**Hong Kong Metropolitan University**

**Jockey Club STEAM Education Resources Sharing Scheme**

**Locating in Darkness**

What is sound?

* Sound is a form of wave.
* A sound wave consists of vibrating particles (振動粒子).
* The vibration propagates as an acoustic wave (聲波) through a transmission medium (傳輸介質), such as air.

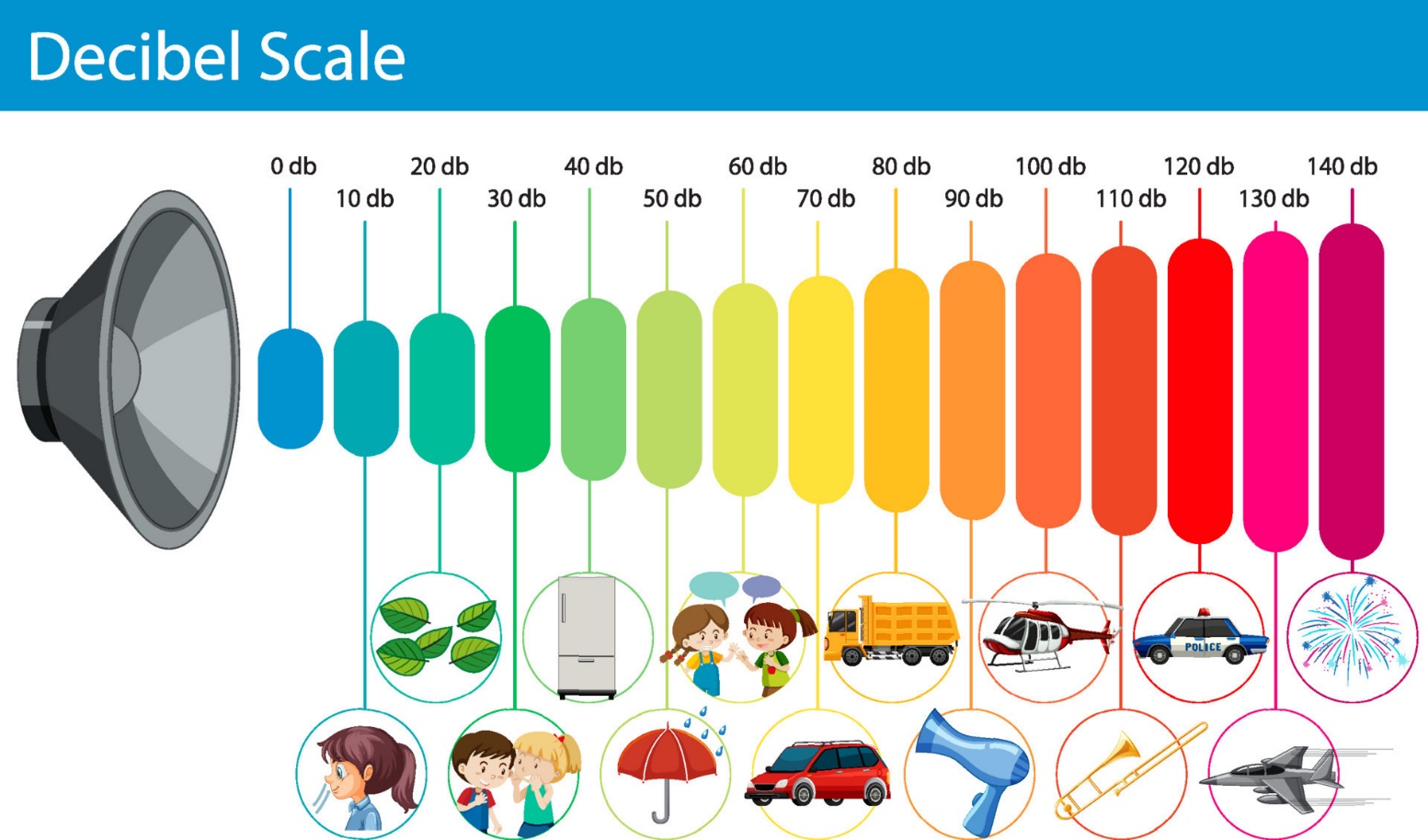
Loudness (響度) of sound

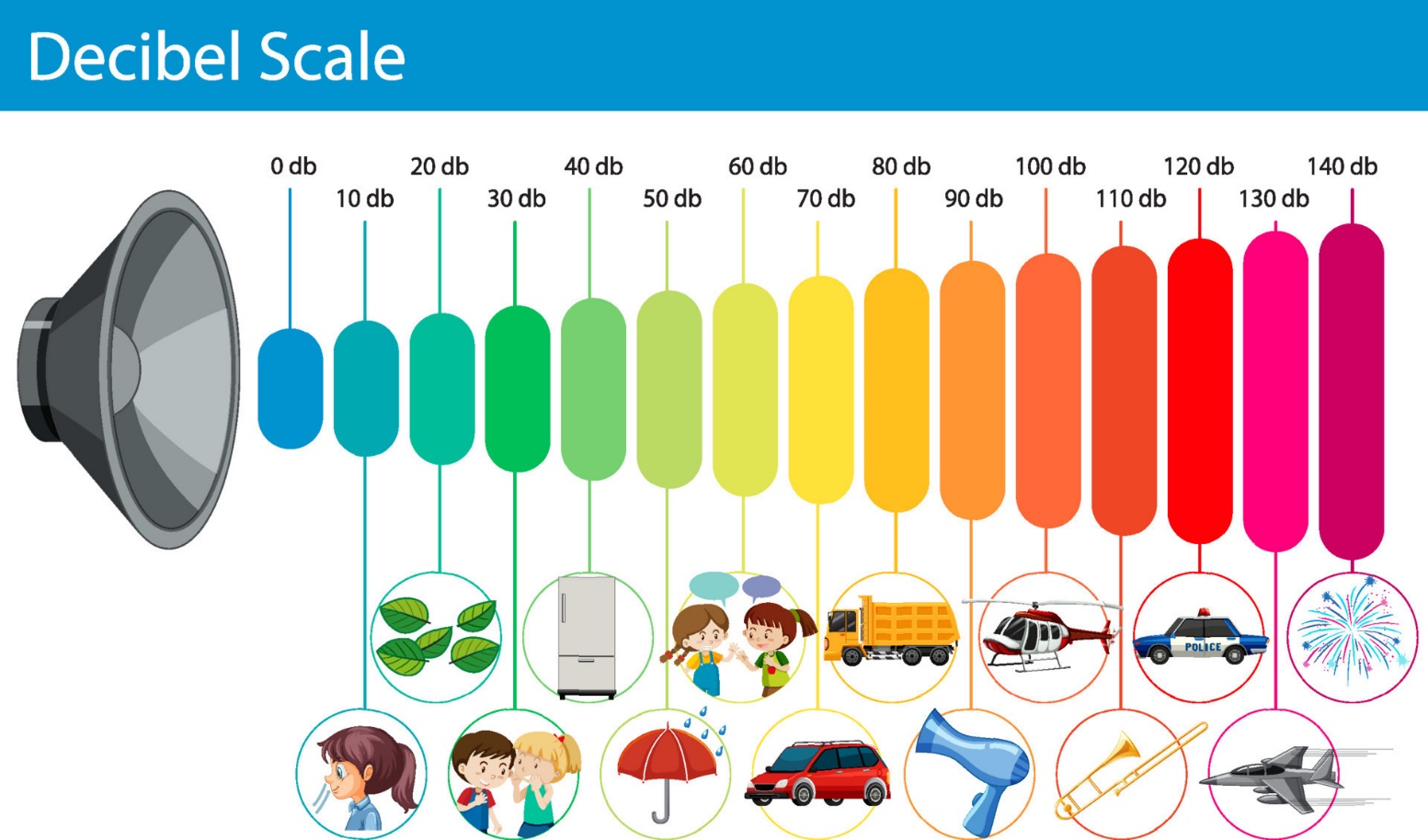
* The loudness of sound is measured as sound intensity level (聲強級).
* Unit of sound intensity level: decibel (dB) (分貝).
* Match the activities and the sound intensity levels:

