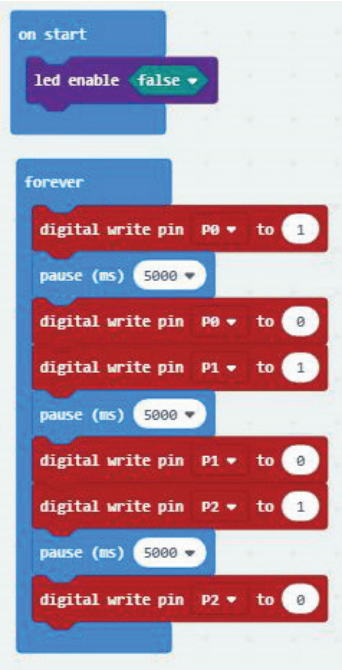
GPIO Board	LED Module
P0	R
P1	G
P2	B
GND	GND

Code

Follow the picture below to write the code then download the hex file. For your convenience, we included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

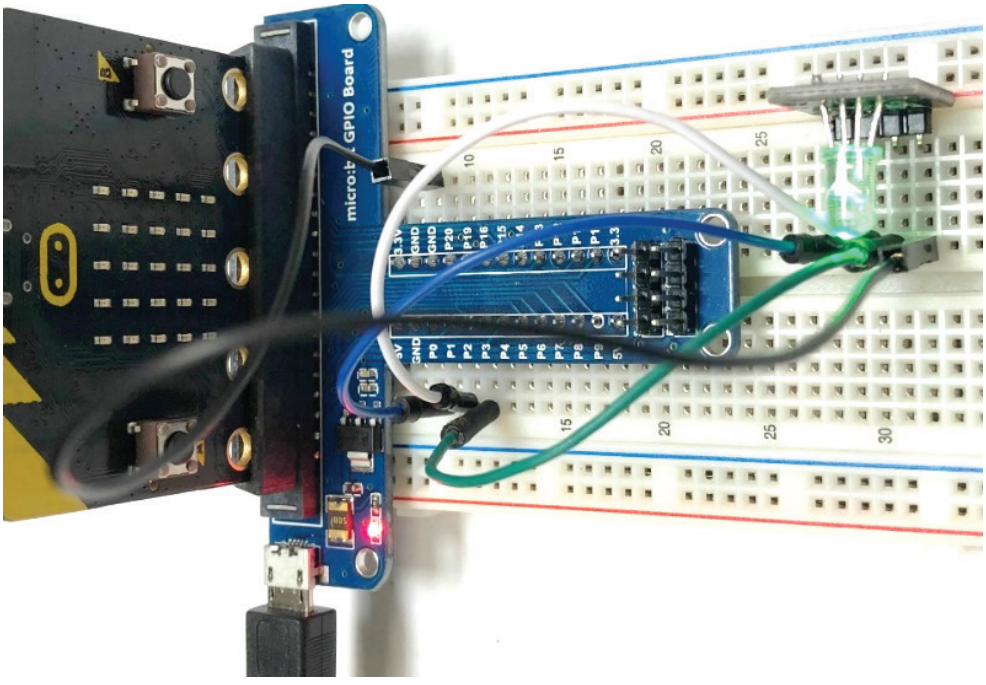
GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-LED-Blink.hex



Results

After adding the hex file to your micro:bit, you should see the color change in the RGB LED module. The delay (pause) is set to 5 seconds by default, although it can be changed by the code.



Project 3: Tilt Sensor Control

The tilt sensor is used for measuring the tilt angle of an object. In certain projects, you need to measure whether the object is level or not.

Components Required

- 1 x micro:bit
- 1 x T-Type GPIO Expansion Board
- 1 x Micro-USB Cable
- 1 x Tilt Sensor Module
- 1 x Breadboard
- 3 x Male-to-Male Jumper Wires

Tilt Sensor

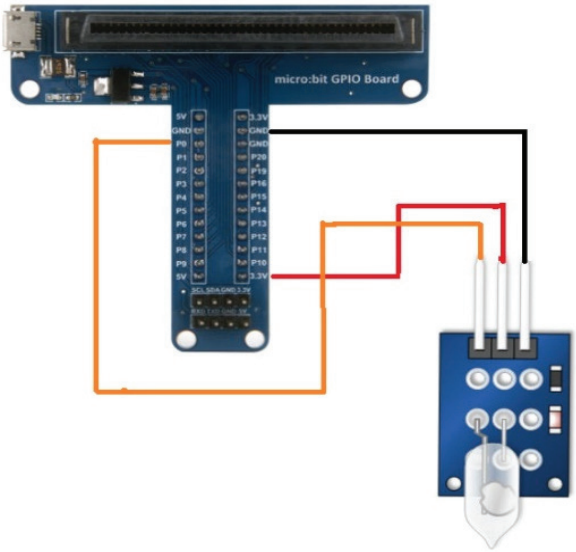
Tilt sensors measure the tilting position with reference to gravity and are used in numerous applications. They enable the easy detection of orientation or inclination. Like mercury switches, they may also be known as tilt switches or rolling ball sensors. When the ball in the tilt switch runs from one end to the other end, the tilt switch will conduct, and create a digital signal or it will break. Depending on this action, the digital value is at the output is recognized by the sensor and a set action will take place accordingly.

