

# The Education University of Hong Kong

## 2022-2023 Quality Education Fund Thematic Network - Tertiary Institutes

### STEM Project Team

SCHOOL: 東華三院鄺錫坤伉儷中學 TWGHs Mr & Mrs Kwong  
Sik Kwan College

TOPIC: School-based Workshop

# Overview of the workshop

## 1. Introduction to IoT (Mr Rex Chim)

- What is IoT and practices in STEM Education
- Different types of micro:bit IoT board
- Different IoT platforms

## 2. Hands-on practices (Ms Ana Lam)

- Monitoring temperature using temperature sensor (DS18B20) and *ThingSpeak*
- Monitoring temperature at *KidsIoT* and remote control the servo motor

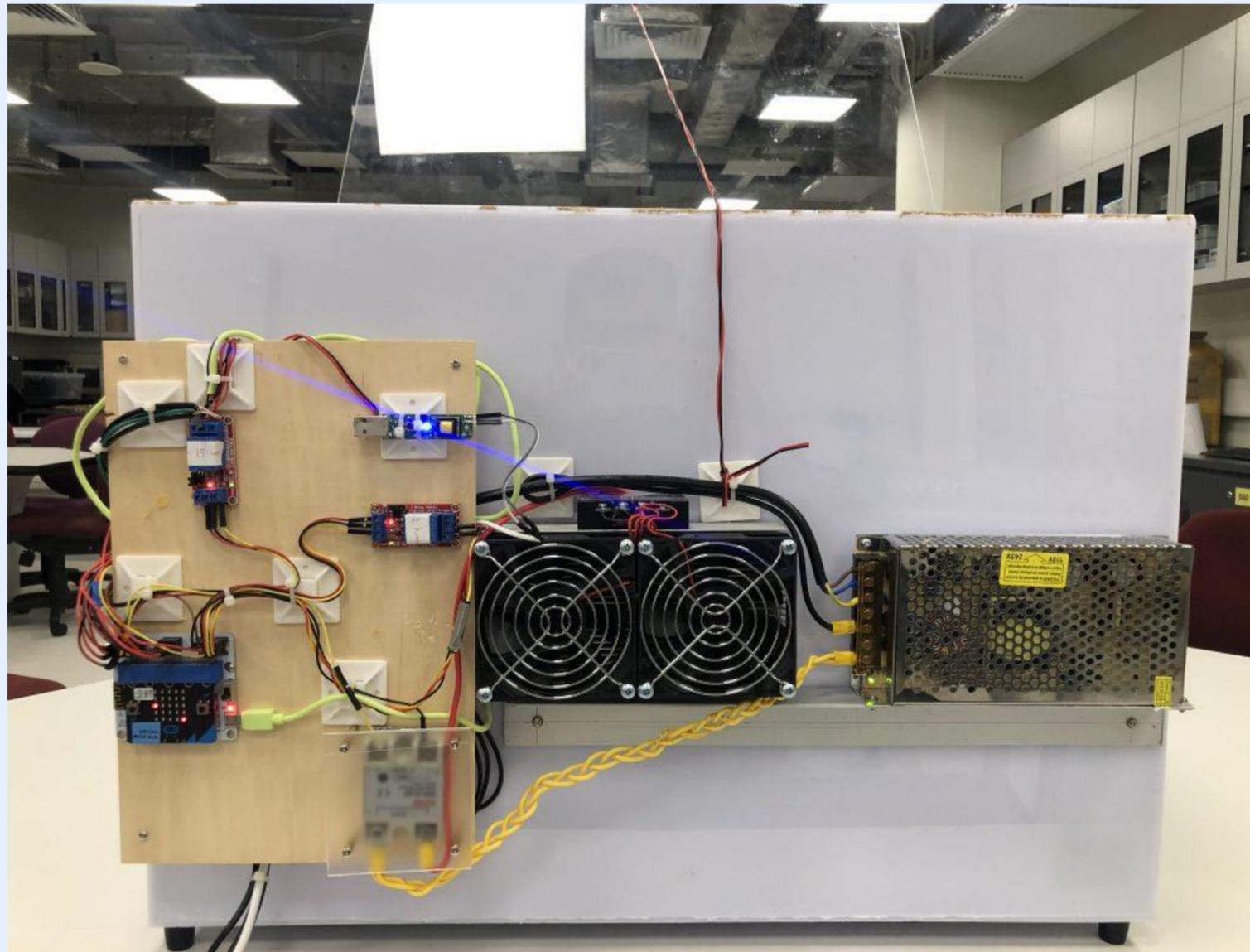
## 3. Assessment in STEM Education (Dr Bill Yeung)

# 1. Introduction about IoT and practices in STEM Education

# What is IoT



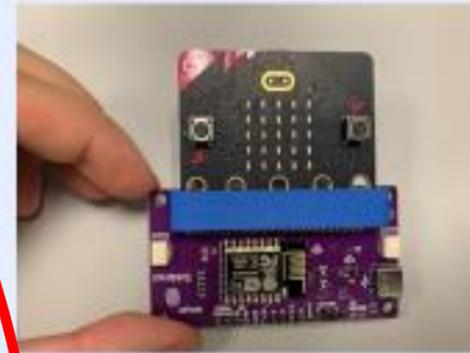
# Uses of IoT in STEM Education



Micro:bit-driven Greenhouse  
Hydroponic Device with IoT

<https://stemsdl21.eduhk.hk/index.php/resources/project-works/iot/iotgreenhouse/>

# Micro:bit IoT Board Comparison



	Esp-01 Wifi module	iot:bit	WiFi:bit	MuseLab
Price (HKD)	6	130	159	646
Difficulty	Advance	Medium	Medium	Easy
Coding platform	Makecode	Makecode	Makecode	Makecode + Scratch + Snap!
IoT Platform Support	ThingSpeak	ThingSpeak, IFTTT, MQTT, Kidslot	ThingSpeak	Cisco, Amazon Alexa, Google Home, IFTTT, ThingSpeak
Source	Esp-01: Taobao or any local STEM material vendors	ELECFREAKS	ETC Educational Technology Connection (HK) Ltd	華輝無線電行有限公司 -門市

# Different IoT platforms

 ThingSpeak

  
Google Assistant

  
IBM Watson

  
CISCO

**IFTTT**

  
ORACLE



 Microsoft Azure  
IoT Platform

  
Kids' IoT

  
amazon alexa

## 2. Hands-on Practices

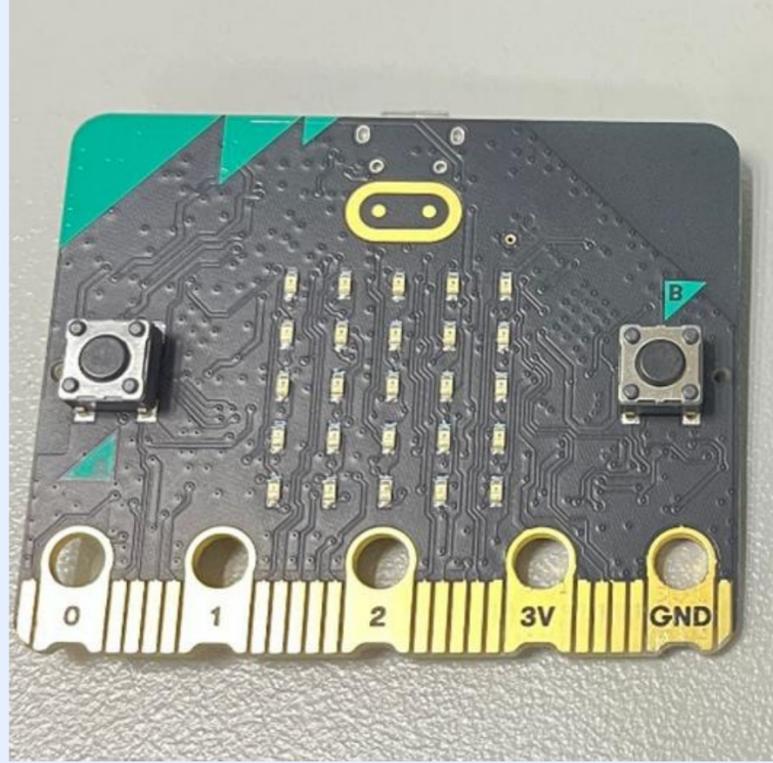
### 2.1. Monitoring temperature using temperature sensor (DS18B20) and ThingSpeak



