香港教育大學
The Education University of Hong Kong

A Project entitled

Develop an IoT STEM Course Package: Smart Home simulation with Micro:bit

Submitted by

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submitted to The Education University of Hong Kong

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Declaration

I, *Choi Yiu Tung* declare that this research report represents my own work under the supervision of *Dr. Cheng Kwok Shing Gary*, and that it has not been submitted previously for examination to any tertiary institution.

Signed

Choi Yiu Tung

7 April 2023

Contents

1. Introduction

The Internet of Things (IoT) is an emerging field transforming how we interact with technology in our daily lives. According to a study from Marketsandmarkets(2021), the IoT industry revenue will increase from 300.3 billion USD to 650.5 billion USD. With the increasing prevalence of IoT devices in homes, schools, and workplaces, individuals need to understand the underlying concepts and technologies that make these devices possible.

In this capstone project, a completed course package includes nine lessons with lesson plans, PowerPoint and assessment materials. They are designed to introduce students to the concepts and principles of IoT, Smart Home, basic programming, and the IoT life cycle. The following contents include the whole concept of this course for educators to understand and exploit the course package in their teaching.

2. Literature review

2.1 Internets of Things in STEM Education

The Internet of Things(IoT) is a new technology field commonly involved in science. As IoT is generally a real-world problem that is close and familiar to students, it facilitates motivation and interest in learning such a topic. In the research from Kusmin(2019), students are actively involved in learning IoT with scenario-based learning, such as "smart Schoolhouse by means of IoT," which is a project to implement IoT devices to solve real-world problems from problem-solving skills and innovative teaching materials. Students will be more involved in a practical experience. Also, career preference in the IoT field increased after IoT stem lessons from the

research. Student Engagement increased and enhanced overall participation and facilitated cooperation, knowledge, and skills acquisition.

2.2 STEM education with Smart Home Technologies

Smart home technology provides an ideal platform for teaching IoT-based STEM concepts, allowing students to interact with a system that is familiar and relevant to their daily lives. The integration of smart home technology in STEM education can provide students with hands-on experience in building and programming connected devices, enabling them to develop skills in coding, data analysis, and critical thinking (Chen & Wu, 2018).

3. Course Design

The course is designed for two secondary students with a unanimous goal of conceptualizing IoT and Smart Home technologies and learning basic programming using micro:bit. Focusing on promoting problem-solving skills and creative thinking by presenting students with real-world problems and challenges. Lastly, The course package will emphasize active learning, with various activities and projects designed to engage students and encourage participation.

3.1 Course structure

The IoT smart home stem course consists of 9 lessons, each lesson with one assessment for learning and one assessment for learning. Totally four products and one project will be produced within the course. In the final lesson, students will present their project to the whole class as a learning achievement.

3.2 Lesson design

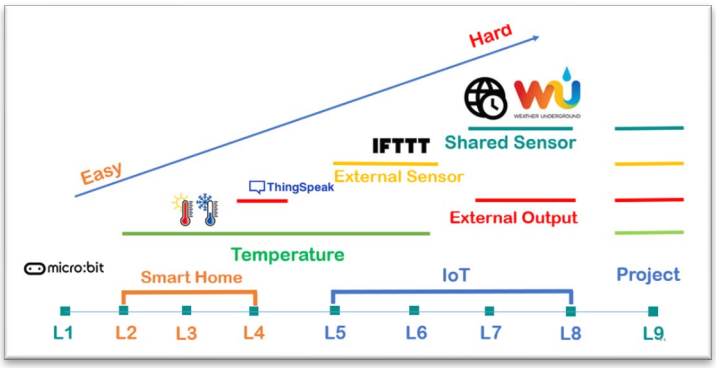


Figure 1 – Structure of the course

For the flow of nine lessons, coherence is the major objective. According to the figure 2, Learned skills is relevant to the next lessons and will be used in the final. The knowledge and products always inherit from the prior lessons to help students absorb and utilize the knowledge in order. As "Learning is most effective when it is organized into a coherent whole, with each element building on and supporting the others."(Wiggins, G., & McTighe, J. ,2005) The design of the lesson order assists students in learning with maximum efficiency.

L	Topic	Shorten Learning Objective	Skill	Product
1	Introduction of IoT and Smart Home	1. Understand the concept and applications of the (IoT) 2. Aware of the field and criteria of IoT implementation	IoT life cycle Smart Home basis	
2	Micro:bit – Basic	1. Introduction to Micro:bit 2. Extension board – IoT:bit	a. Active OLED b. Show number/string c. Install IoT:bit	Hello Word
3	Micro:bit – Advance	Advance Micro:bit programming	a. Variable b. if-else statement c. Retrieved data	Temperature Alarm *Combine Lesson **2** skills
4	Micro:bit – SmartHome	1. Control physical components 2. Complete an Automatic task	a. Control components b. Connect GVS port	Automatic Temperature Controls *Combine Lesson **2,3** skills
5	IoT – Data Visualize	1. Introduction to ThingSpeak 2. Data upload and analysis in ThingSpeak	a. Connect sensors b. Retieved data from sensors c. ThingSpeak	Home Monitor *Combine Lesson **2,3,4** skills
6	IoT –Notice with Email	1. Introduction to IFTTT 3. Completion of a Data life cycle	a. Create Applet	Home monitor + Notice *Combine Lesson **2,3,4,5** skills
7	IoT – NTP Clock	1. Introduction to NTP 2. Retrieve data from the Internet	a. Access Internet data	NTP clock + Smart light *Combine Lesson **2,3,4,5,6** skills
8	IoT – Shared sensor	1. Utilize the shared Internet data and sensor 2. Control micro:bit through the IFTTT applet	a. Access service b. Control Micro:bit through the Internet	Automatic light/window *Combine **all** Lesson skills
9	Project – Smart home tour	1. Showing the learning accomplishment		**ALL skills**

Figure 2 – Lessons overview of the course

Concept – IoT life cycle

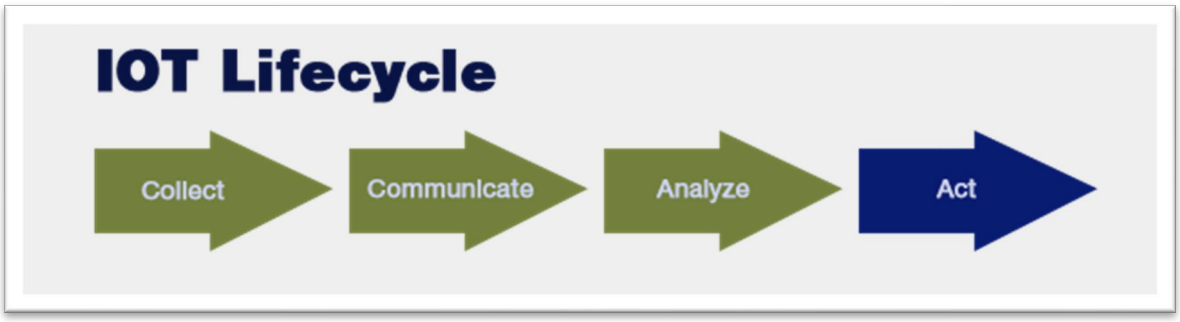
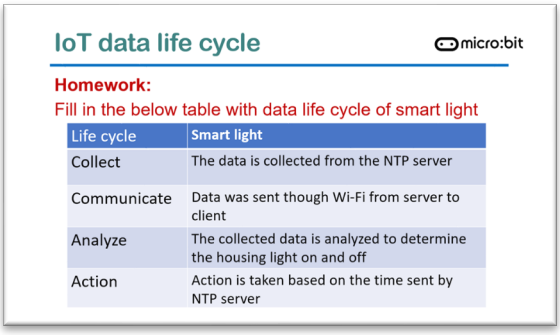


Figure 3 – IoT life cycle

The IoT life cycle plays a crucial role in the course by providing a framework for students to understand the flow of data in IoT systems. Students must follow the life cycle when designing and implementing IoT systems as the cycle can guarantee the products fulfilled IoT characteristic. Therefore, the table of IoT life cycle is provided in different lessons and assessment to assess their understanding of IoT(Figure 3).



IoT data life cycle

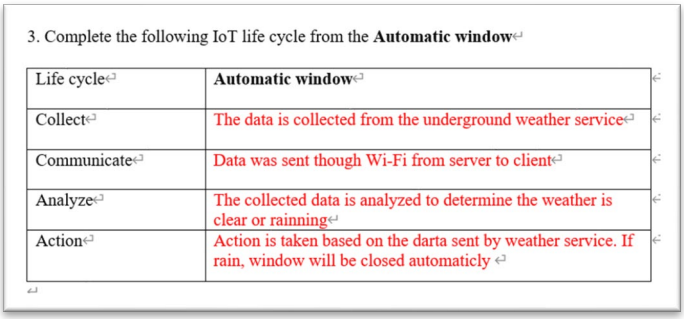
micro:bit

Homework:

Fill in the below table with data life cycle of smart light

Life cycle	Smart light
Collect	The data is collected from the NTP server
Communicate	Data was sent though Wi-Fi from server to client
Analyze	The collected data is analyzed to determine the housing light on and off
Action	Action is taken based on the time sent by NTP server

Figure 4 – "IoT life cycle" table of L8 from PPT



3. Complete the following IoT life cycle from the **Automatic window**

Life cycle	**Automatic window**
Collect	The data is collected from the underground weather service
Communicate	Data was sent though Wi-Fi from server to client
Analyze	The collected data is analyzed to determine the weather is clear or rainning
Action	Action is taken based on the darta sent by weather service. If rain, window will be closed automaticly

Figure 5 – "IoT life cycle" table from WS8

3.3 Teaching Materials

a. Tools

Micro:bit

The main platform of the course is to introduce coding and electronics with blocky programming.

IoT:Bit

The extension board is manufactured by Smarthon. Provide WIFI connection, Extended Dupont wire connection port, and OLED. A core tool to implement IoT technology in the course.

b. Lesson plan

Nine lesson plans consist of topics, learning objectives, learning outcomes and teaching contents. Detailed description outlined to ensure learner can access the topic in the correct order with coherence to achieve effective teaching.

c. PowerPoint

Each lesson had its own PowerPoint to visualize the teaching contents of the corresponding lesson. The slides can help the learner to understand the abstract concept with graphical. Moreover, detailed instructions are included to help students follow instructions from complicated activities such as ThingSpeak registration(Figure 6) and programming. Therefore, the guidance is suggested to be printed and distributed to students to assist the slow learner.

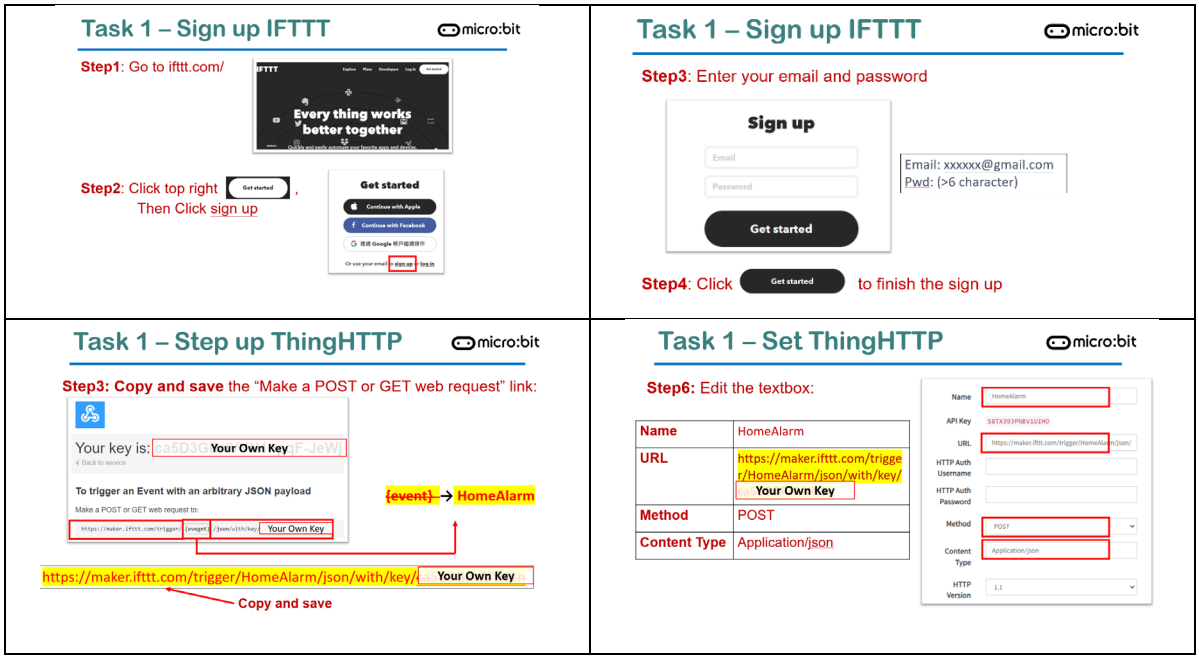


Figure 6 – PowerPoint slides of Lesson 6 – Steps of activite

d. Assessment

Worksheet

For each lesson, a worksheet will be printed for every student. Each worksheet is divided into three parts:

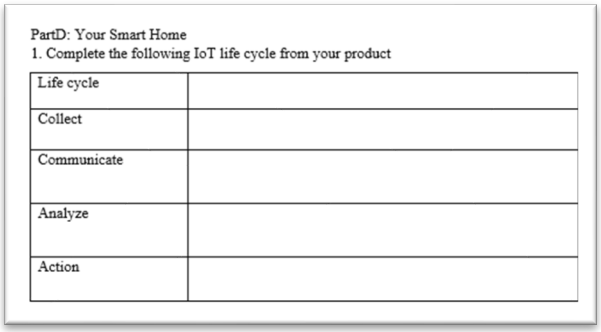
Part A is a class exercise that requires students to complete the question during the class. Those questions are synchronized with the teaching content from the corresponding PowerPoint. The design implements assessment for learning which help teachers access and monitor the student's comprehension during the class.

Part B is a home exercise for the student to finish the assessment at home, which is an assessment of learning for the teacher to evaluate the learning progress of each lesson. The question is focused on the corresponding lesson's contents.

Part C is the inquiry-based question section for students to answer the question proposed at the beginning of class. The question had no model or suggested answer as the purpose is for brain-storming to engage student interest and critical thinking. Teachers are advised to review and give feedback on the answer to assess student understanding for the effectiveness of inquiry-based learning.

e. Project – Smart Home Tour

The project will be introduced at the end of the 8th lesson as the final project and assessment of learning of the course. The requirement and outline are designed based on the learning outcome of this course. Students need to utilize all the learned concepts and skills to finish the product which is "Smart home automatic task", "IoT life cycle", "Data Visualize", and "IFTTT applets". Four people as a group to build their smart home and present it on the 9th present. Moreover, students must complete worksheet 8, which is also designed with instructional guidance to check if their product fulfilled the requirement(Figure 7). If student ability is under expectations, they can apply and combine all the products in the previous to complete the project.



PartD: Your Smart Home
1. Complete the following IoT life cycle from your product

Life cycle	
Collect	
Communicate	
Analyze	
Action	

Figure 7 – IoT life cycle from WS8 for Project

To maximize the project's outcome and cope with the diversity in the classroom, heterogeneous grouping in peer scaffolding is advised. The mixing ability in a group can help students be

exposed to a more comprehensive approach. Also, Low ability students who are grouped with higher-ability peers may benefit from the higher level of academic discourse and problem-solving, which is also a solution for the diversity of the classroom.

3.4 Pedagogy implementation

Inquiry-based question

L	Topic	Inquiry-based questioin
1	Introduction of IoT and Smart Home	How has IoT impacted the way we live?
2	Micro:bit – Basic	
3	Micro:bit – Advance	What type of feature from Micro:bit can be implemented on Smart Home?
4	Micro:bit – SmartHome	What products of Smart Home can be made by Micro:bit?
5	IoT – Data Visualize	Why visualized and online data is important to home?
6	IoT –Notice with Email	Why "Action" still need when we already have Smart Home automatic service?
7	IoT – NTP Clock	What kind of data can be collected from the internet?
8	IoT – Shared sensor	Why we used shared online data instead of our sensor? What are their differences?

Figure 8– Table of Inquiry-based questions in the course

The lessons consist of 7 inquiry-based ones at the beginning of lessons and homework. Inquiry-based questions help students in STEM education develop critical thinking and problem-solving skills by providing opportunities to explore, investigate, and experiment. (NRC, 2012) This approach allows them to explore the concepts and applications of these technologies and develop a deeper understanding of how they work and encourage active learning.

Scaffolding theory

Scaffolding	Materials and explainatioin
Prior Knowledge/ backtracking	PowerPoint: Review the prior lesson Design: Inherit knowledge and skill
Demonstrating/ Explaining	PowerPoint: Detailed step to follow
peer	Heterogeneous grouping
Materials	Provide worksheet, powerpoint to suppot the teaching and learning
Question	Inquiry based question to engage active learning

Figure 9 – Scaffolding theory applied in the course package

Scaffolding is used in the course to consider the diversity of classrooms, focusing on scaffolding to support students of all abilities, such as Demonstrating, backtracking, peer and Materials.

Moreover, teachers are suggested to provide an extra week for consultation between lessons 8 and 9 to provide students have sufficient time and support to achieve better results.

Problem-based task

The task from the course is based on a real-world scenario which is a practical application. The task involved problem-based pedagogy, which promotes hands-on, active learning, and enhances students' problem-solving skills. By engaging in a task that requires the learned skills, the student can better understand the topic. According to a study by Savery and Duffy (2001), problem-based learning can improve student motivation, learning outcomes, and the ability to apply knowledge in real-world settings.

4. Pilot Study

A pilot study was conducted with ten secondary school students to evaluate the effectiveness of the course. The ten students did not know IoT but had limited Arduino programming knowledge.

4.1 Survey from 10 students

In knowledge achievement, students increase 56% and 43% understanding of the smart home and IoT concepts. They mostly agree the course developed new skills and knowledge and increased interest in the IoT field.

But for the degree of difficulty, students reflect that the activities are slightly difficult, such as the ThingSpeak and IFTTT tasks. The instruction can be further detailed to assist the student in catching up and understanding.

4.2 Problem Encountered

The technical issue is the main problem encountered in the pilot studies. The task required lots of hands-on tools, which made failure Frequently happen, such as WIFI connection problems, wire connections, malfunction of the device, etc. Those incidents slowed down and interrupted the lesson. Therefore, the teacher must have extensive experience and flexibility to coping the problems.

5. Discussion

The analysis of the outputs and pilot study data highlighted several important points. Firstly, the course design and lesson plans effectively achieved the learning objectives. The use of micro:bit

as a tool to learn IoT concepts and coding was well received by students, and they showed improvement in their programming skills throughout the program. The simulation of a smart home environment also helped to contextualize the concepts and made the learning more engaging for students.

Some challenges were encountered during the pilot study, such as technical issues with the micro:bit and the need for additional time to complete some of the activities. These issues were addressed through modifications to the lesson plans and technical support provided to students.

6. Conclusion

In conclusion, this course package for teaching IoT and smart home concepts with micro:bit is an effective secondary school STEM education tool. Using micro:bit as a tool for learning IoT and coding concepts was particularly effective, and the simulation of a smart home environment helped contextualize the learning for students. The course design and lesson plans were well-received by students, and the pilot study showed that the course achieved its learning objectives. Also, the package had modified after the pilot study to achieve a better version.

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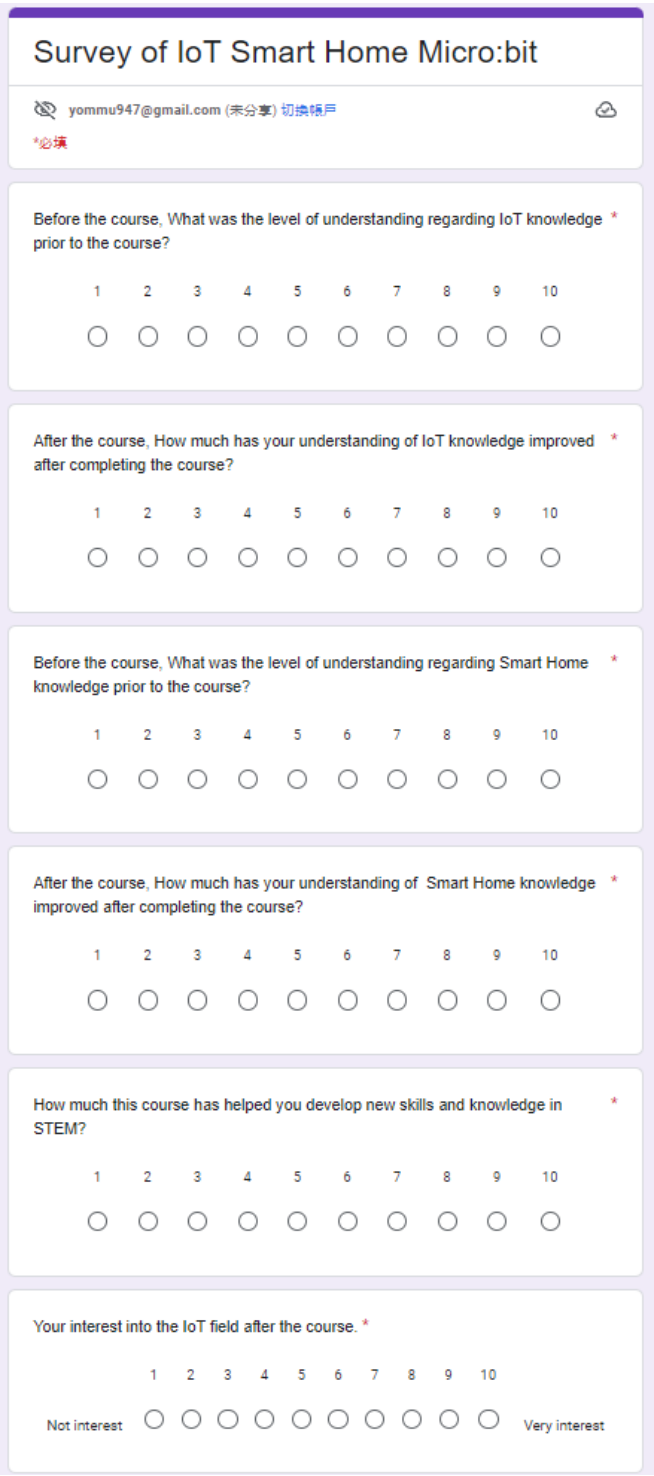
Appendix 1 – Pilot study survey



Survey of IoT Smart Home Micro:bit

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*必填

Before the course, What was the level of understanding regarding IoT knowledge prior to the course? *

1 2 3 4 5 6 7 8 9 10

After the course, How much has your understanding of IoT knowledge improved after completing the course? *

1 2 3 4 5 6 7 8 9 10

Before the course, What was the level of understanding regarding Smart Home knowledge prior to the course? *

1 2 3 4 5 6 7 8 9 10

After the course, How much has your understanding of Smart Home knowledge improved after completing the course? *

1 2 3 4 5 6 7 8 9 10

How much this course has helped you develop new skills and knowledge in STEM? *

1 2 3 4 5 6 7 8 9 10

Your interest into the IoT field after the course. *

1 2 3 4 5 6 7 8 9 10

Not interest — Very interest

Appendix 2 – Survey result from the 10 students

Survey data						
Students	Q1	Q2	Q3	Q4	Q5	Q6
A	7	10	8	9	7	5
B	4	7	6	10	8	5
C	6	8	3	9	10	7
D	6	8	6	9	5	7
E	6	7	8	10	7	9
F	3	10	7	9	8	9
G	8	9	7	9	6	8
H	4	9	2	6	5	8
I	5	9	7	9	10	10
J	6	9	9	10	7	6
Mean	5.5	8.6	6.3	9	7.3	7.4
Improvement of IoT knowledge						56%
Improvement of Smart Home knowledge						43%
Agree on develop new skills and knowledge						7.3
Interest into the IoT field after the course						7.4

0Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

Lesson 1 – Introduction of IoT and Smart Home

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	Introduction of IoT and Smart Home		

1. Learning Objective
    a. Understand the concept and applications of the Internet of Things (IoT)
    b. Aware of the field and criteria of IoT implementation
2. Expected Outcome
    a. Distinguish the difference between IoT and traditional information communication
3. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
5	Introduction to the course	Introduce the learning outcomes Inquiry-based question: How has IoT impacted the way we live?	Direct Teaching	Lesson 1 PPT
15	What is Smart home	Introduce the criteria and example of Smart home		
10	What is IoT	Definition of IoT		
5		The life cycle of IoT		
5		Example of IoT		
10	IoT & Smarthome	Relationship between others		
10	Q&A and Conclusion	Reflection of the IBQ		WS1

Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

Lesson 2 – Micro:bit – Basic

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	Micro:Bit – Basic		

1. Learning Objective
    a. Introduction to micro:bit
        i. The basic function of Micro:bit
        ii. Micro:bit programming environment (MakeCode)
        iii. Basic blocky programming
            a. Display text and patterns on LED
    b. Install extension board
2. Expected Outcome
    a. Able to create basic programs with micro:bit
    b. Using the IoT extension board
    c. Aware of the potential, functional and expansibility of Micro:bit
3. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
5	Revision	Introduce the learning outcomes	Direct TeachingPPT	Lesson 2 PPT
10	Introduction to Micro:bit	Overview of the features and capabilities of Micro:bit		
10	Makecode Trial	Showing heart led on the micro:bit	Hands on	Micro:bit PC USB A to B
15		Find out the difference between "On start" and "forever" by making animation		
5	Extension board	Overview of the features and capabilities of extension board	Direct Teaching	Lesson 2PPT
10	Makecode Trial	Showing "Hello Word" with OLED	Hands on	IoT:bit

				Micro:bit
5	Homework	Distribute homework		Lesson 2 PPT
	Conclusion	Recall today's learning contents		

Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

Lesson 3 – Micro:bit – Advance

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	Micro:Bit – Advance		

1. Learning Objective
    a. Advance Micro:bit
        i. Building a Counter with micro:bit
            a. Learn variable
        ii. Building a Temperature Alarm
            a. Learn if-else statement
            b. Sensor data
2. Expected Outcome
    a. Learn how to get the value from sensors
    b. Distinguish different circumstances with if-else statement
3. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
5	Revision	Introduce the learning outcomes	Direct Teaching	Lesson 3 PPT
Hands-on				
5	Variable	Learn the variable from calculating	Direct Teaching	Lesson 3 PPT
10	Counter	Practical exercise on the variable using	Hands-on	Micro:bit IoT:bit PC
15	Temperature detection	Trial on internal sensor from micro:bit		
5	if-statement	Showing how the if work in scenario	Direct Teaching	Lesson 3 PPT
5	else statement	Showing how the if-else work in		

		scenario		
10	Temp alarm – if-statement	Reaction to the data by if-statement with multi-condition	Hands-on	Micro:bit IoT:bit PC
5	Conclusion	Recall today learning contents	Direct Teaching	Lesson 3 PPT

Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

Lesson 4 – Micro:bit – SmartHome

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	Micro:bit – SmartHome		

1. Learning Objective
    a. Inquiry-based question: What products of Smart Home can be made by Micro:bit?
    b. Complete the requirement of a smart home automatic task
    c. Hands-on activities (Smart home)
        i. Control components – Motor/Servo
        ii. Problem-solving of the specific scenario
            a. Automatic Temperature Controls
2. Expected Outcome
    a. Apply learning in a practical setting and to experience the process of setting up a Smart Home simulation
    b. Problem-solving on smart home scenarios.
    c. Distinguish different circumstances with if-statement
3. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
5	Revision and IBQ	Introduce the learning outcomes	Direct Teaching	Lesson 4 PPT
5	GVS extension	Introduce the GVS feature and how to attach the components to the proper pin		
10	Control the servo	Introduce and teach how to control the 180 degree servo with micro:bit	Hands-on	Micro:bit IoT:bit Servo PC

10	Control the Motor	Introduce and teach how to control the motor with micro:bit	Hands on	Micro:bit IoT:bit Motor
20	Automatic Fan	Task for combing the Temp alarm and fan with if-else statement	Hands on	
5	Relection to the Inquiry-based Question	Ask for idea sharing and Braimstoming	Q&A	Lesson 4 PPT
5	Evaluation	Demonstrate the sample from teacher and students	Direct Teaching	
	Conclusion	Recall today learning contents		

Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

Lesson 5 – Data Visualize

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	IoT – Data Visualize		

1. Learning Objective
    a. Introduction to ThingSpeak
    b. Data upload and analyze in ThingSpeak
2. Expected Outcome
    a. Create channels for data uploading
3. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
5	Revision and IBQ	Introduce the learning outcomes "How visualized data help us?"	Direct Teaching	Lesson 5 PPT
8	Advantages of Data upload	Compare the current monitor data showing the model and online data		
17	ThingSpeak	Create AC and Channel and capture the API key. Teacher step by step Demo	Hands on	Lesson 5 PPT (Printed Ver.) Micro:bit IoT:bit Sound Sensor Light Sensor
16	Micro:bit programming	Create a program for data uploading: Temperature Record Extra: New Channel for other sensor		
13	External sensor	1. Introduce the addon sensor for micro:bit 2. Install sound sensor and upload the data toThingSpeak		
5	Evaluation	Demonstrate the sample from teacher and students	Direct Teaching	Lesson 5 PPT
	Conclusion	Recall today learning contents		

Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

Lesson 6 – Notice with Email

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	Notice with Email		

1. Learning Objective
    a. Introduction to IFTTT
        i. "Action" stage in IoT lifecycle with notification
        ii. Applet with ThingSpeak and IFTTT email service
2. Expected Outcome
    a. Understand the whole process of IoT life cycle
3. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
5	Revision and IBQ	Introduce the learning outcomes	Direct Teaching	Lesson6 PPT
3	"Action" of IoT life cycle	Explain the importance with scenario		
5	Email	Introduce the email service from IFTTT and ThingSpeak		
2	Introduce the scenario	Explain the scenario with using IFTTT		
20	Create IFTTT Applet	Step by step instruction		Printed PPT
15	ThingHTTP	Step by step instruction		
5	Project testing	Testing the project	Hand-on	Micro:bit IoT:bit PC
5	Conclusion	Recall today's learning contents	Direct Teaching	Lesson6 PPT

Reference

Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

Lesson 7 – NTP Clock

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	NTP Clock		

1. Learning Objective
    a. Understand NTP
    b. Definition of "Data" in IoT criteria
2. Expected Outcome
    a. Create an NTP clock with micro:bit
    b. Using NTP as data to create IoT product
3. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
5	Revision and IBQ	Introduce the learning outcomes	Direct Teaching	Lesson 7 PPT
5	Introduce the NTP	Briefly introduce the NTP and its relation of IoT		
20	Create NTP clock	Build an NTP clock with Microbit Programming	Hands-on	Micro:bit IoT:bit PC
20	Task – Smart Light	Build an automatic light using an NTP clock		
5	Evaluation	Demonstrate the sample from the teacher and students	Direct Teaching	
5	Conclusion	Recall today's learning contents		Lesson 7 PPT

Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

Lesson 8 – IFTTT - Collect from the Internet

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	IFTTT - Collect from the Internet		

1. Learning Objective
    a. Introduction to public service from IFTTT
    b. Utilize the shared Internet data and sensor to complete the IoT
    c. Control micro:bit through the IFTTT applet
2. Expected Outcome
    a. Understand the concept of IoT life cycle
    b. Complete the Smart Home IoT product
3. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
5	Revision and IBQ	Review the Data life cycle of last lesson and introduce the learning outcomes	Direct Teaching	Lesson 8 PPT
5	IFTTT service	Introduce different IFTTT service		
15	Sun raise/set light	Task for student: Control the light by local sun raise time	Hands-on	Micro:bit Iot:bit Servo PC
20	Automatic window	Step by step guide for creating an automatic window that responds to weather	Direct Teaching & Hands-on	
5	Evaluation	Demonstrate the sample from the teacher and students	Direct Teaching	
5	Conclusion	Demonstrate the sample from the teacher and students	Direct Teaching	Lesson 8 PPT
5	Project	Describe the Project and present for next lesson		

Develop an IoT STEM Course Package from Smart Home simulation with Micro:bit

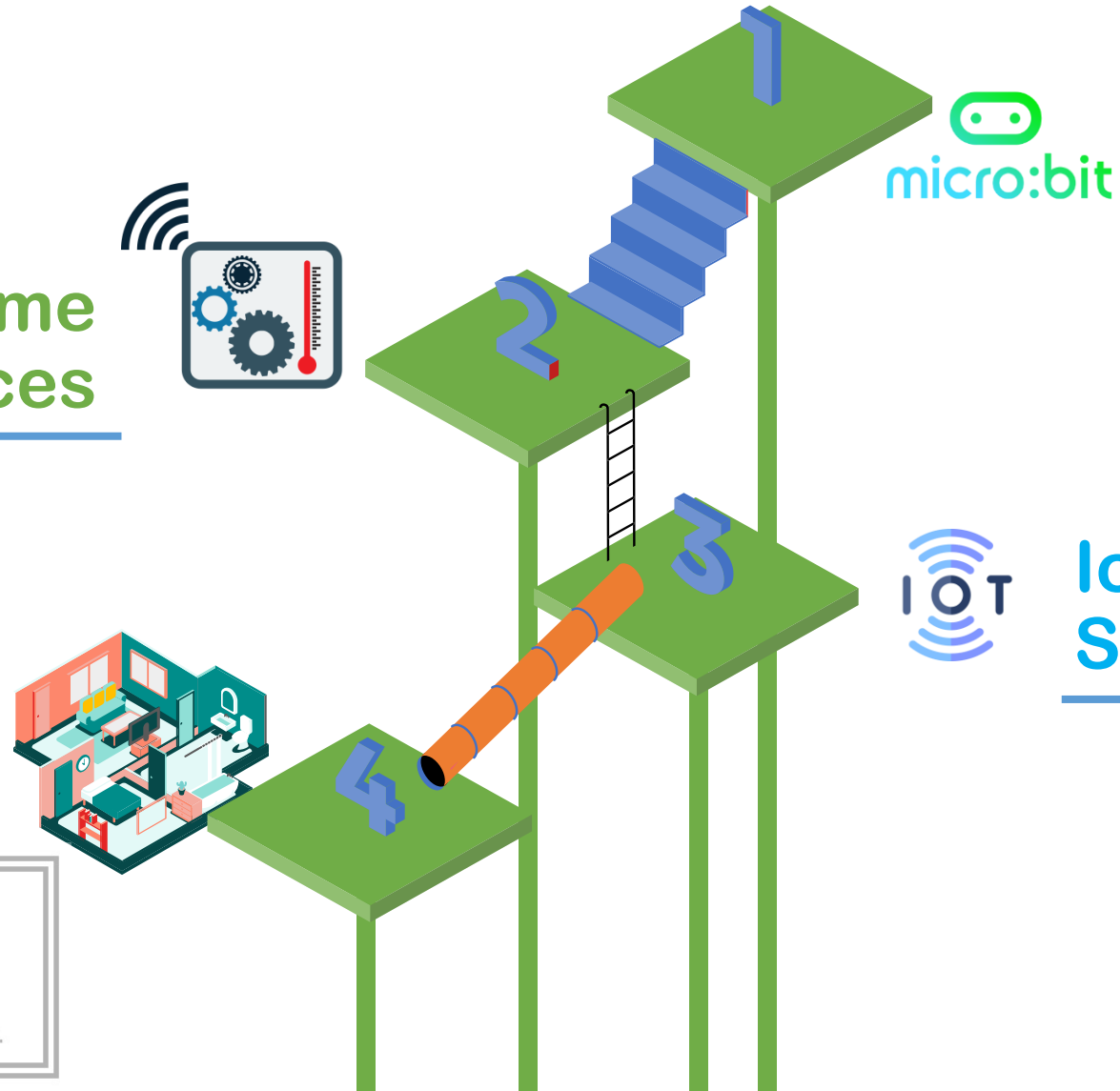
Lesson 9 – Smart Home Tour

Class	Secondary 2	**Date**	TBC
Venue	TBC	**Duration**	60mins
Subject	Computer Literacy	**Venue**	TBC
Topic	Smart Home Tour		

1. Learning Objective
    a. Each group of students introduces their project outcome
        i. Showing the learning accomplishment of the course
2. Lesson Procedure

Times(min)	Topic	Content	Activities	Material
10	Preparation stage	Let student prepare their present and final adjustment		
Presentation start				
40 - 45	Presentation	Each group has 5 min presentation. 5mins buffer Teacher: Evaluate and complement briefly for each group. Student: Review other groups with Google Form	Presentation	Google Form Student's work
5	Conclusion	Conclusion for the whole lesson and course.	Direct teaching	

Contacts of Course



Micro:bit Programming

Smart Home Devices

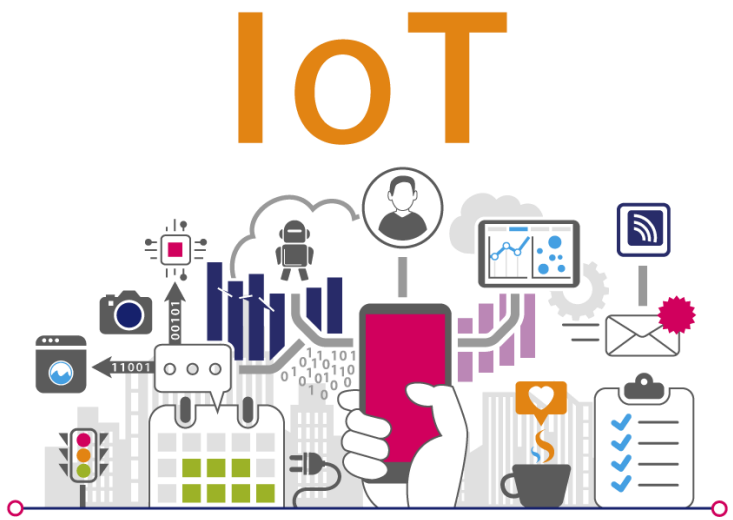
IoT with Smart Home

Project completion

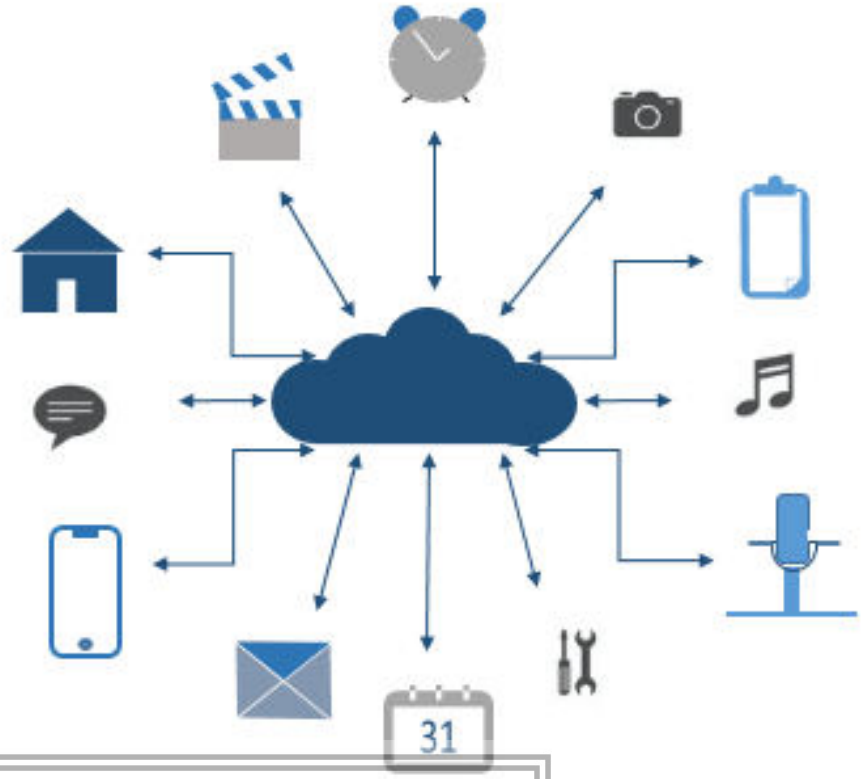
Lesson 1

What is Internet of things

Why need to involve internet?



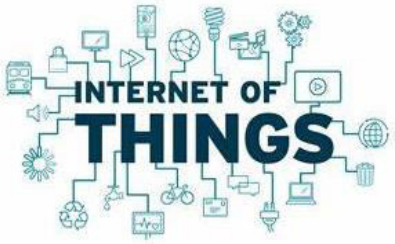
Internet of Things



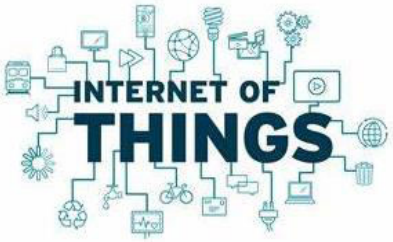
- Internet of Things (IoT)
  1. The **devices** that ***communicate** between **devices or cloud**
  2. Communicate **though the Internet or great scale network**

*Communicate: IoT devices **exchange data and command.**

How IoT impact our daily life?



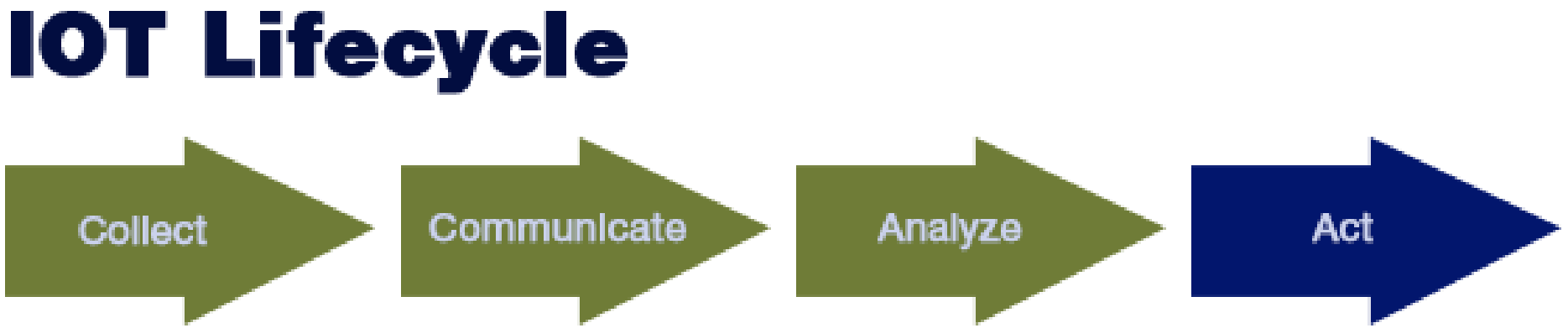
Internet of Things



With connecting the device though extensive internet. People can access and share the data, device, sensors. Which help:

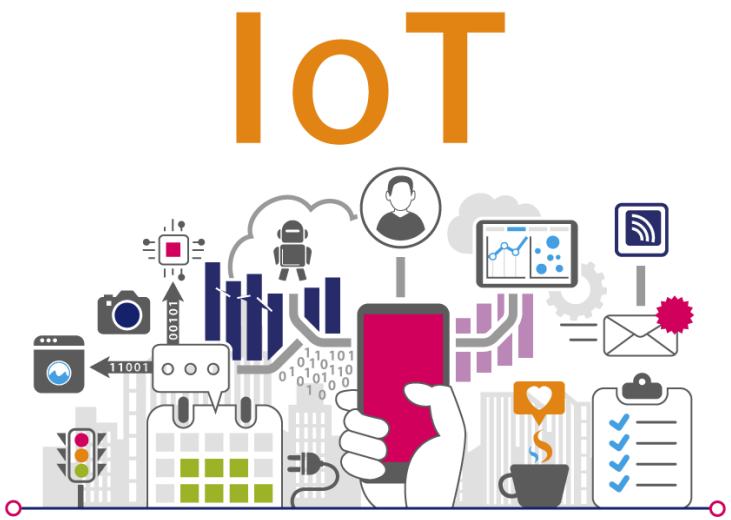
- Minimize human effort
- Increase productivity and efficiency
- Advanced Data Collection
- More……

Life cycle of IoT

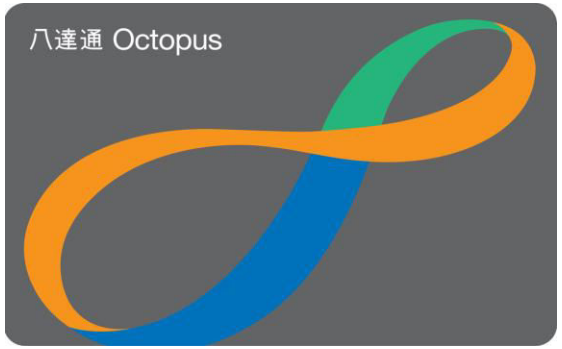


Any examples of IoT?

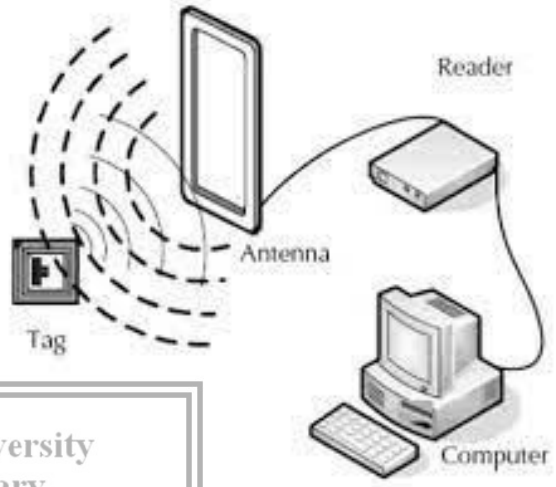
Notice some daily life products



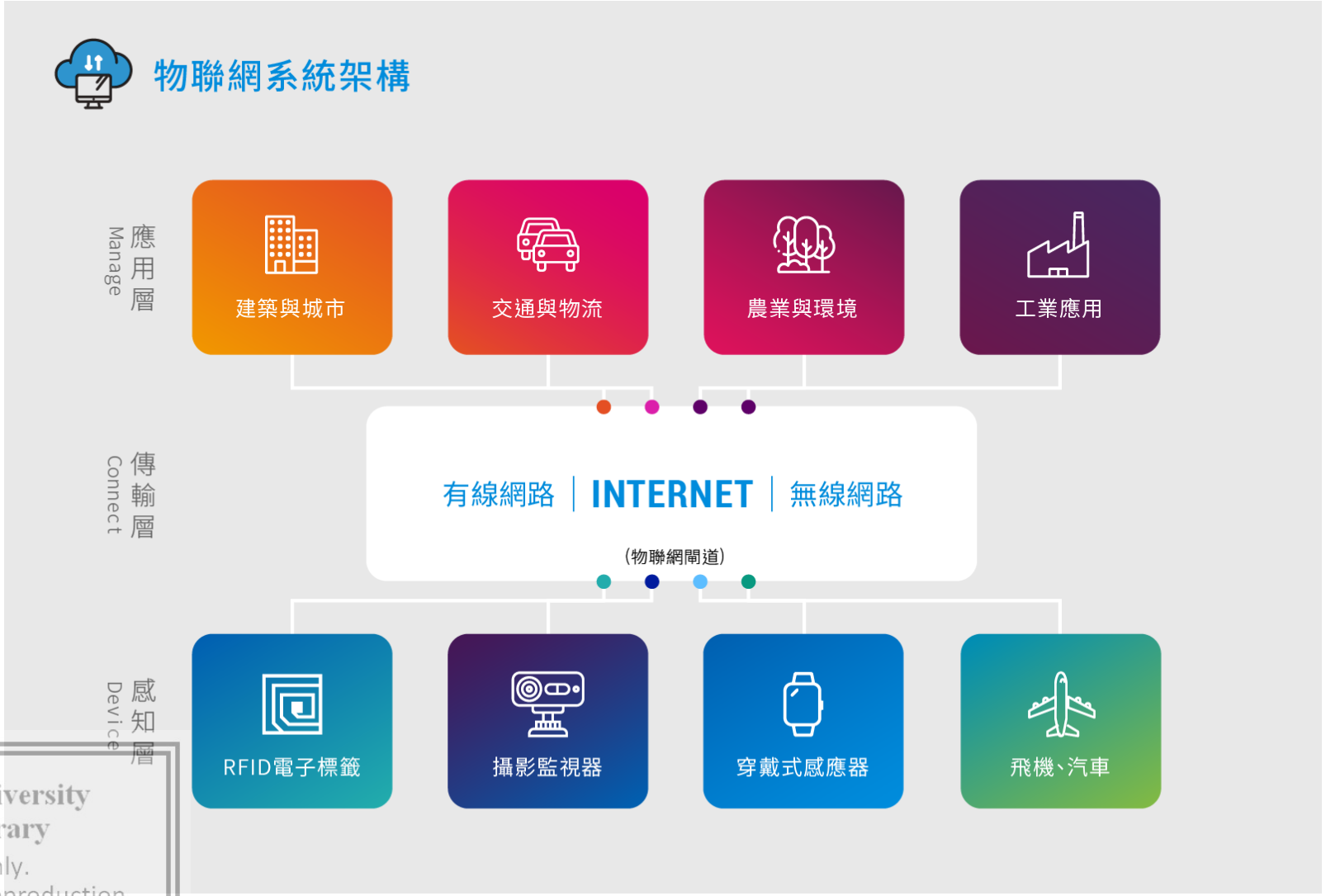
Examples of IoT



- **Octopus Card:**
  - RFID(Radio Frequency identification)
  - Owner's card communicate between computer without physical contact

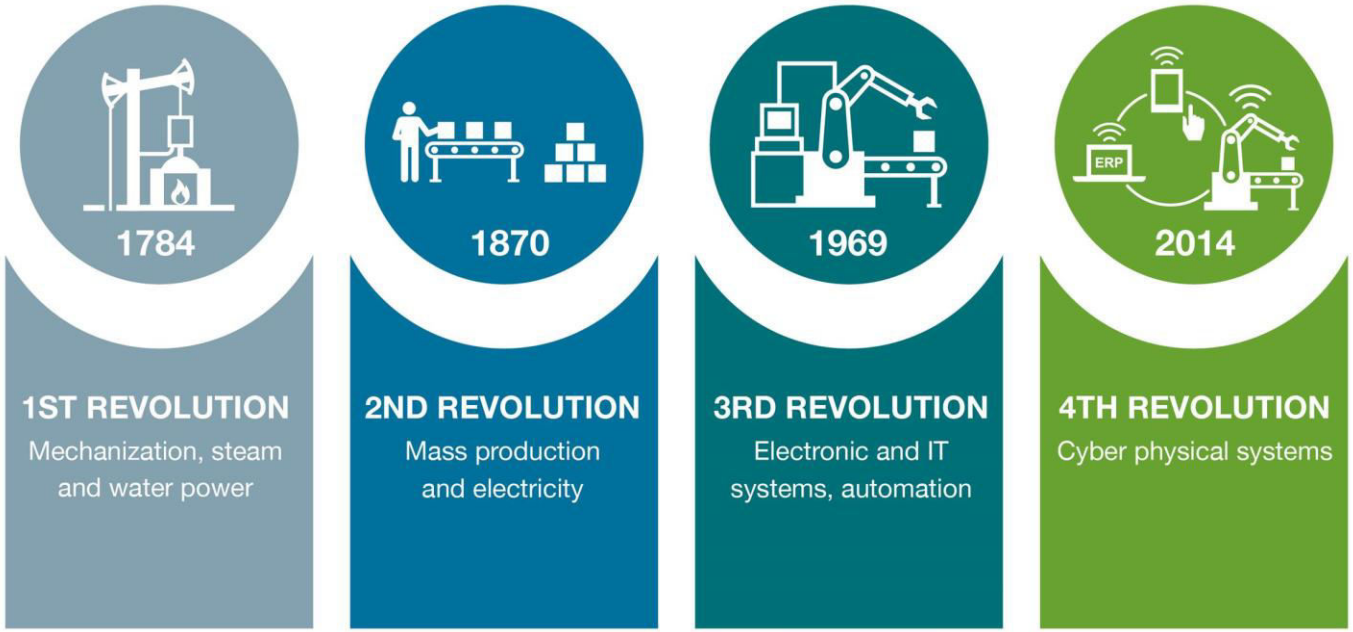


Examples of IoT



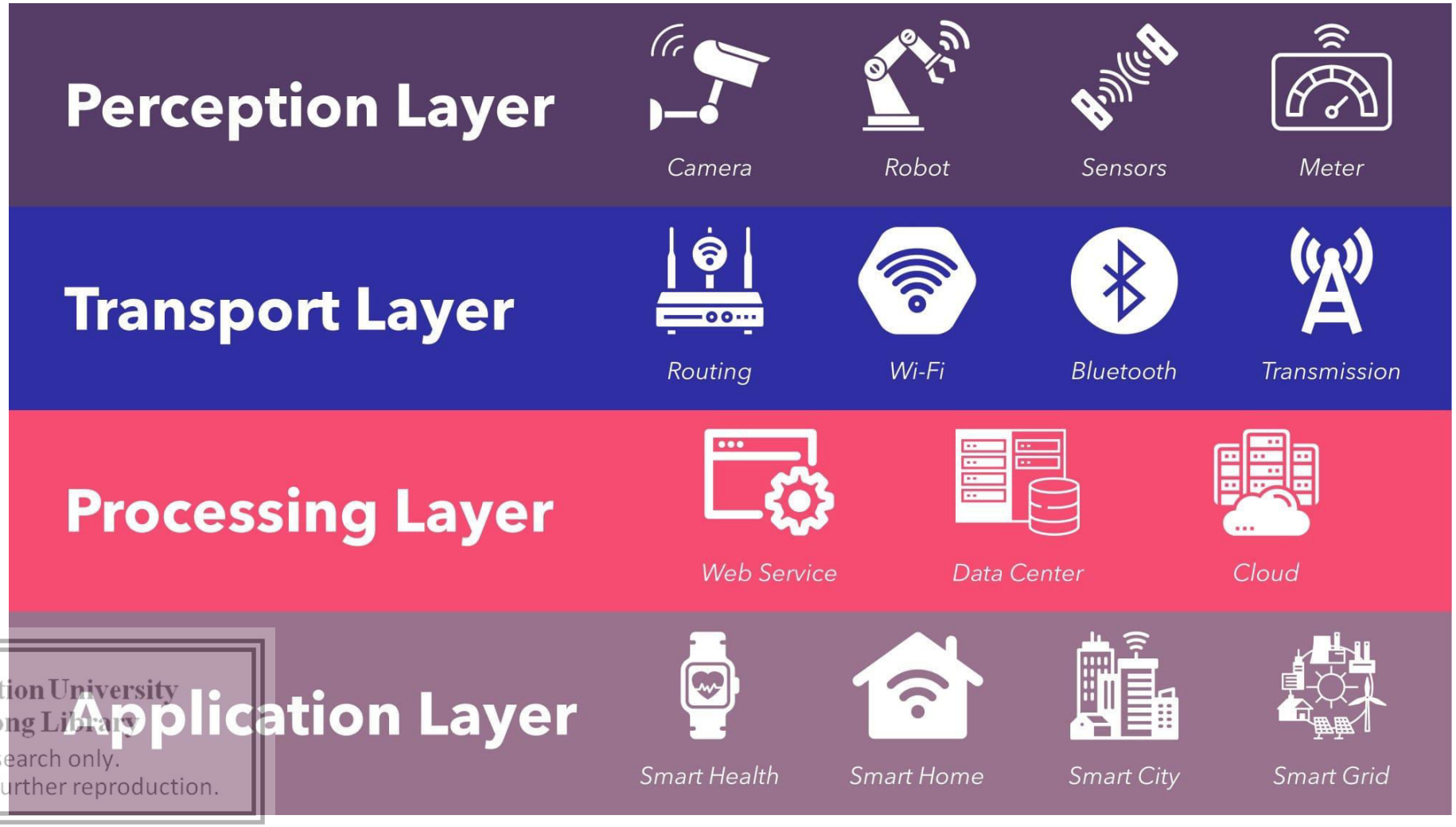
Importance & future

- Industry 4.0
  - Fourth Industrial Revolution
    - Digitization of the manufacturing sector, driven by disruptive trends including:
      1. Data and connectivity
      2. Analytics
      3. Human-machine interactio
      4. Improvements in robotics.