Specifications

- Operating Voltage: 3.3 - 5VDC
- Signal Interface: Digital

Connections

GPIO	Sensor
P0	S
3.3V	+
GND	GND

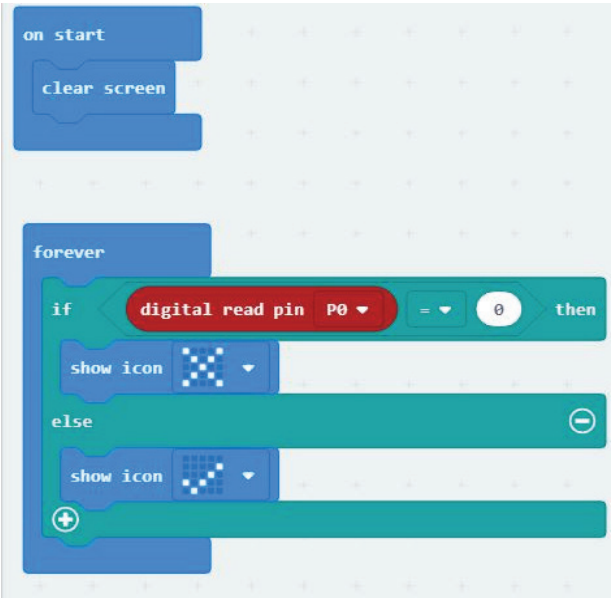


Code

Follow the picture below to write the code then download the hex file. For your convenience, we included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

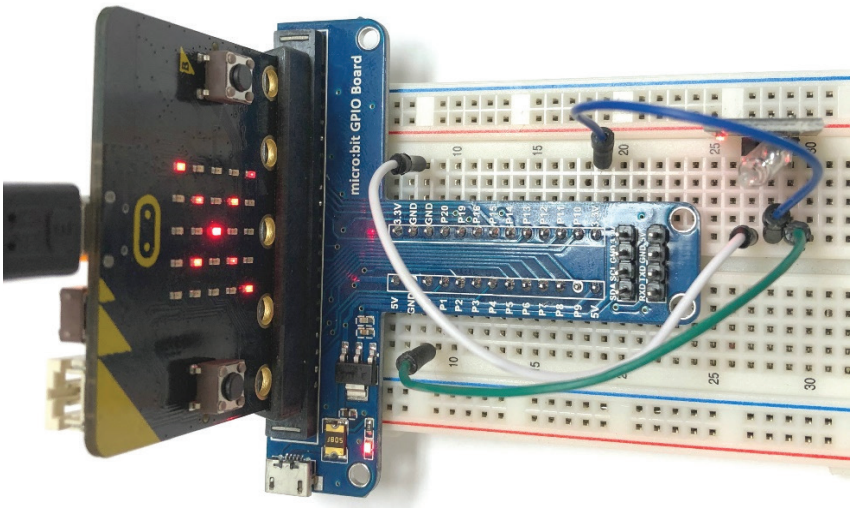
GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-Tilt-sensor.hex



Results

When the module senses no tilt, it sets the signal pin (the orange wire in the previous page's figure) that is connected to GPIO P0 to LOW or OFF. At this time you should see an X glowing on the micro:bit. If you tilt your breadboard by a few degrees the sensor triggers to HIGH or ON state, you should see a checkmark on the micro:bit's LED matrix.



Project 4: Obstacle Avoidance Using IR Sensor

You have perhaps seen a smart robot that can automatically avoid an obstacle ahead. In this project, you will use an Infrared (IR) module as an obstacle avoidance sensor combined with micro:bit to detect an object ahead.

Components Required

- 1 x micro:bit
- 1 x T-Type GPIO expansion board
- 1 x Micro-USB Cable
- 1 x IR Sensor
- 3 x Male-to-Male Jumper wires
- 1 x Breadboard

IR Sensor

The infrared obstacle detector sensor is a distance adjustable module. It has a pair of infrared transmitting and receiving LEDs. The transmitter emits an infrared ray of a certain frequency. When the infrared signal transmission direction encounters an obstacle, the infrared rays are reflected towards the receiving tube. At this time, the signal terminal outputs a LOW-level signal (i.e. 0 Volts DC). This change in voltage should be seen by the micro:bit in order to take pre-defined action. This action should be defined when you write your code for the micro:bit.

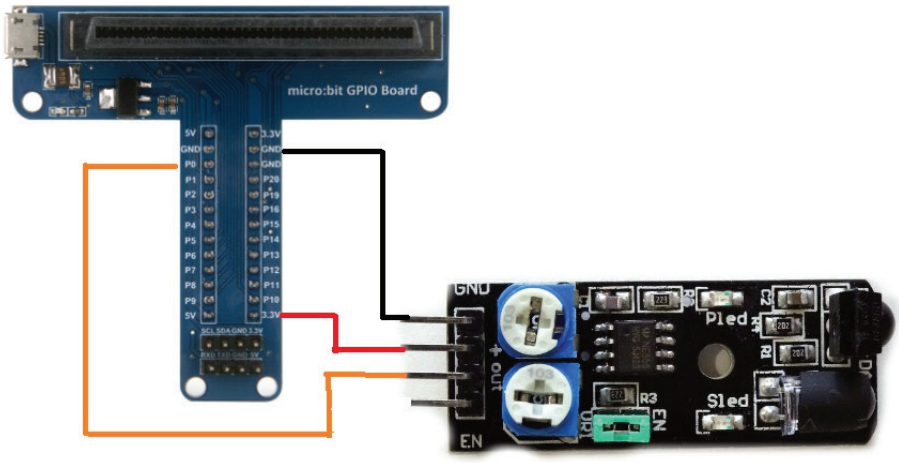
If no obstacle is detected, the emitted infrared ray is weakened as it travels a further and eventually disappears; thus, the receiving LED will not sense a reflection. At this time, the signal terminal outputs a HIGH-level signal (i.e. 3-5Volts DC). This signal should be seen by the micro:bit as a non-critical state meaning that no obstacle is found and therefore no counteraction is needed. The potentiometers/variable resistors on the IR module are used for changing the detection distance and sensitivity. The effective distance is around 2 to 40cm.