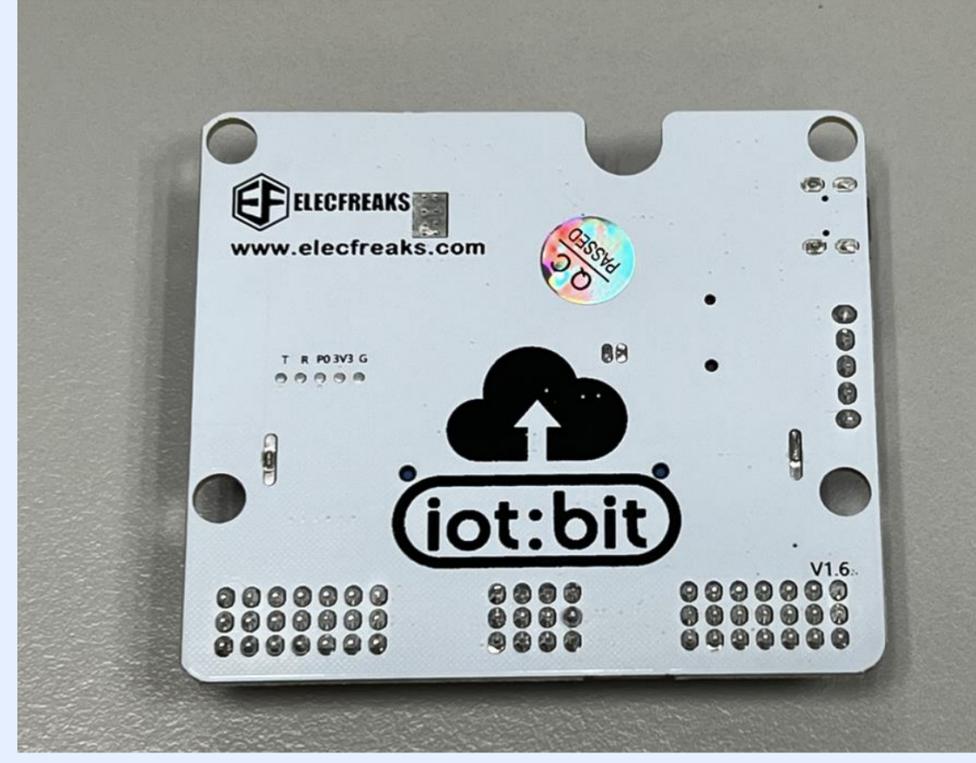
# Materials



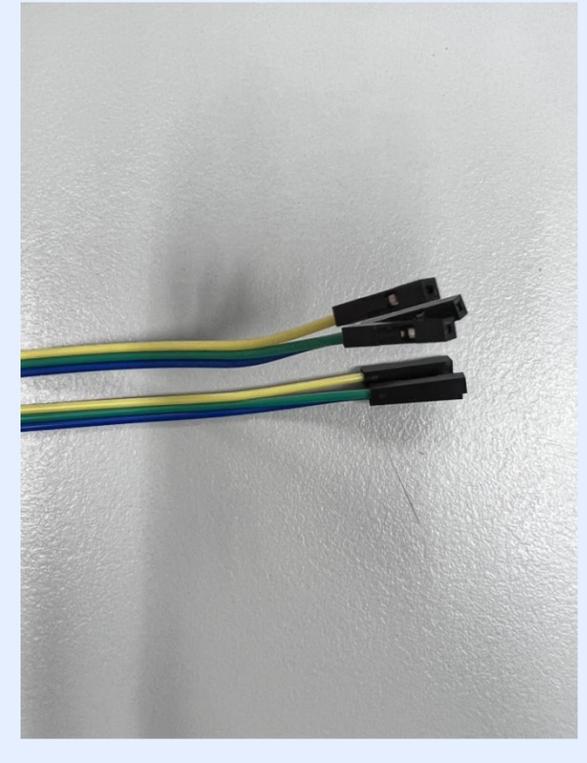
Water-proof  
Temperature Sensor  
(DS18B20)



