

Smarthon Plant Kit for micro:bit

User Guide

About Smarthon Plant Kit for micro:bit

Plants are tremendously important to life on earth. They are the foundations of our ecosystem, producing life-giving oxygen, absorbing carbon dioxide and influencing climate as a carbon sink as well as providing food to us.

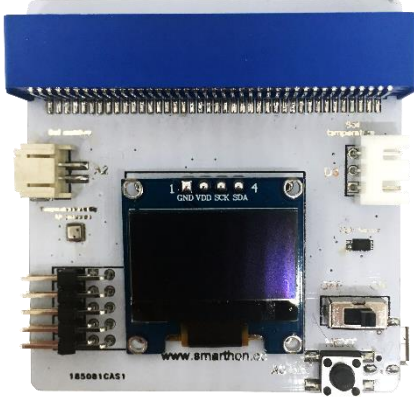
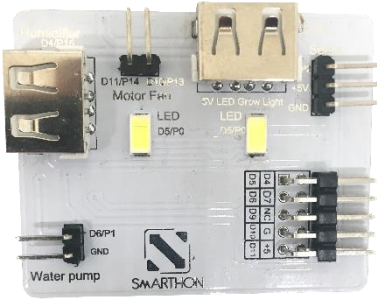


Smarthon Plant Kit is a scientific aid with Multiple Sensors and Actuators for students to learn and conduct experiment on plant studies. Simply using the graphical programming on BBC micro:bit makecode platform, it would be much easier for students to set up plant experiment. Not only can students learn about plant biology, they are also encouraged to ignite their creativity to design and study the particular projects on plant growth in deep.

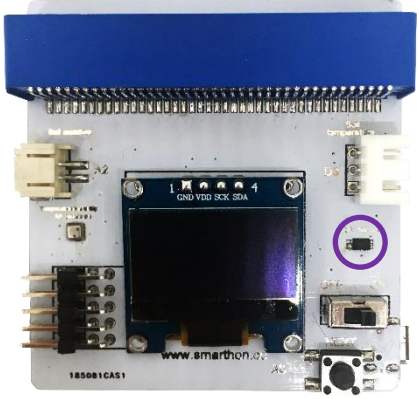
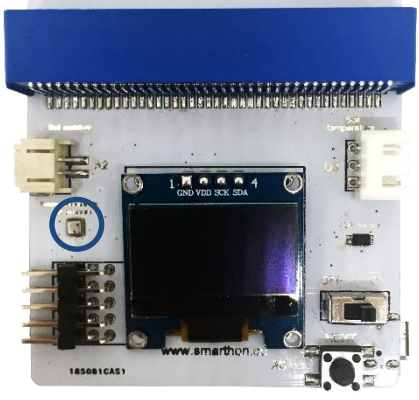
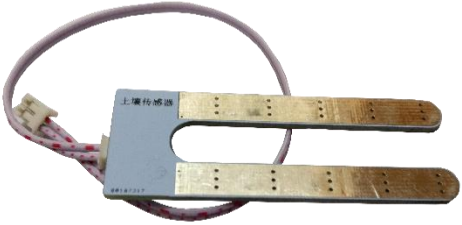
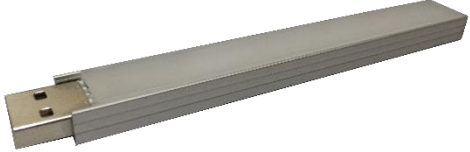





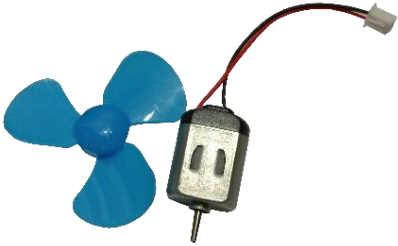
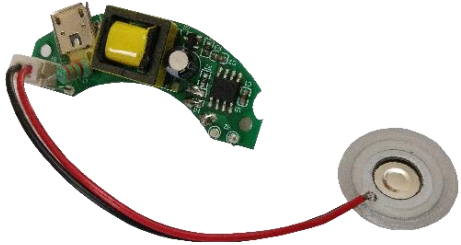

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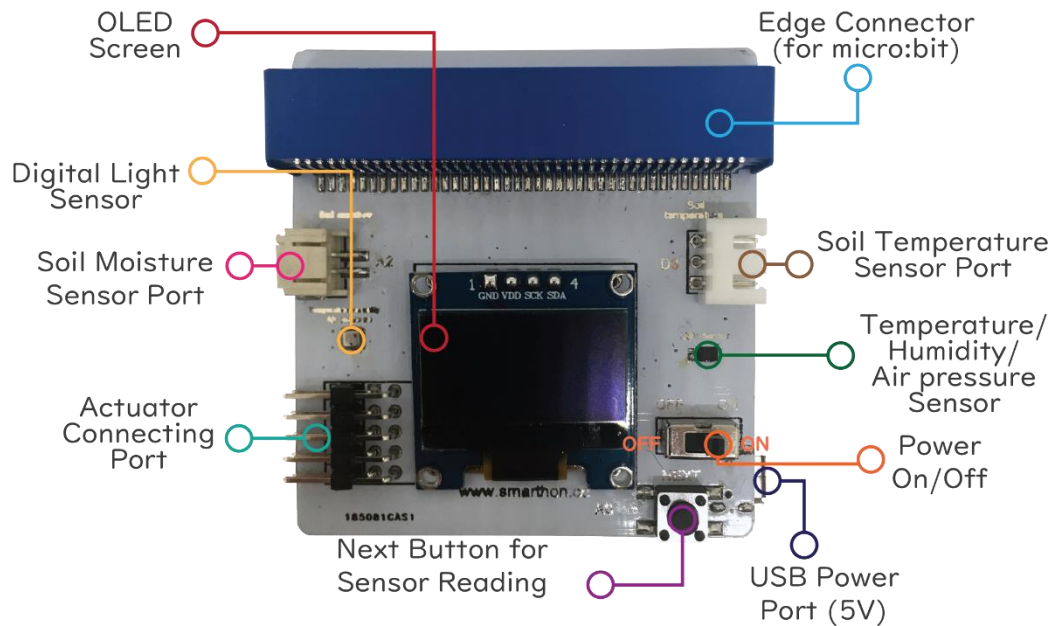
Product Introduction - Smarthon Plant Kit for micro:bit

1	<p>Multiple Sensors for plant</p> <p>The Multiple Sensors for plant is a board consolidating all the sensors for the plant growth, namely temperature sensor, humidity sensor, altitude sensor, light sensor as well as soil humidity sensor. The instant value of all modules can be read on the monitor screen in the shield. Also, micro:bit can be plugged on it, so all sensors can communicate with micro:bit.</p>	
2	<p>Multiple Actuators for plant</p> <p>The Multiple Actuators for plant is a output board with five ports, including a USB port, a water pump port, a motor fan port, a humidifier port and a servo port. To use the 10P connecting wire to connect Multiple Sensors and Multiple Actuators, then Multiple Actuators can execute direct or conditional commands of the micro:bit.</p>	
3	<p>Connecting wire</p> <p>The 10P connecting wire is a bridge between Multiple Sensors and Multiple Actuators. Connecting wire must be at the same direction when it uses.</p>	
4	<p>Multiple sensors base</p> <p>This is a simple base for placing Multiple Sensor board.</p>	

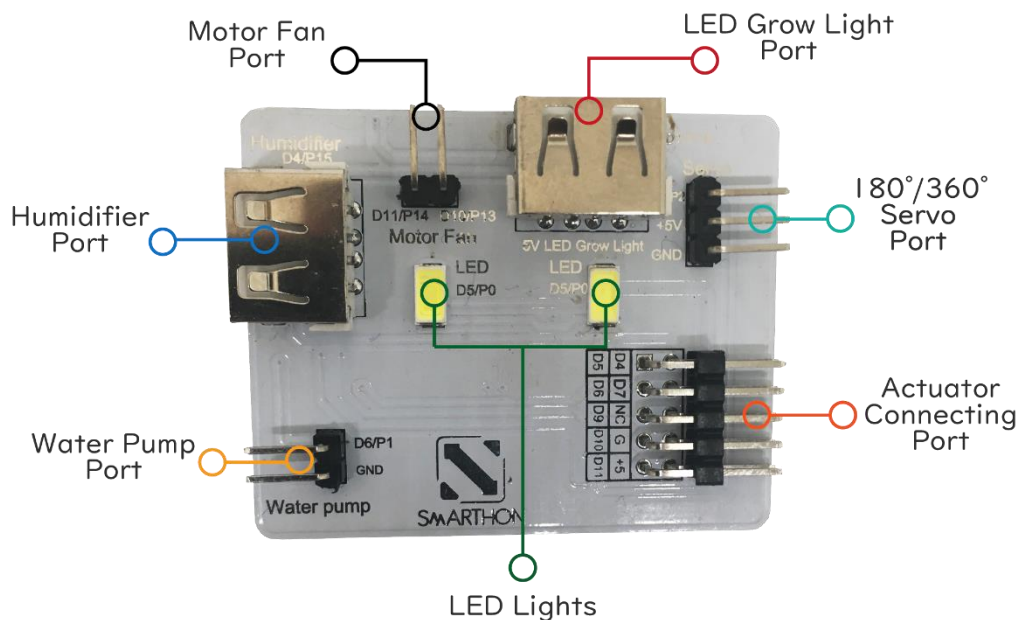
5	<p>Temperature, Humidity and Air pressure sensor</p> <p>3 sensors are combined in a chip placed on the Multiple Sensors board. This sensor can measure the temperature and moisture level of the ambient conditions and both are the basic elements for plant growth.</p>	
6	<p>Digital light sensor</p> <p>Digital light sensor is used to detect the light level in the surrounding environment and the unit of the light sensor is lux. Users can access the light level directly by pressed the button and are able to control the LED Grow Lights by light sensor.</p>	
7	<p>Soil humidity sensor</p> <p>This is a sensor to determine the soil moisture level. Adequate water is the initial element for the plant growth. Users can conduct the experiment on plant growth on different soil moisture level and analyze it.</p>	
8	<p>LED grow light</p> <p>Sunlight is one of the main factors to affect the photosynthesis of the plant. There are 4 colours (Blue, Red, Green, Red/Blue Mixed) of LED Grow lights that you can select. It can help you to conduct the experiment on the relationship between light spectrum and plant growth.</p>	
9	<p>USB stand (for LED grow light)</p> <p>USB Stand for LED grow light is to connect the USB Base and LED Grow Lights. The foldable stand allows you to adjust the angle and height of LED Grow Lights.</p>	