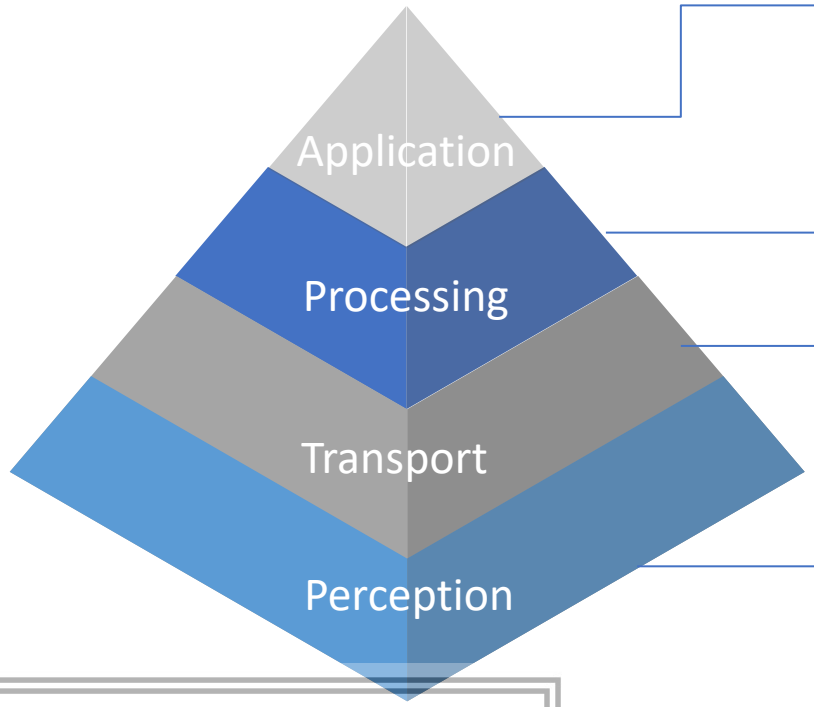


Architecture of IoT

4 Layers of IoT:



The 4 layers of This couse



Smart Home

Micro:bit, Cloud

WIFI, Internet

Sensors

Application Layers

Smart Home

What is Smart Home?

- How can it help you?

Smart Home aka Home Automation

01 A system connected with controllable home attributes

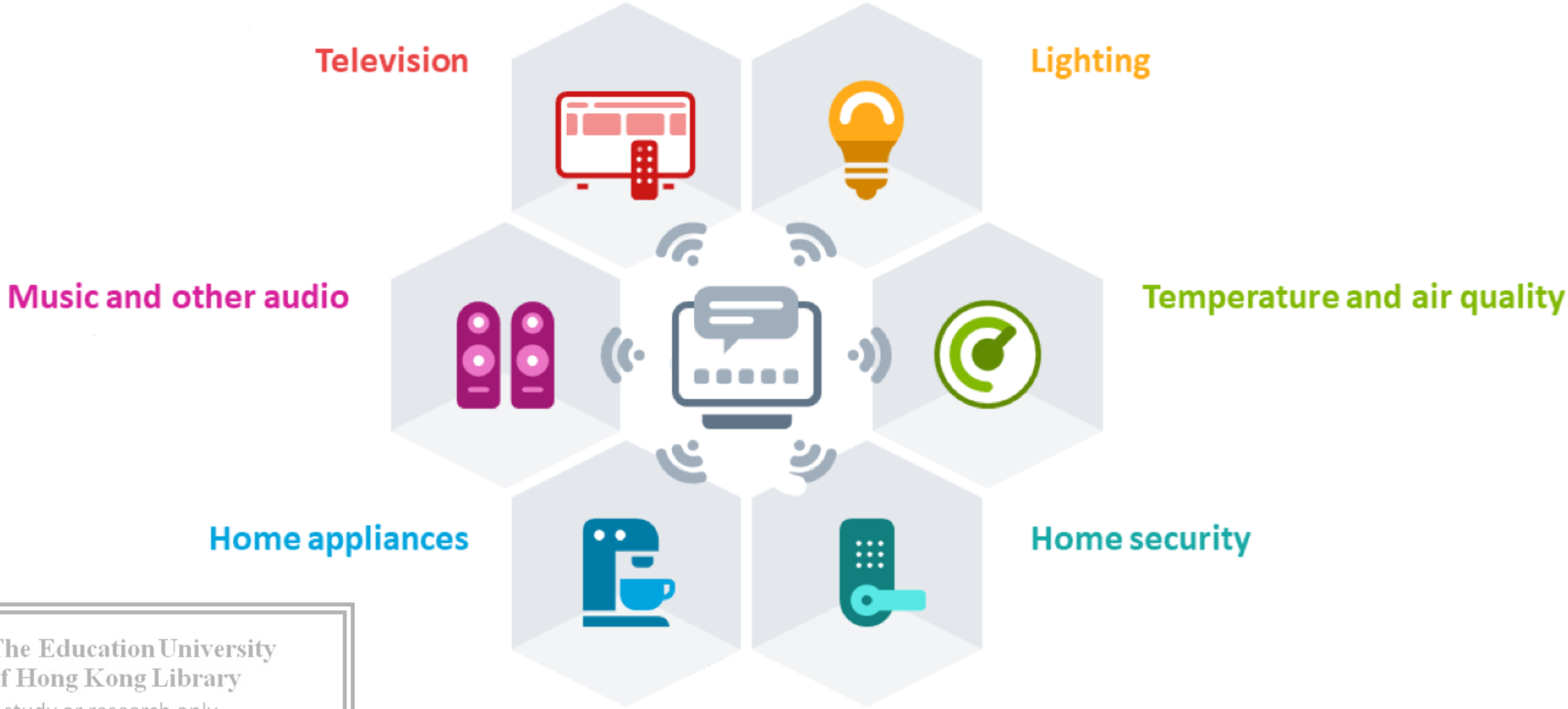
02 The system work automaticlly by regulating

Smart home devices?

- What kind of devices you know?

Example of Smart home devices

Example of Smart home devices



How can it help you?

- The benefits?

Benefits of Smart home

Security

Convenience

Comfort

Energy efficiency

Benefits of Smart Home

- Provides homeowners with convenience

- Task Automation

IoT & Smart Home

What is the benefits?

IoT & Smart Home

- **Anywhere and Anytime**
  - Monitor your house in real time
  - Regulating and control your home appearance
  - Review the data(e.g., Security cam, energy usage)

Conclusion

- **Internets of Things (IoT)**
  - connects devices to the Internet enabling them to exchange data and command.
  - The devices that communicate between devices or cloud.

- **Smart Home**
  - A system connected with controllable home attributes
  - Work automatically by regulating

Question to think

- How has IoT impacted the way we live?

Revision of Lesson 1

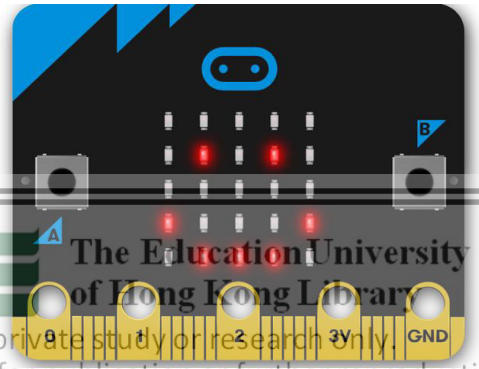
- **Internets of Things (IoT)**
  - The devices that communicate between devices or cloud.

- **Smart Home**
  - A system connected with controllable home attributes
  - Work automatically by regulating

Lesson 2

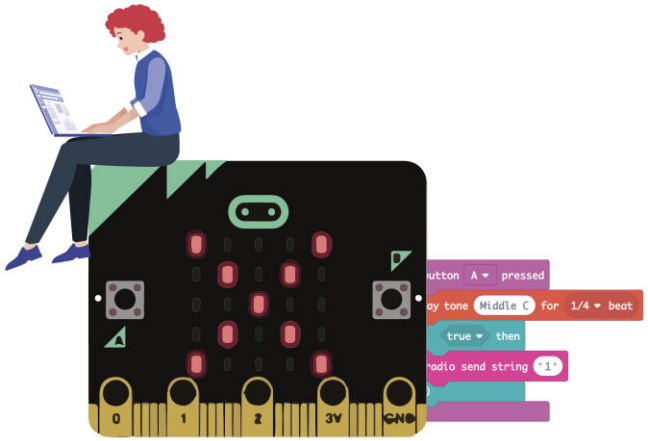
Micro:bit - Basic

How Micro:bit can be used for IoT projects?

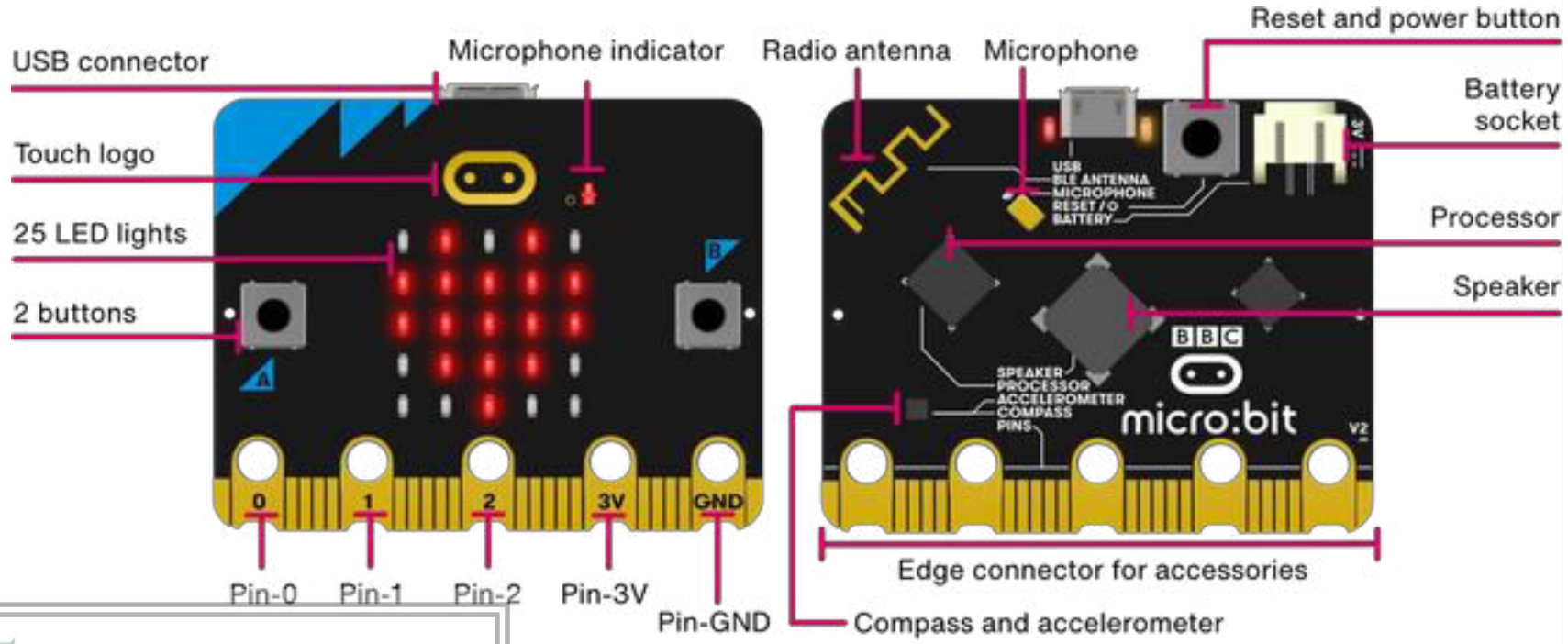


micro:bit

- Micro:bit is a pocket-sized computer
- It has LED light display, buttons, sensors and many input/output features
- Allow programmed with blocky language/ Python

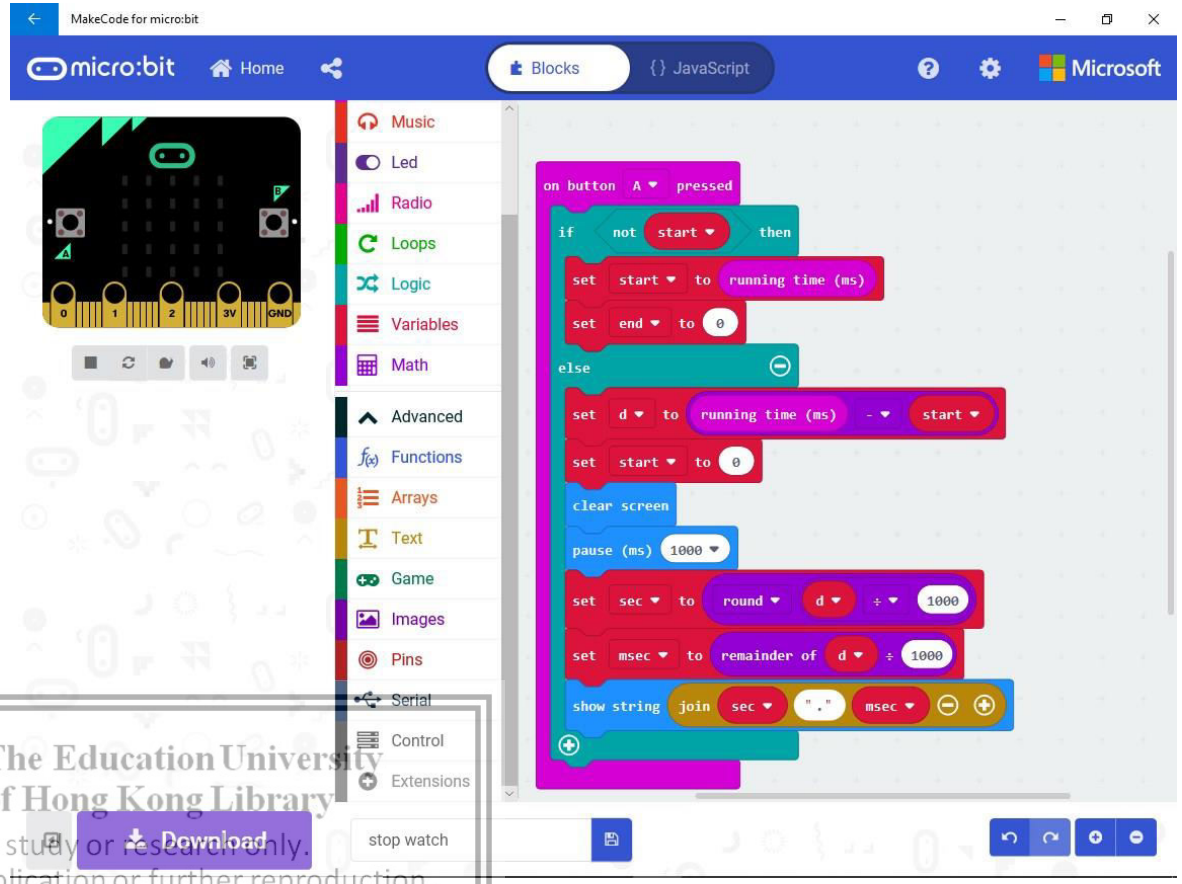


micro:bit



micro:bit

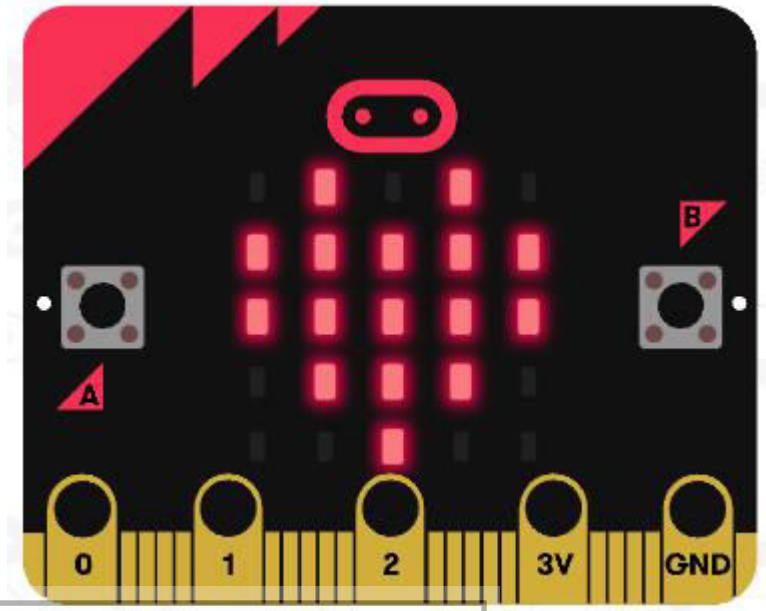
Makecode.org is the Blocks / JavaScript code editor for the micro:bit powered by Microsoft MakeCode.



Activity 1

micro:bit

Show the Heart Led patterns!



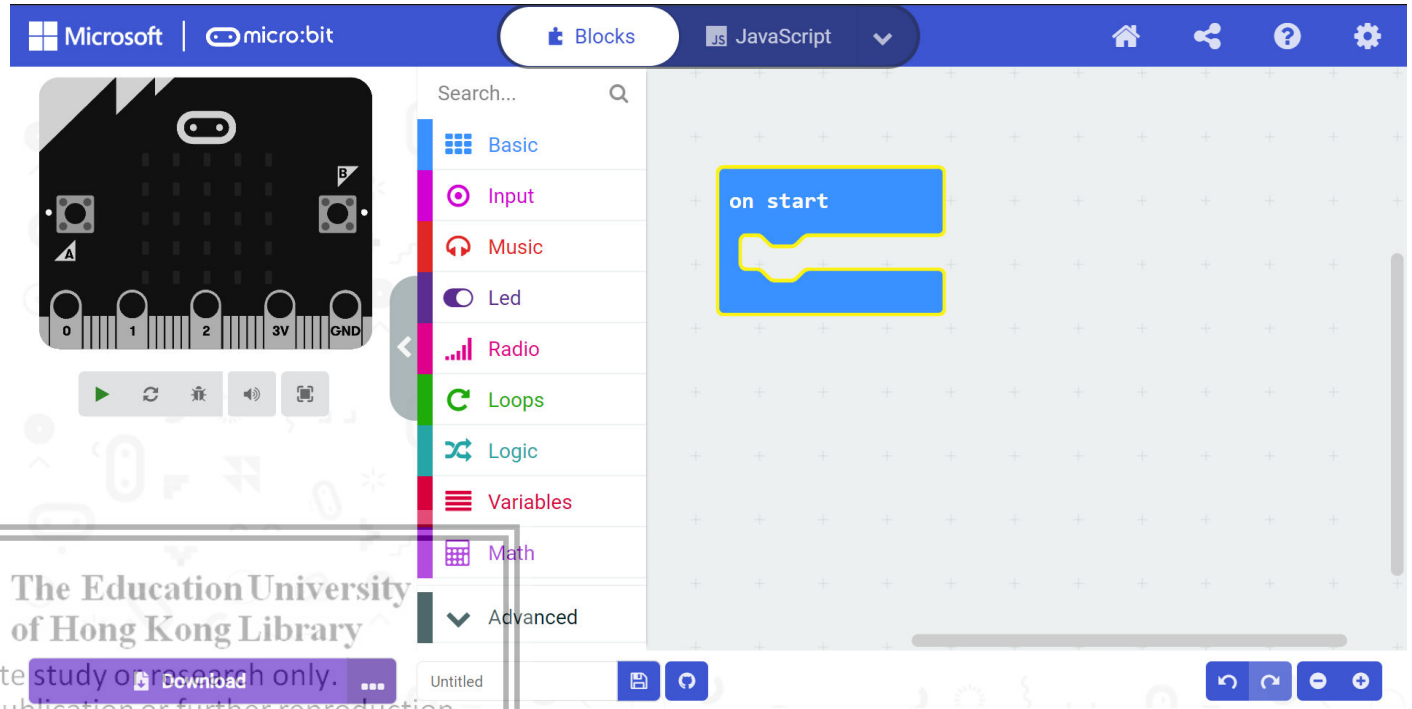
Activity 1

micro:bit

Step1:

1. Go to Makecode.org/

2. Click on “New Project”



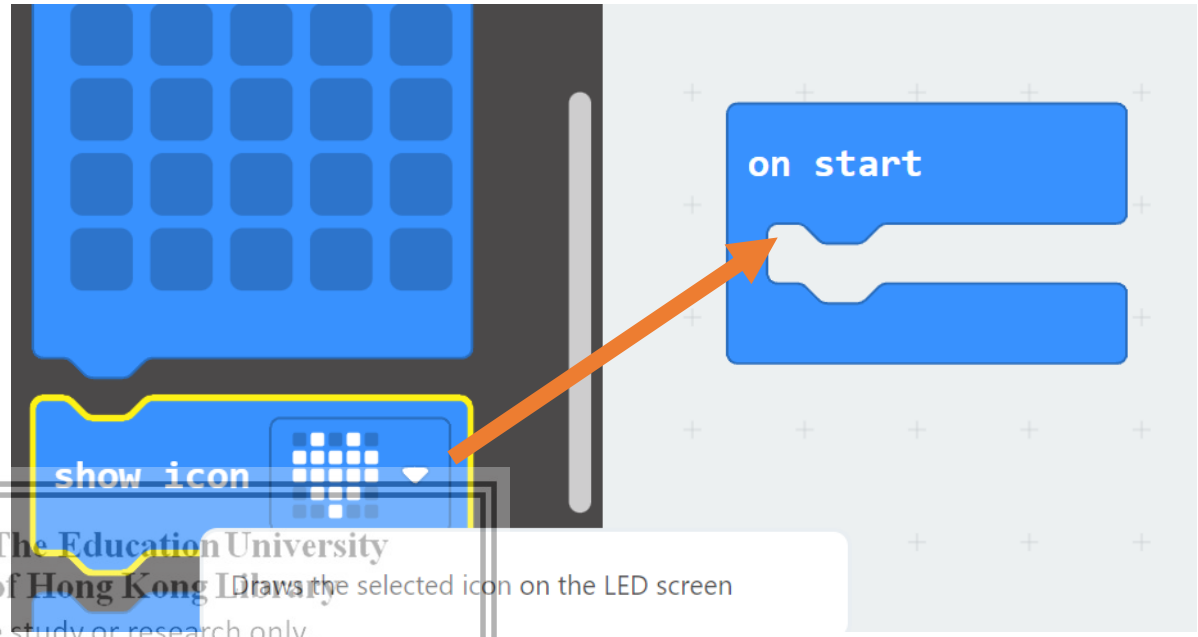
Activity 1

micro:bit

Step2:

1. Click Basic on the menu

2. Snap the block into the on start



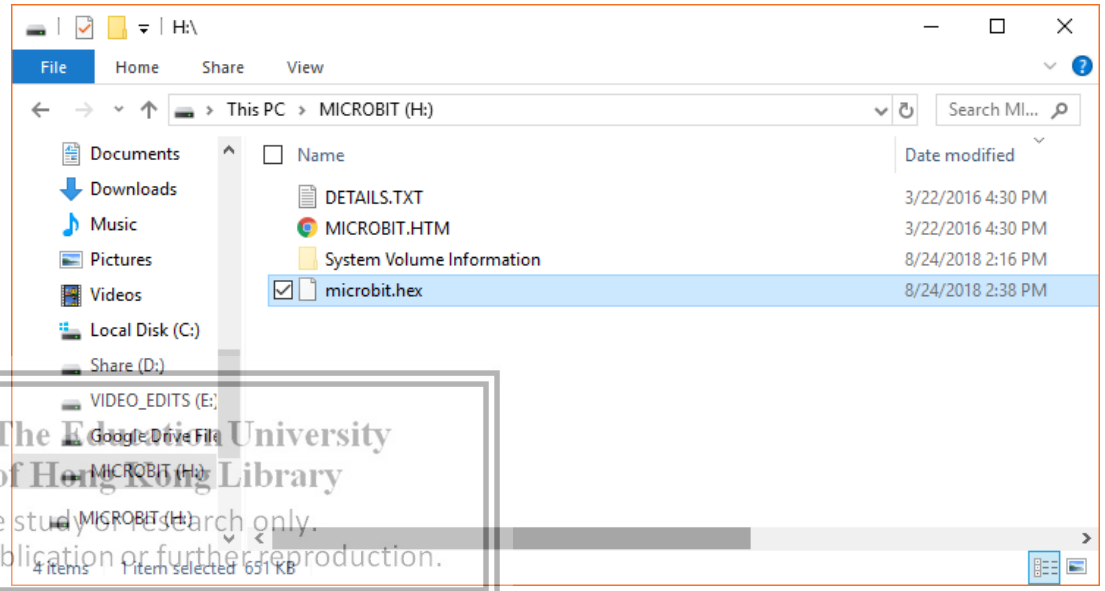
Activity 1

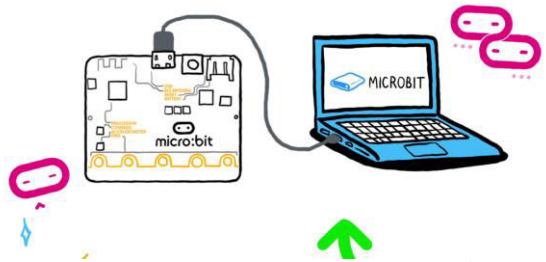
micro:bit

Step3:

1. Click the 

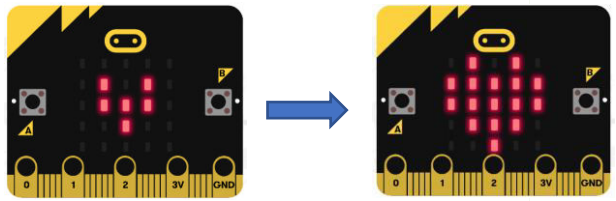
2. Connect your micro:bit to pc with USB
3. Drag the .hex file into the micro:bit

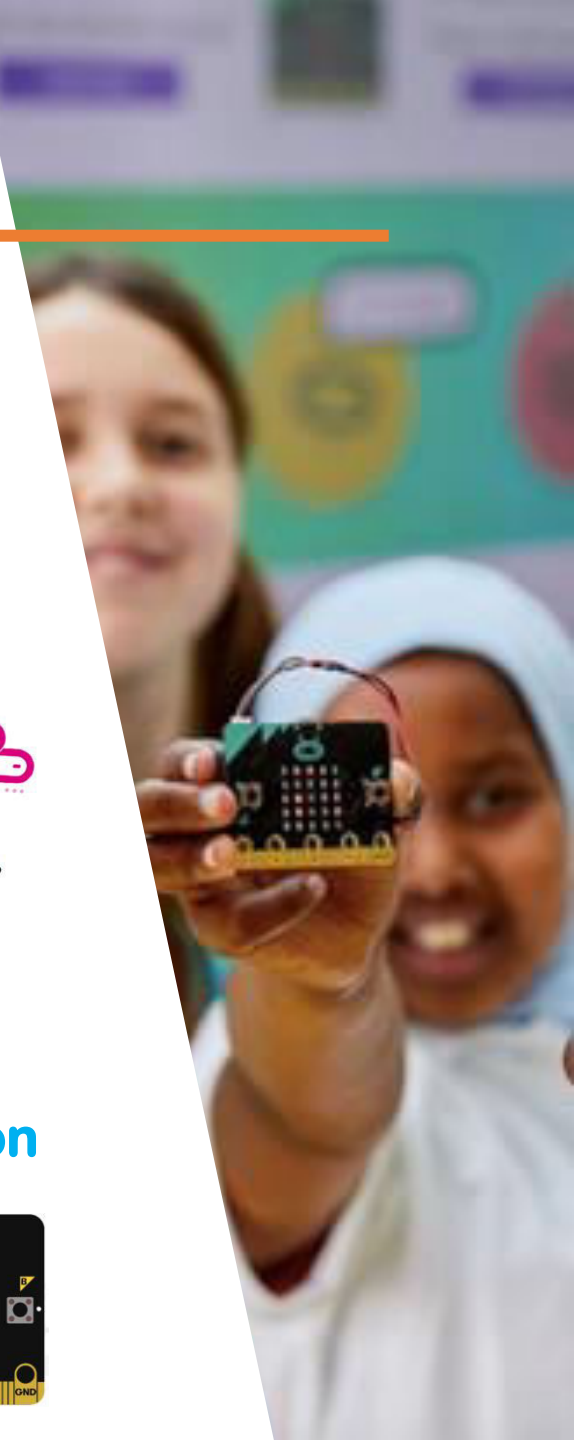




Extra Task!!

Try to make an animation





Activity 2

micro:bit

What is the difference between these two block?

Activity 2

micro:bit

Task: Try to use single one of them with this combination.

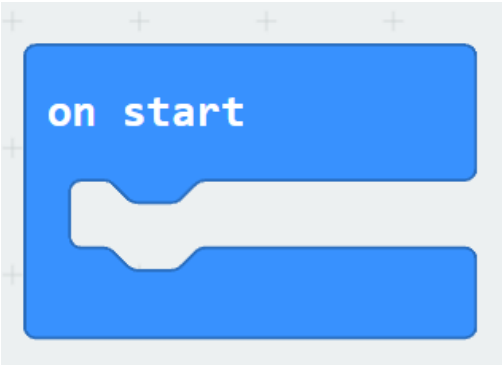
or

What is the difference?

Activity 2

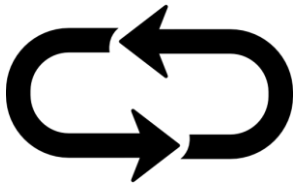
micro:bit

Answer:



Only do once after boot/start

Loop all the time



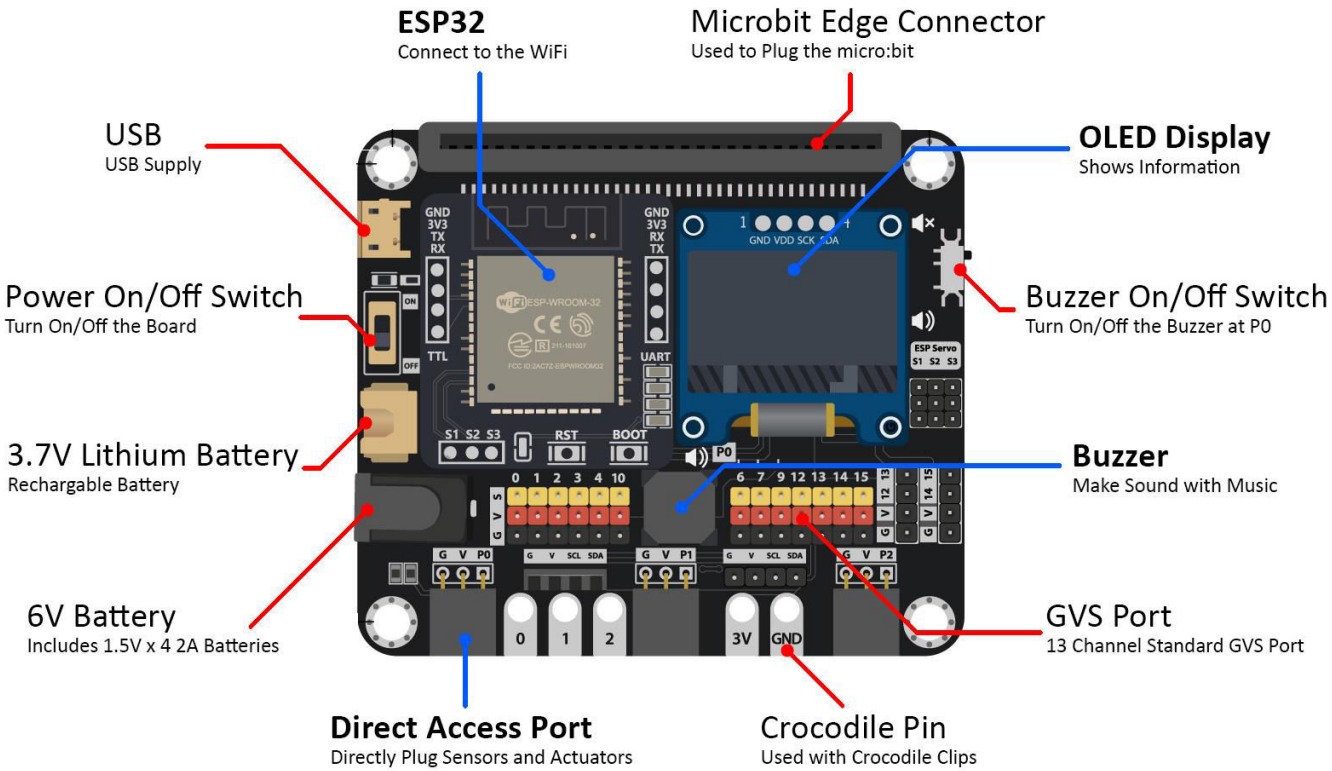
Extension

micro:bit

IoT:bit is an extension board that provide a much powerful function to micro:bit.

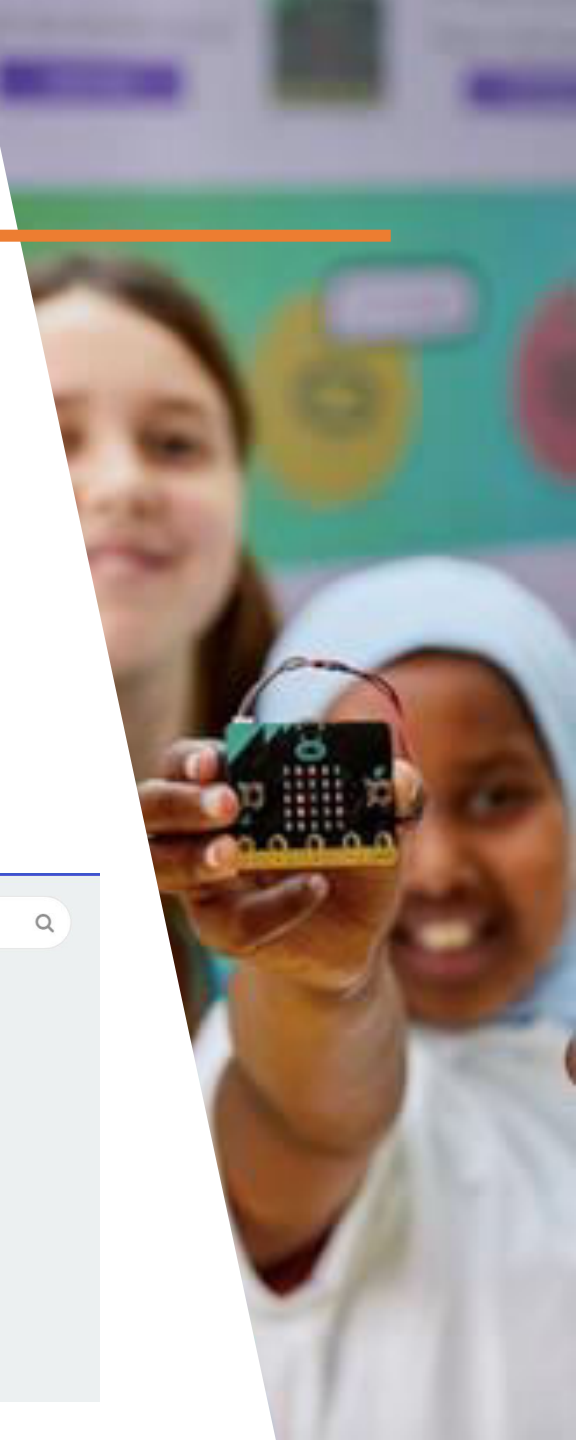
Function:

1. Extended 13 Socket
2. ESP32 Wifi Module
3. Buzzer
4. OLED Display



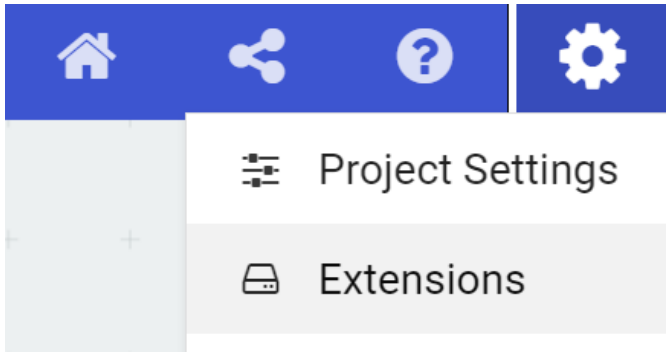
Activity 3

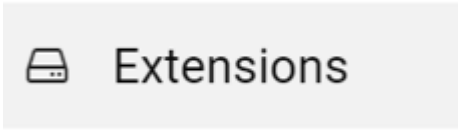
micro:bit



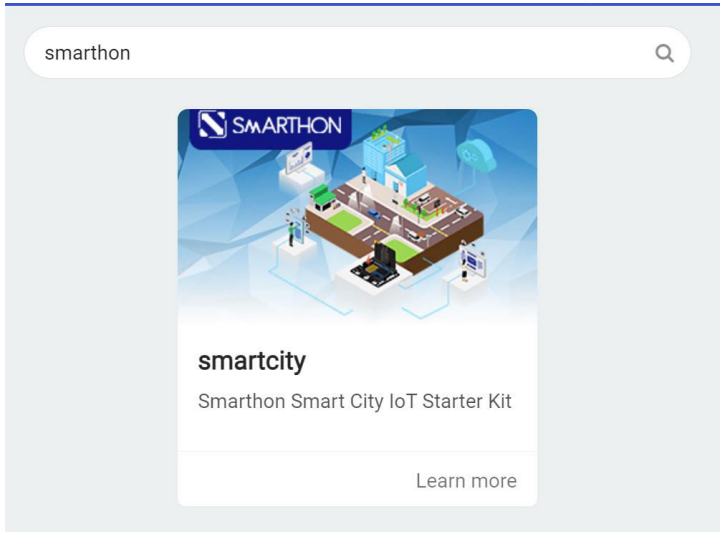
Adding the extension

1. Go to top right corner and click 



2. Select 

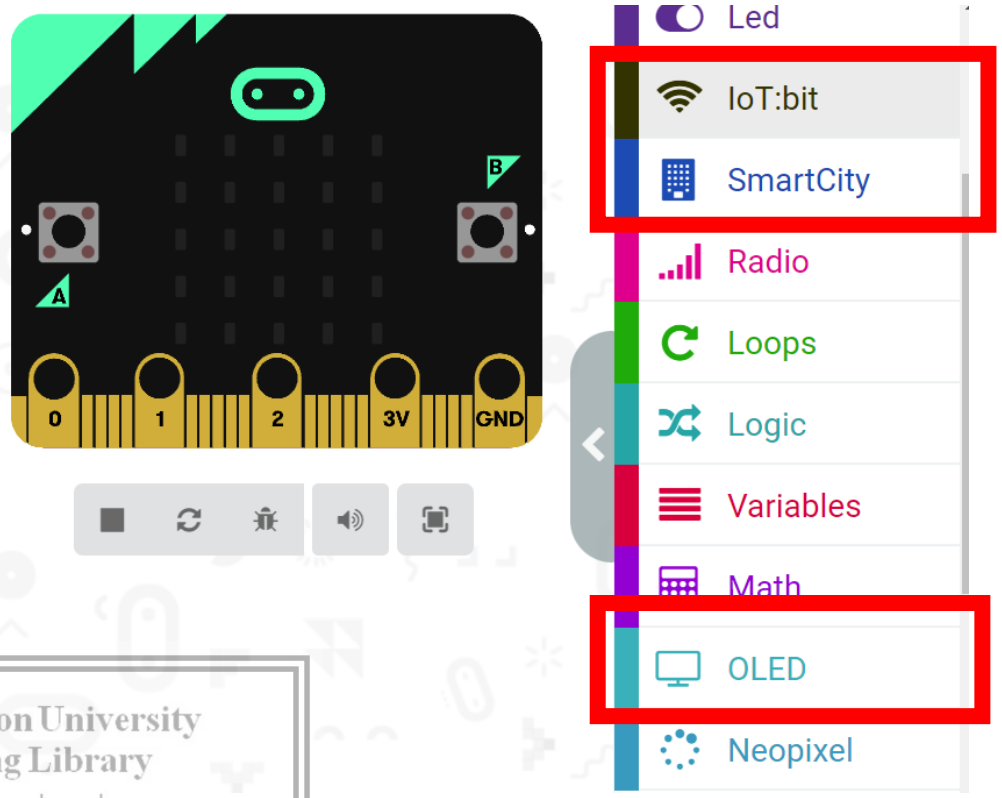
3. Search “smartcity” and click



Activity 3

micro:bit

Now you can see these two package is added

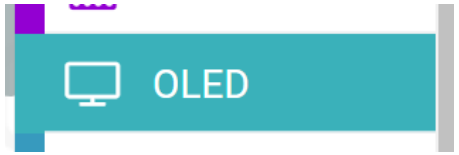


Activity 4

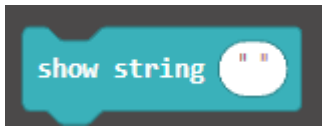
micro:bit

Task: Use the OLED to showing “Hello World!”

Steps:

1. Click 

2. Snap 

into the “On Start”
3. Snap 

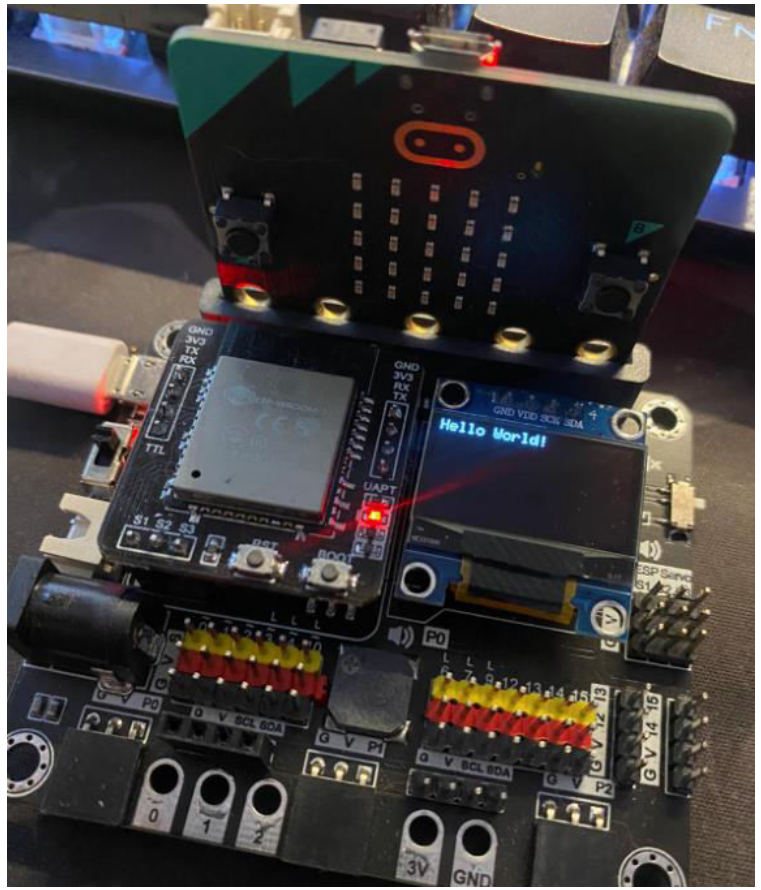
after
4. Type “Hello Word!”
5. Then download

Activity 4

micro:bit

Task: Use the OLED to showing “Hello World!”

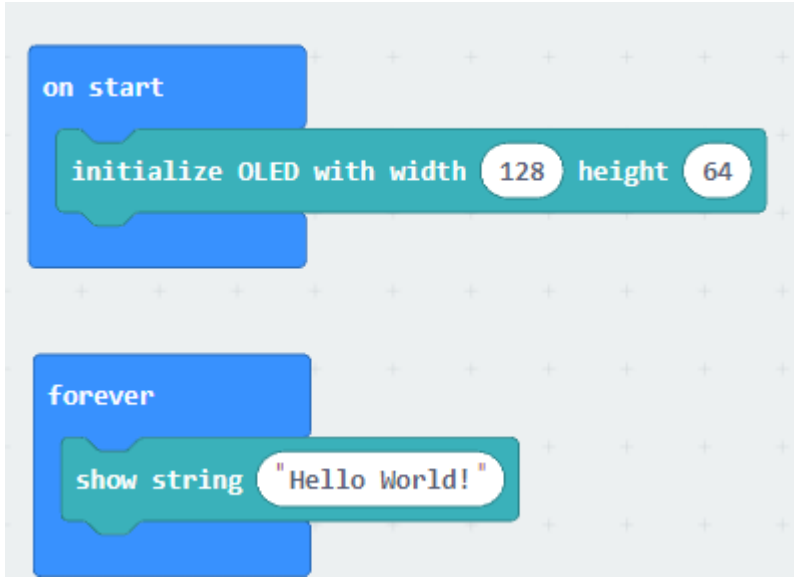
DEMO:



Activity 5

micro:bit

What if placing the “Hello Word!” in “Forever” block?



What will happen?

Try to snap  after “Show string”

Conclusion

micro:bit

1. How to use the 5x5 LED
2. Difference of “On Start” and “Forever”
3. The IoT extension board “IoT:bit”
4. Showing “Hello World!” on OLED display

Revision

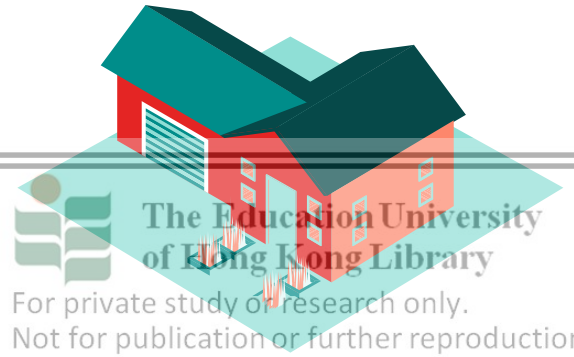
micro:bit

1. How to use the 5x5 LED
2. Difference of “On Start” and “Forever”
3. The IoT extension board “IoT:bit”
4. Showing “Hello World!” on OLED display

Lesson 3

Micro:bit - Advanced

What type of feature from Micro:bit that can be implement on Smart Home



Lesson 3

Micro:bit - Advanced

Today's Contents

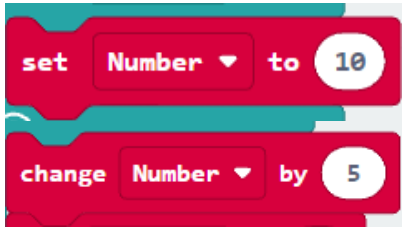
1. Micro:bit Counter
   - Variable

2. Temperature Alarm
   - Bulit in sensor
   - If-else Statement

Variable

micro:bit

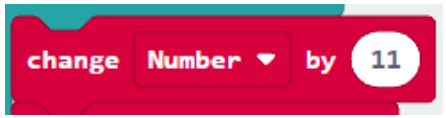
Variable can store data such as “Number”, “Word” for after use. For examples, Lets Number = 0 be the initial value.

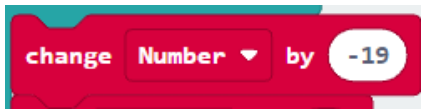


Number = 1

Number = 0 + 5 = 5

Exercise 1:

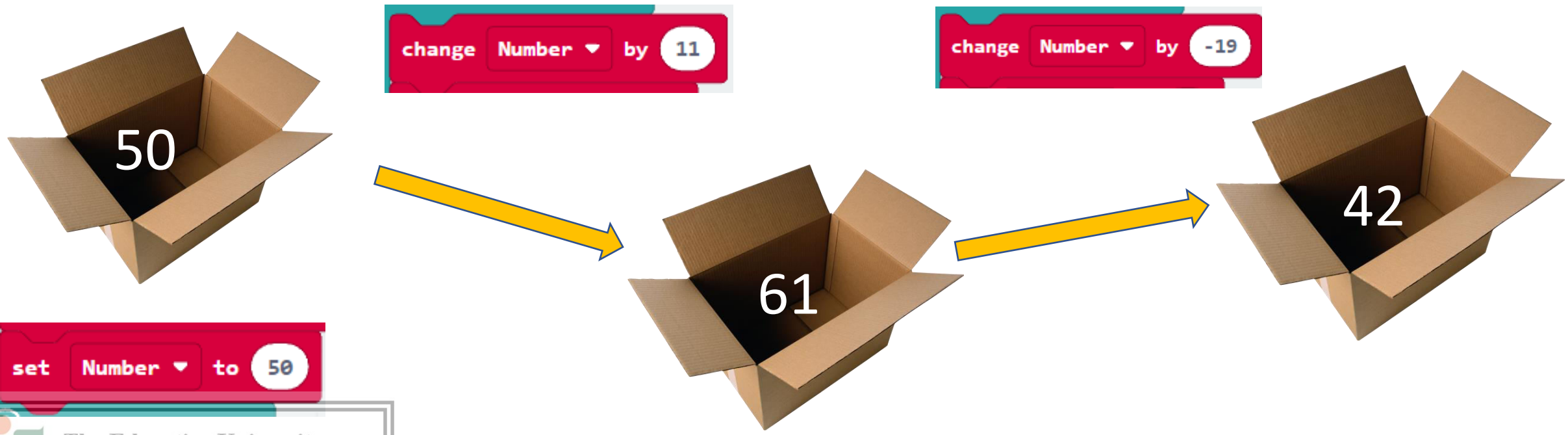




Variable

micro:bit

Answer:



Task 1

micro:bit

Counter:

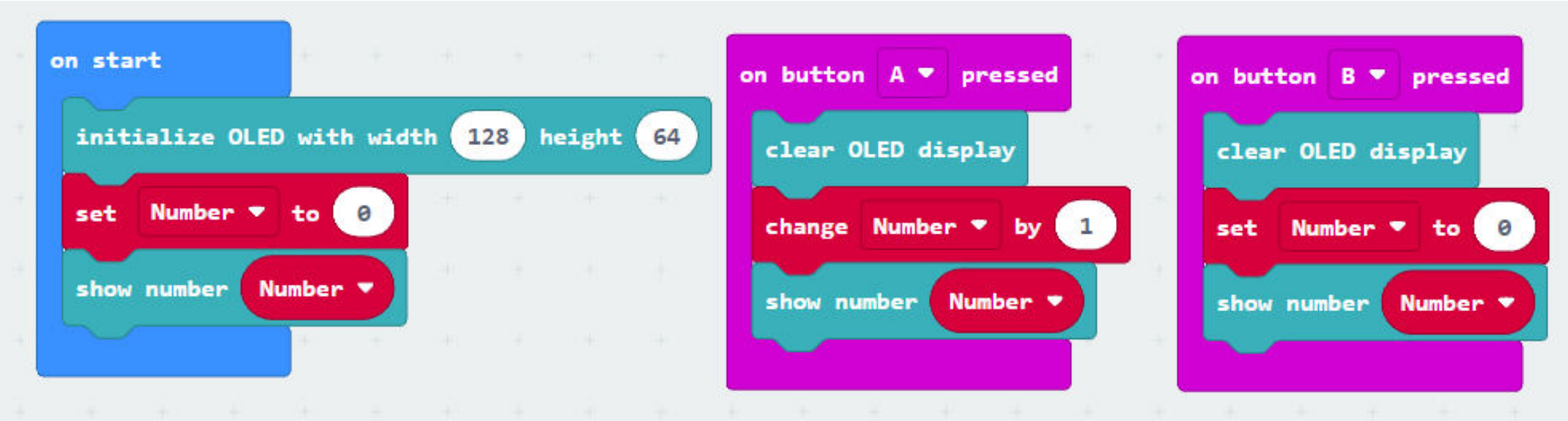
Try to use micro:bit to create a counter.