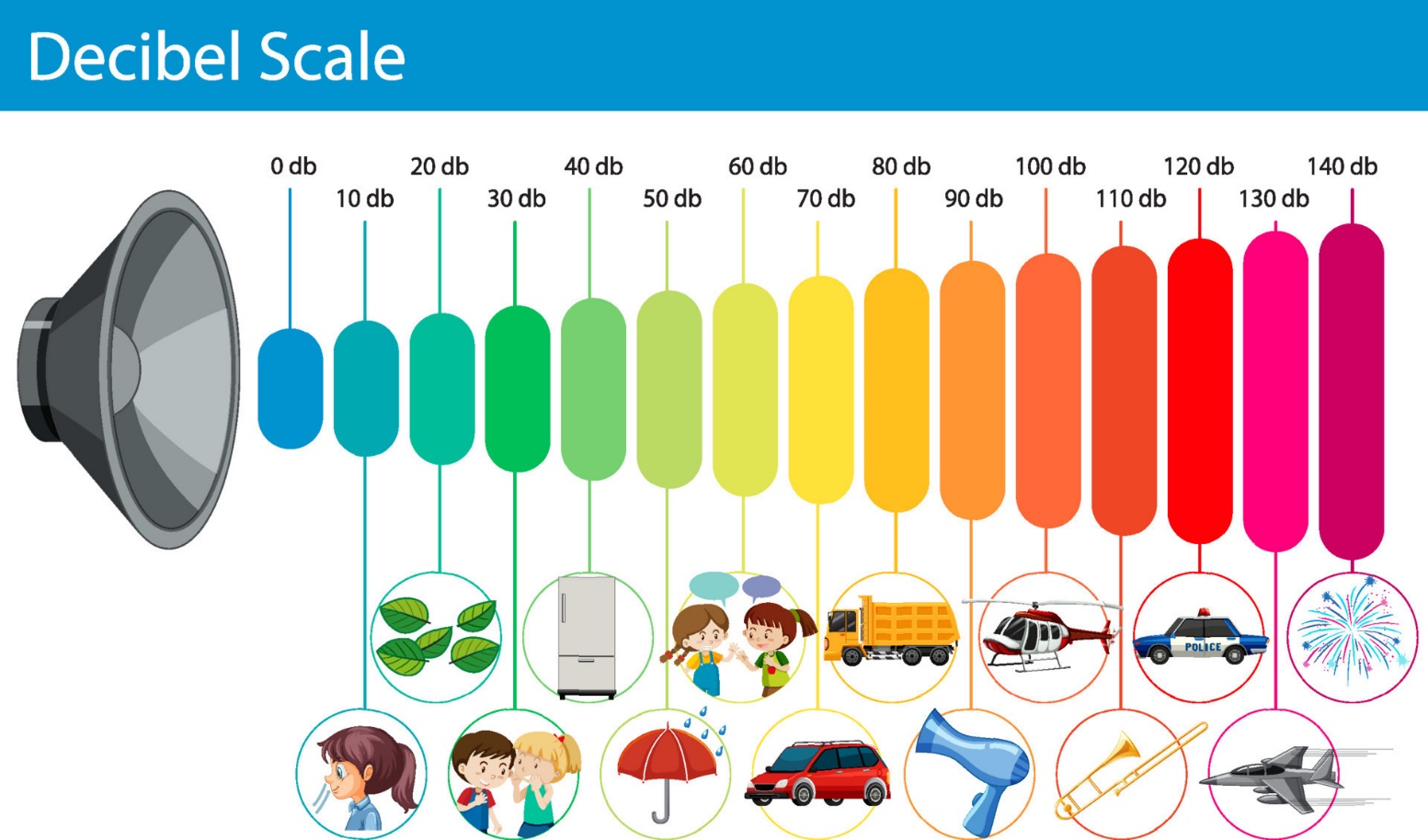
60 dB

120 dB

80 dB







* Normally, when the sound intensity level exceeds \_\_\_\_\_\_\_\_\_\_\_\_\_ dB, human ears will feel pain.
* When the sound intensity level reaches 160 dB, human ears may suffer from instant perforation of the eardrum (鼓膜瞬間穿孔).