Specifications

- Working Voltage: 3.3 - 5VDC
- Working current: 20mA
- Working temperature: -10 - 50°C
- Detection distance: 2-40cm

Connections

GPIO	SENSOR
GND	GND
3.3V	+
P0	OUT
Not in use	EN



Code

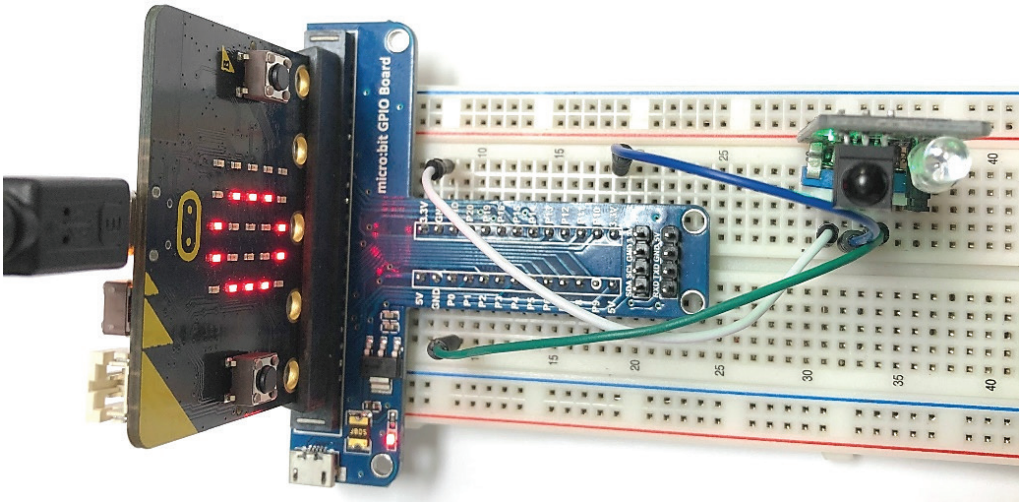
Follow included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-Obstacle-Avoidance.hex

Results

Adjust the potentiometer for the transmitter and the receiver sensitivity to your liking for better results. When an obstacle is detected, “1” is displayed on the micro:bit LED and when it’s not, it shows 0.



Project 5: Magnetic Switch

In this project, you are going to use the reed switch and the micro:bit provided in the sensor kit.

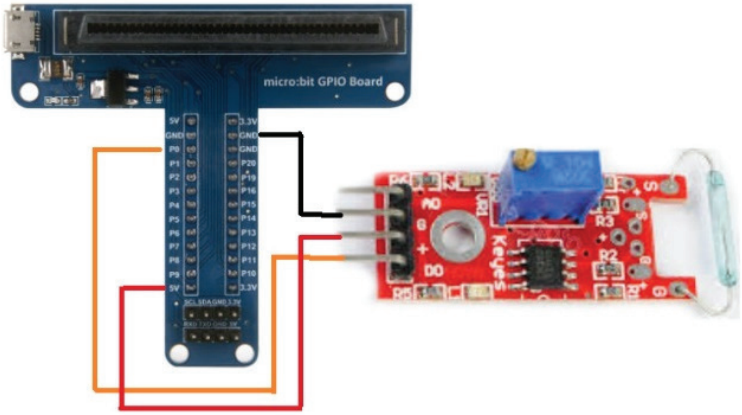
Components Required

- 1x micro:bit
- 1 x Micro-USB Cable
- 1 x T-Type GPIO Expansion Board
- 1 x Reed Switch Module
- 3 x Male-to-Male Jumper Wires
- 1 x Breadboard

Reed Switch

Reed switch is an electrical switch operated by an applied magnetic field. The name “reed” is the metal part inside the switch envelope casing that is relatively thin and wide. It’s working principle is that the magnetic field magnetizes the reed, so that it can be turned ON and OFF to create a switching effect. However, since it is a contact type switch it’s lifespan is limited and can be easily to be damaged during a long constant repeative usage.

Reed switch has been widely applied in household appliances, cars, communication, industry, healthcare and security areas. Furthermore, it can also be applied to other sensors and electric devices such as liquid meter, door magnet, reed relay and more.

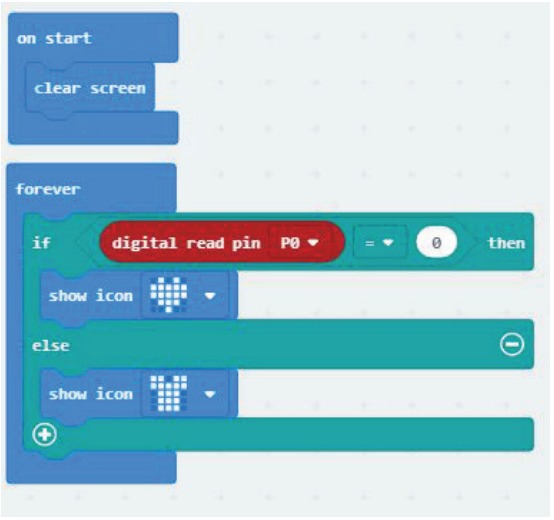


Connections

GPIO	Reed Switch module
5V	+
GND	GND
P0	D0

Code

Follow the picture below to write the code then download the hex file. For your convenience, we included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

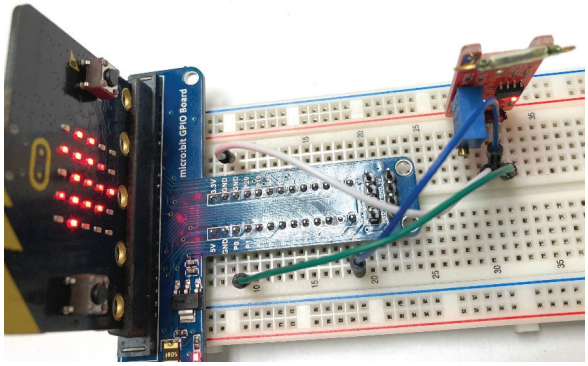


GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-Magnetic-Switch.hex

Results

When a magnetic field is detected near to the sensor, you can see a heart-shaped figure on the micro:bit. When there is no magnetic field near the reed switch a T-shirt is shown on the micro:bit’s LED matrix.