10	<p>USB base (for LED grow light)</p> <p>USB Base for LED grow light with a USB port is used to connect the Multiple Actuators and LED grow light.</p>	
11	<p>Water pump and pipe</p> <p>Water pump and pipe is used to watering the plants. Adequate water is crucial to the plant and you can control it precisely by using the soil moisture detector. Simply setting up the soil moisture level, then the water would be pumped automatically once it is being under the level.</p>	
12	<p>Motor fan</p> <p>This is a module to adjust the air-temperature. You can set up the command with the temperature sensor by switching on the fan when it is too hot. Also, the speed of the motor fan can be adjusted in the makecode platform.</p>	
13	<p>Humidifier</p> <p>Humidifier is used to increase the humidity level when it is too dry. There are 2 parts of the module. User should put the humidifier on the surface of the water only. For the electronic part of the module, it should keep dry and clear.</p>	
14	<p>USB Cable</p> <p>USB cable is to connect Humidifier and Multiple Actuators for plant.</p>	

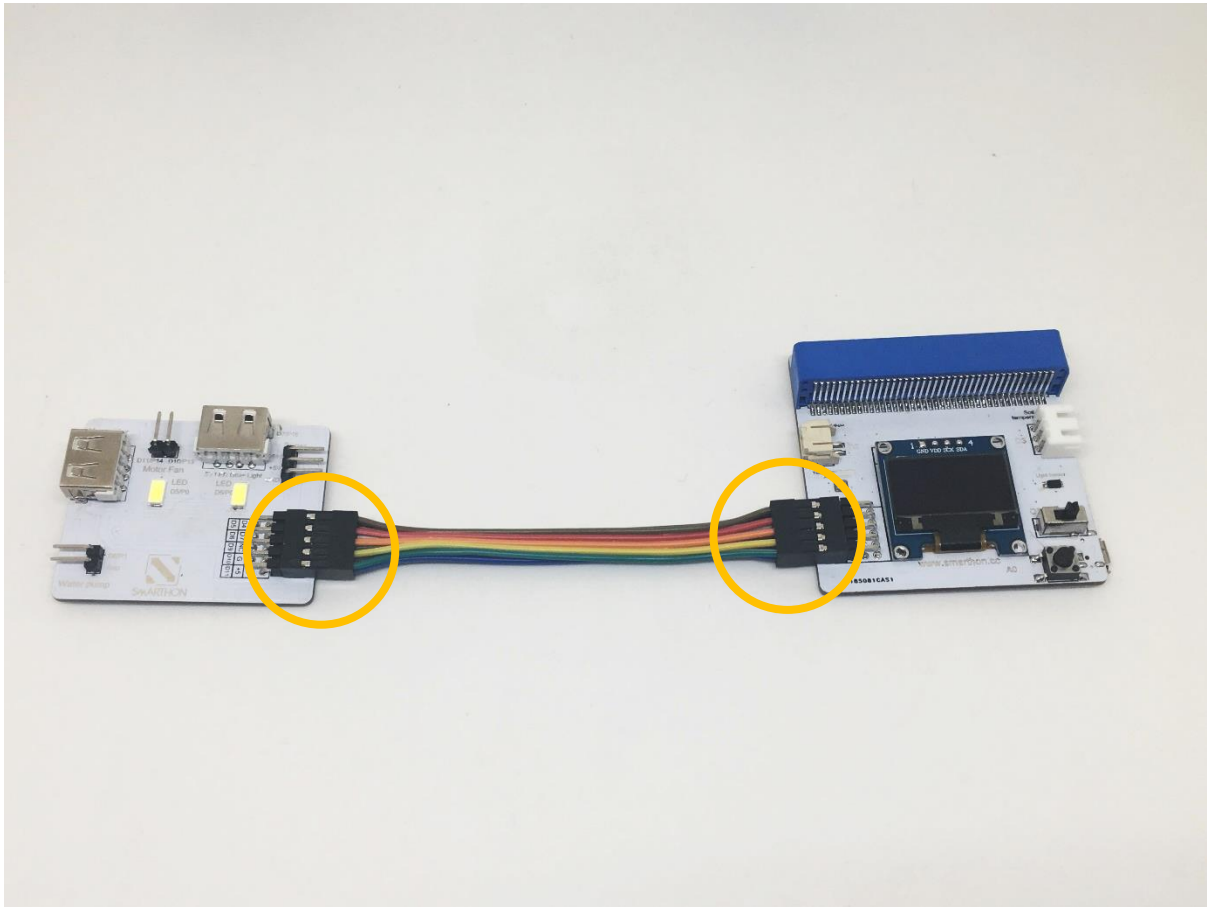
Introduction for Multiple Sensors for plant



Introduction for Multiple Actuators for plant



Basic Connection Between Multiple Sensors and Multiple Actuators

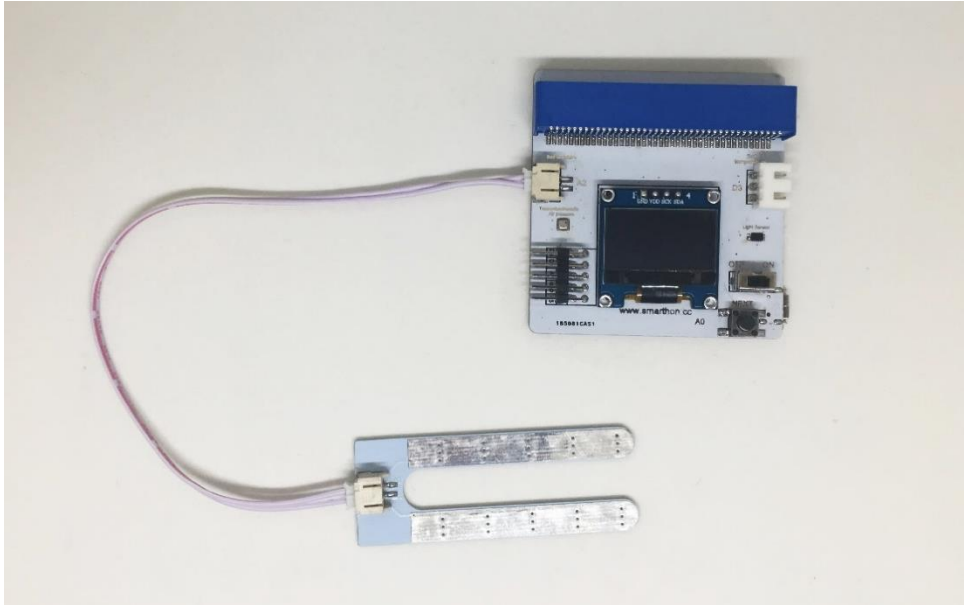


*To make sure the connecting wire is on the same direction.

Hardware User Guide:

A. Sensors and Multiple Sensors for plant

Most of the sensors are placed on the board of Multiple Sensors, namely temperature/humidity/air-pressure sensor and digital light sensor. Soil moisture sensor will be shown as a demo.