Pitch (音高/音調) of sound

* Sound with a higher pitch (高音調) means the sound wave has a higher frequency (高頻率).
* Unit of frequency: Hertz (Hz) (赫茲/赫)
* My own range of hearing frequencies (聽覺頻率):

From \_\_\_\_\_\_\_\_\_\_ Hz to \_\_\_\_\_\_\_\_\_\_ Hz

* Sounds with frequencies higher than 20,000 Hz are called ultrasounds (超聲波).

Speed of sound

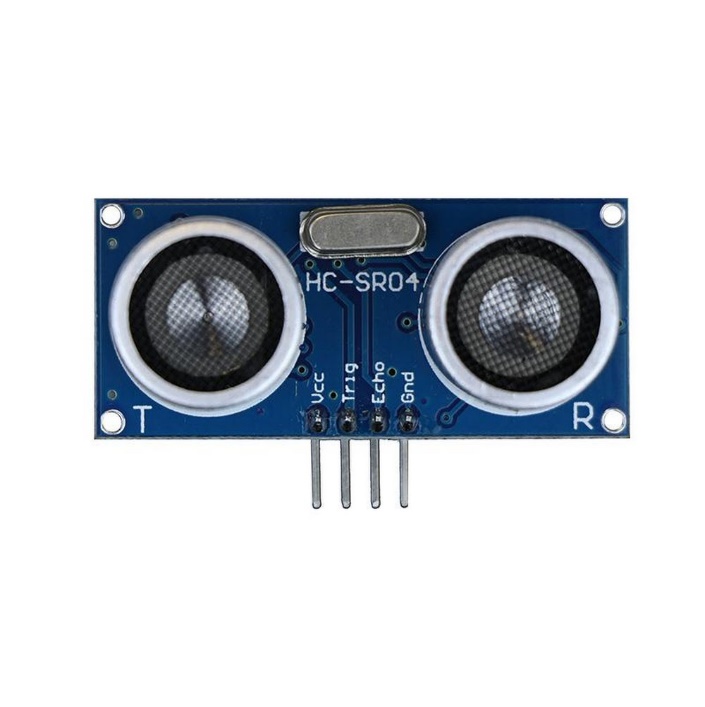
* At 20°C, the speed of sound in air is 343 metres per second.
* The speed of sound \* is / is not affected by loudness or pitch.

Sonar (聲納) and echolocation (迴聲定位)

* SONAR stands for SO\_\_\_\_\_\_\_\_\_\_ NA\_\_\_\_\_\_\_\_\_\_ and R\_\_\_\_\_\_\_\_\_\_
* Active sonar (主動聲納) and animal echolocation have similar working principles:

1. A pulse (脈衝) of a sound wave is emitted from a device / an animal.
2. The pulse reaches an object and reflects (反射).
3. The device / animal receives the echo (回聲) and senses the distance of the object.