Project 6: Relay Switch

Every day in life, we use the 110V AC mains to power our household electrical appliances. Usually, these appliances have a switch so that we can control their operation. To avoid the possible dangers of working with the high voltage AC mains, relays are used as an intermediary device that act as a switch. They are controlled using a safe voltage via a relay controller circuit. It is possible to program the relay circuit to cut the power from critical devices in case of a surge or brownout.
In this project, you will learn how to use a relay switch module with the micro:bit to turn an LED module ON and OFF.
Note: This project simulates the usage of a relay module to demonstrate real-world applications.

Components Required

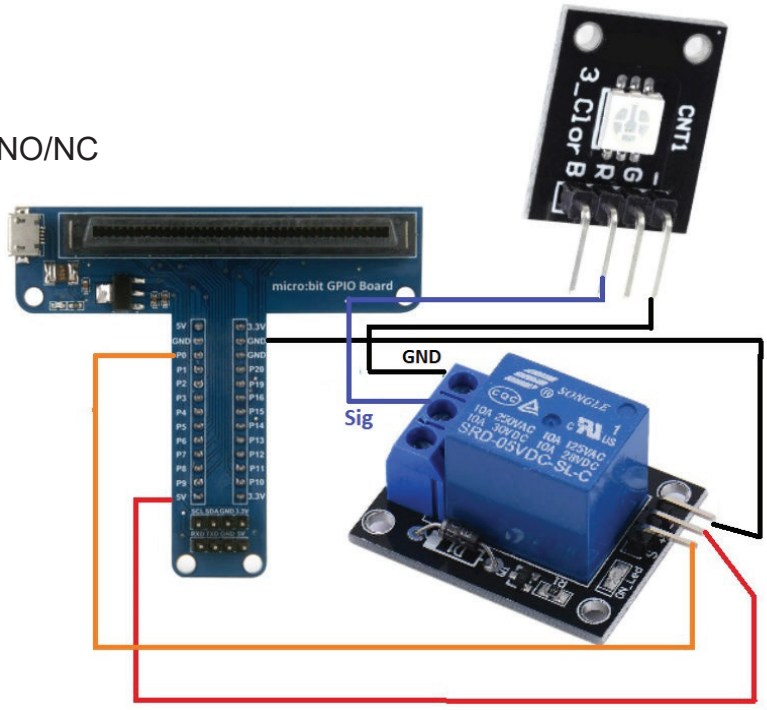
- 1 x micro:bit
- 1 x Micro-USB Cable
- 1 x T-Type GPIO Expansion board
- 1 x Relay Switch
- 3 x Male-to-Male Jumper Wires
- 1 x Breadboard

Relay Module

A relay is an electrically operated switch that can be turned ON or OFF, allowing or preventing the current to flow through, and can be controlled with low voltages such as the 3.3V provided by the micro:bit GPIO pins. Controlling a relay module with the micro:bit is as simple as controlling any other output. This module uses a high quality SONGLE 5V relay. When a 0 Volt signal is supplied to the S pin, the relay is open and the device is connected to the relay's output will also be OFF. By supplying a 5VDC signal to the relay, it closes the circuit and turns on the device. This is the old fashion way of controlling high voltage devices. Although, now with developments in the electronics industry, MOSFETs are used to control high voltage devices.

Specifications

- Supply Voltage: 5VDC
- Supply Current: 150mA MAX
- Rated Load: 10A 250VAC
- Configuration: Single pull, single throw, NO/NC contacts
- Operating temperature: -30 - 70°C



Connections

GPIO	Relay Module	LED Module
5V	+	N/A
GND	-	N/A
P0	S	N/A
	Sig	R or G or B
	GND	-

Code

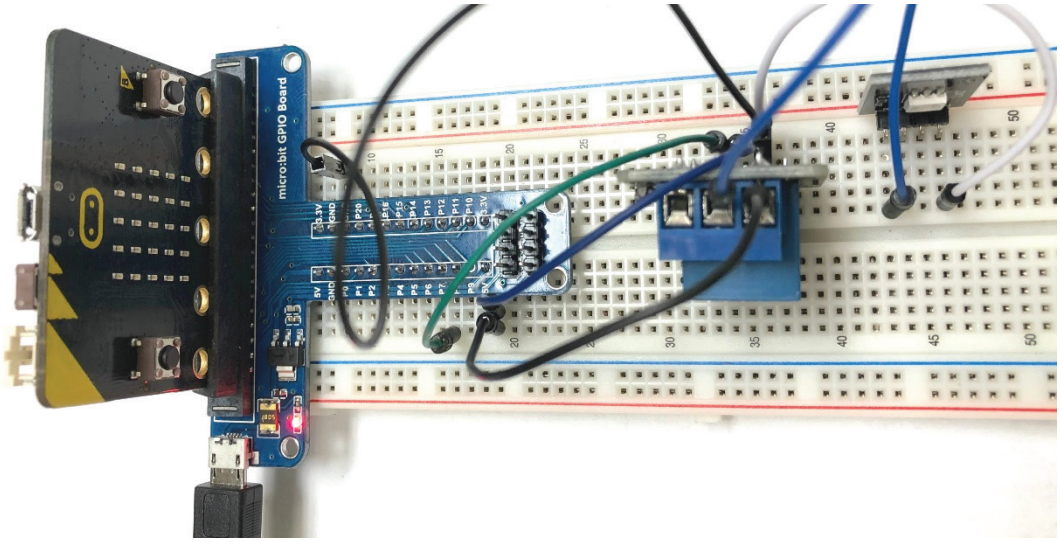
Follow the picture below to write the code then download the hex file. For your convenience, we included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-Relay.hex

Results

The code provided above opens and closes the relay every 1-2 seconds in order to turn the LED ON and OFF. You can observe the SMD LED is switching ON and OFF.