1. If A pressed, +1
2. If B pressed, Set to Zero

Task 1

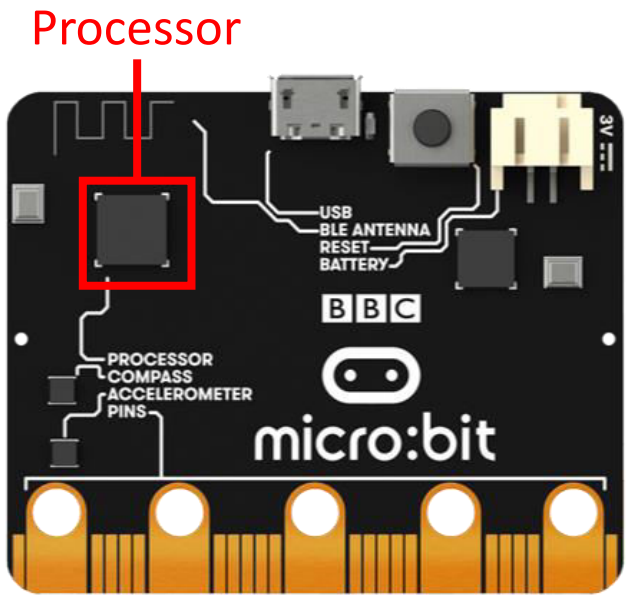
micro:bit

Answer:



Build-in Sensor

Micro:bit can measure the **processor(CPU)** temperature to calculate the surrounding temperature.



Task 2

Measure the Temperature with programming.

Let micro:bit show on the OLED. And keep it updated.

Hints:

1. Temperature is a number
2. Clear screen after each output

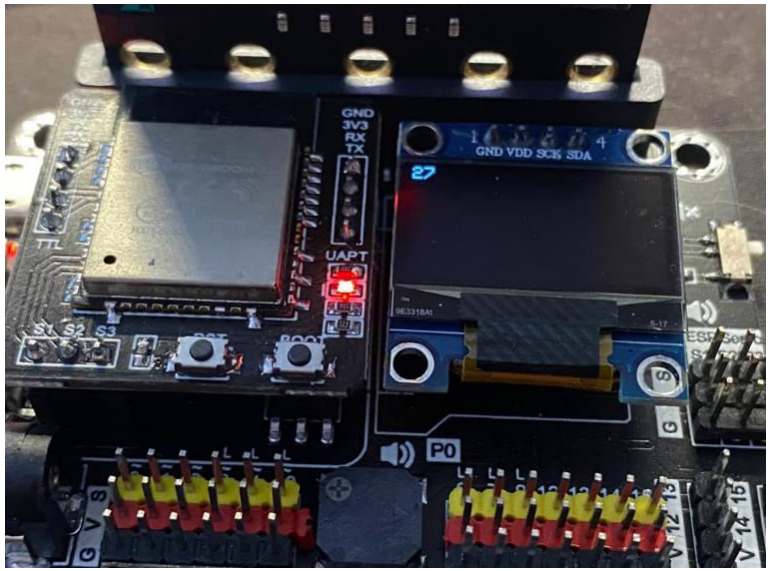
Task 2

micro:bit

Measure the Temperature with programming.

Let micro:bit show on the OLED. And keep it updated.

Answer:



Task 2.2

micro:bit

Did you notice some problem?

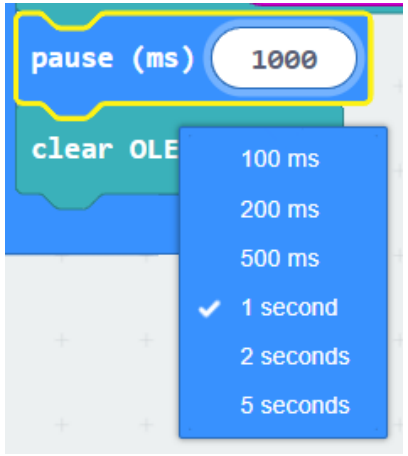
1. Flashing
2. Do everyone know the meanings?

Solve it!

Hints

1. Add “pause” before clear screen
2. Add explanation with string before the temperature

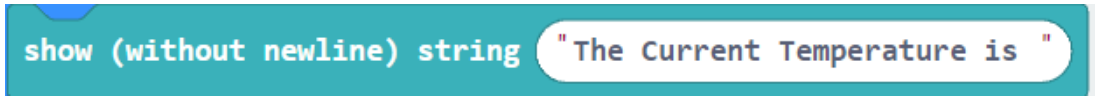
Task 2.2



Use pause

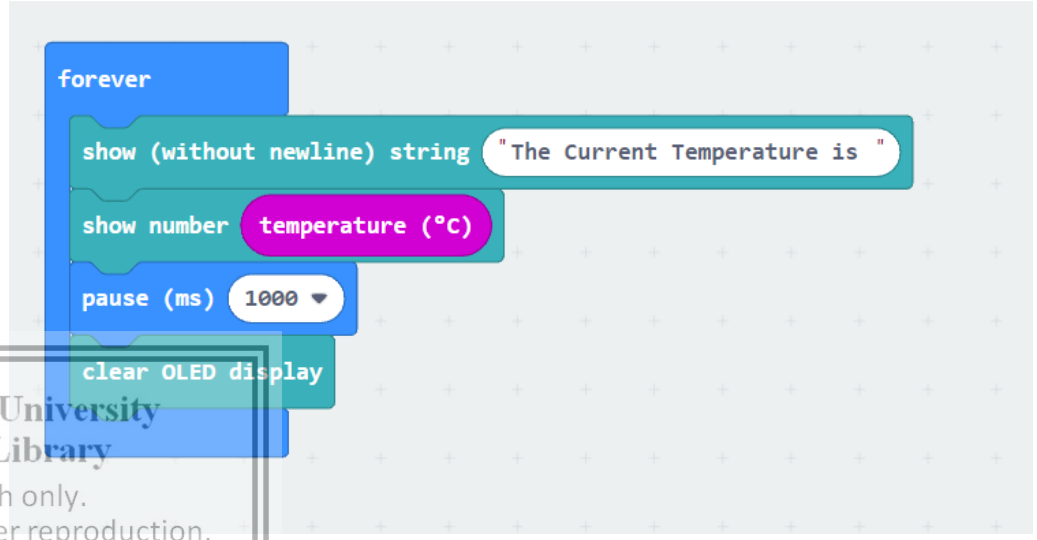
1000ms = 1second

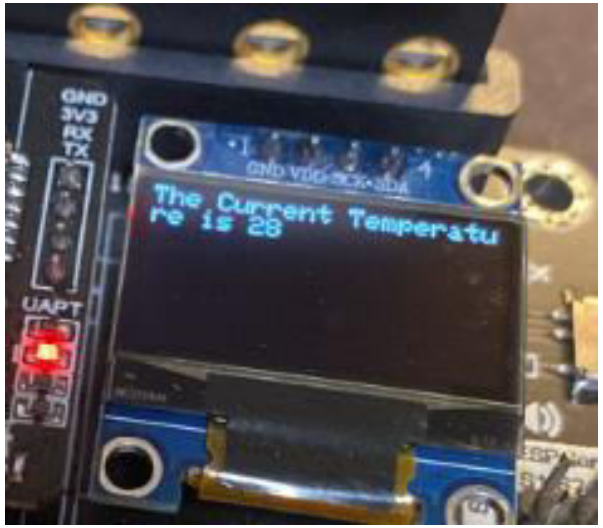
2000ms = 2second



This block allow adding string without open new line after each output

Answer:

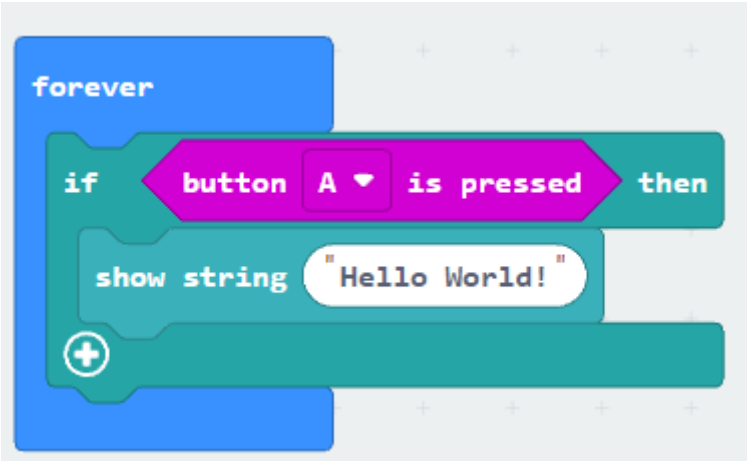




If-statement

micro:bit

"If" statement is conditional block. Only run if the condition fulfilled. For example:



What will the LED show if:

Start = _____

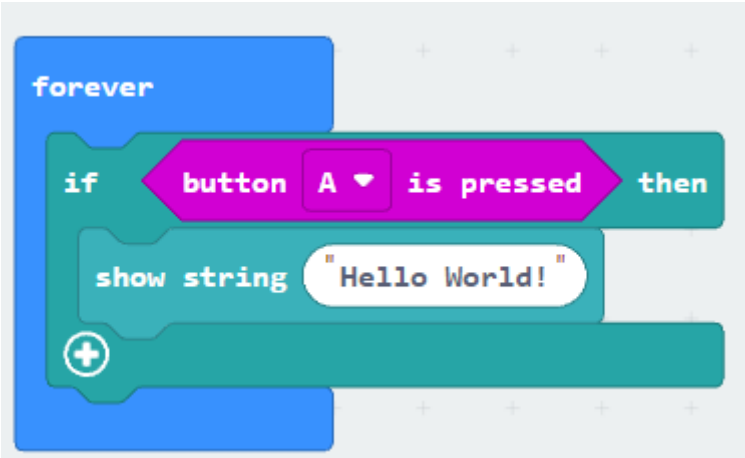
Press B = _____

Press A = _____

If-statement

micro:bit

“If” logic statement is conditional block. Only run if the condition fulfilled. For example:



What will the LED show if:

Start = Nothing

Press B = Nothing

Press A = Hello World!

If-else statement

micro:bit

“else” statement come useful if no condition fulfilled.

For example

What will the LED show if:

Start =_____

Press A =_____

If-else statement

micro:bit

"else" statement come useful if no condition fulfilled.

For example

What will the LED show if:

Start = Press the Button A

Press A = Hello World!

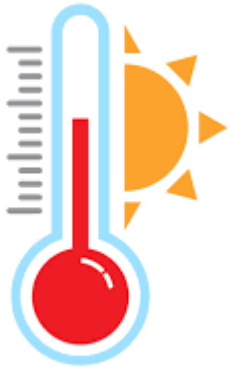
Temperature Alarm

micro:bit

Smart Home Scenario:

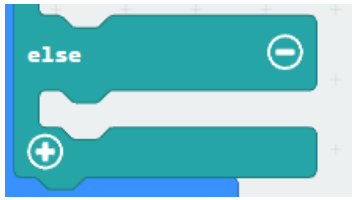
Build a Temperature Alarm with following function:

1. Showing current Temperature in OLED
2. Description of the Temperature.
3. Buzzer will ring if the temperature is higher than 30



Hints:

Use music function to play sound



Press + and – symbol to add condition

Comparation

Hot: >_____

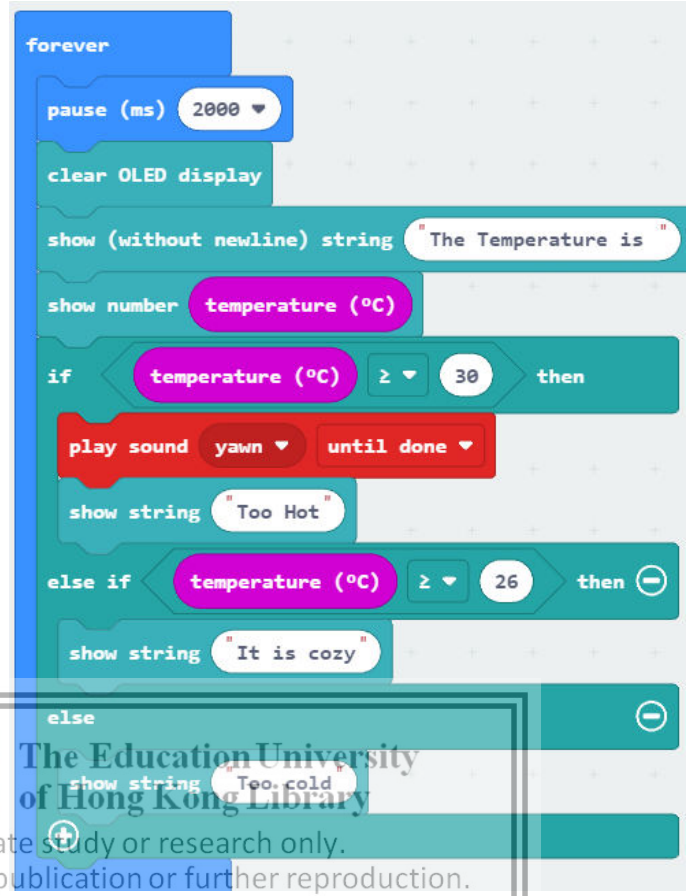
Cozy: >_____

Temperature Alarm

micro:bit

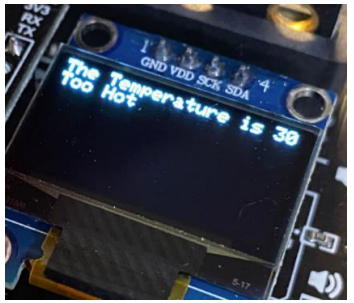
Smart Home Scenario:

Solution:



If: (Depends on current temperature)
Hot: > 30
Cozy: > 26

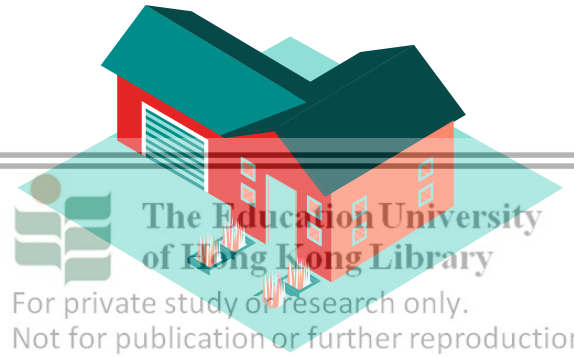
You can test:
“HOT” with finger pressing the CPU
“Cold” with facing AC fan



Lesson 3

What type of feature from Micro:bit that can be implement on Smart Home?

Reflection



Conclusion

micro:bit

1. Micro:bit Counter

- Variable
  - Variable can **store** the data and use after

2. Temperature Alarm

- Bulit in sensor
  - CPU can measure the surrounding temperature
- If-else Statement
  - A conditional statement only run if the condition fulfilled

Revision

micro:bit

1. Micro:bit Counter

- Variable
  - Variable can **store** the data and use after

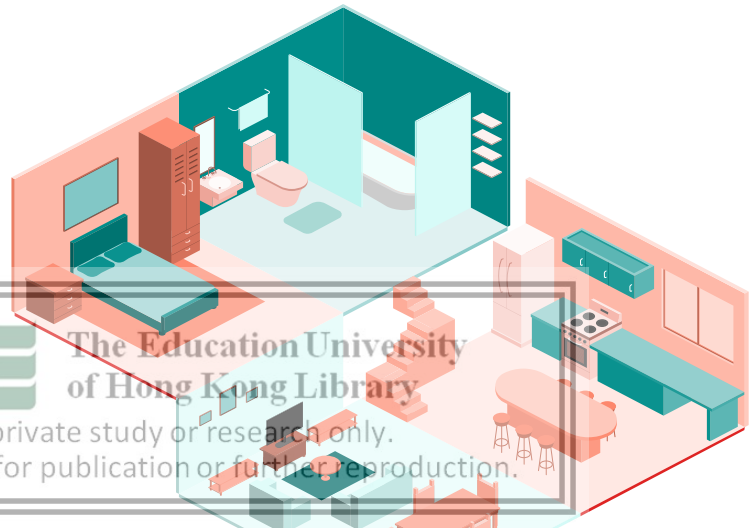
2. Temperature Alarm

- Bulit in sensor
  - CPU can measure the surrounding temperature
- If-else Statement
  - A conditional statement only run if the condition fulfilled

Lesson 4

Smart Home

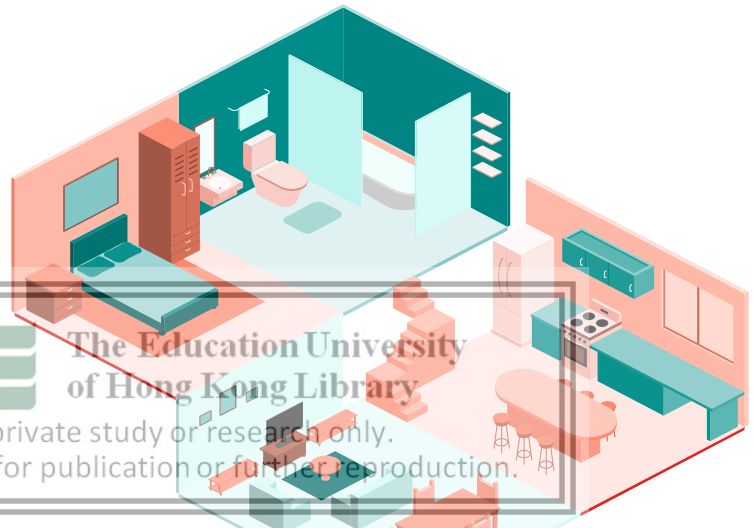
Automation of Tasks



Lesson 4

What products of Smart Home can be made by Micro:bit?

Question before start



Lesson 4

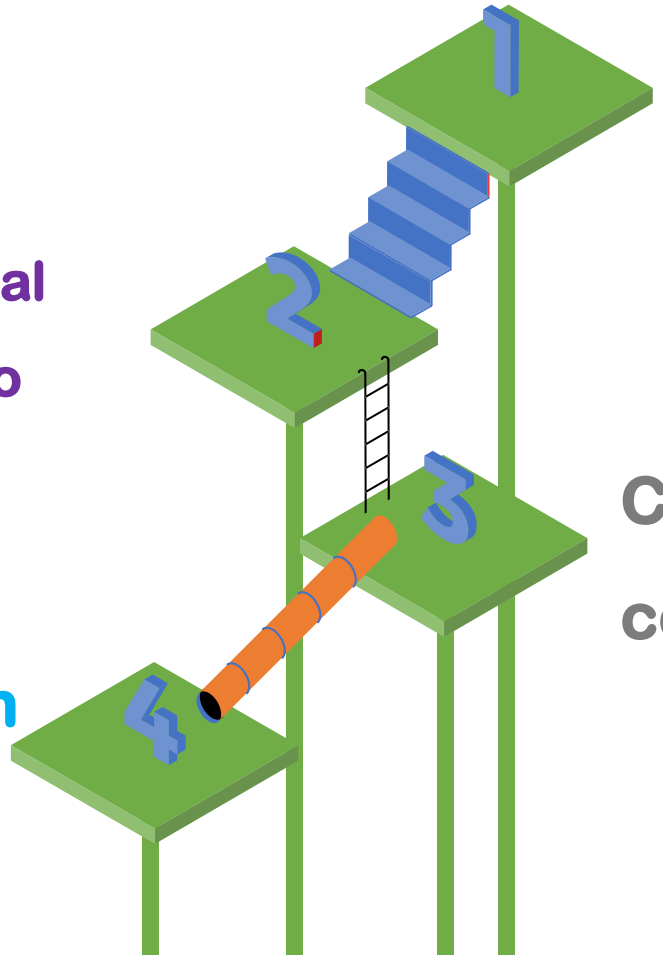
micro:bit

Automatic Temperature Controls

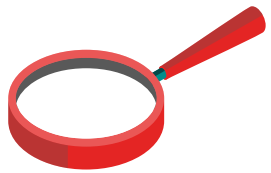
Today's Contents

Install the components to GVS pin

Control the external component - Servo



Control the external component - Motor

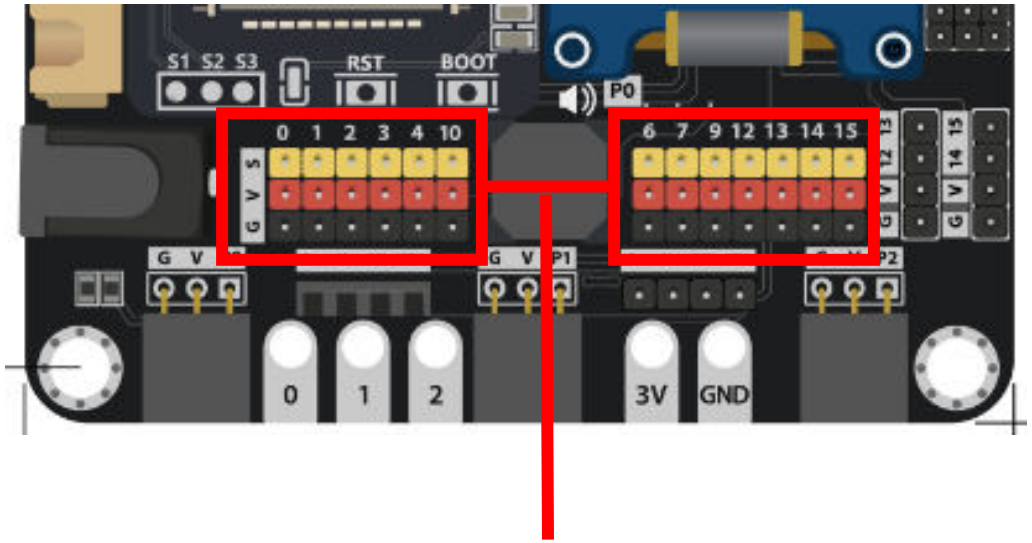


Prototyping with cardboard

Extension

micro:bit

IoT:bit:



- 3 Pin GVS Port

Port for connecting the external **input and output components** with **Dupont Line.**

Connecting Guide

		IoT:Bit (Pin)
S	Signal Port	Data Pin
V	Voltage (+)	3v3
G	Ground (-)	GND

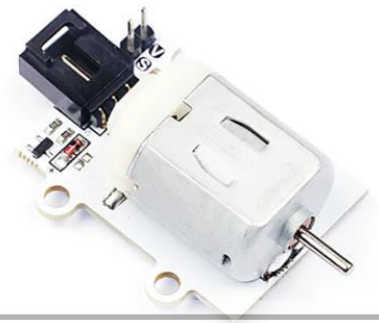
Dupont Line

Output module

Micro:bit can **control** different **physical output** module/parts,

For examples:

Motor



180-degree Servo

LED

Control the Servo

To control the Servo with micro:bit.

1. Connect the Servo to GVS port
   - Chose one available port (P0-P15)

As the Dupont come with different colors. We need to connect to proper GVS port instead of following the color.

Following the WS(4)

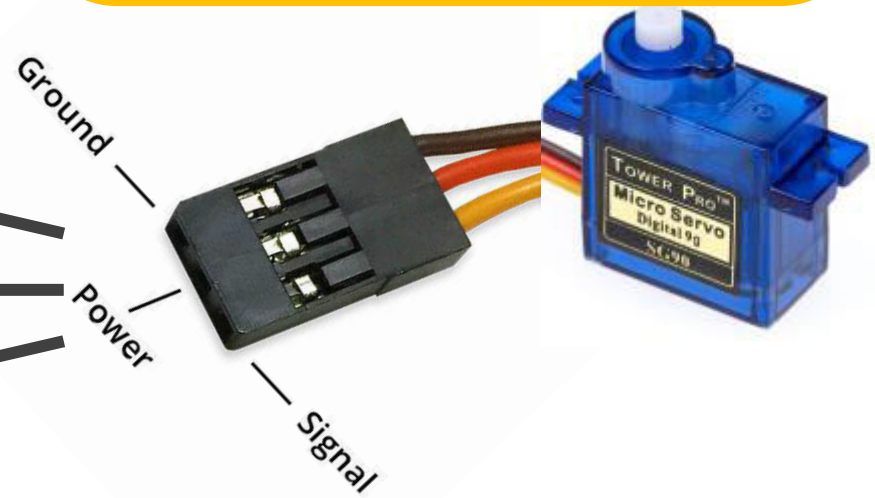
		IoT:Bit (Pin)
S	Signal Port	Data Pin
V	Voltage (+)	3v3
G	Ground (-)	GND

Colors

( )

( )

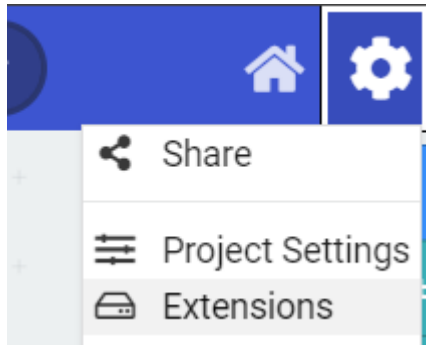
( )

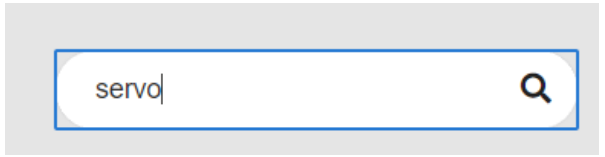


Control the Servo

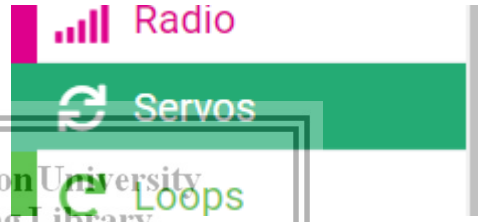
2. Adding extension to Makecode.org

1. Search and add the servo extension





2. Adding servo block to code



Task 1

micro:bit

Control the Servo with button with following description:

1. Press A, Turn 10° the servo arm to left
2. Press B, Turn 10° the servo arm to right

Hints

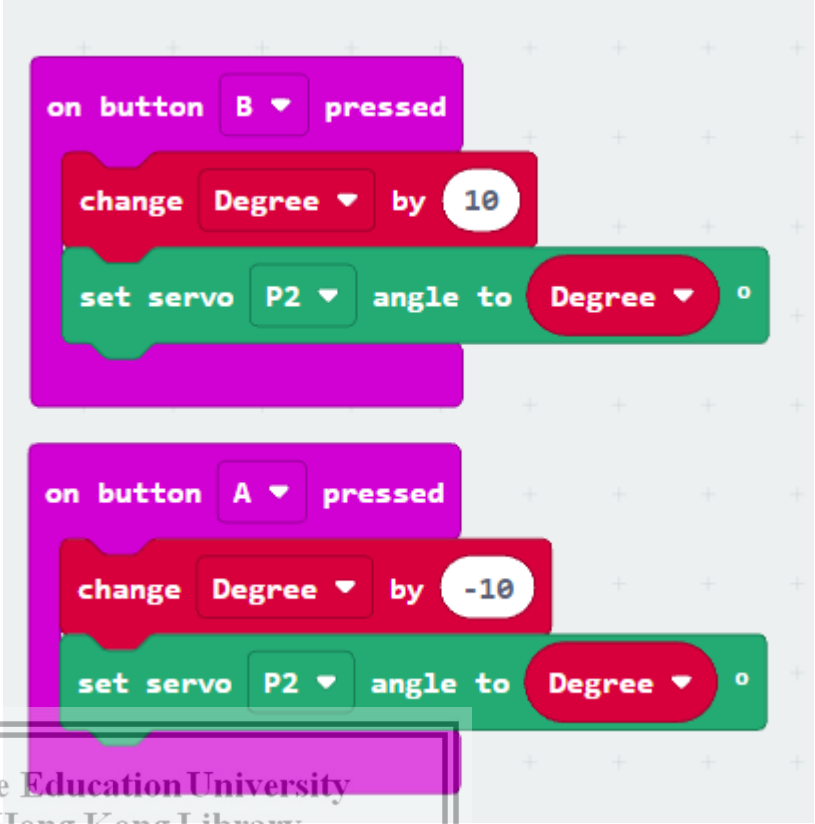
1. 180 ° = Right, 0 ° = Left
2. Use variable
   - Plus or minus one with each press

Servo Arm

Task 1

micro:bit

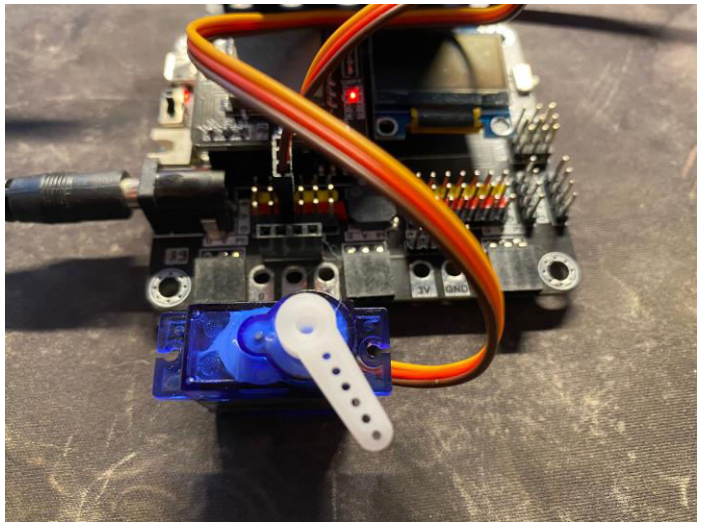
Solution Demo



Question:

Why sometimes the press won't respond?