Ultrasonic Sensor – HC-SR04



R stands for

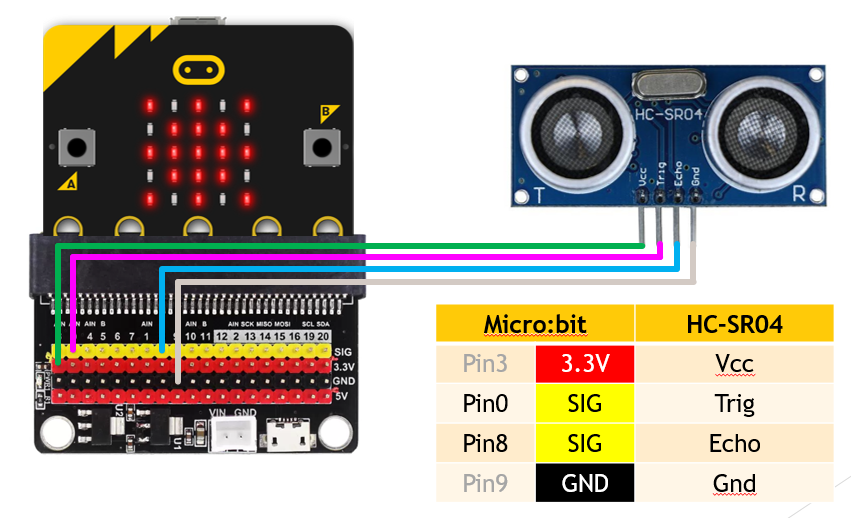
\_\_\_\_\_\_\_\_\_\_

T stands for

\_\_\_\_\_\_\_\_\_\_

Source: https://uk.rs-online.com/web/p/bbc-micro-bit-add-ons/2153181

Connection



High voltage 高電壓

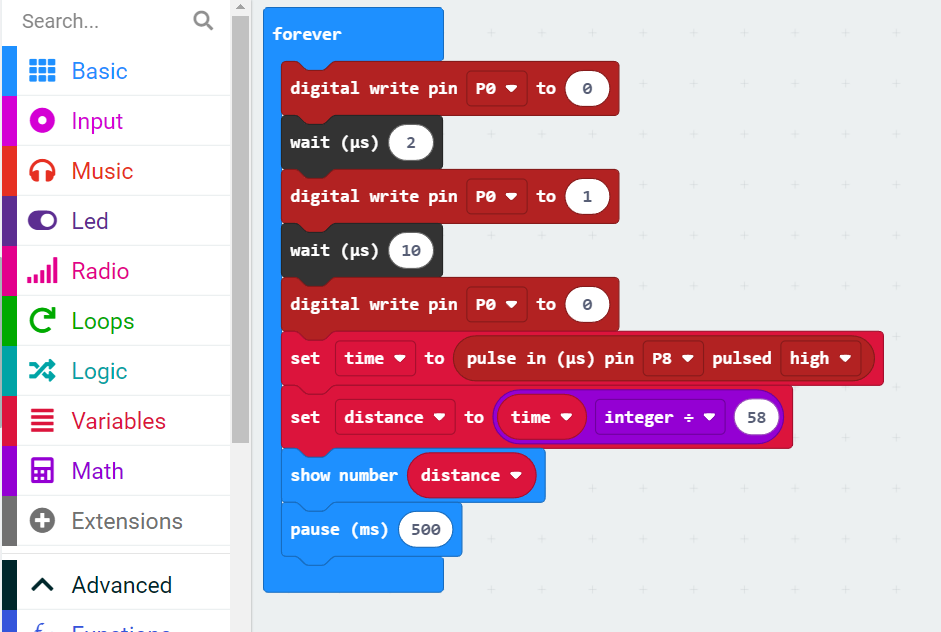
Ground 接地

Transmitter 發射器

Receiver 接收器

**Coding – Distance Sensor**

The program is a combination of two components. The first component is the distance sensor (測距器). The program controls the device to emit an ultrasound pulse, record the time of the reflected pulse and calculate the distance repeatedly every 0.5 seconds.



Selecting 

|  |  |
| --- | --- |
| Step | Button |
| 1 | Press |
| 2 | Select |
| 3 | Drag  into the “forever” block |

Selecting 

|  |  |
| --- | --- |
| 1 | Select |
| 2 | Drag  into the “forever” block |

Change the value in 

|  |  |
| --- | --- |
| 1 | Click  in |
| 2 | Input desired values to change. |

Change the value in 

|  |  |
| --- | --- |
| 1 | Click  in |
| 2 | Input desired values to change. |

Setup the time variable

|  |  |
| --- | --- |
| 1 | Select |
| 2 | Click |
| 3 | Input “time”, then click “OK”. As shown below: |
| 4 | Drag  into the “forever” block |
| 5 | Select , then select |
| 6 | Under the “Pulse” subsection, drag  to replace the  in |