Project 7: Ultrasonic Sensor

Ultrasonic sensor are great for all kind of projects that need distance measurement. In this project you will learn how to use an ultrasonic module with your micro:bit to detect the distance between the module and an obstacle ahead.

Components Required

- 1 x micro:bit
- 1 x T-Type GPIO Expansion Board
- 1 x Micro-USB Cable
- 1 x Ultrasonic Sensor Module
- 3 x Male-to-Male Jumper Wires
- 1 x Breadboard

Ultrasonic Sensor

The ultrasonic detector module HC-SR04 can provide 2 to 450cm non-contact measurement distance, and its accuracy is up to 3mm. It includes an ultrasonic transmitter, receiver and control unit. This module emits ultrasonic waves upon receiving an active high trigger signal. When the ultrasonic waves encounter an object and reflect, the module outputs an echo signal. The distance is determined by the time difference between the trigger signal and the echo signal

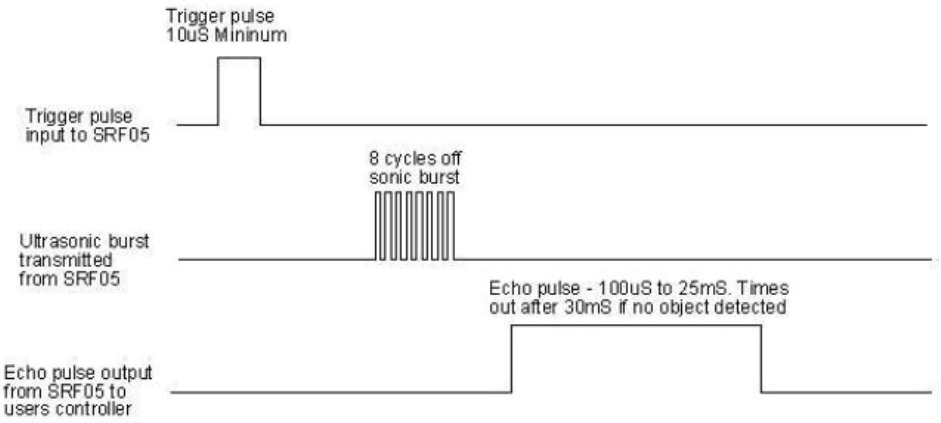
Sensor Handling Procedure

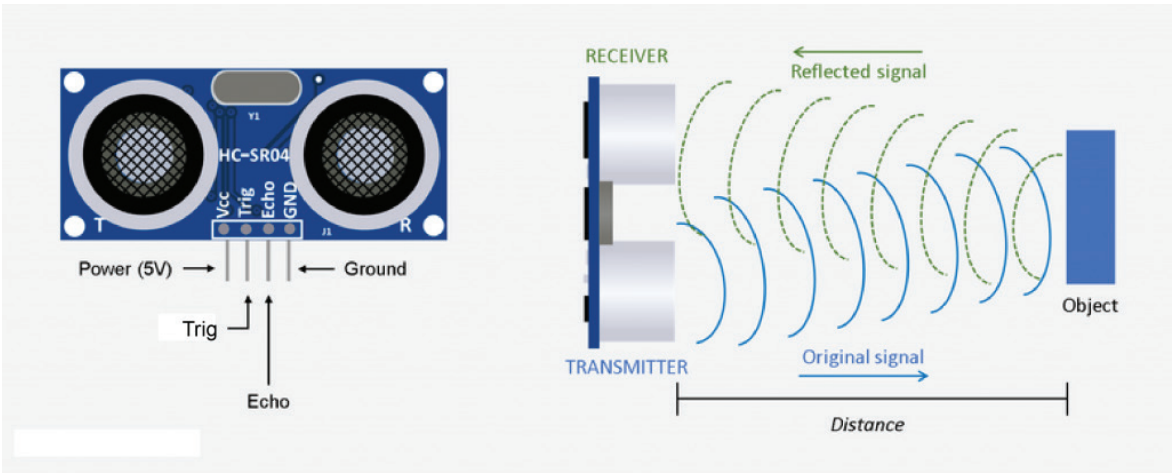
1. Keep the trigger signal (Trig) low upon initialization, then send a 10μS high-level signal to the sensor to start measuring.
2. The triggered sensor will send a burst of 40KHz ultrasonic waves. Meanwhile the micro:bit should wait for an echo signal is usually generated within microseconds after the ultrasonic waves are transmitted. If there is no reflection towards the receiver, the echo pin will have a long 30mS pulse otherwise when an obstacle is detected, the echo pulse will last for 100μS to 25mS depending on the distance.