Micro:bit



IoT Board

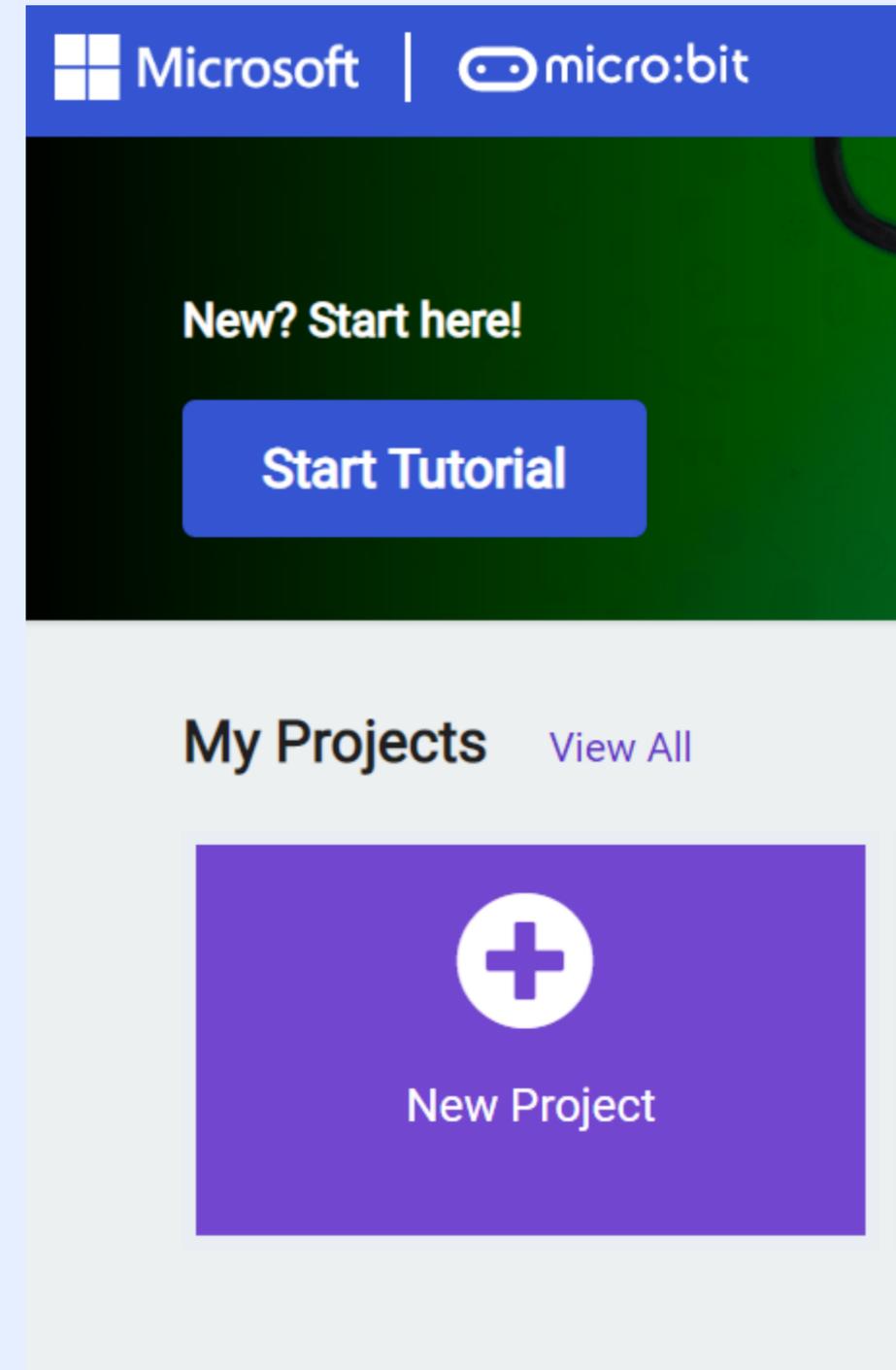


Dupont  
Jumper Cables

# Makecode

<https://makecode.microbit.org/>

➤ New Project and name the project



# Add Extensions

The screenshot displays the Microsoft MakeCode micro:bit editor. The top navigation bar includes the Microsoft logo, the 'micro:bit' label, and tabs for 'Blocks' (selected) and 'JavaScript'. On the right side of the navigation bar are icons for home, share, help, and settings. The left-hand block palette lists various categories: Input, Music, Led, Radio, Loops, Logic, Variables, Math, Extensions (circled in red), and Advanced. The main workspace shows a script with two blocks: 'on start' and 'forever'. The bottom of the editor features a 'Download' button, a workspace name 'KSK workshop1', and several utility icons like save, refresh, and zoom.

# 1. Add DS18B20 to Makecode

Add extension: <https://github.com/DFRobot/pxt-ds18b20>

<https://github.com/DFRobot/pxt-ds18b20>

Lights and Display

Software

Science

Robotics

Gaming

Networking

Microsoft | micro:bit

**ds18b20**

DFRobot pxt-ds18b20,read  
temperature by ds18b20

User-provided extension, not  
endorsed by Microsoft. Learn M

Logic

Variables

Math

**DS18B20**

Octopus

OLED

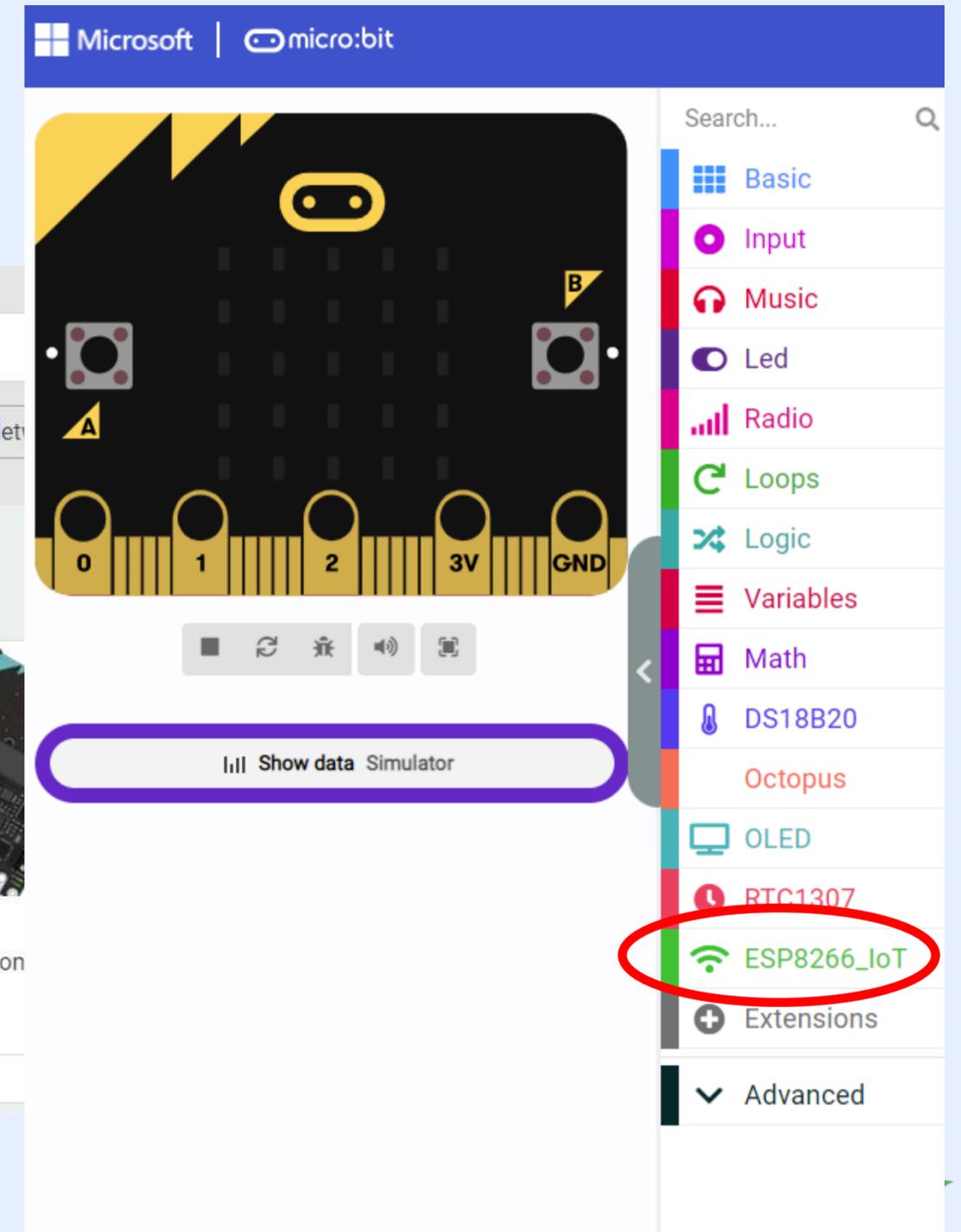
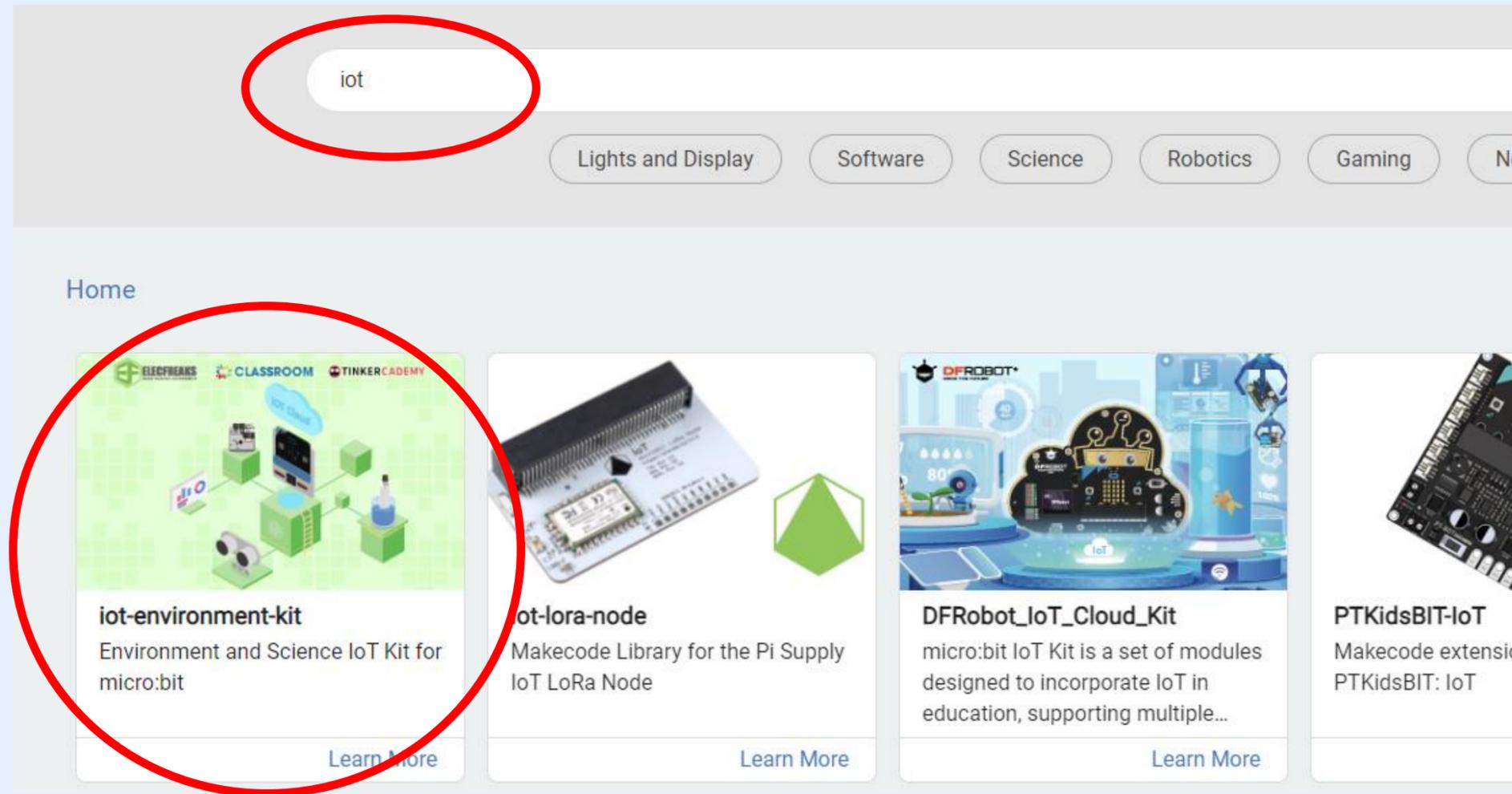
RTC1307