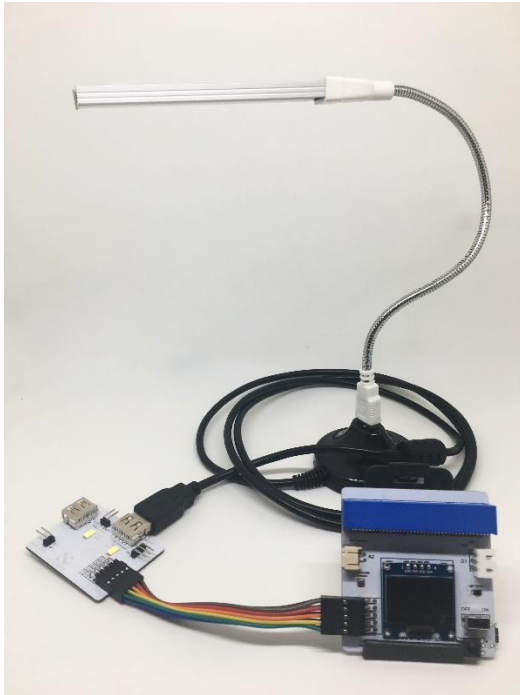


B. Actuators and Multiple Actuators for plant

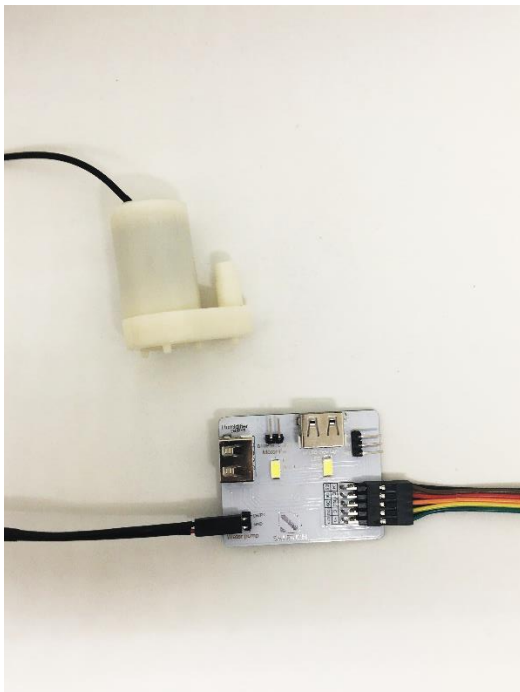
How to connect the actuator modules and Multiple Actuators for plant?

Please follow the instructions shown below to plug actuator modules into Multiple Actuators correctly to ensure all the modules work effectively.

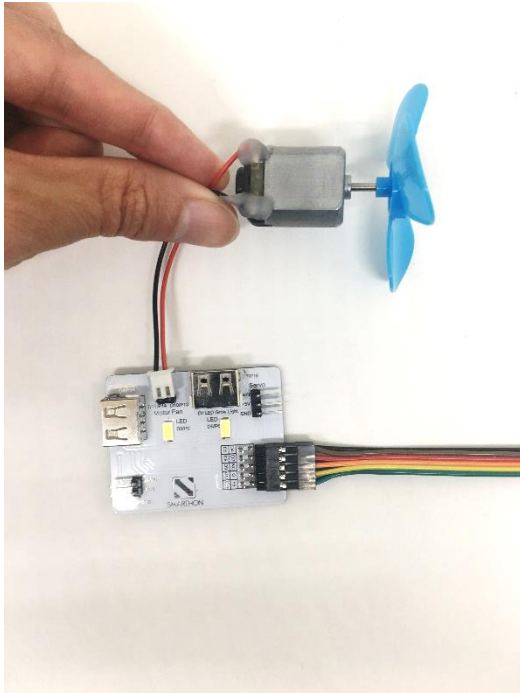
1. LED grow light



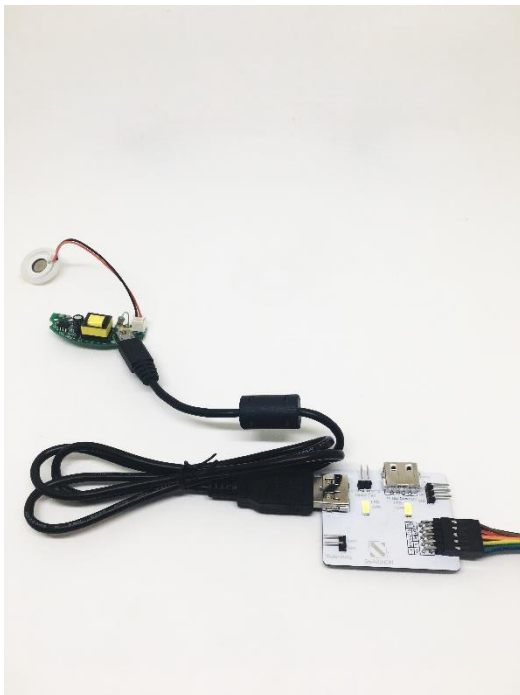
2. Water pump



3. Motor fan



4. Humidifier



Reading sensors - Temperature, Humidity, Altitude, Light, Soil humidity

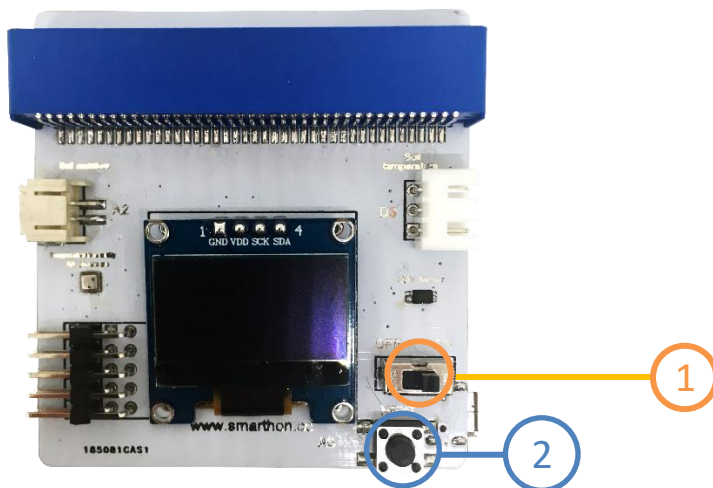
Part List:

1. Multiple Sensors for plant X1
2. Temperature, Humidity and Air pressure Sensor X1 (placed on the Multiple Sensors)
3. Digital Light Sensor X1 (placed on the Multiple Sensors)
4. Soil humidity sensor X1

You can learn reading sensors and its' interruption which can help you to conduct other projects.

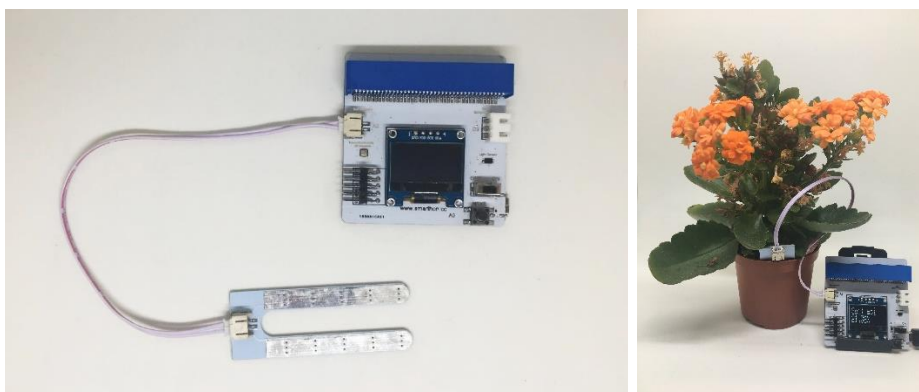
1. Switch on the power button
2. Pressed the button in the right bottom corner of the Multiple Sensors for plant

It shows the temperature, humidity, air Pressure, light as well as soil humidity.



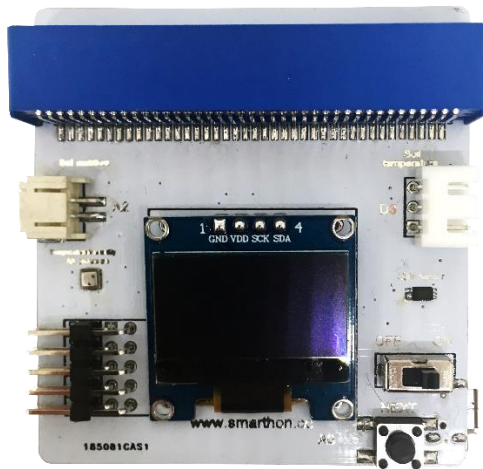
Soil moisture sensor will be shown as an example:

1. Soil Moisture Sensor



When you plug the soil moisture sensor into the port on Multiple Sensors for micro:bit, the screen shows 0.10%; while when you put the soil moisture into the plant with watering, the screen shows around 94%. It indicates that the larger number of the screen shown, the soil moisture level is higher.

Reading the other three sensors:



Temperature: _____

Humidity: _____

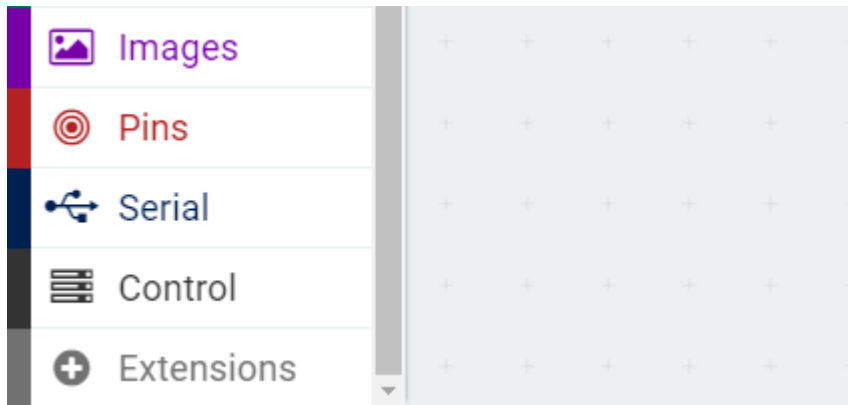
Digital Light sensor: _____

How to program Smarthon Plant Kit on micro:bit

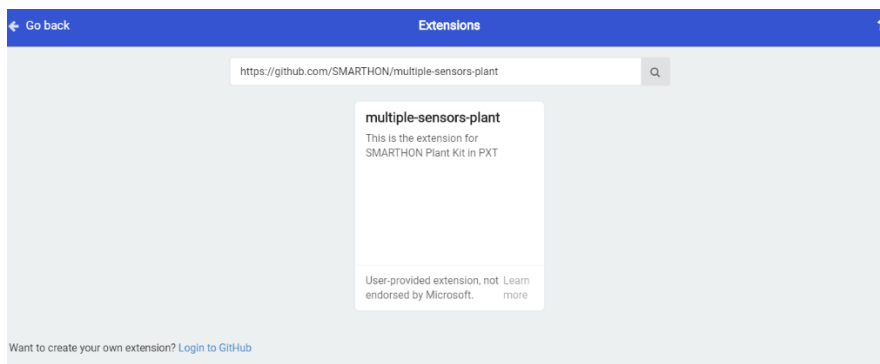
To Program Smarthon modules with micro:bit, you need to add the Smarthon Plant Kit packages to the BBC micro:bit makecode platform and initialize it first.