Distance (m) = Echo Pulse Duration (S) X Velocity of Sound(340m/S) X 0.5

Specifications

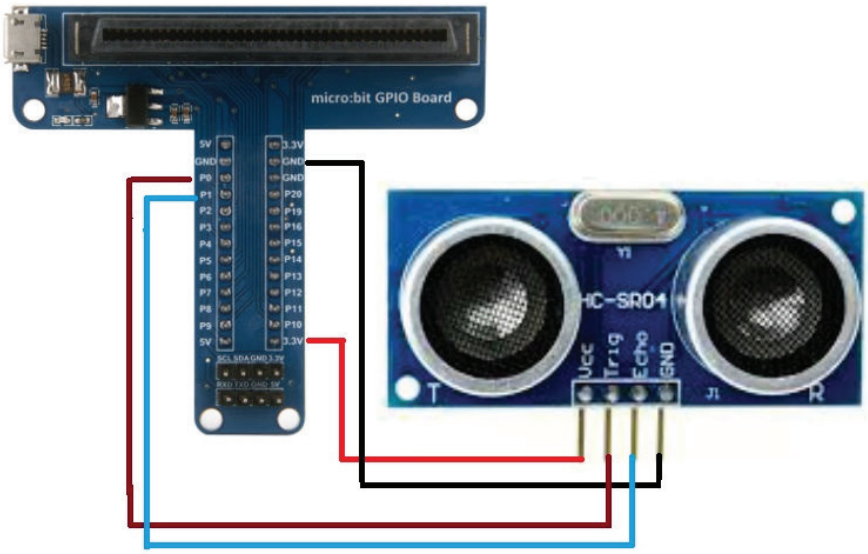
- Operating Voltage: 5VDC
- Operating Current: 15mA
- Detection Range: 2 - 450cm
- Detecting Angle: 15 degrees





Connections

GPIO	Ultrasonic Sensor Module
VCC	3.3V
P0	Trig
P1	Echo
GND	GND

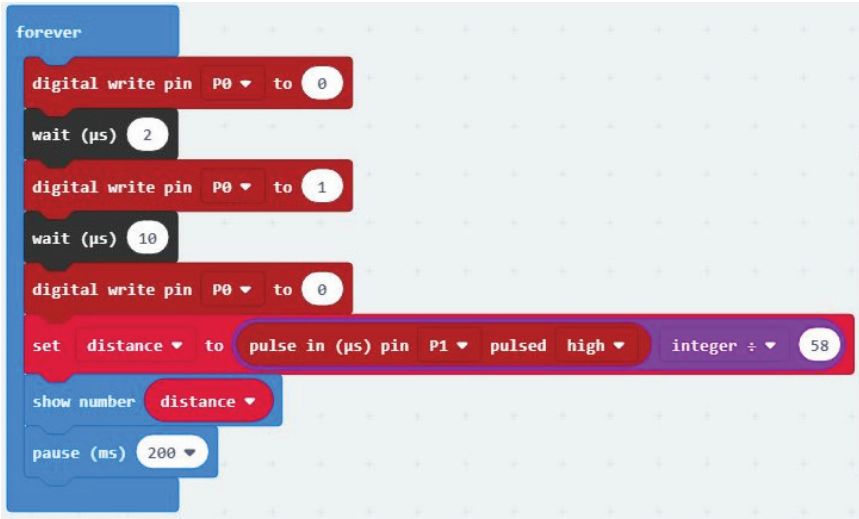


Code

Follow the picture below to write the code then download the hex file. For your convenience, we included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

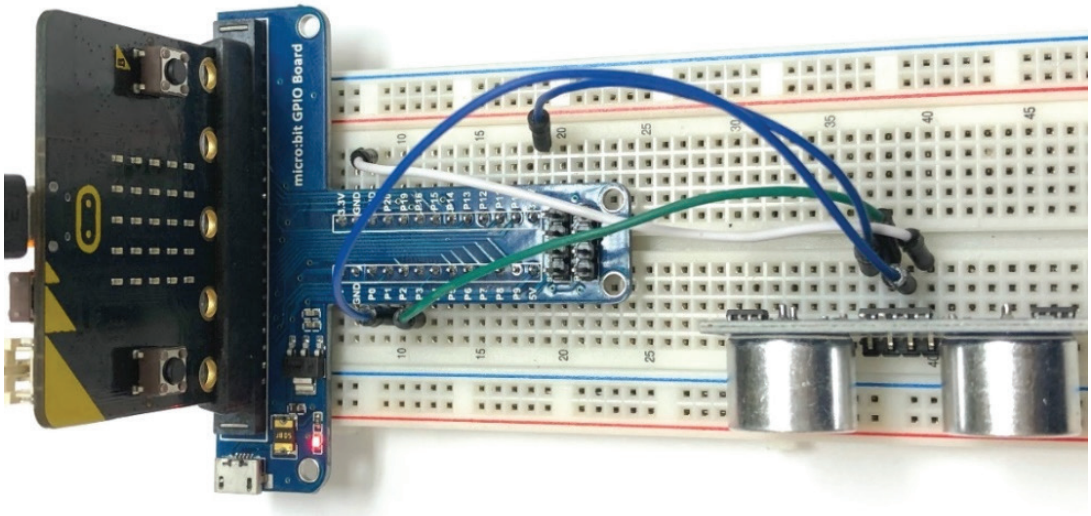
GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-ultrasonic-sensor.hex



Results

The calculated distance should be displayed on the micro:bit's LED matrix. Try experimenting by putting objects at different distances from the sensor.



Project 8: Analog Temperature Sensor

This project you will learn how to use an analog temperature sensor module with your micro:bit. The wiring is straight forward and the programming is easy to understand.