ESP8266\_IoT

Extensions

# 2. Add IoT-environment-kit to Makecode

## Add extension: IoT-environment-kit



# Coding

Link: [https://makecode.microbit.org/\\_Y2g2v4XAq4rq](https://makecode.microbit.org/_Y2g2v4XAq4rq)

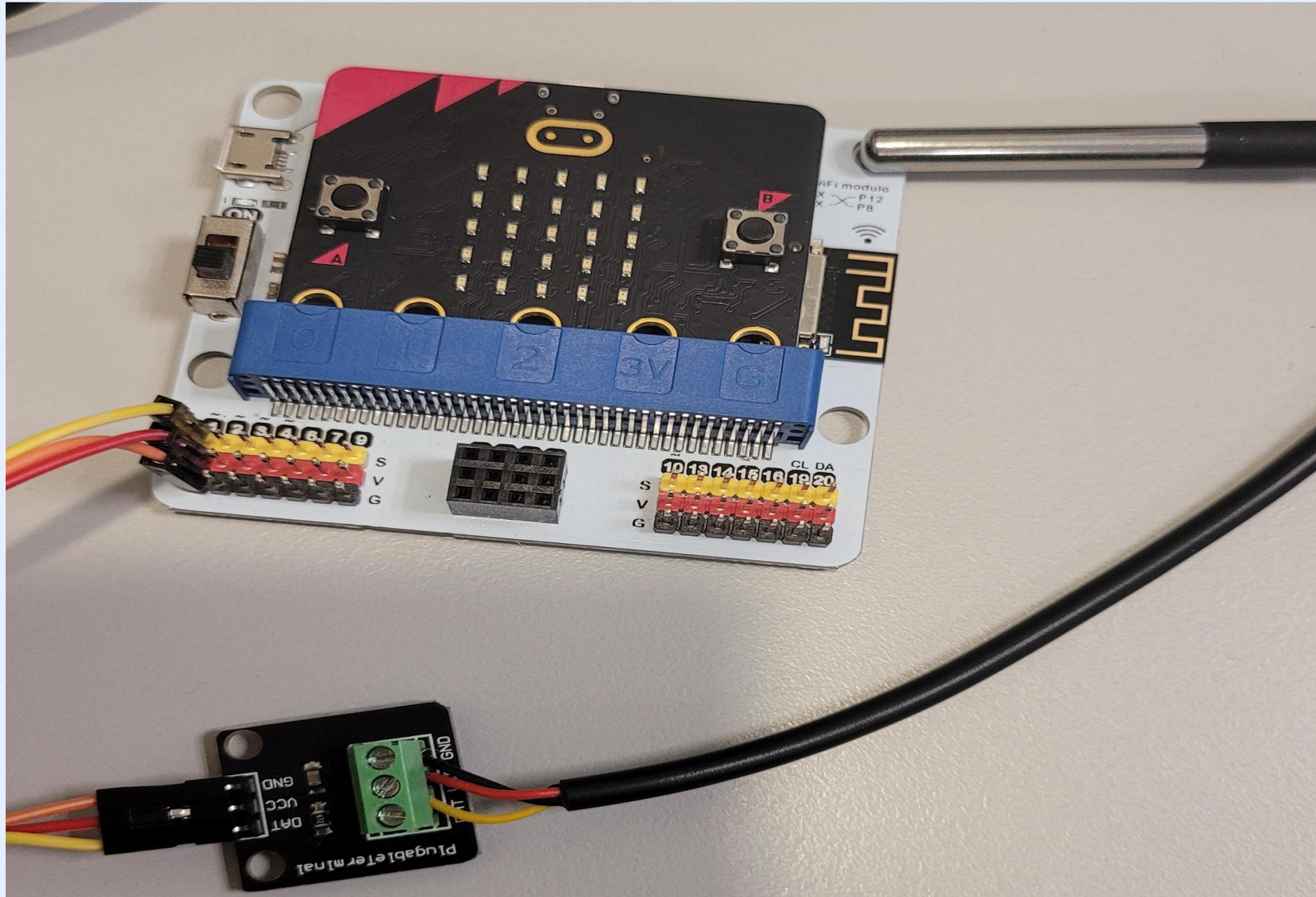
```
on start
  set ESP8266 RX P8 TX P12 Baud rate 115200
  connect Wifi SSID = "KSKC_eLearning" KEY = "Kskc24699010"
  if Wifi connected true then
    show icon [grid icon]
```

Drag in these blocks.  
Then enter the Wi-Fi name and  
the password.

```
forever
  connect thingspeak
  set data to send ThingSpeak
  Write API key = "DP3P89XWFT9JD7M0"
  Field 1 = pin1 Temperature_number
  Upload data to ThingSpeak
  show number pin1 Temperature_number
  pause (ms) 2000
```

Change the API key  
(Copy the API key from  
your ThingSpeak  
account)