Steps:

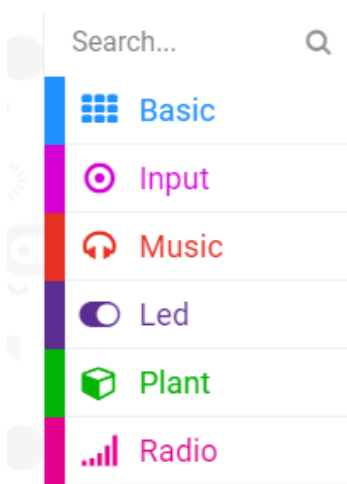
1. Find the "Extensions" block at the bottom



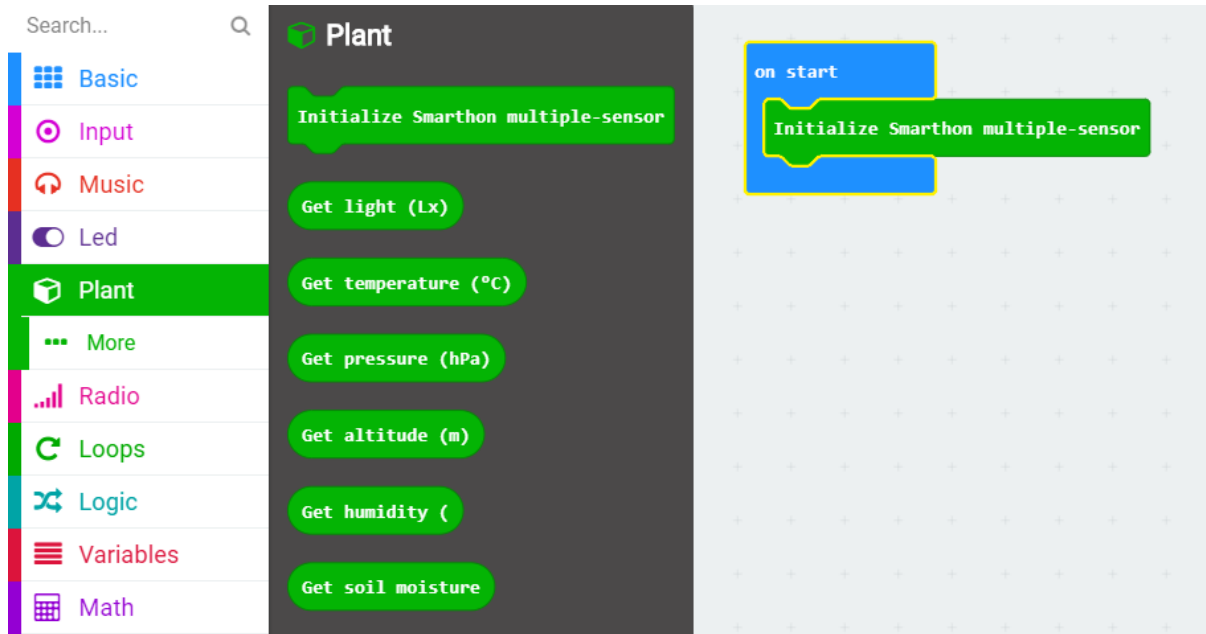
2. Search "<https://github.com/SMARTHON/multiple-sensors-plant>"



3. Clicked "multiple sensors" and you can see "Plant" package has been successfully added under "Led".



4. Initialize Smarthon Plant Kit to add all the functions



Project 1: Read Sensors on micro:bit 25 LED lights

Level: ★ ☆ ☆ ☆ ☆

Part List:

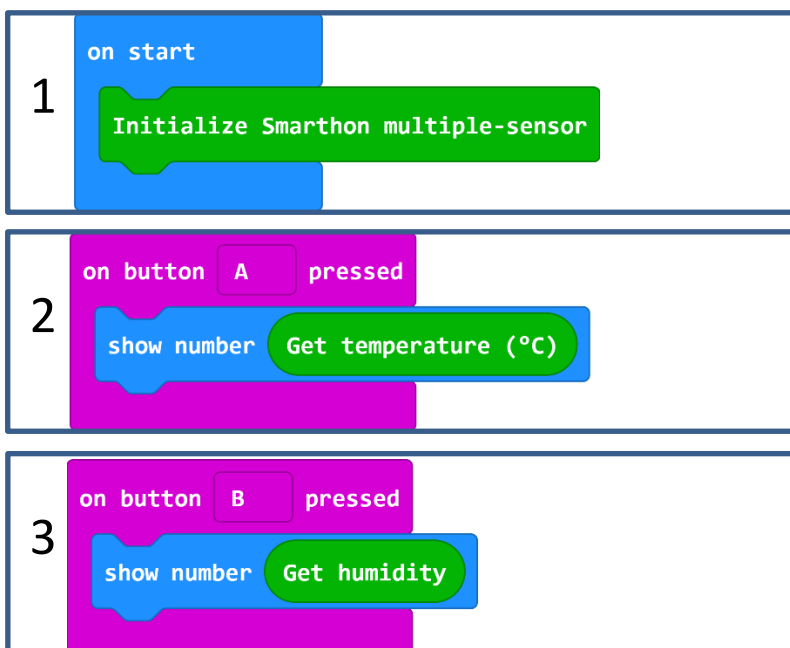
1. Temperature/Humidity Sensor X1
2. Multiple Sensors for plant X1
3. Multiple Actuators for plant X1
4. Connecting Wire X1
5. micro:bit X1
6. USB Cable X1

Description:

You can learn how to get the value of the sensor and show on micro:bit LED. Temperature/Humidity sensor will be illustrated in this demo.

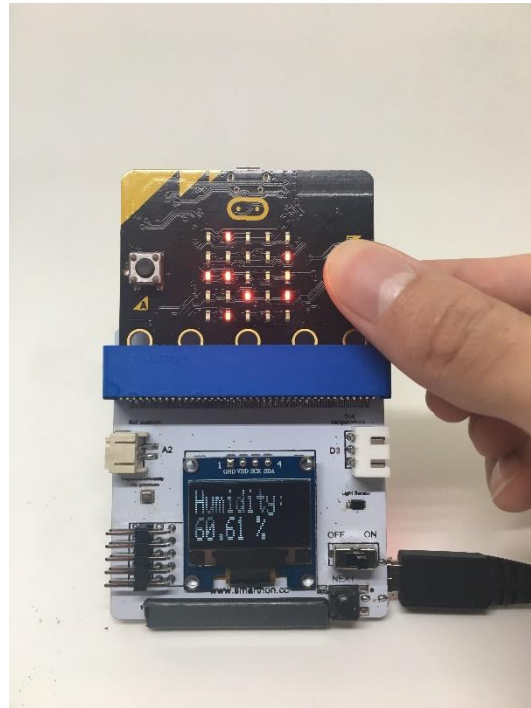
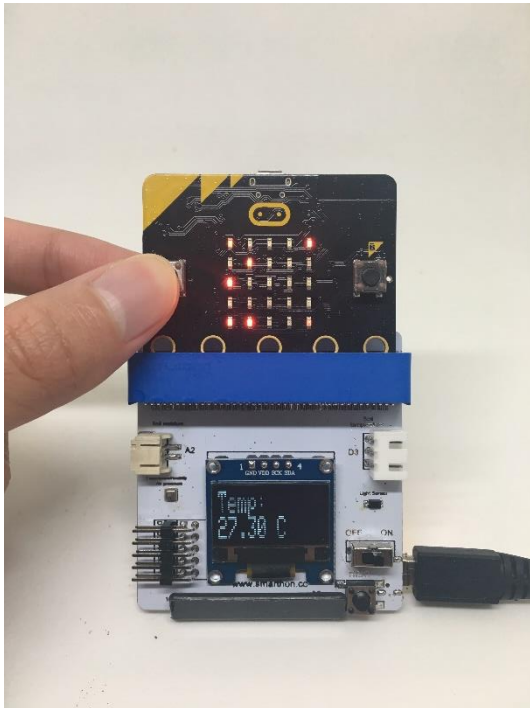
Steps:

1. Basic (Add block *on start*) > Plant (Add block *Initialize Smarthon multiple-sensor*)
2. Input (Add block *on button A is pressed*) > Basic (Add block *show number*) > Plant (Add block *Get temperature (°C)*)
3. Input (Add block *on button A is pressed*, change "A" into "B") > Basic (Add block *show number*) > House (Add block *Get humidity*)



Hardware:

4. **Download** the code and transfer to micro:bit
5. Plug the micro:bit into Multiple Sensors
6. Pressed micro:bit button A to see the temperature and button B to see the humidity



- Try to show the other sensors value on micro:bit LED.