Change the  value

|  |  |
| --- | --- |
| 1 | In , click |
| 2 | Select the desired pin (P8) |

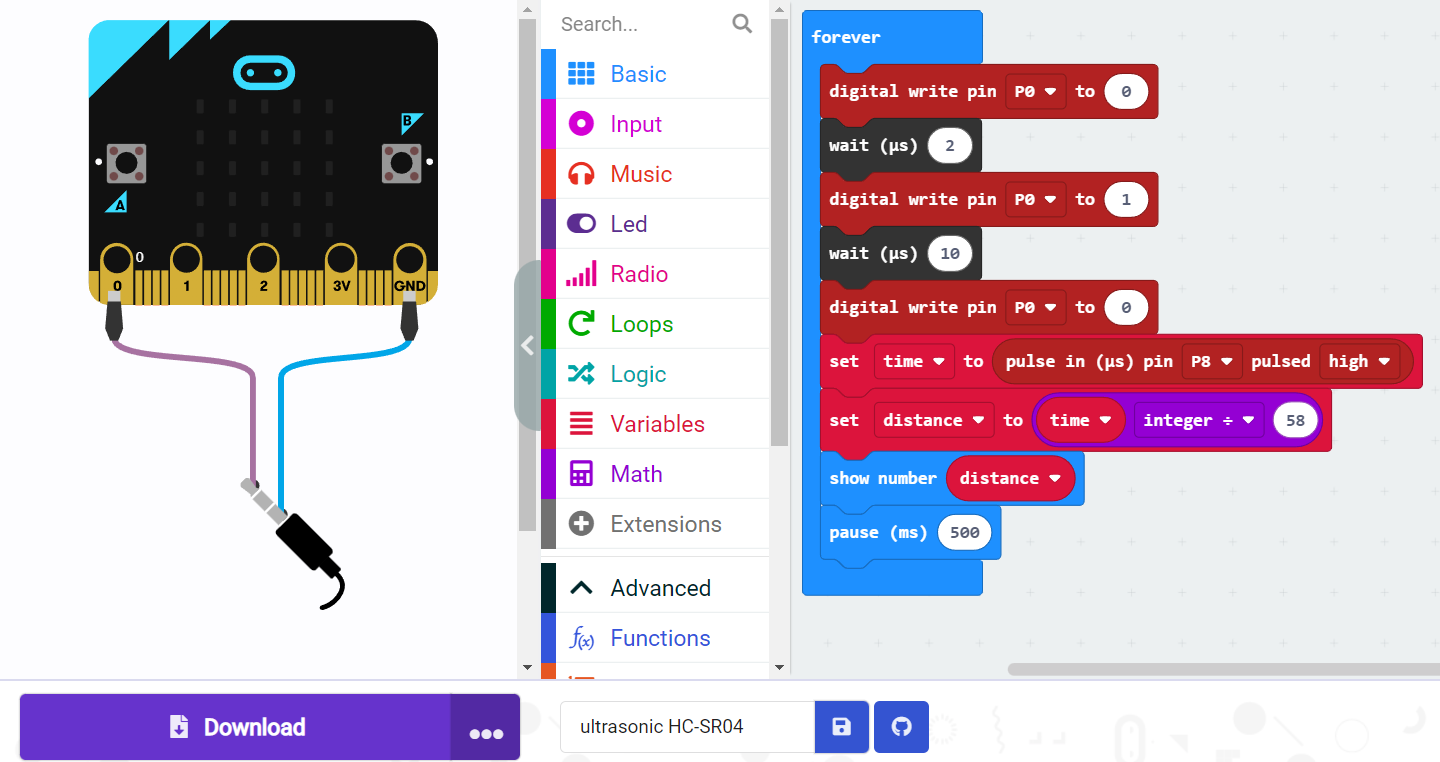
Setup the distance variable

|  |  |
| --- | --- |
| 1 | Select |
| 2 | Click |
| 3 | Input “distance”, then click “OK”. As shown below: |
| 4 | Drag  into the “forever” block |
| 5 | Select |
| 6 | Drag  to replace the  in |
| 7 | Click  in |
| 8 | Select “integer ÷”, as shown below: |
| 9 | Select |
| 10 | Drag  to replace the first  in |
| 11 | Click  in the , input “58” |