# Temperature sensor setting



## Sign Up to

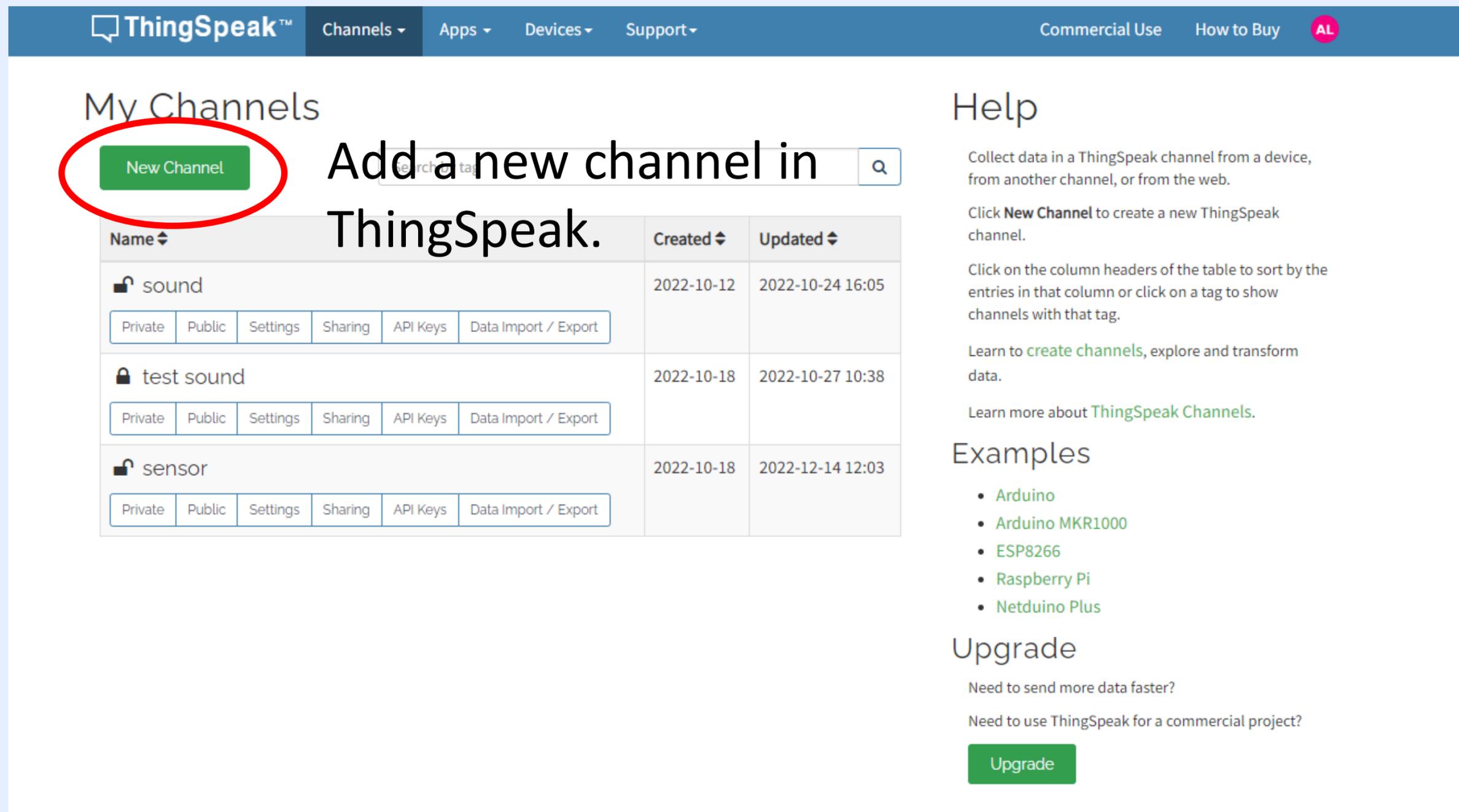
<https://thingspeak.com/login?skipSSOCheck=true>

The screenshot shows the ThingSpeak login interface. At the top, there is a navigation bar with 'ThingSpeak™', 'Channels', 'Apps', 'Support', 'Commercial Use', and 'How to Buy'. Below the navigation bar, there is a message: 'To use ThingSpeak, you must sign in with your existing MathWorks account or create a new one. Non-commercial users may use ThingSpeak for free. Free accounts offer limits on certain functionality. Commercial users are eligible for a time-limited free evaluation. To get full access to the MATLAB analysis features on ThingSpeak, log in to ThingSpeak using the email address associated with your university or organization. To send data faster to ThingSpeak or to send more data from more devices, consider the paid license options for commercial, academic, home and student usage.'

The login form includes the MathWorks logo, an 'Email' input field, and a 'Next' button. Below the input field, there are links for 'No account? Create one!' and a note: 'By signing in, you agree to our privacy policy.'

Below the login form is a diagram illustrating the IoT architecture. It shows 'SMART CONNECTED DEVICES' connected to a central router. The router is connected to a cloud labeled 'DATA AGGREGATION AND ANALYTICS ThingSpeak™'. The cloud is connected to a computer monitor labeled 'MATLAB®' and 'ALGORITHM DEVELOPMENT SENSOR ANALYTICS'.

# Create a New Channel



ThingSpeak™ Channels Apps Devices Support Commercial Use How to Buy AL

## My Channels

[New Channel](#)

Search by tag

## Add a new channel in ThingSpeak.

Name	Created	Updated
sound <a href="#">Private</a> <a href="#">Public</a> <a href="#">Settings</a> <a href="#">Sharing</a> <a href="#">API Keys</a> <a href="#">Data Import / Export</a>	2022-10-12	2022-10-24 16:05
test sound <a href="#">Private</a> <a href="#">Public</a> <a href="#">Settings</a> <a href="#">Sharing</a> <a href="#">API Keys</a> <a href="#">Data Import / Export</a>	2022-10-18	2022-10-27 10:38
sensor <a href="#">Private</a> <a href="#">Public</a> <a href="#">Settings</a> <a href="#">Sharing</a> <a href="#">API Keys</a> <a href="#">Data Import / Export</a>	2022-10-18	2022-12-14 12:03

## Help

Collect data in a ThingSpeak channel from a device, from another channel, or from the web.

Click **New Channel** to create a new ThingSpeak channel.

Click on the column headers of the table to sort by the entries in that column or click on a tag to show channels with that tag.

Learn to [create channels](#), explore and transform data.

Learn more about [ThingSpeak Channels](#).

## Examples

- [Arduino](#)
- [Arduino MKR1000](#)
- [ESP8266](#)
- [Raspberry Pi](#)
- [Netduino Plus](#)

## Upgrade

Need to send more data faster?

Need to use ThingSpeak for a commercial project?

[Upgrade](#)

## At New Channel:

### New Channel

Name

Description

Field 1	<input type="text" value="Field Label 1"/>	<input checked="" type="checkbox"/>
Field 2	<input type="text"/>	<input type="checkbox"/>
Field 3	<input type="text"/>	<input type="checkbox"/>
Field 4	<input type="text"/>	<input type="checkbox"/>
Field 5	<input type="text"/>	<input type="checkbox"/>
Field 6	<input type="text"/>	<input type="checkbox"/>
Field 7	<input type="text"/>	<input type="checkbox"/>
Field 8	<input type="text"/>	<input type="checkbox"/>

Metadata

Tags   
(Tags are comma separated)

Link to External Site

Link to GitHub

Enter the  
Name and  
field name.

# Copy the API Key at ThingSpeak

Channel ID: 2069594  
Author: mwa0000027897217  
Access: Private

Private View Public View Channel Settings Sharing **API Keys** Data Import / Export

+ Add Visualizations + Add Widgets Export recent data

### Channel Stats

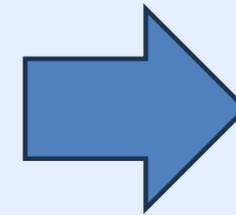
Created: [less than a minute ago](#)  
Entries: 0

Field 1 Chart

pH

Date

ThingSpeak.com



Channel ID: 2069594  
Author: mwa0000027897217  
Access: Private

Private View Public View Channel Settings Sharing **API Keys** Data

### Write API Key

Key **2SG9P7UL2CSAHXQF**

Generate New Write API Key

# Paste the API Key (from ThingSpeak) to MakeCode

## At MakeCode

```
on start
  set ESP8266 RX P8 TX P12 Baud rate 115200
  connect Wifi SSID = "KSKC_eLearning" KEY = "Kskc24699010"
  if Wifi connected true then
    show icon [grid icon]
```

```
forever
  connect thingspeak
  set data to send ThingSpeak
  Write API key = "DP3P89XWFT9JD7M0"
  Field 1 = pin1 Temperature_number
  Upload data to ThingSpeak
  show number pin1 Temperature_number
  pause (ms) 2000
```

Paste here.