Project 2: Control Actuators – micro:bit button A/B

Level: ★ ☆ ☆ ☆ ☆

Part List:

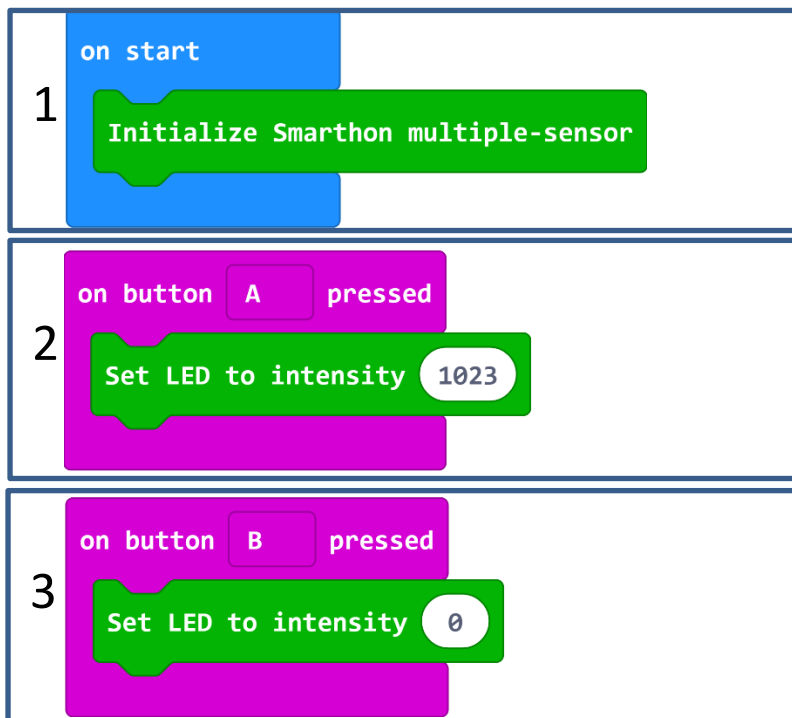
1. LED lights X2 (placed on the Multiple Actuators for plant)
2. Multiple Sensors for plant X1
3. Multiple Actuators for plant X1
4. Connecting wire X1
5. micro:bit X1
6. USB Cable X1

Description:

In project 2, you can learn how to use micro:bit Button A/B to control LED lights on Multiple Actuators.

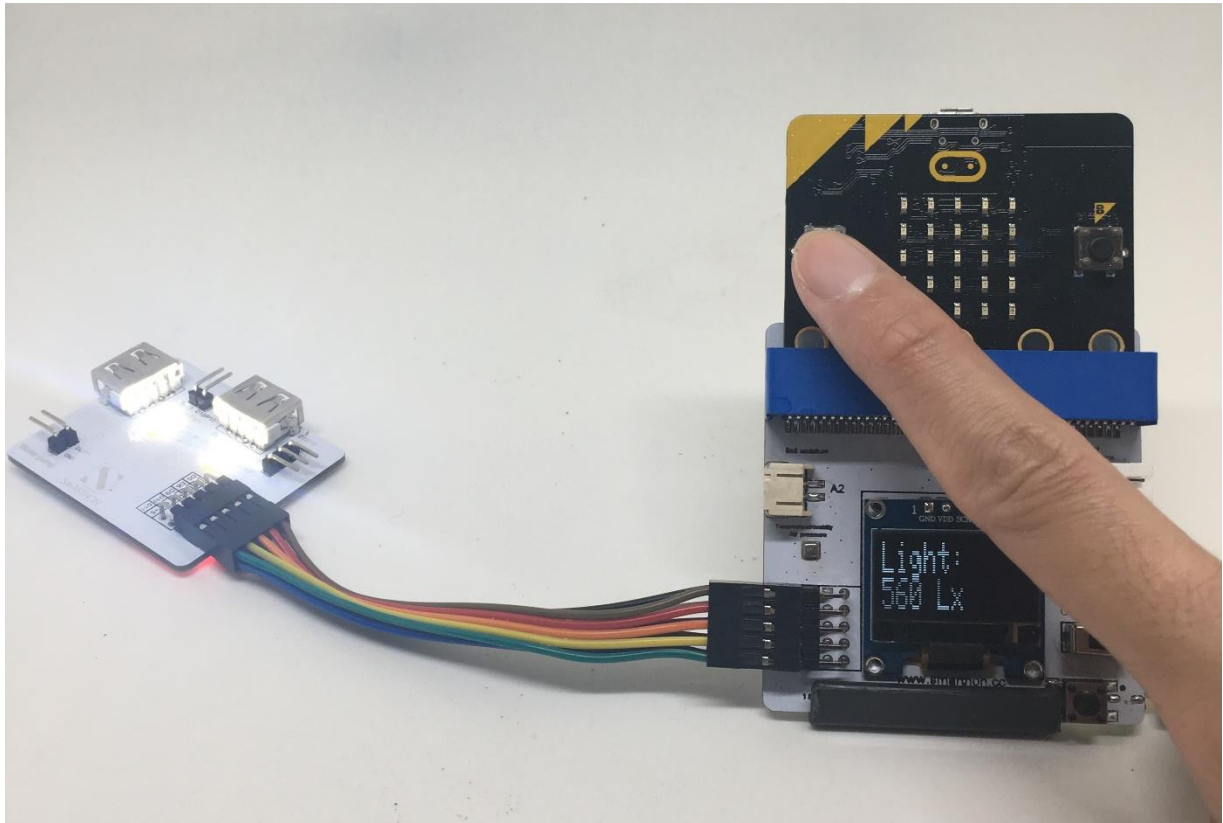
Steps:

1. Basic (Add block *on start*) > Plant (Add block *Initialize Smarthon multiple-sensor*)
2. Input (Add block *on button A is pressed*) > Plant-More (Add block *Set LED to intensity 0*, change "0" to "1023")
3. Input (Add block *on button A is pressed*, change "A" into "B") > Plant-More (Add block *Set LED to intensity 0*)



Hardware:

4. Connect Multiple Sensors and Multiple Actuators by connecting wire
5. **Download** the code and transfer to micro:bit
6. Plug the micro:bit into Multiple Sensors
7. Pressed micro:bit button A to turn on the LED light; button B to turn off the LED light



- Try to use micro:bit Button A/B to control other outputs – motor fan, humidifier, water pump and LED grow lights

Project 3: Smart LED Grow Light

Level: ★ ★ ☆ ☆ ☆

Part List:

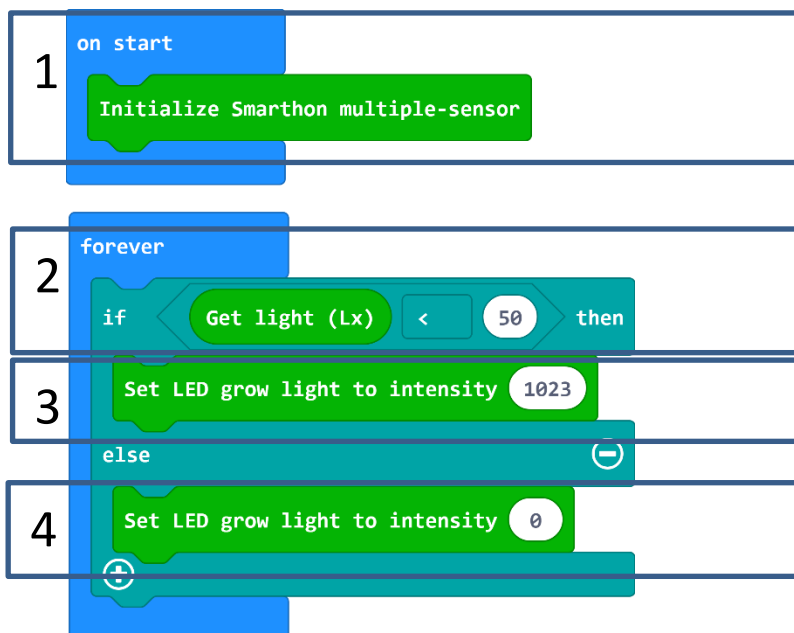
1. Digital Light Sensor X1 (placed on Multiple Sensors for plant)
2. LED Grow Light X1
3. USB Base (for LED Grow Light) X1
4. USB Stand (for LED Grow Light) X1
5. Multiple Sensors for plant X1
6. Multiple Actuators for plant X1
7. Connecting Wire X1
8. micro:bit X1
9. USB Cable X1

Description:

In project 3, you can learn how to control LED grow light by digital light sensor.