Show the result and loop

|  |  |
| --- | --- |
| 1 | Select |
| 2 | Drag  into the “forever” block |
| 3 | Select |
| 4 | Drag  to replace the  in |
| 5 | Select |
| 6 | Drag  into the “forever” block |
| 7 | Click  in , input “500” |

**Download the code**

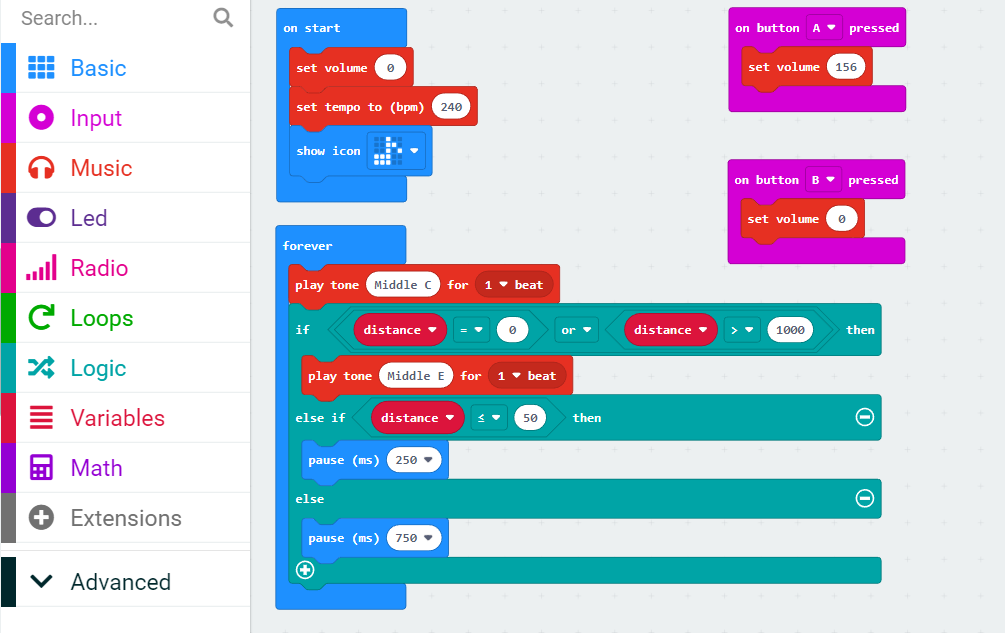


**Test your device**

1. Switch on the micro:bit, and place the sensor in front of an object at a certain distance.
2. Read the number shown on the micro:bit and see if the device works properly.

**Coding – Alert system**

The second component is the alert system (警報系統). It consists of a sound volume control and a sound emitting function based on the distance value.



On start configuration

|  |  |
| --- | --- |
| 1 | Select |
| 2 | Drag  into the “on start” block |
| 3 | Drag  into the “on start” block |

Configuring the volumes

|  |  |
| --- | --- |
| 1 | Click  in |
| 2 | Input desired values for different purposes |

Configuring the tempo

|  |  |
| --- | --- |
| 1 | Click  in |
| 2 | Input “240” |

Setup the alert configuration

|  |  |
| --- | --- |
| 1 | Select |
| 2 | Drag  on the coding space  (In this program, you will have two “forever” blocks) |
| 3 | Select |
| 4 | Drag  into the “forever” block |
| 5 | Select |
| 6 | Drag  into the “forever” block, then press |
| 7 | Drag  to replace the |
| 8 | Drag  in both place of |
| 9 | Drag  in the  block |
| 10 | Select |
| 11 | Drag  into the “if” block |
| 12 | Select |
| 13 | Drag  into the “else if” block and the “else” block |

Configure the logical comparison 

|  |  |
| --- | --- |
| 1 | Select |
| 2 | Drag  to replace the first  in |
| 3 | Click  in |
| 4 | Select the desired comparison symbol, as shown below: |
| 5 | Click  in , input the desired values |

Setup 

|  |  |
| --- | --- |
| 1 | Click  in |
| 2 | Input desired values for different purposes |

Setup 

|  |  |
| --- | --- |
| 1 | Select |
| 2 | Drag  on the coding space |
| 3 | Click  in the  if you want to change the input to another button(s). |