# Sharing the link

Channel ID: 2069594  
Author: mwa0000027897217  
Access: Private

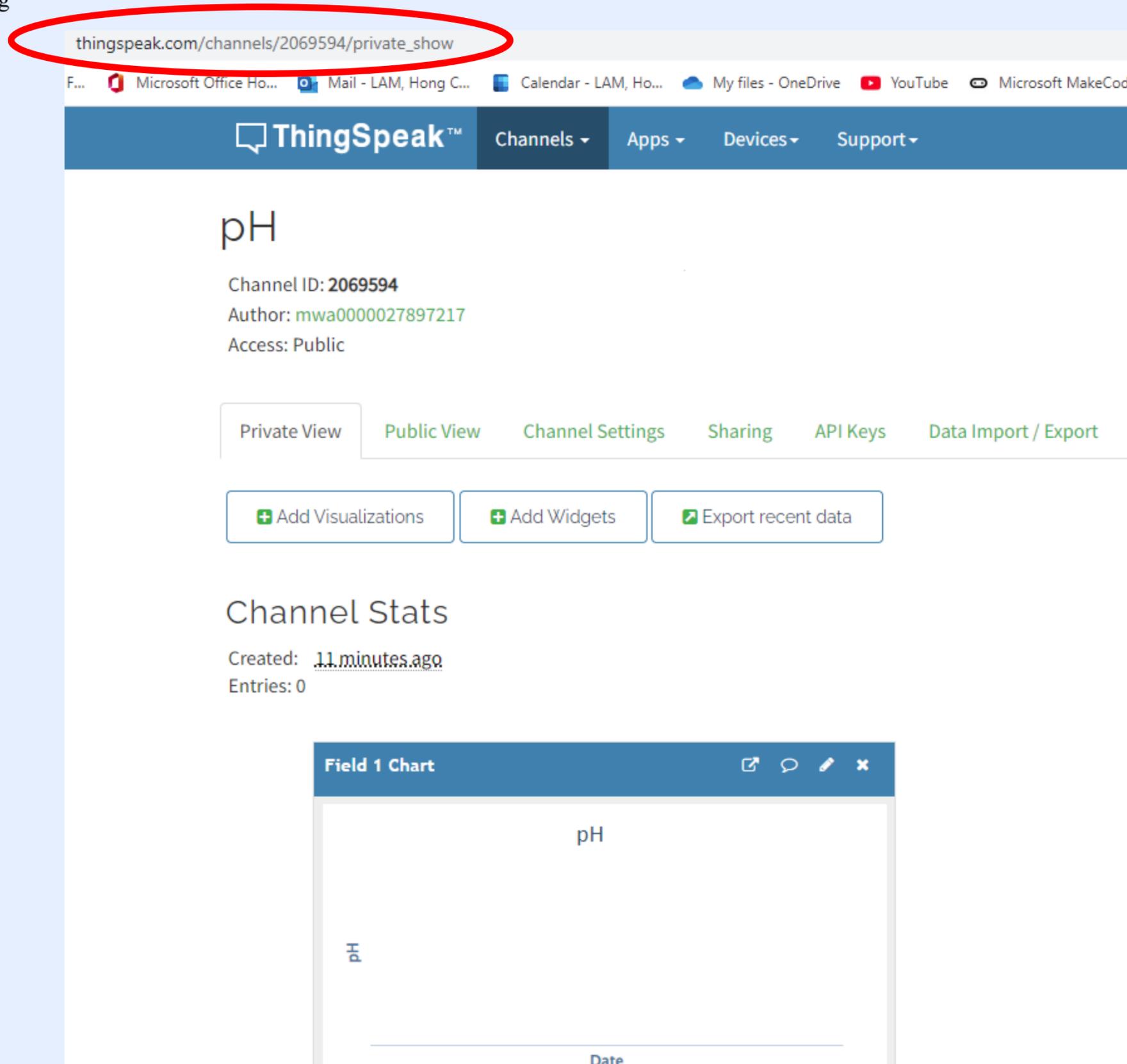
Private View   Public View   Channel Settings   **Sharing**   API Keys

## Channel Sharing Settings

Keep channel view private  
 Share channel view with everyone  
 Share channel view only with the following users:

Email Address     

If you want to share the data with everyone with the link, click here.



The screenshot shows a web browser window displaying a ThingSpeak channel page. The address bar at the top contains the URL `thingspeak.com/channels/2069594/private_show`, which is circled in red. Below the browser window, the ThingSpeak interface is visible, including the channel name 'pH', its ID '2069594', author 'mwa0000027897217', and access level 'Public'. There are navigation tabs for 'Private View', 'Public View', 'Channel Settings', 'Sharing', 'API Keys', and 'Data Import / Export'. Below these are buttons for '+ Add Visualizations', '+ Add Widgets', and 'Export recent data'. The 'Channel Stats' section shows 'Created: 11 minutes ago' and 'Entries: 0'. At the bottom, a 'Field 1 Chart' is partially visible, showing a graph with 'pH' on the y-axis and 'Date' on the x-axis.

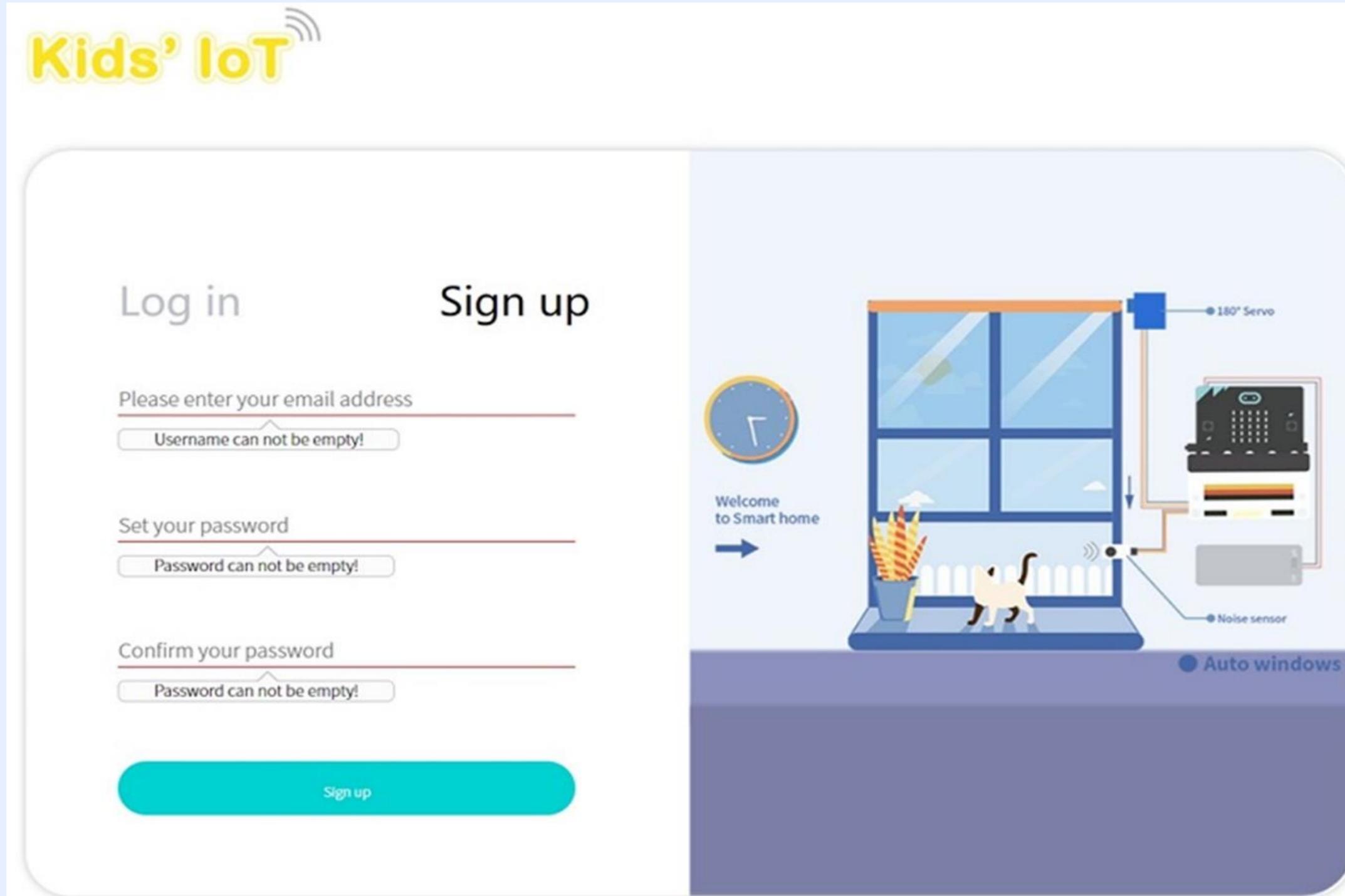
Share this link.