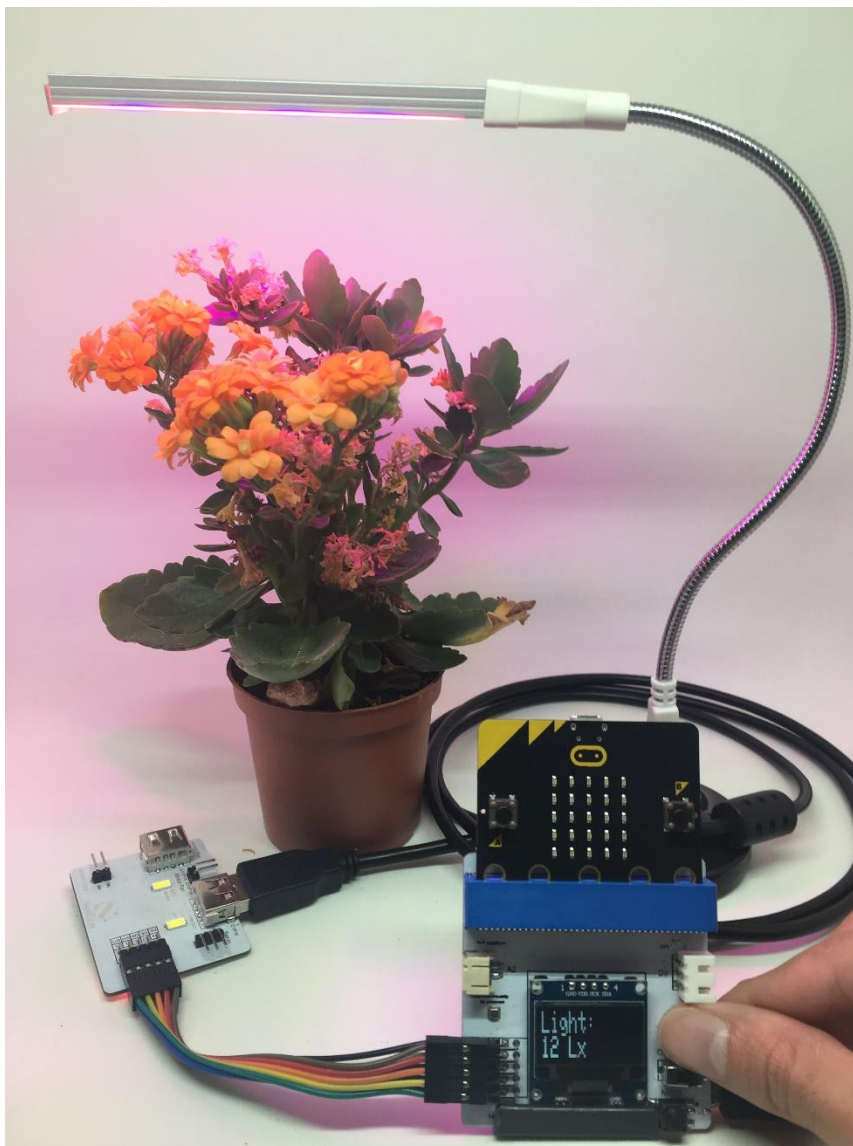
Steps:

1. Basic (Add block *on start*) > Plant (Add block *Initialize Smarthon multiple-sensor*)
2. Basic (Add block *forever*) > Add Logic (Add block *if...then...else*) > For *if*: Logic (Add block *0 = 0*, change "0" to Plant "Get light (Lx)"; "=" to ">"; "0" to "50")
3. For *then*: Plant-More (Add block *Set LED grow light to intensity 0*, change "0" to "1023")
4. For *else*: Plant -More (Add block *Set LED grow light to intensity 0*)



Hardware:

5. Connect Multiple Sensors and Multiple Actuators by connecting wire
6. Connect USB Base (for LED Grow Light) to 5V LED Grow Light (D7/P16) port of Multiple Actuators
7. Connect **LED Grow Light** and USB Base by **USB Stand** (for LED Grow Light)
8. Adjust the USB Stand to fit the plant
9. **Download** the code and transfer to micro:bit
10. Plug the micro:bit into Multiple Sensors
11. Try to cover the light sensor by hand to test if the LED Grow Light works properly



Experiment:

- Do different colours of LED grow lights affect the direction of plant growth?
- Do different colours of LED grow lights affect the rate of photosynthesis?
- Do different types of LED grow lights affect plant growth?
- What is the difference between sunlight and LED grow light among the plant growth?

Project 4: Automatic Irrigation (watering)

Level: ★ ★ ☆ ☆ ☆

Part List:

1. Soil Moisture Sensor
2. Water Pump & Pipe X1
3. Multiple Sensors for plant X1
4. Multiple Actuators for plant X1
5. Connecting Wire X1
6. micro:bit X1
7. USB Cable X1
8. A glass of water X1

Description:

In project 4, you can learn how to watering the plant automatically by soil moisture detector.

Steps:

1. Basic (Add block *on start*) > Plant (Add block *Initialize Smarthon multiple-sensor*)
2. Functions (Make a Function > New function name:) > watering_2_seconds) > Plant-More (Add block *Set Motor pump to intensity 0*, change "0" to "400") > Basic (Add block *pause (ms) 100*, change "100" to "2000") > > Plant-More (Add block *Set Motor pump to intensity 0*) > Basic (Add block *pause (ms) 100*, change "100" to "10000")
3. Basic (Add block *forever*) > Logic (Add block *if...then...else*, add 1 more *if...then...else*, delete *else*) > For 1st *if*: Logic (Add block *0 = 0*, change "0" to Plant *"Get soil moisture"*; "=" to "<"; "0" to "50")
4. For *then*: Advanced>Functions (Add block *call function watering_2_seconds*)
5. For *else if*: Logic (Add block *0 = 0*, change "0" to Plant *"Get soil moisture"*; "=" to ">"; "0" to "90")
6. For *then*: Plant-More (Add block *Set Water pump to intensity 0*)

1

on start

Initialize Smarthon multiple-sensor

2

function watering_2_seconds

Set Water pump to intensity 400

pause (ms) 2000

Set Water pump to intensity 0

pause (ms) 10000

3

forever

if

Get soil moisture < 50

then

call function watering_2_seconds

4

else if

Get soil moisture > 90

then

Set Water pump to intensity 0

5

else if

Get soil moisture > 90

then

Set Water pump to intensity 0

6

else if

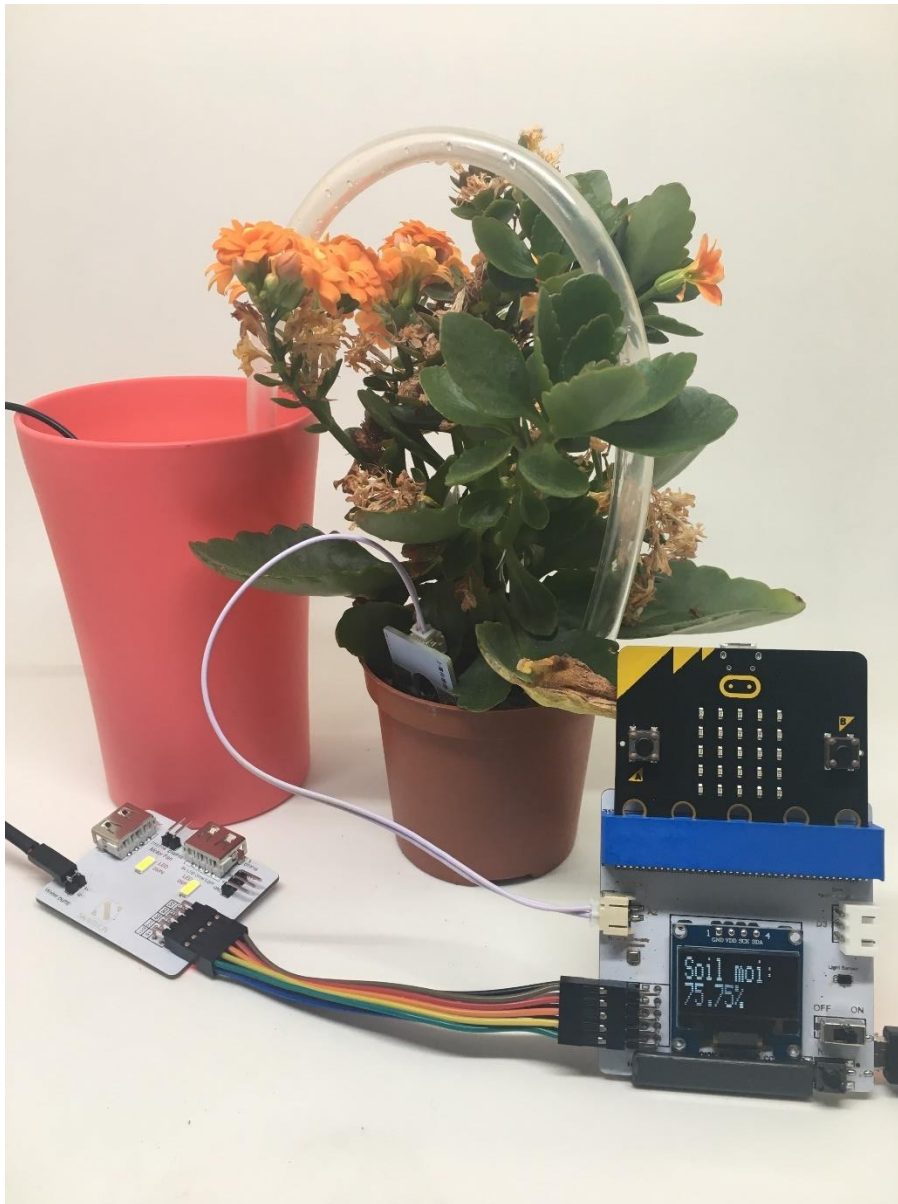
Get soil moisture > 90

then

Set Water pump to intensity 0

Hardware:

7. Connect Multiple Sensors and Multiple Actuators by connecting wire
8. Connect Water Pump and Pipe
9. Connect Water Pump & Pipe to Water pump (D6/P1) port of Multiple Actuators
10. **Download** the code and transfer to micro:bit
11. Plug the micro:bit into Multiple Sensors



Experiment:

- How does soil moisture level affect seed germination?
- Does soil moisture level affect the size of leave?
- Does soil moisture level affect photosynthesis or respiration of the plant?
- Does soil moisture level affect root growth?
- Does water salinity affect plant growth?