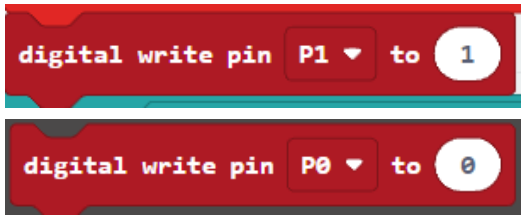
***WS(4)**



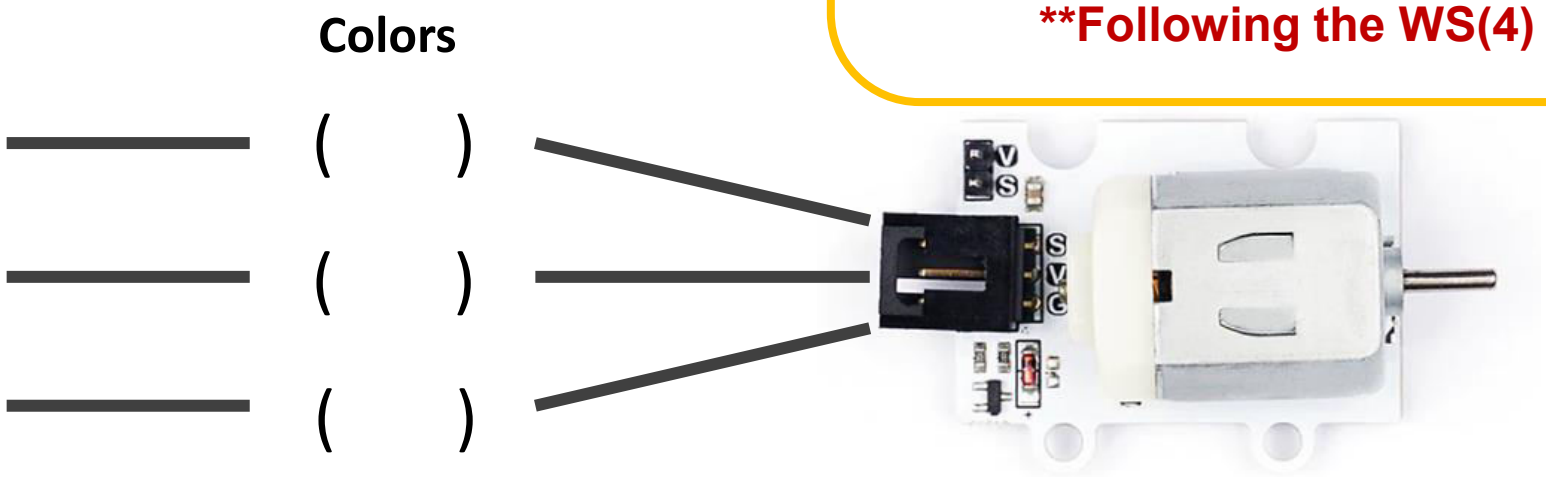
Control the external component - Motor

To control the motor spinning with micro:bit.

1. Connect the Motor to GVS port
   - Chose one available port (P0-P15)
2. Control the signal to corresponding pin with
   - 1 = Start spin
   - 0 = Stop spin



		IoT:Bit (Pin)
S	Signal Port	Data Pin
V	Voltage (+)	3v3
G	Ground (-)	GND

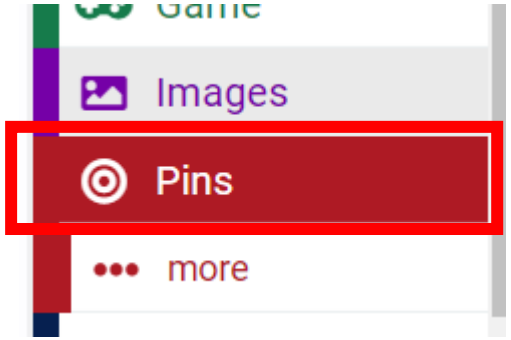


As the Dupont come with different colors. We need to connect to proper GVS port instead of following the color.

****Following the WS(4)**

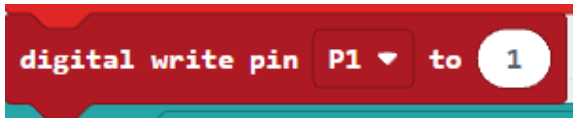
Task 2 - Control the Motor

Adding “Pin read” code:



Select **Pins** from Column

Select **digital write pin** from Column

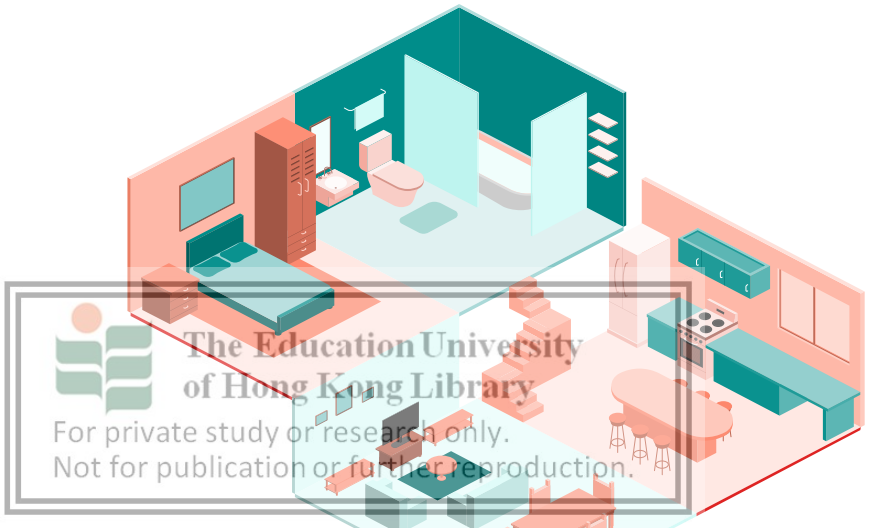


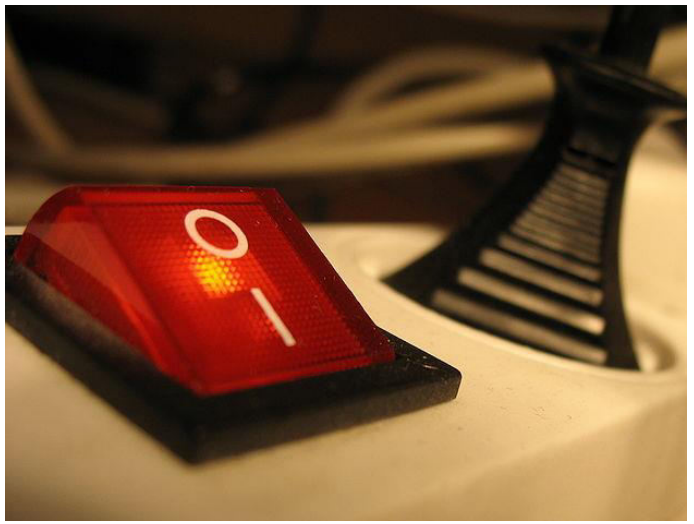
Giving “1” to pin P1 to activate the

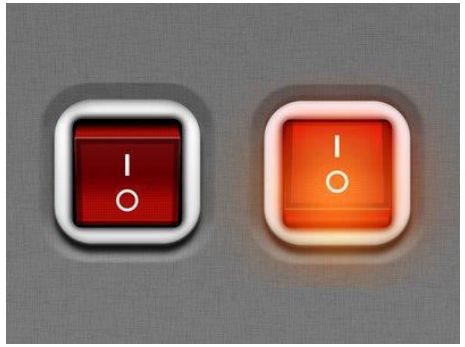
Giving “0” to pin P1 to activate the

Why “1” and “0”

Question before start



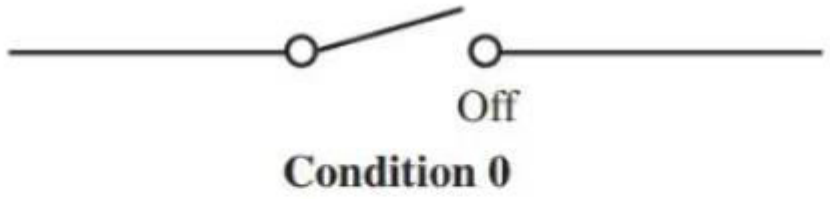




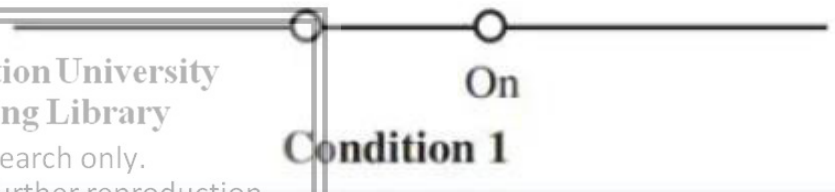
Why “1” and “0”

Binary signal:

Digital devices communicate in **Boolean value** which can be conveniently called 1 and 0.



0 = Circuit Break = Off



1 = Have signal = On

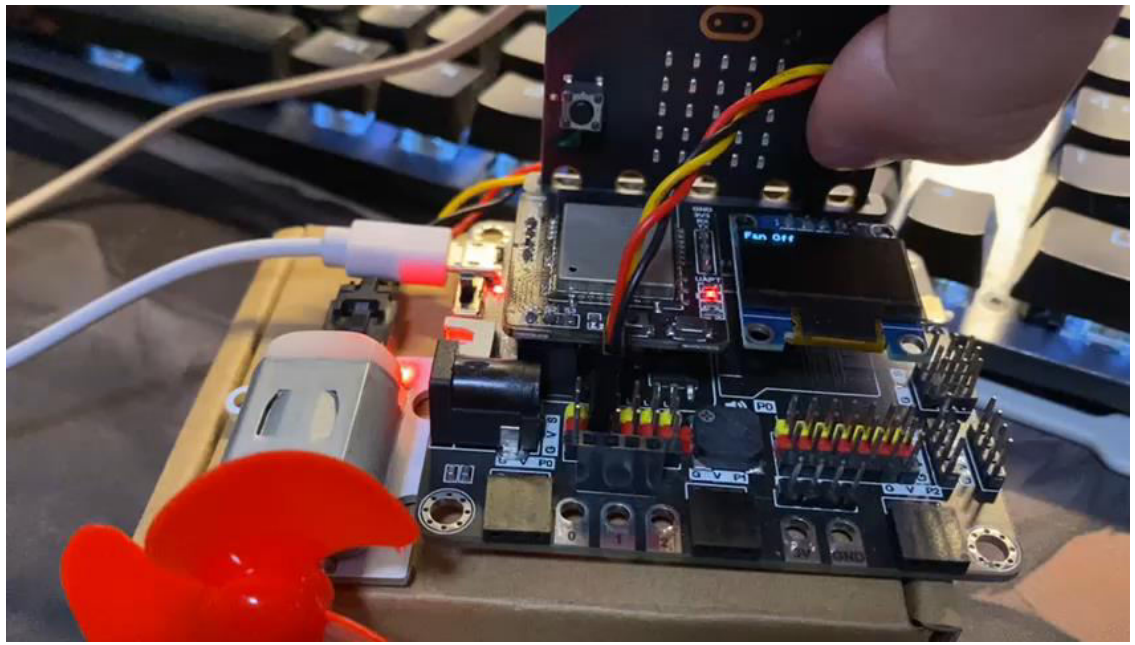
Control the Motor

Reference Code:

Drive the motor with pressing A and B.

```
on button A pressed
    clear OLED display
    show string "Fan Off"
    digital write pin P1 to 0

on button B pressed
    clear OLED display
    show string "Fan ON"
    digital write pin P1 to 1
```

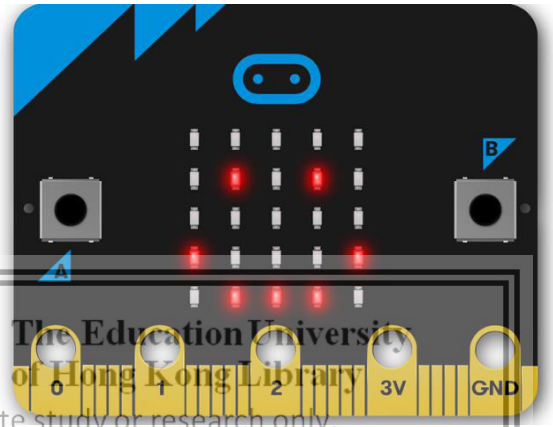


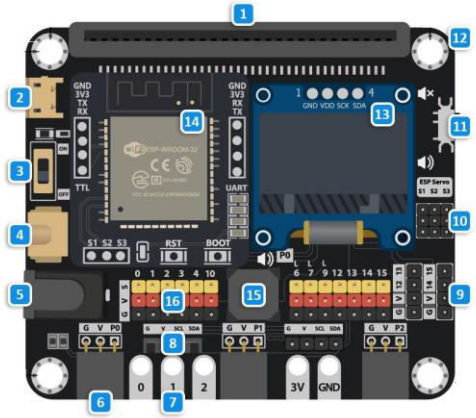
Task – 1st Product

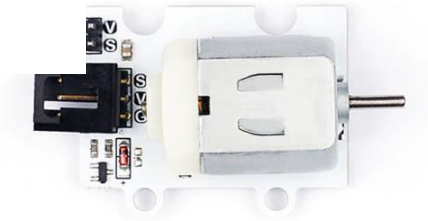
Automatic Temperature Control:

Combine the last lesson **Temp Alarm**. Build a system that can automatedly control the ambient temperature with Motor Fan.

Materials:

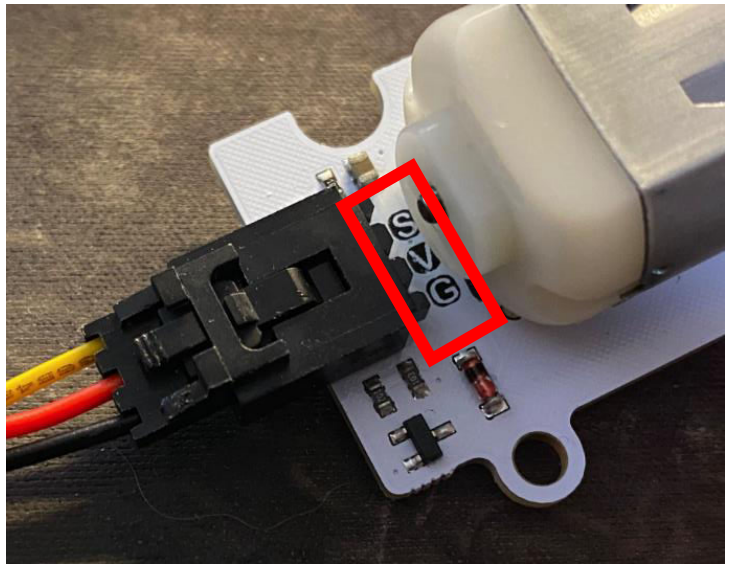


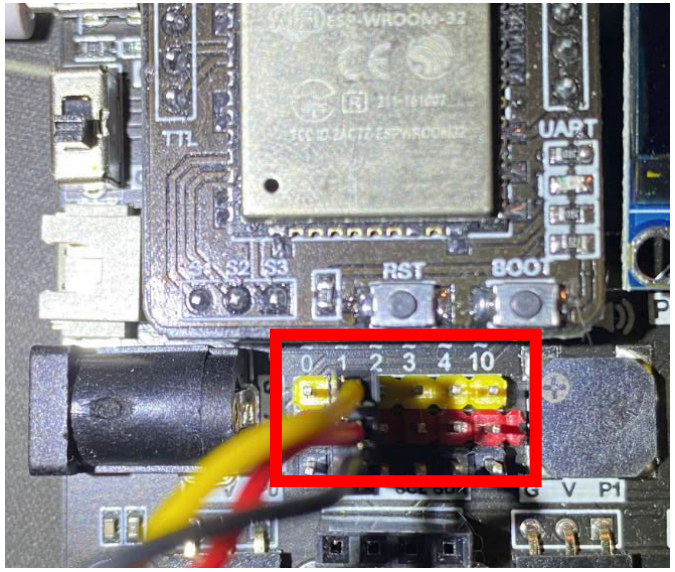


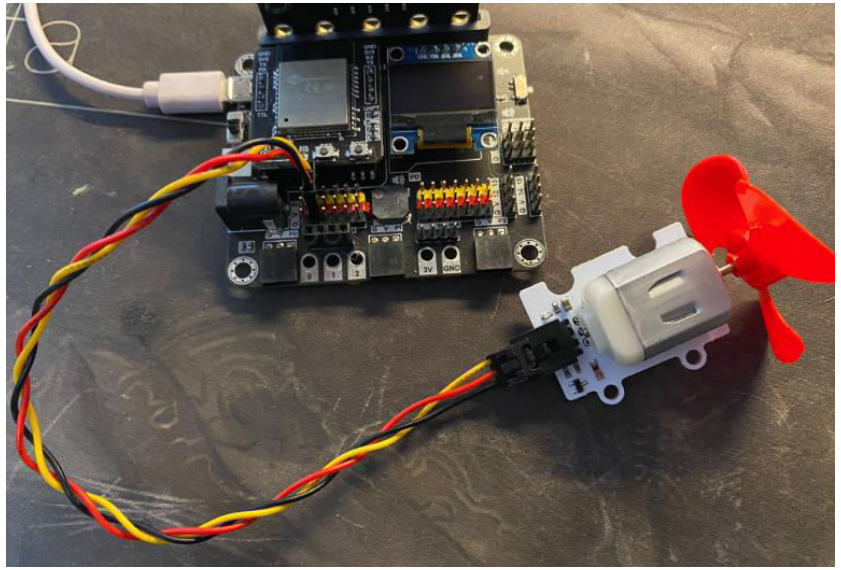


Task – 1st Product

Solution:1. Connect the components







Step 1:

Connect the Motor to GVS pin

Step 2

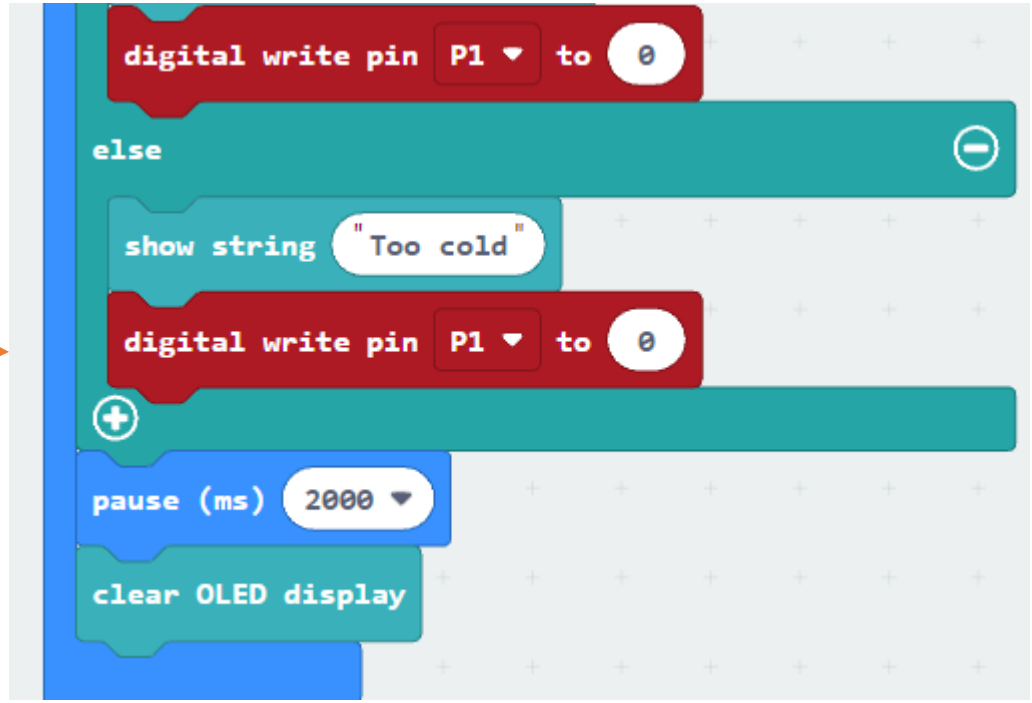
Connect the other side to IoT:Bit with Pin( )

Step 3

Attach the Fan blade to motor

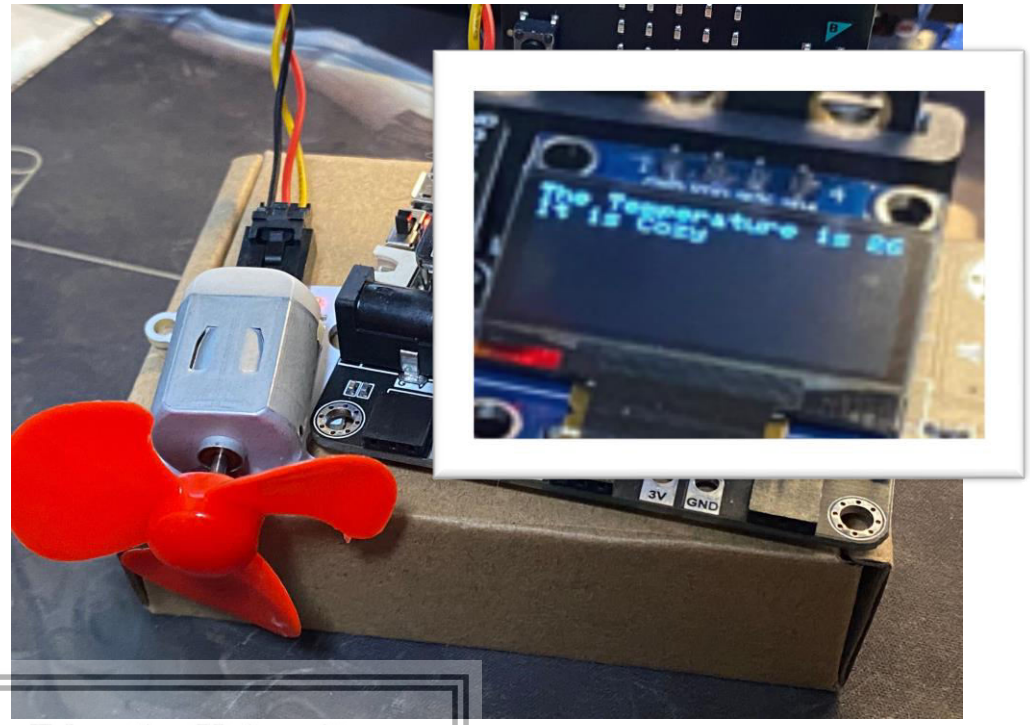
Task – 1st Product

Solution: 2. Coding

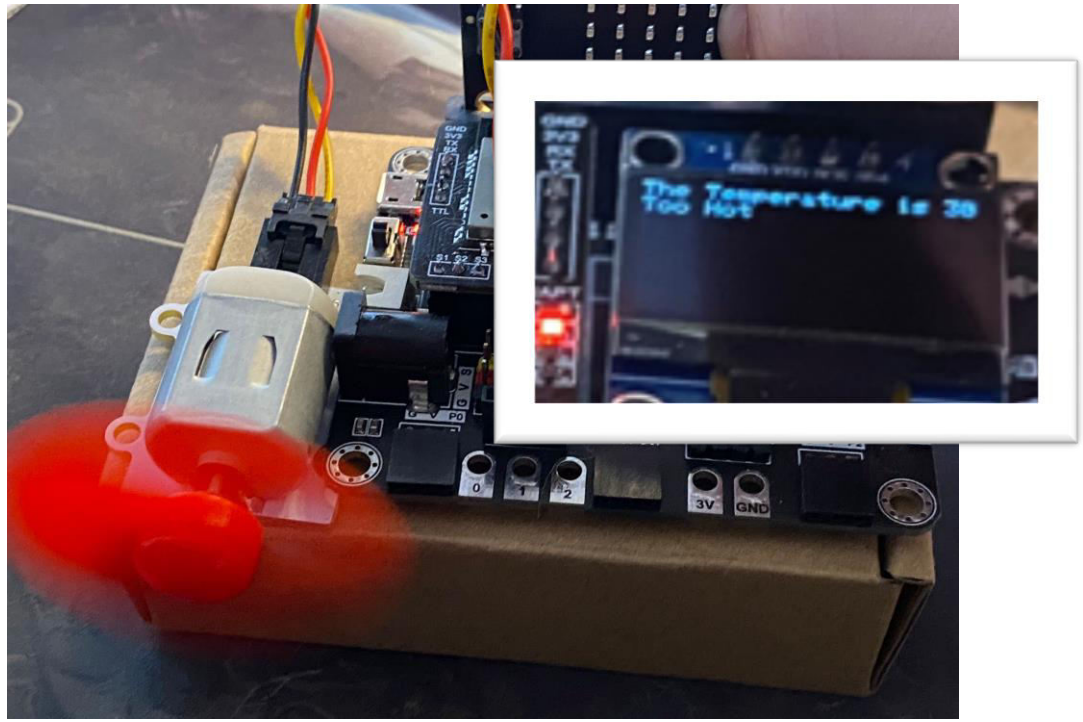


Task – 1st Product

Solution: 3. Demo



COZY – FAN Off

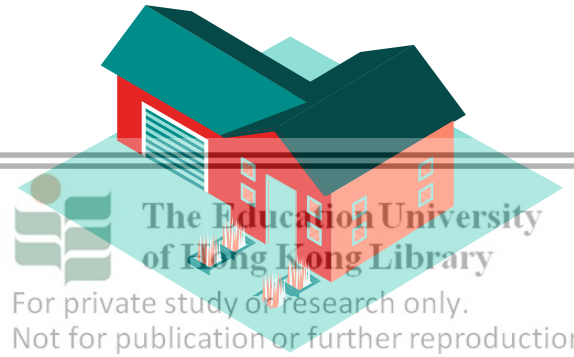


COZY – FAN Off

micro:bit

What products of Smart Home can be made by Micro:bit?