Components Required

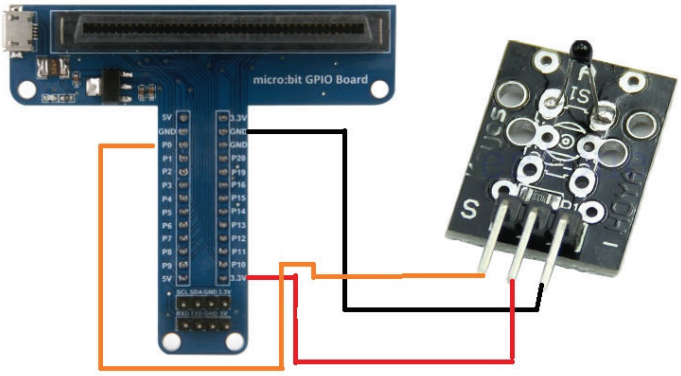
- 1 x micro:bit
- 1 x T-Type GPIO Expansion Board
- 1 x Micro-USB Cable
- 1 x Analog Temperature Sensor Module
- 3 x Male-to-Male Jumper Wires
- 1 x Breadboard

Temperature Sensor

This analog temperature module is based on a thermistor whose resistance varies with temperature change. It can detect the surrounding temperature changes in real time. A variation in resistance equals a variation in the output analog voltage. The analog value is later converted to digital via programming. This sensor is convenient and effective, it is widely applied to household appliances, garden control systems, and other applications.

Specifications

- Interface Type: Analog
- Operating voltage: 3.3 - 5VDC
- Temperature Range: -55 - 315°C



Connections

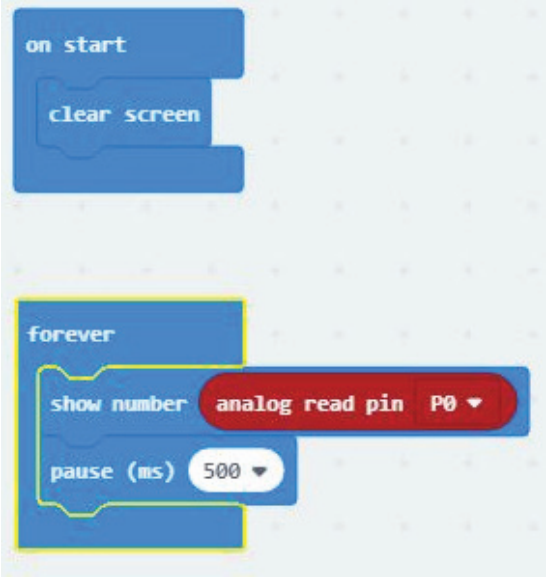
GPIO	Temperature Sensor
3.3V	+
GND	-
P0	S

Code

Follow the picture below to write the code then download the hex file. For your convenience, we included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

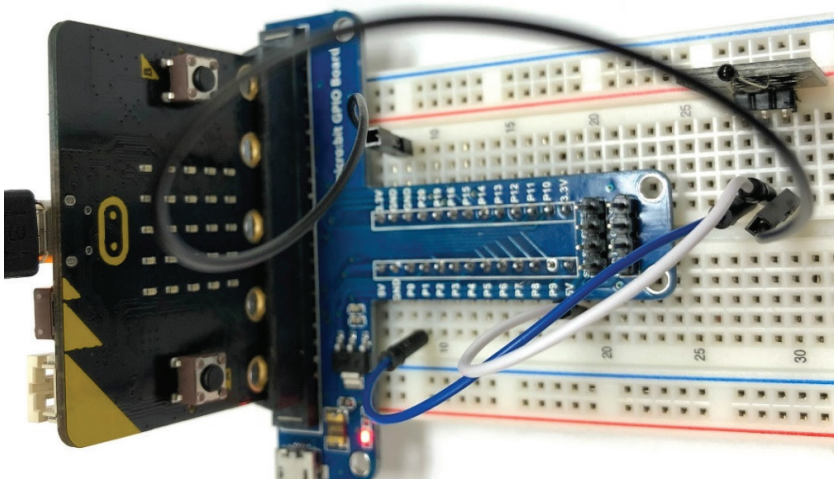
GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-Analog-Temperature.hex



Results

You can observe that the current temperature of your location which will be displayed on the micro:bit's LED matrix.



Project 9: Joystick

In this project, you will learn how to control a joystick. You can use the joystick to control a DC motor which is provided in the kit.

Components Required

- 1 x micro:bit
- 1 x T-Type GPIO Expansion Board
- 1 x Micro-USB Cable
- 1 x Joystick Module
- 3 x Male-to-Male Jumper Wires
- 1 x Breadboard

Joystick Module

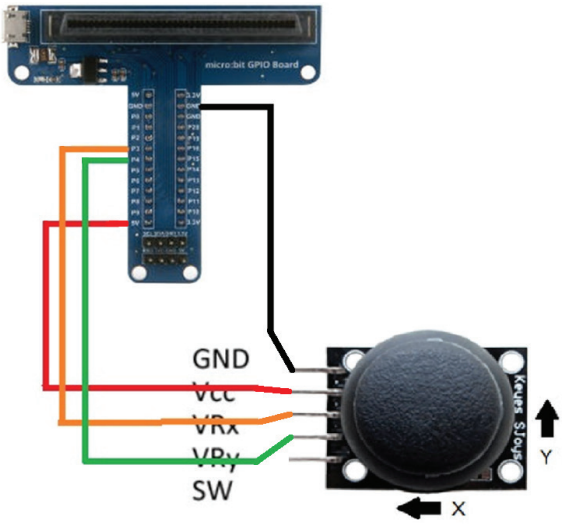
Lots of interactive projects may require a joystick. This module provides an affordable and easy to use solution. On the joystick module, there are 2 signal terminals VRx and VRy, which can simulate the X and Y axes. Connect them to the micro:bit as shown below. By controlling the X and Y analog input values you can control the coordinate of an object in X and Y axis. This module has another signal pin (SW) which is used as a button.