Project 5: Smart Environment (temperature control)

Level: ★ ☆ ☆ ☆ ☆

Part List:

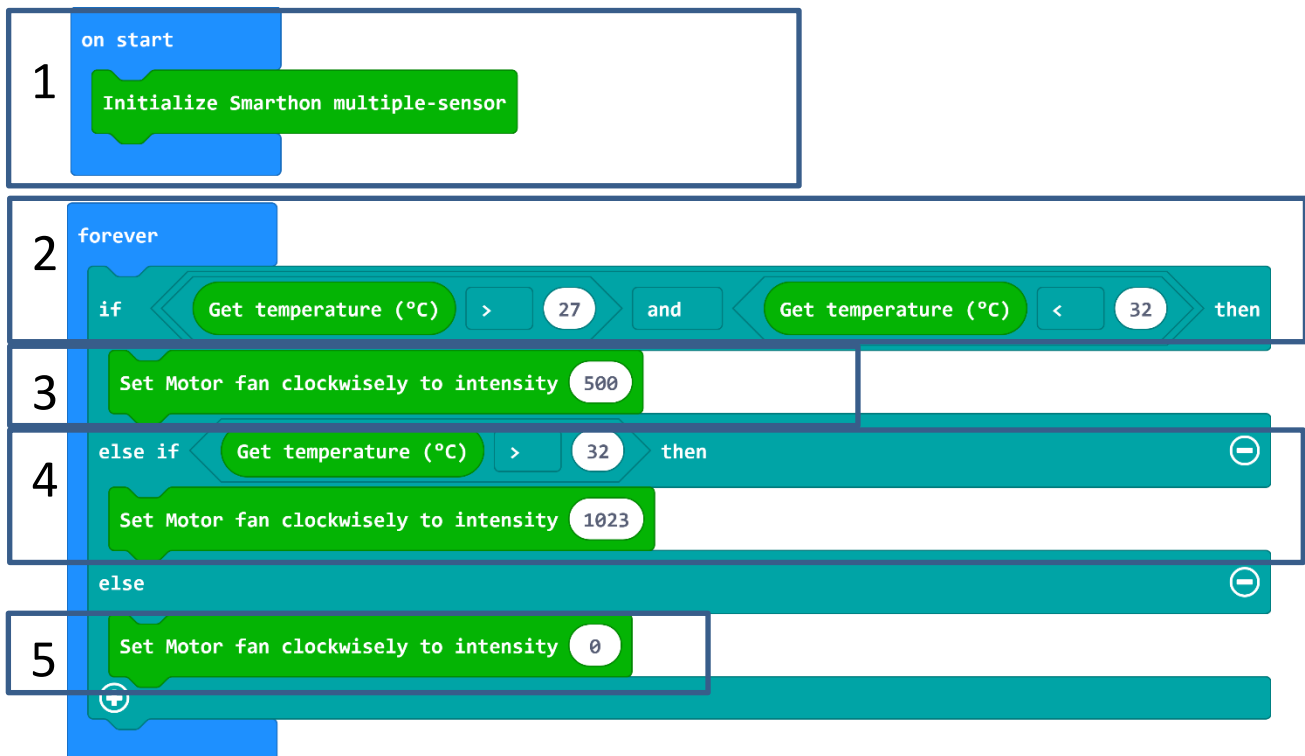
1. Temperature Sensor X1 (placed on Multiple Sensors for plant)
2. Motor Fan X1
3. Multiple Sensors for plant X1
4. Multiple Actuators for plant X1
5. Connecting Wire X1
6. micro:bit X1
7. USB Cable X1

Description:

In project 5, you can learn how to make a fan automation that allows you to control the ambient temperature.

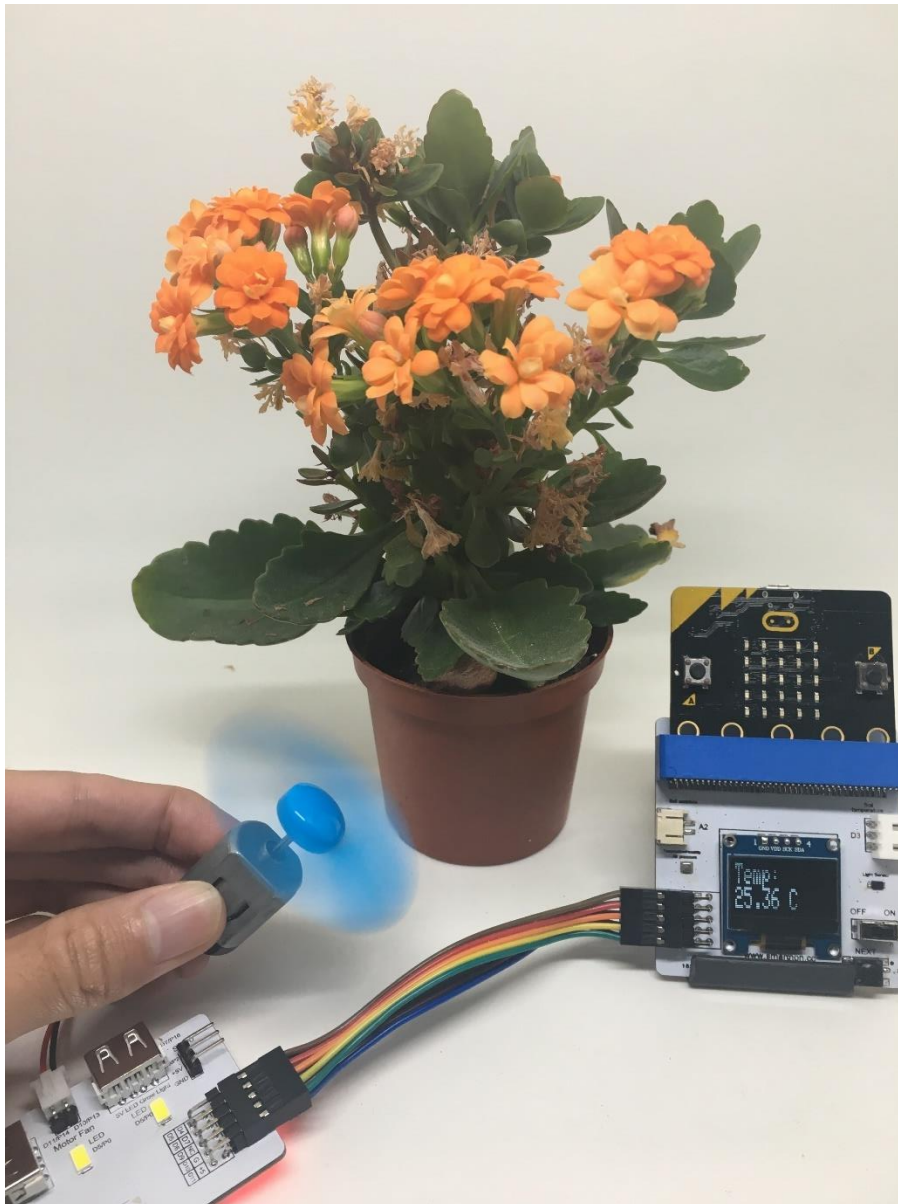
Steps:

1. Basic (Add block *on start*) > Plant (Add block *Initialize Smarthon multiple-sensor*)
2. Basic (Add block *forever*) > Logic (Add block *if...then...else*, add 1 more *if...then...else*) > For 1st *if*: Logic (Add block *" " and " "*, 1st *" "*: Add block *0 = 0*, change *"0"* to Plant *"Get temperature(°C)"*; *"="* to *">"*; *"0"* to *"27"* ; 2nd *" "*: Add block *0 = 0*, change *"0"* to Plant *"Get temperature(°C)"*; *"="* to *"<"*; *"0"* to *"32"*)
3. For *then*: Plant-More (Add block *Set Motor fan clockwise to intensity 0*, change *"0"* to *"500"*)
4. For *else if*: Logic (Add block *0 = 0*, change *"0"* to Plant *"Get temperature(°C)"*; *"="* to *">"*; *"0"* to *"32"*) > For *then*: Plant-More (Add block *Set Motor fan clockwise to intensity 0*, change *"0"* to *"1023"*)
5. For *else*: Plant-More (Add block *Set Motor fan clockwise to intensity 0*)



Hardware:

6. Connect Multiple Sensors and Multiple Actuators by connecting wire
7. Connect Motor fan to Motor Fan (D11/P14; D10/P13) port of Multiple Actuators
8. **Download** the code and transfer to micro:bit
9. Plug the micro:bit into Multiple Sensors



Experiment:

- How does temperature affect plant growth?
- Does temperature affect seed growth?
- Does motor fan affect plant transpiration rates?