## 2. Hands-on Practices

2.2. Monitoring temperature at KidsIoT and remote control the servo motor



Sign Up to <https://www.kidsiot.cn/>



**Kids' IoT**

Log in      Sign up

Please enter your email address  
Username can not be empty!

Set your password  
Password can not be empty!

Confirm your password  
Password can not be empty!

Sign up

Welcome to Smart home

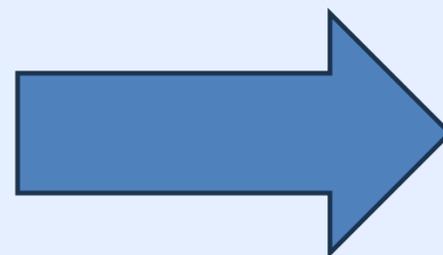
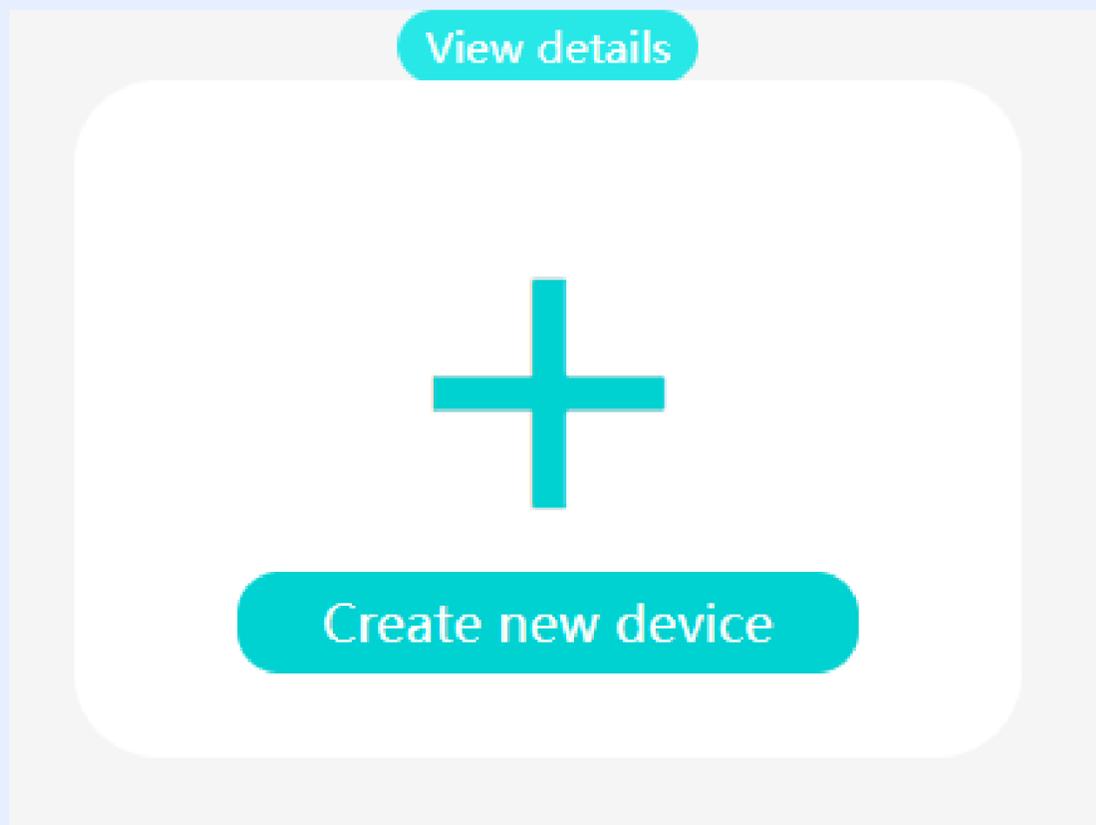
180° Servo

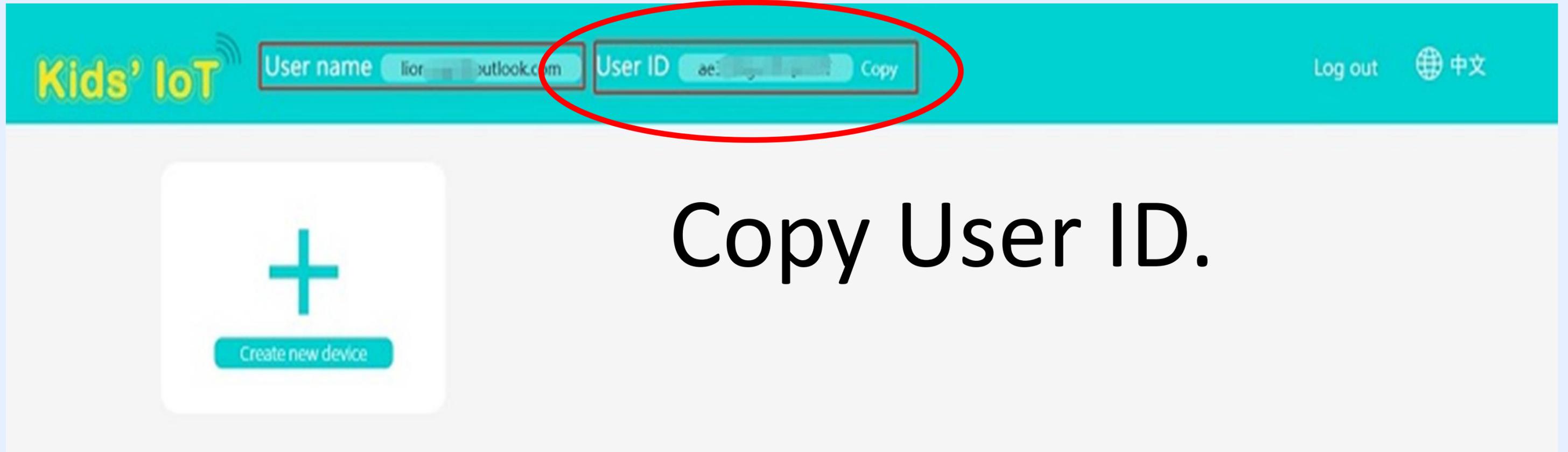
Noise sensor

Auto windows

The screenshot displays the 'Kids' IoT' website interface. On the left, there is a sign-up form with three input fields: 'Please enter your email address' (with a 'Username can not be empty!' error message), 'Set your password' (with a 'Password can not be empty!' error message), and 'Confirm your password' (with a 'Password can not be empty!' error message). A teal 'Sign up' button is at the bottom. On the right, a diagram illustrates a smart home setup. It features a window with a '180° Servo' motor, a 'Noise sensor', and 'Auto windows' functionality. A clock shows the time as approximately 10:10, and a cat is visible on the floor near the window.