Specifications

- Operating voltage: 3.3VDC
- Interface: 2x Analog, 1x Digital

Connections

GPIO	Joystick
5V	VCC
P3	VRx
P4	VRy
GND	GND

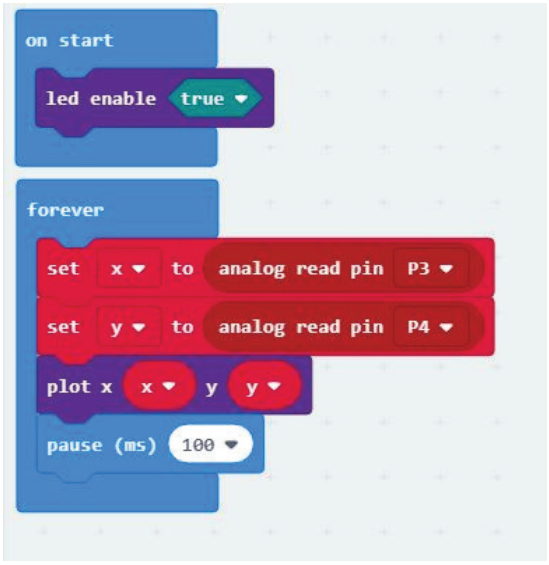


Code

Follow the picture below to write the code then download the hex file. For your convenience, we included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

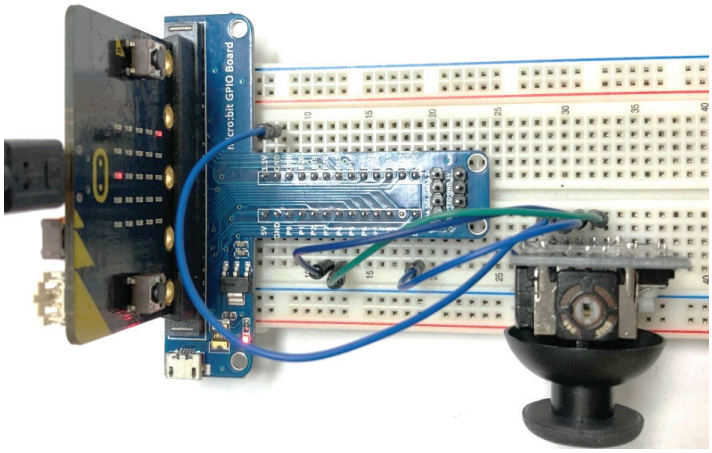
GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-Joystick.hex



Results

After uploading the code to the micro:bit, you can observe different patterns of LED lights varying to the movement of the joystick.



Project 10: Button Control

When designing a circuit, buttons and switches are the most commonly used components. The micro:bit main board has two built-in tactile buttons. However, sometimes you may still need to use external buttons. In this project, you will learn how to use a button module to control the LED matrix of your micro:bit.

Components Required

- 1 x micro:bit
- 1 x T-Type GPIO Expansion Board
- 1 x Micro-USB Cable
- 1 x Button Module
- 3 x Male-to-Male Jumper Wires
- 1 x Breadboard

Button Module

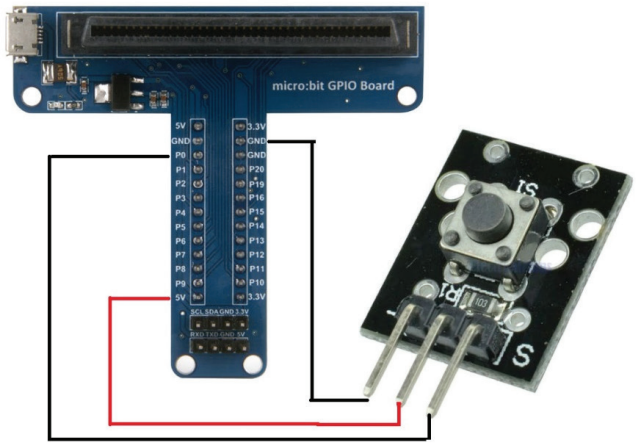
This is a basic button module. Buttons are a type of commonly used components to control electronic devices. Usually, they are used as switches to connect or disconnect circuits, or to control the operation of devices. This module integrates a push button with three connection pins.

Specifications

- Supply voltage: 3.3V to 5VDC
- Interface: Digital

Connections

GPIO	Button Module
P0	S
5V	+
GND	-

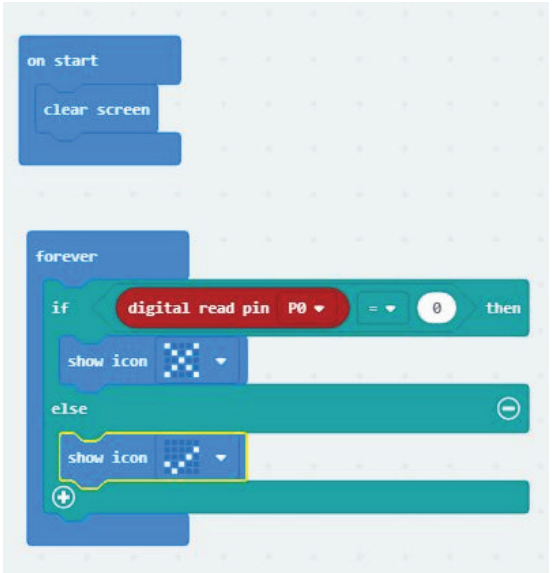


Code

Follow the picture below to write the code then download the hex file. For your convenience, we included the hex files on GitHub. Connect the micro:bit using the USB cable and add the hex file.

GitHub Link: https://github.com/abra-kits/MicroBit-Sensor-Kit-MB-SENSOR-KIT

Look for: microbit-Button-Control.hex



Results

When you press the button, a checkmark sign should be displayed, otherwise an “X” will be displayed on the LED matrix.