Project 6: Automatic Humidity Control

Level: ★ ☆ ☆ ☆ ☆

Part List:

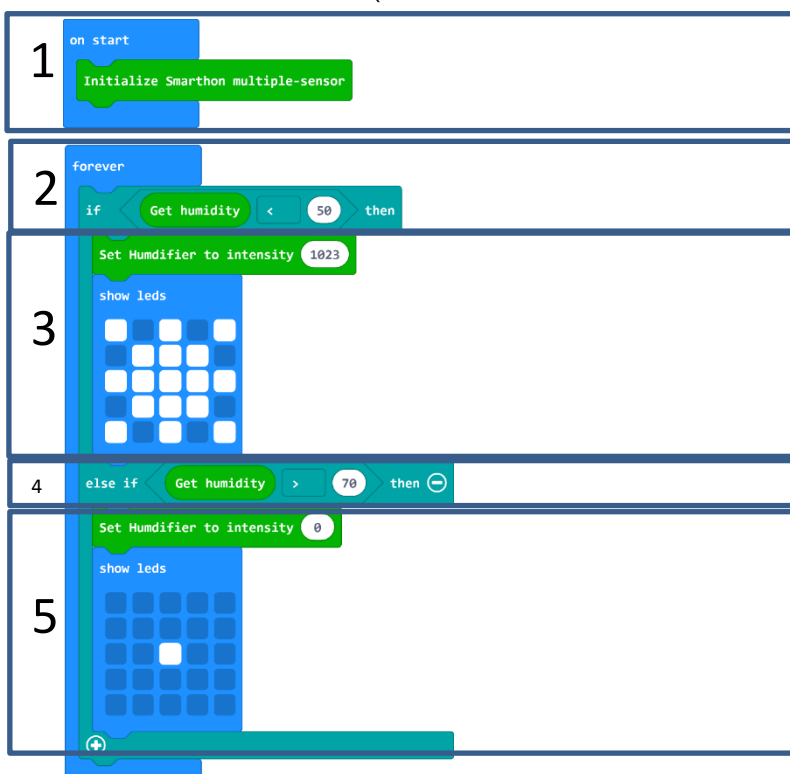
1. Humidity Sensor X1 (Placed on the Multiple Sensors)
2. Humidifier X1
3. Multiple Sensors for micro:bit X1
4. Multiple Actuators for micro:bit X1
5. Connecting Wire
6. micro:bit X1
7. USB Cable X2
8. A bottle of water X1

Description:

In project 6, you can learn how to increase humidity level by a humidity sensor.

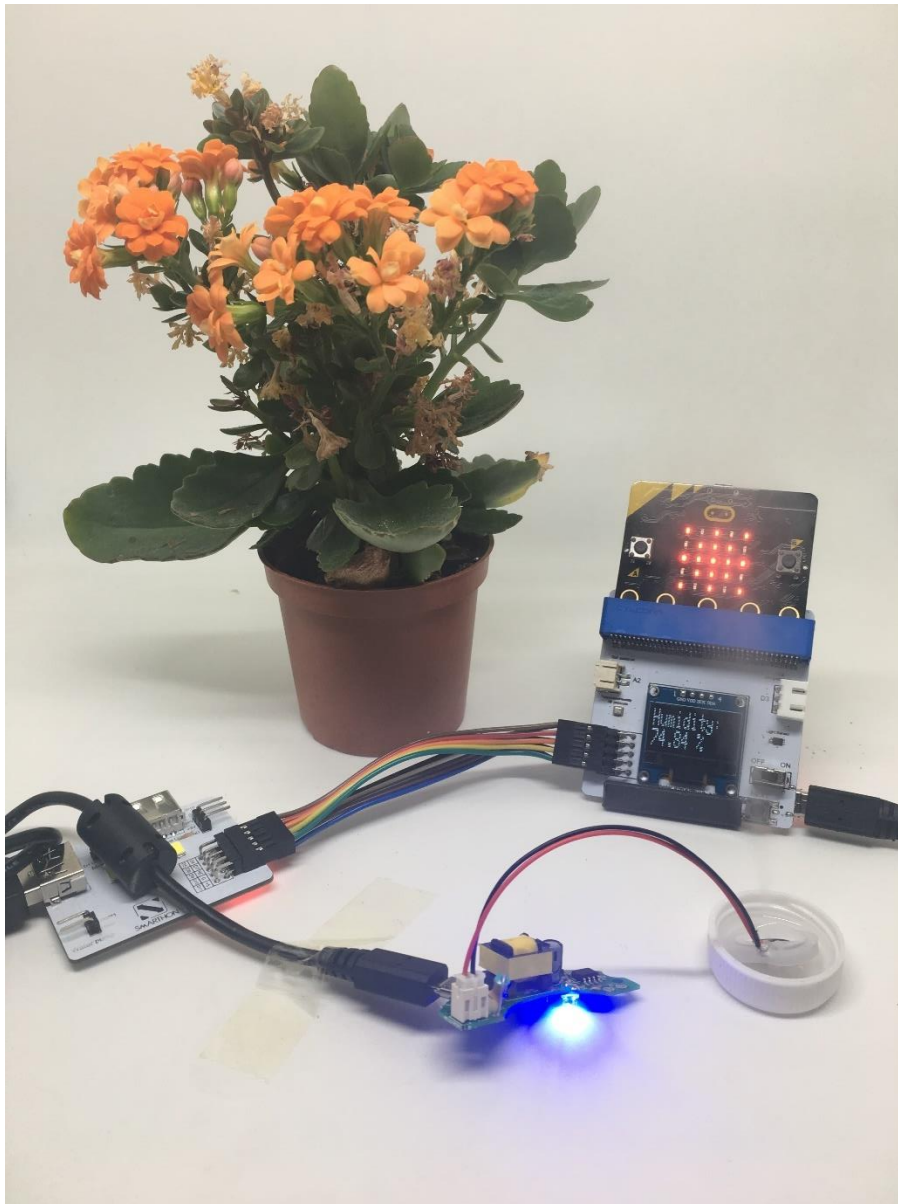
Steps:

1. Basic (Add block *on start*) > Plant (Add block *Initialize Smarthon multiple-sensor*)
2. Basic (Add block *forever*) > Logic (Add block *if...then...else*, add 1 more *if...then...else*, delete *else*) > For 1st *if*: Logic (Add block *0 = 0*, change *"0"* to Plant *"Get humidity"*; *"="* to *"<"*; *"0"* to *"50"*)
3. For *then*: Plant-More (Add block *Set Humidifier to intensity 0*, change *"0"* to *"1023"*) > Basic (Add block *show leds*)
4. For *else if*: Logic (Add block *0 = 0*, change *"0"* to Plant *"Get humidity"*; *"="* to *">"*; *"0"* to *"70"*)
5. For *then*: Plant-More (Add block *Set Humidifier to intensity 0*) > Basic (Add block *show leds*)



Hardware:

6. Connect Multiple Sensors and Multiple Actuators by connecting wire
7. Connect Humidifier module and USB Cable
8. Connect Humidifier & USB Cable to Humidifier (D4/P15) port of Multiple Actuators
9. **Download** the code and transfer to micro:bit
10. Plug the micro:bit into Multiple Sensors



Experiment:

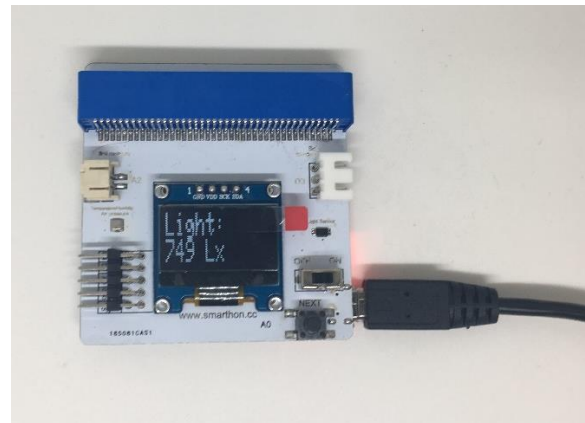
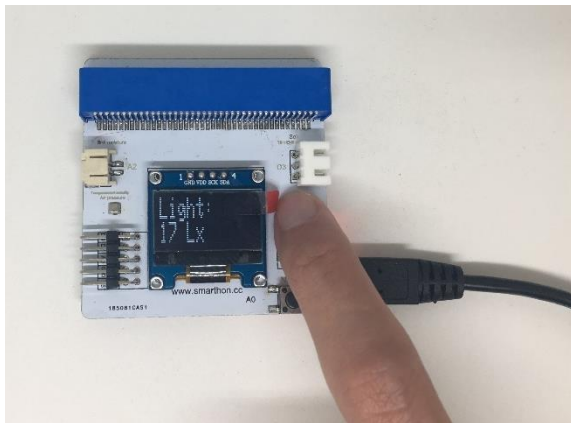
- Does humidifier affect plant transpiration rates?
- Does humidity level affect plant height?
- Does humidifier extend plant life during low soil moisture level?

Appendix I: Reading Sensors Answer

Temperature & Humidity:

Please feel free to write down the value of the current condition.

Digital Light sensor:



When there is a sunlight, the digital light sensor value is around 900-1055 lx; while otherwise when you use a finger to cover the digital light sensor has decreased 17 lx. It reveals that when it is dark, the digital light sensor value becomes smaller.