Create new device, “Topic” is the only identification code (the only device in the account), and you can revise the device name (only 10 devices can be created).





**Copy User ID.**

Kids' IoT

User name

User ID: 6YqrAlj1jXN

Log out

中文

Click "View Details" to see the data table and figure.

Return to device list

Equipment\_2

Last 10 Last 100 Export Data

No.	Time	Data
1	2019-11-02 16:13:58	29
2	2019-11-02 16:13:53	25
3	2019-11-02 16:13:48	42
4	2019-11-02 16:13:43	46
5	2019-11-02 16:13:38	48
6	2019-11-02 16:13:33	50
7	2019-11-02 16:13:28	47
8	2019-11-02 16:13:21	47
9	2019-11-02 16:13:16	15
10	2019-11-02 16:13:11	30



Remote Control

# Coding - KidsIoT setting

```
on start
  set ESP8266 RX P8 TX P12 Baud rate 115200
  connect Wifi SSID = "KSKC_eLearning" KEY = "Kskc24699010"
  if Wifi connected true then
    show icon [grid icon]
  +
  forever
    Connect KidsIoT with userToken: "c594CKqlCttIMyr0" Topic: "1"
    Upload data pin1 Temperature_number to kidsiot
    pause (ms) 2000
```

User ID

Topic number

# Different types of servo motor



Micro-servo motor  
(SG-90) (Analog Vs  
Digital)



High Torque Servo Motor  
Metal Gear  
MG995 (Analog –180/360  
Degree)

# Servo motor (Analog Vs Digital)

- Analog signal is a continuous signal --> use to give signal of angles
- Digital signals are time-separated signals --> e.g. 1 or 0

## At Makecode

```
on start
  set ESP8266 RX P8 TX P12 Baud rate 115200
  connect Wifi SSID = "KSKC_eLearning" KEY = "Kskc24699010"
  if Wifi connected true then
    show icon [grid icon]

forever
  Connect KidsIoT with userToken: "c594CKq1CttIMyr0"
  Upload data pin1 Temperature_number to kidsiot
  pause (ms) 2000

When switch on
  if pin1 Temperature_number > 30 then
    servo write pin P2 to 180
  else
    servo write pin P2 to 90
```

Link: [https://makecode.microbit.org/\\_FtMJWL3XU7jq](https://makecode.microbit.org/_FtMJWL3XU7jq)

# KidsIoT setting(Remote Control) Analog servo

```
on start
  set ESP8266 RX P8 TX P12 Baud rate 115200
  connect Wifi SSID = "KSKC_eLearning" KEY = "Kskc24699010"
  if Wifi connected true then
    show icon [grid icon]
    servo write pin P2 to 0
```

```
forever
  Connect KidsIoT with userToken: "c594CKqlCttIMyr0" Topic: "1"
  Upload data pin1 Temperature_number to kidsiot
  pause (ms) 2000
```

```
When switch on
  if pin1 Temperature_number > 30 then
    servo write pin P2 to 90
    pause (ms) 2000
  else
    servo write pin P2 to 0
```

Link: [https://makecode.microbit.org/\\_bfp49HDt7bJT](https://makecode.microbit.org/_bfp49HDt7bJT)

# KidsIoT setting(Remote Control)

**Kids' IoT** User name  User ID 6YqrAhurNXIN  Log out 中文

Return to device list

### Equipment\_2

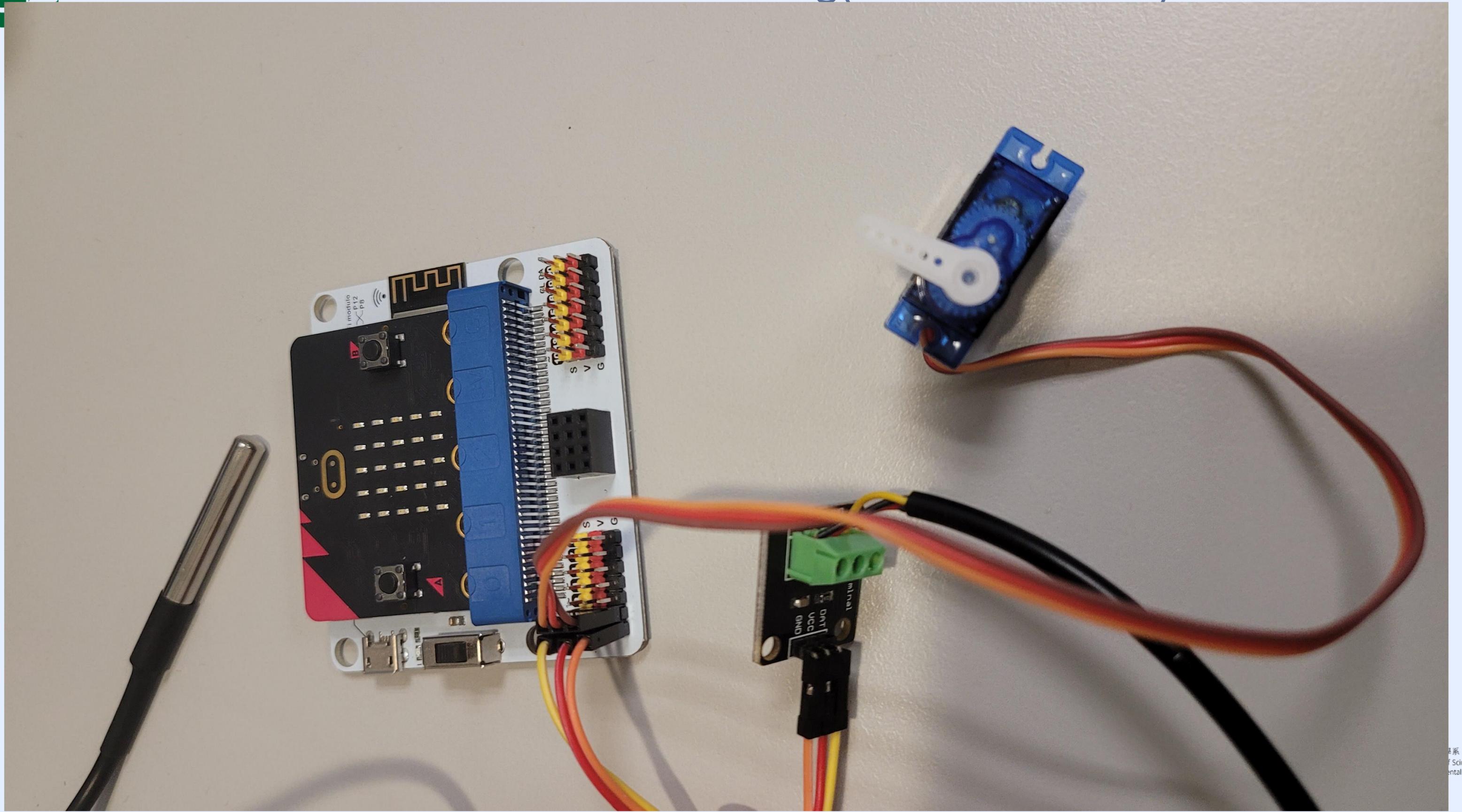
\* Last 10 Last 100 Export Data

No.	Time	Data
1	2019-11-02 16:13:58	29
2	2019-11-02 16:13:53	25
3	2019-11-02 16:13:48	42
4	2019-11-02 16:13:43	46
5	2019-11-02 16:13:38	48
6	2019-11-02 16:13:33	50
7	2019-11-02 16:13:28	47
8	2019-11-02 16:13:21	47
9	2019-11-02 16:13:16	15
10	2019-11-02 16:13:11	30

Remote Control  Can only remote one time!!!

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# KidsIoT setting(Remote Control)



# 3. Assessment in STEM Education