Reflection

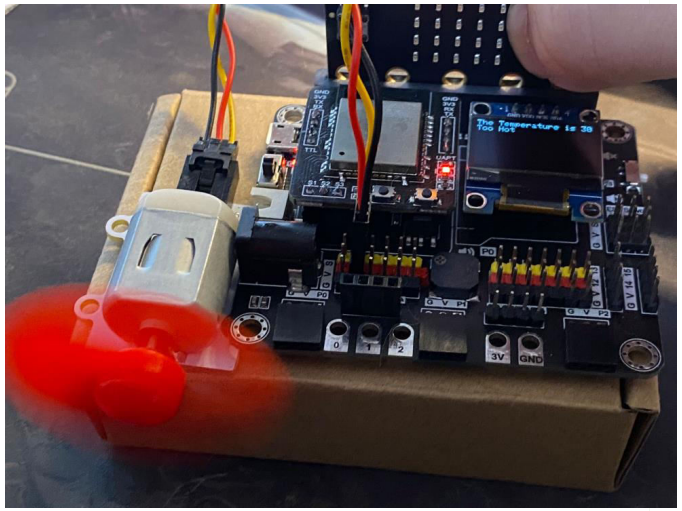


Conclusion

micro:bit

- Automatic Temperature Controls

1. Install the components to GVS pin
2. Control the external component
   - Motor
   - Servo
3. Build the Automatic Fan
   - Automation Task

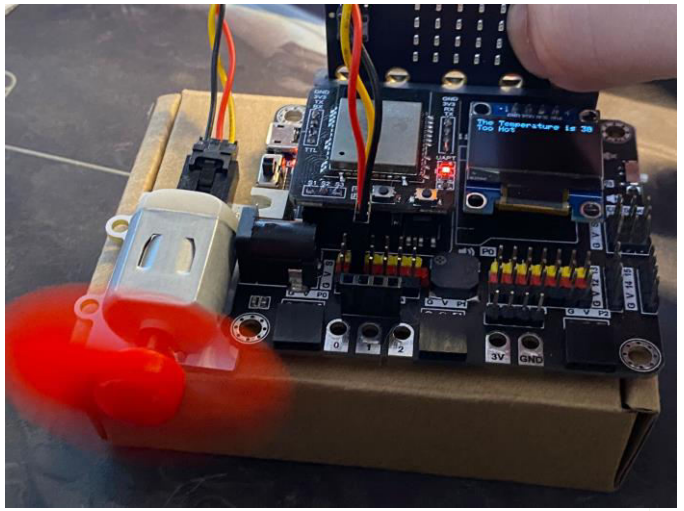


Revision

micro:bit

- **Automatic Temperature Controls**

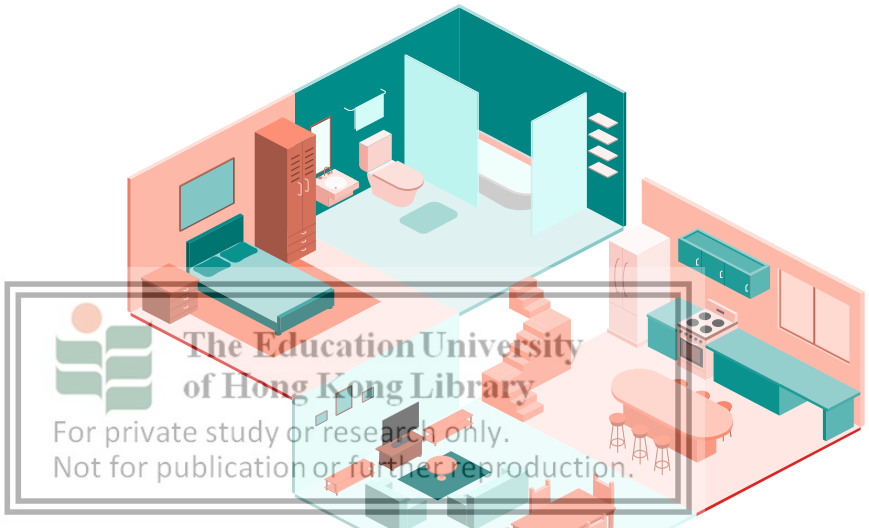
1. Install the components to GVS pin
2. Control the external component
   - Motor
   - Servo
3. Build the Automatic Fan
   - Automation Task



Lesson 5

Data Visualization

ThingSpeak

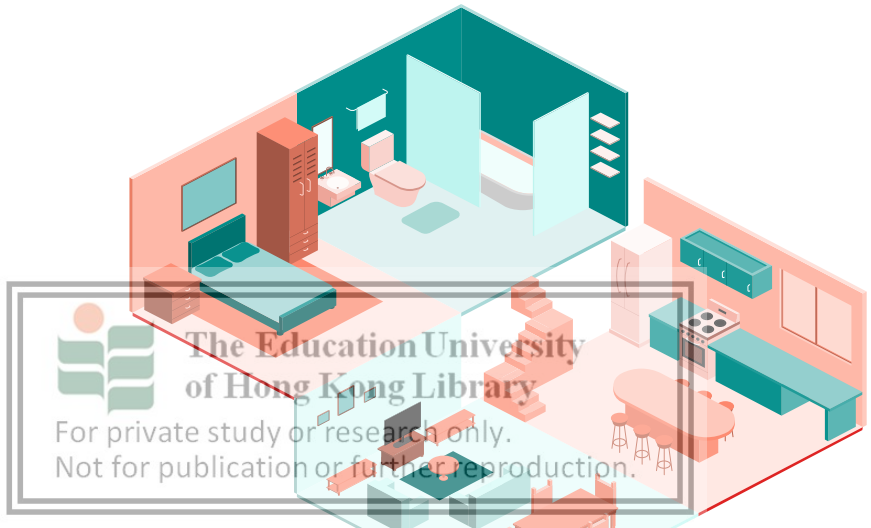


Lesson 5

micro:bit

Why is visualized and online data important to home?

ThingSpeak



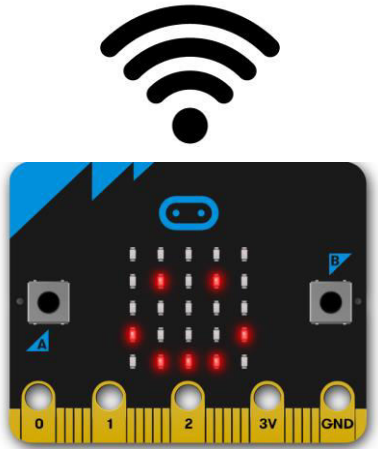
Lesson 5

micro:bit

Upload Data to ThingSpeak

Today's Contents

ThingSpeak



Sign up ThingSpeak

Connect Device to online

Home Monitoring

External Sensor and upload

Data Visualization

micro:bit

Data is rare, represent the data to information can achieve:

- Easier to understand
- identify patterns, trends in large amount of data

Upload data to online

micro:bit

ThingSpeak:

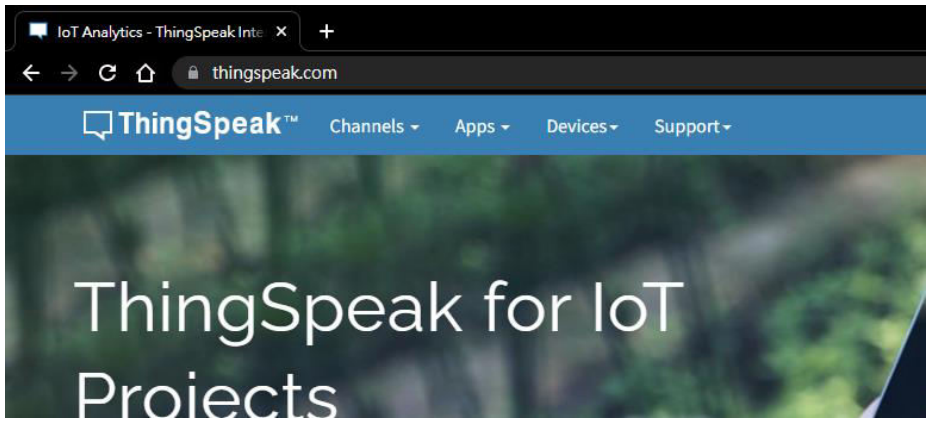
1. A Free online application platform for the IoT
2. Provide real-time data aggregation and analytics
3. Allow sending data to ThingSpeak Cloud from your devices

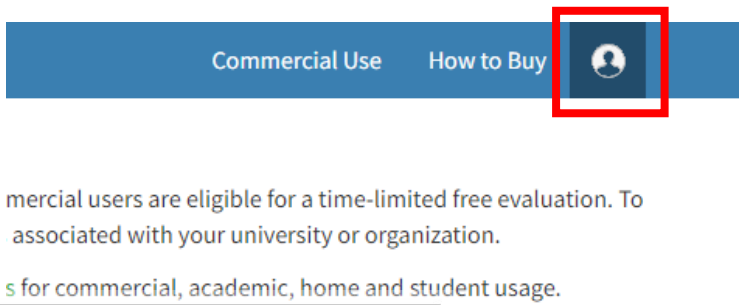
ThingSpeak

ThingSpeak – Sign Up

micro:bit

Step1: Go to https://thingspeak.com/





Step2: Click the 

ThingSpeak

ThingSpeak – Sign Up

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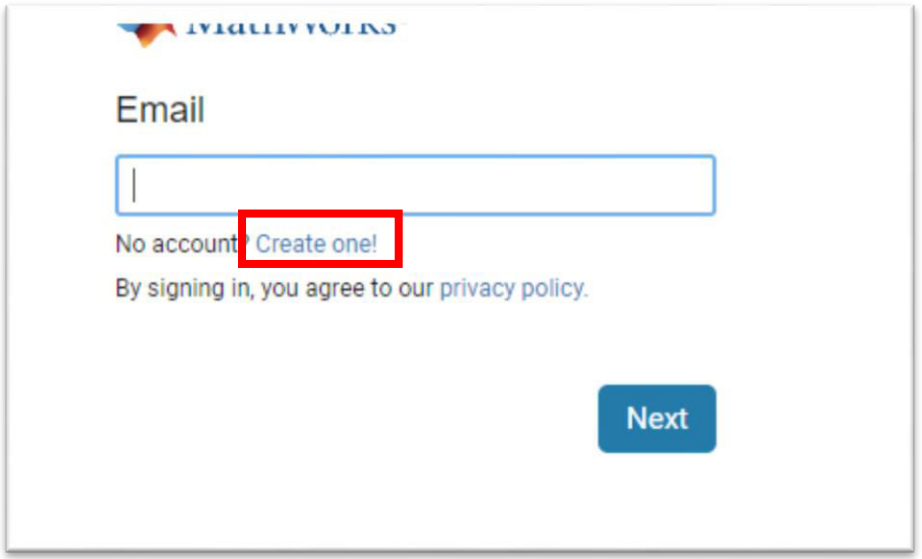
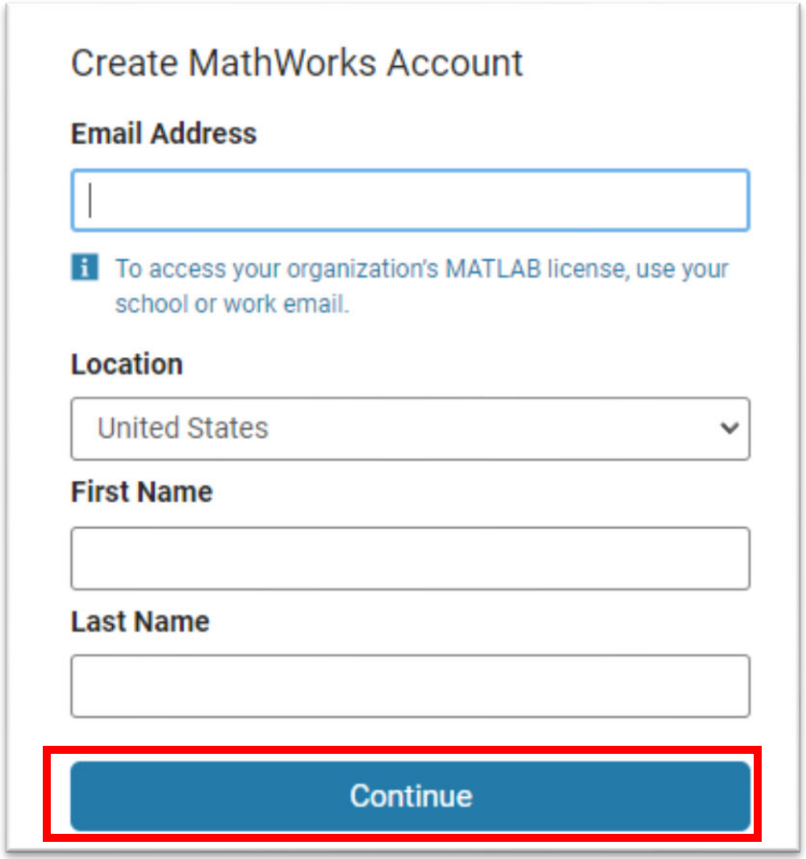
Step2:

Click the "create one!"



Step3:

Fill in the info



ThingSpeak – Sign Up

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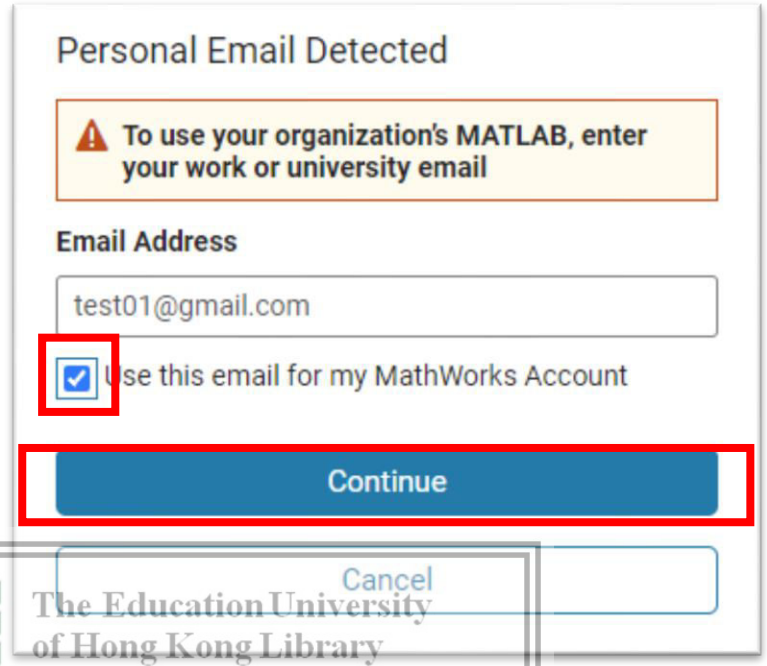
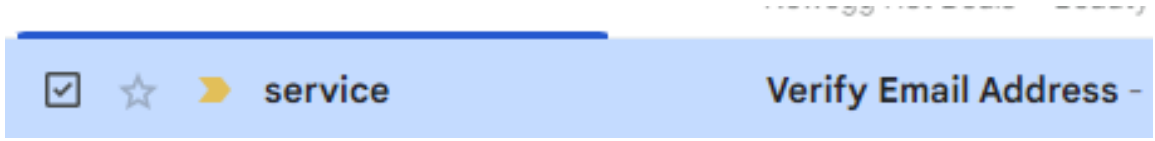
Step4:

Tick the box then continue

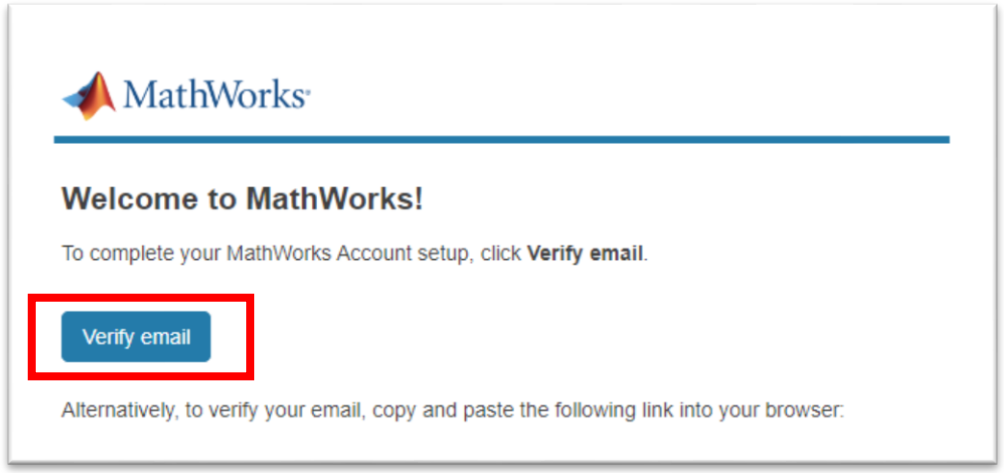


Step5:

Login your email and find Email - “Verify Email Address”



Step6: Click

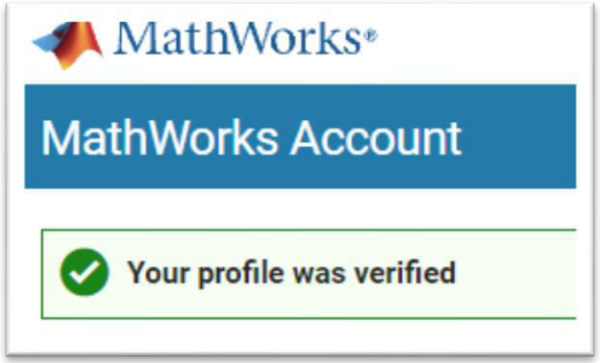


ThingSpeak – Sign Up

micro:bit

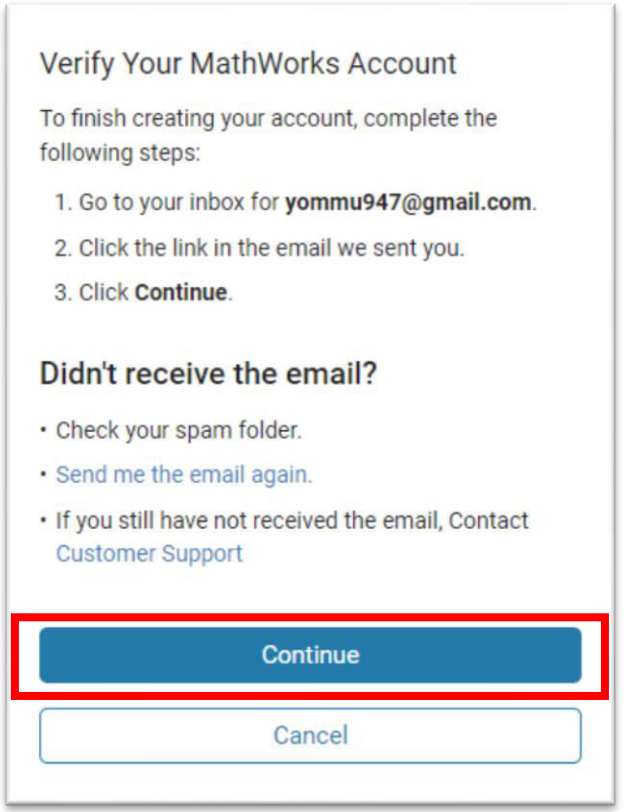
Step7:

After clicked, Website will show message of success



Step8:

Go back the website from step4, Click continue

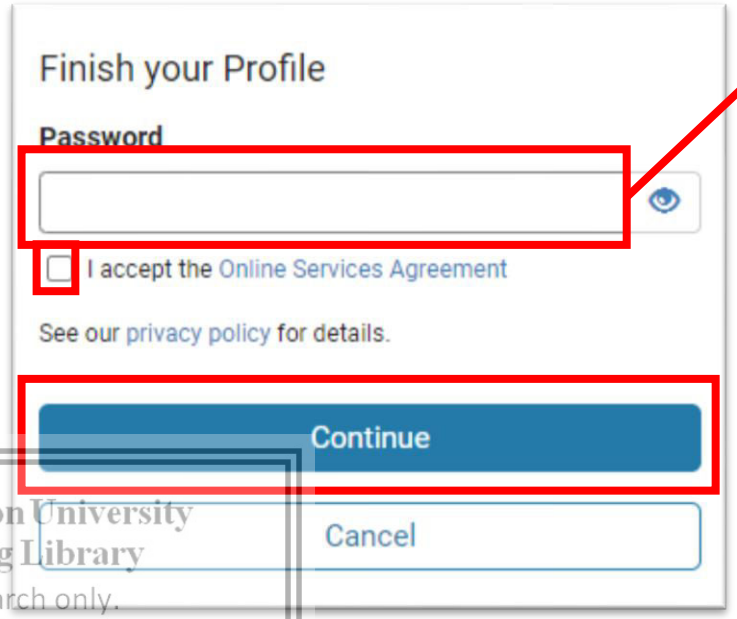


ThingSpeak – Sign Up

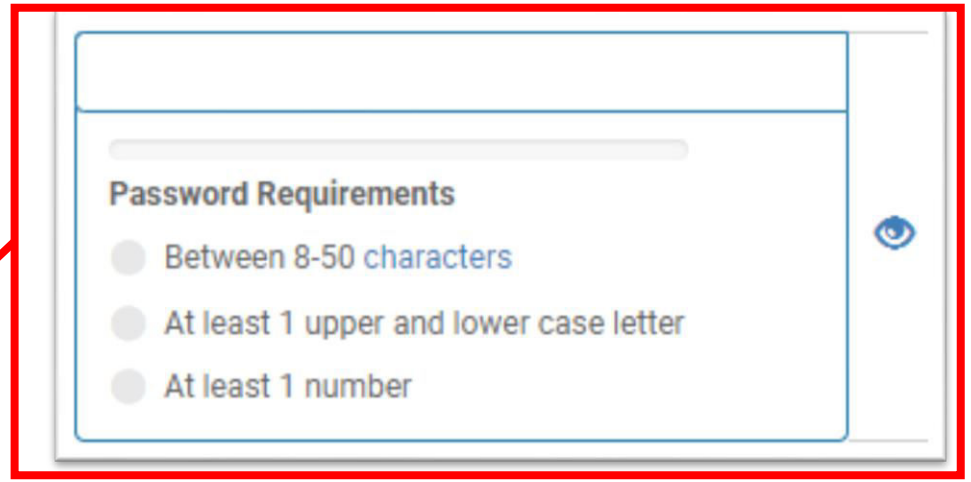
micro:bit

Step9:

1. Fill in the password
2. Tick the agreement box
3. Continue.

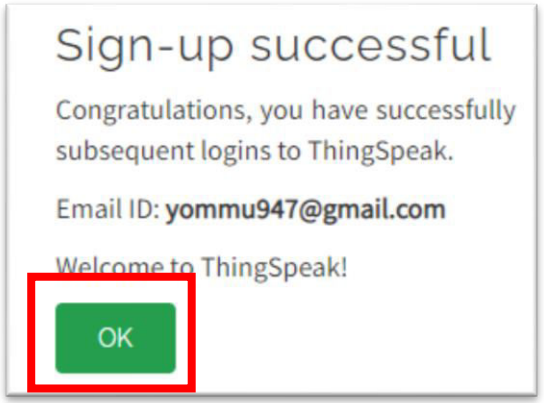


Password Requirements



Step10:

Click



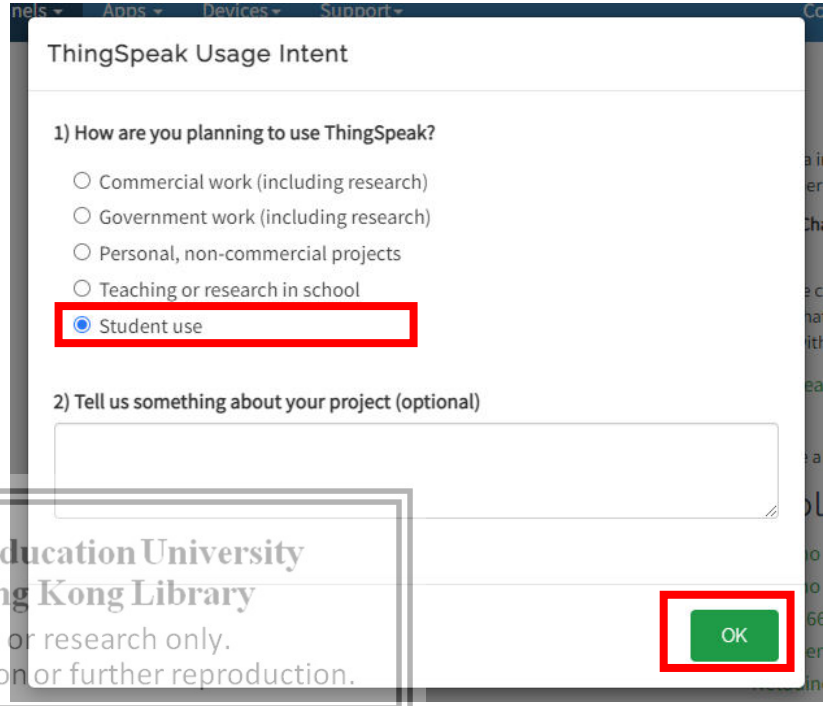
ThingSpeak – Sign Up

micro:bit

Step11:

Fill in the survey

1. “Student use”
2. Click OK



Step11:

Click

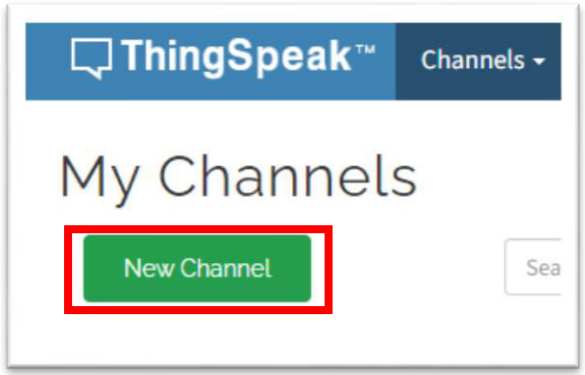
ThingSpeak – Create Channel

micro:bit

Step1:

Go to https://thingspeak.com/channels/

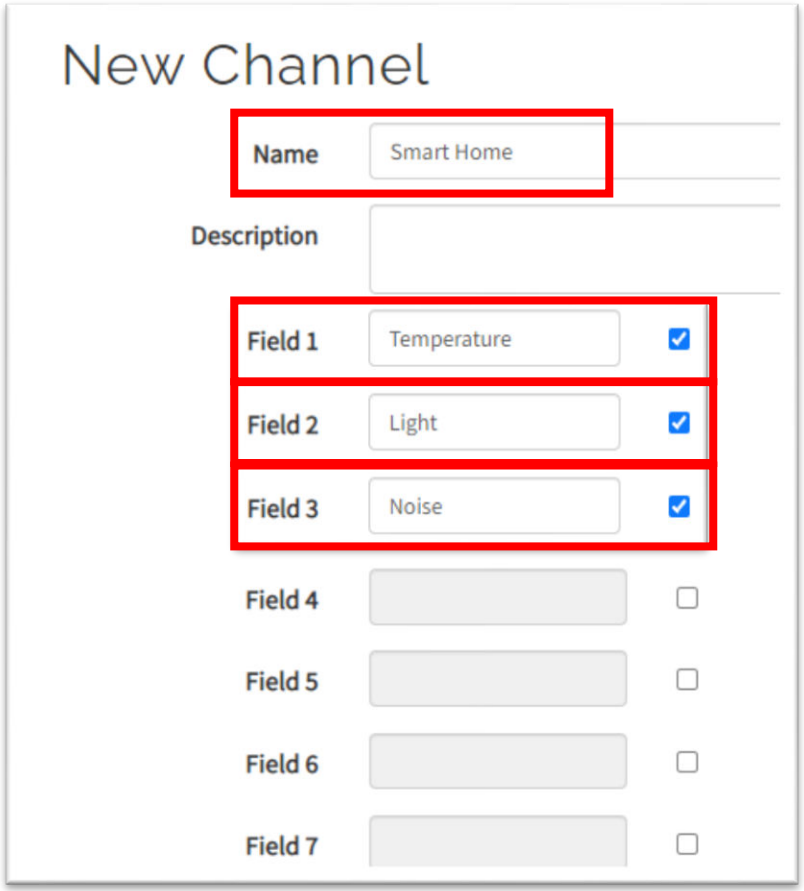
1. Click New Chanel



Step2:

In the new page:

1. Name = “Smart Home”
2. Tick Field 1 to 3
3. Field1 = “Temperature”
4. Field2 = “Light”
5. Field3 = “Noise”

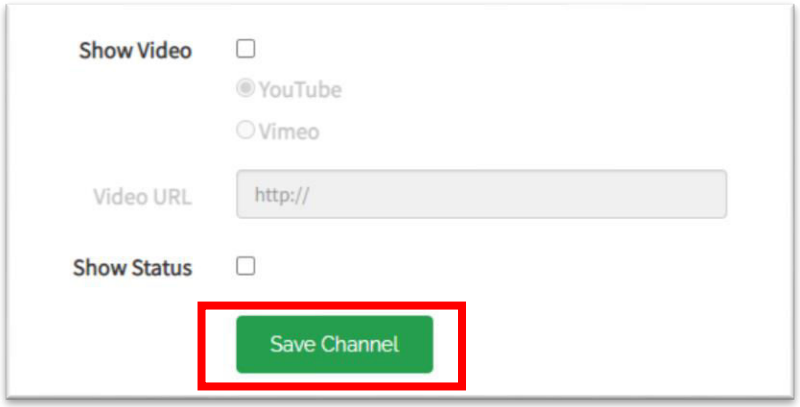


ThingSpeak – Create Channel

micro:bit

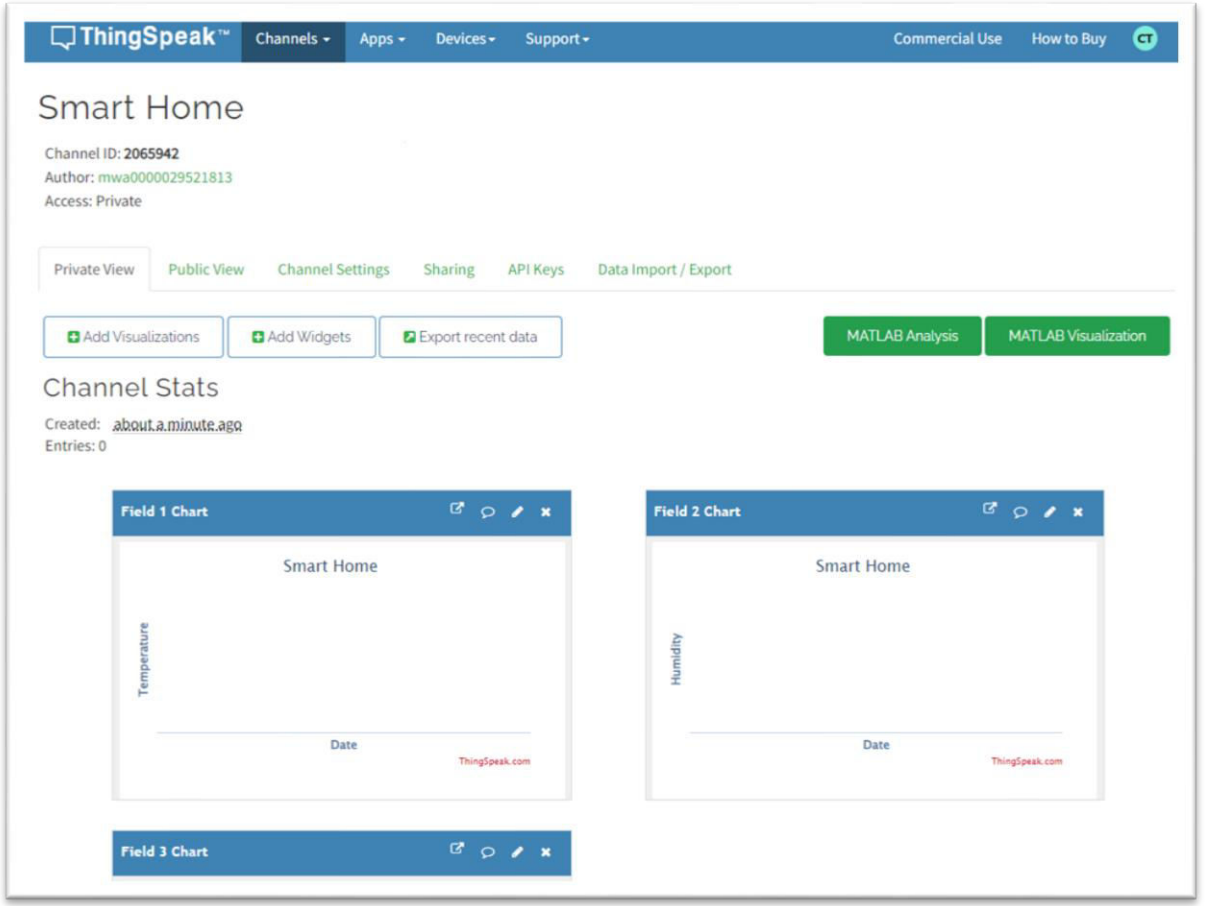
Step3:

Scroll down to click “Save Channel”



Step4:

Redirect to Channel page



ThingSpeak – Create Channel

micro:bit

Step3:

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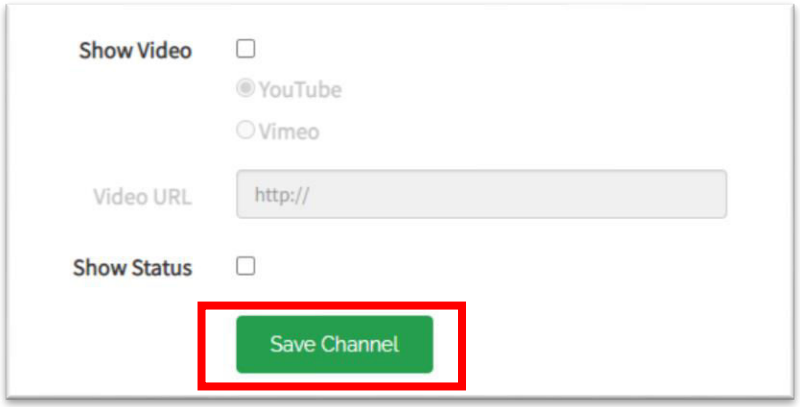
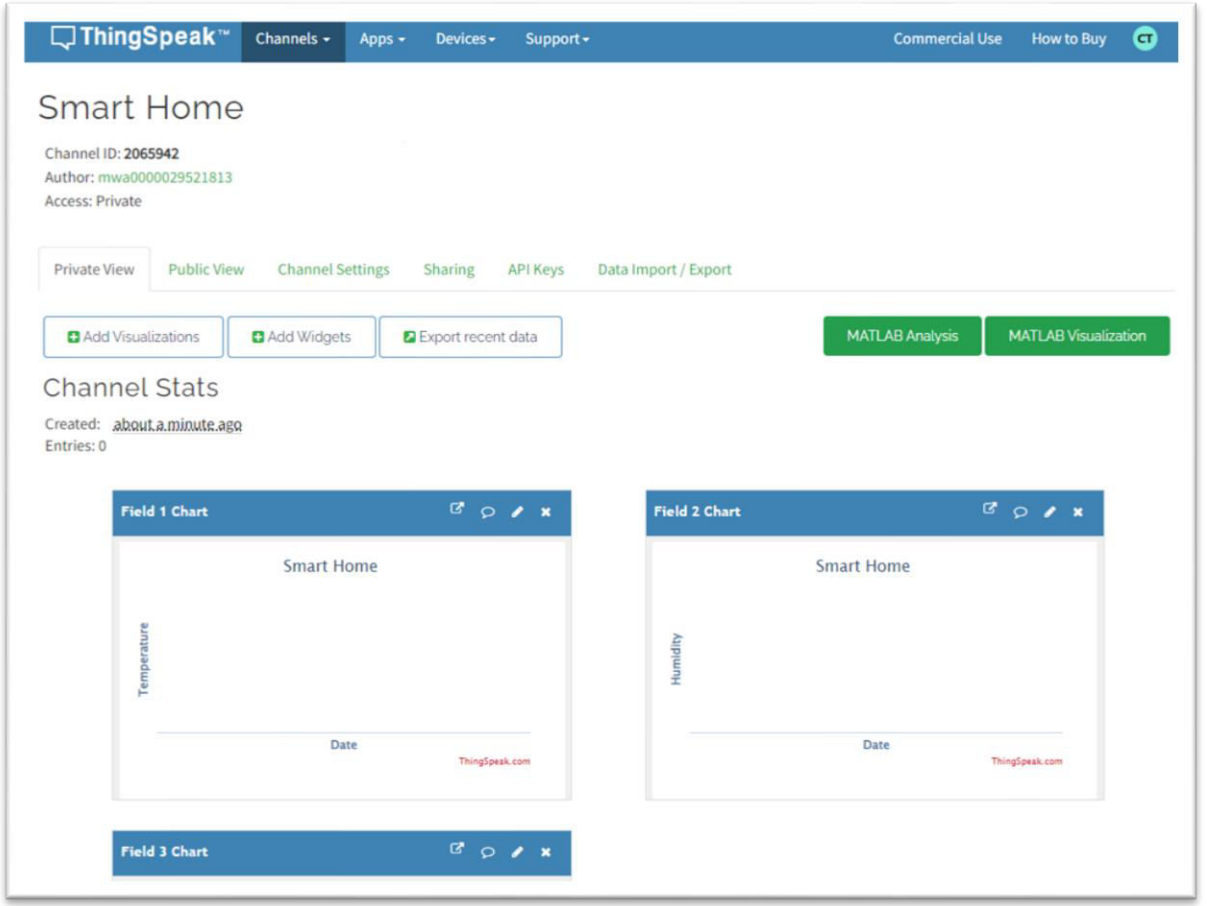


Step4:

Redirect to Channel page



ThingSpeak – Capture API Key

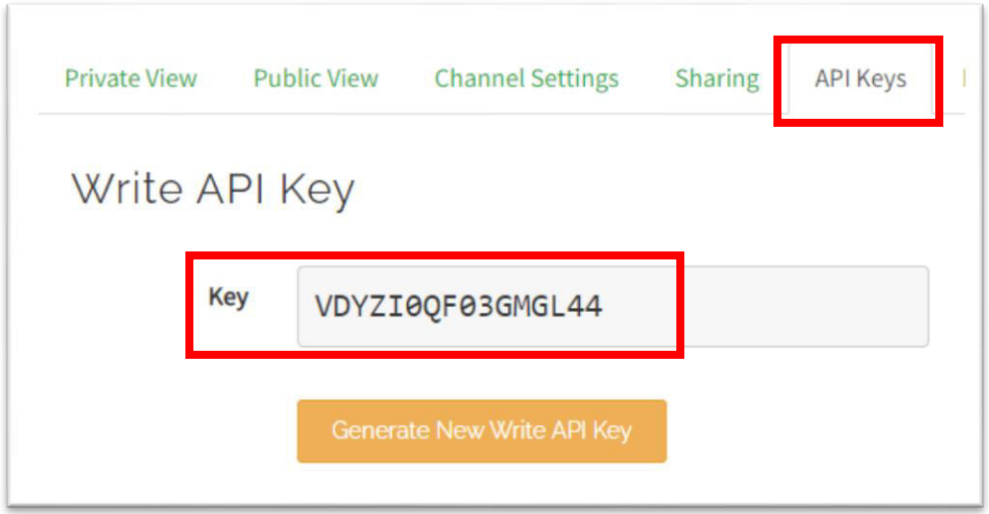
micro:bit

API Key

- Read API Key
  - Allows you to read data from a channel
- Write API Key
  - API key to update a channel

Steps:

Click on the “API Keys”, Copy and save the Write API Key



Connect device to Internet

micro:bit

The beginning of IoT:

Online your device

Internet of Things

- Internet of Things (IoT)
  1. The **devices** that ***communicate** between **devices or cloud**
  2. Communicate **though Internet**

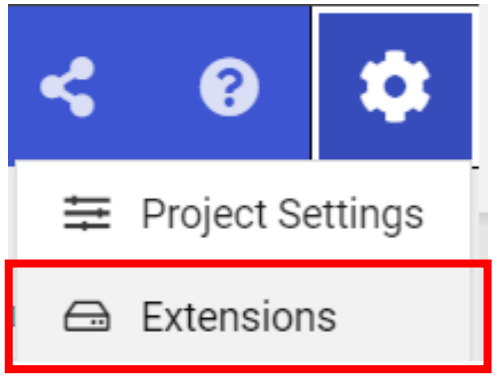
*Communicate: IoT devices **exchange data and command.**

How IoT impact our daily life?

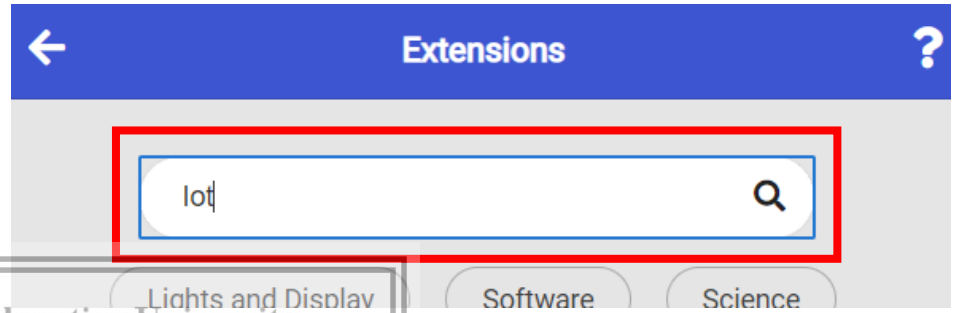
Connect device to Internet

Coding:

- Step 1: Adding extension



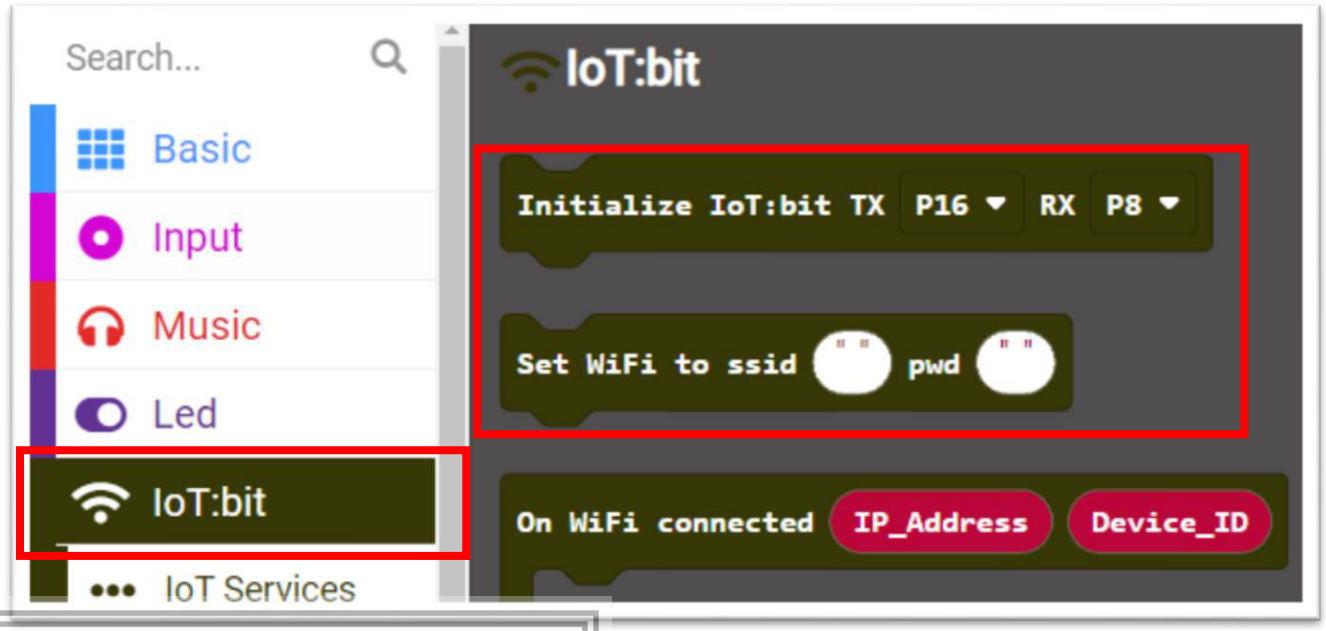
- Step2: Search “iot” and select ”smartcity”

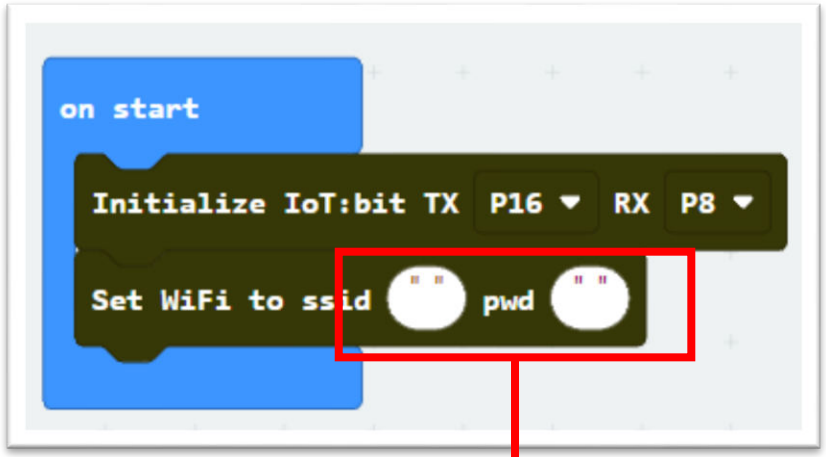


Connect device to Internet

Coding:

- Step 3: Adding the block to “On Start”





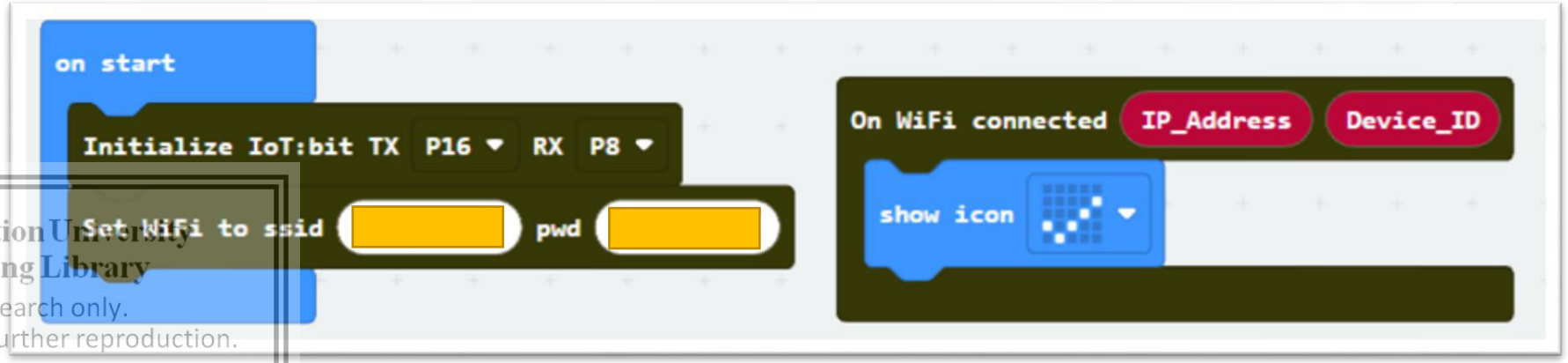
ssid = _____

pwd = _____

Connect device to Internet

Coding:

- Step 4: Add the if block to ensure the WiFi is connected



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Coding:

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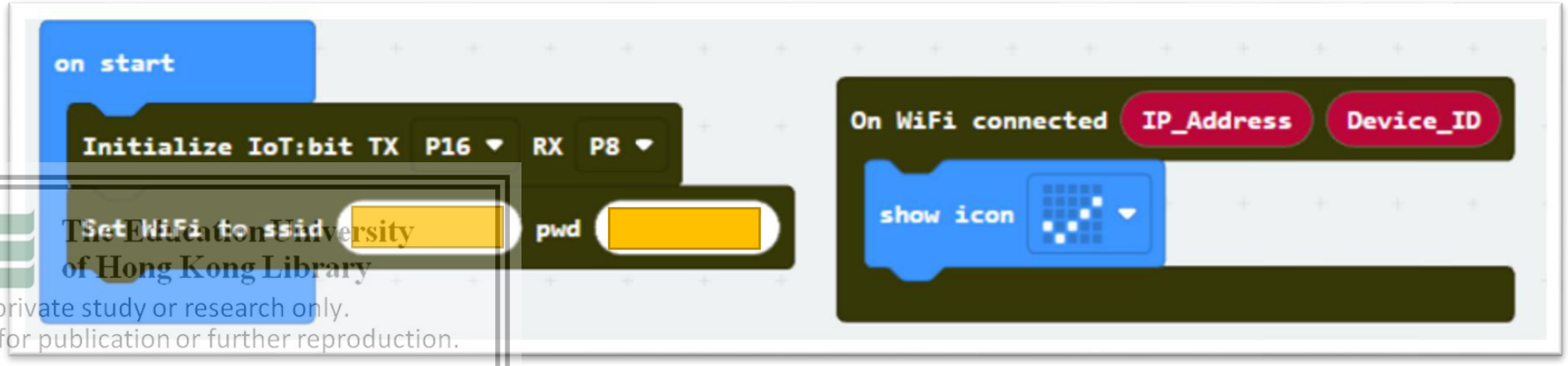

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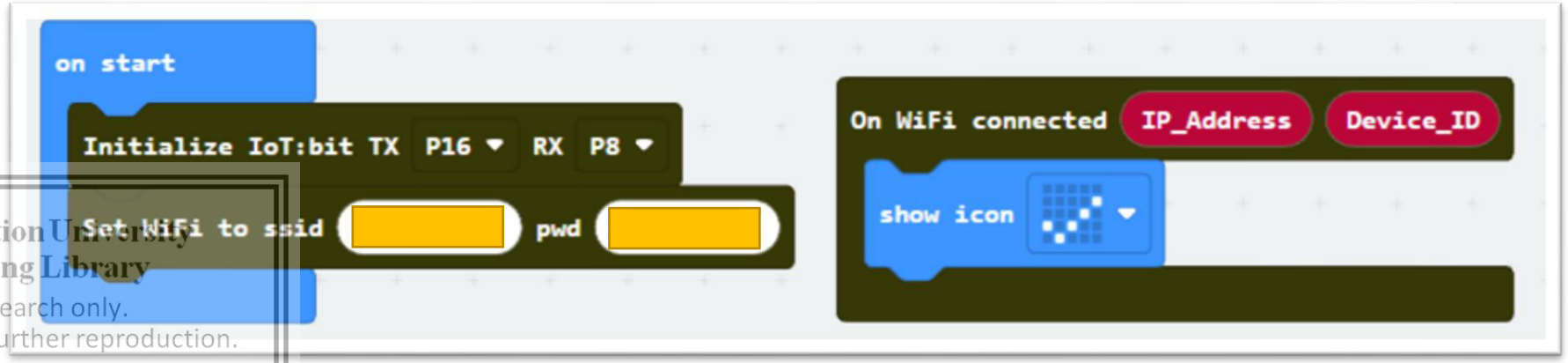
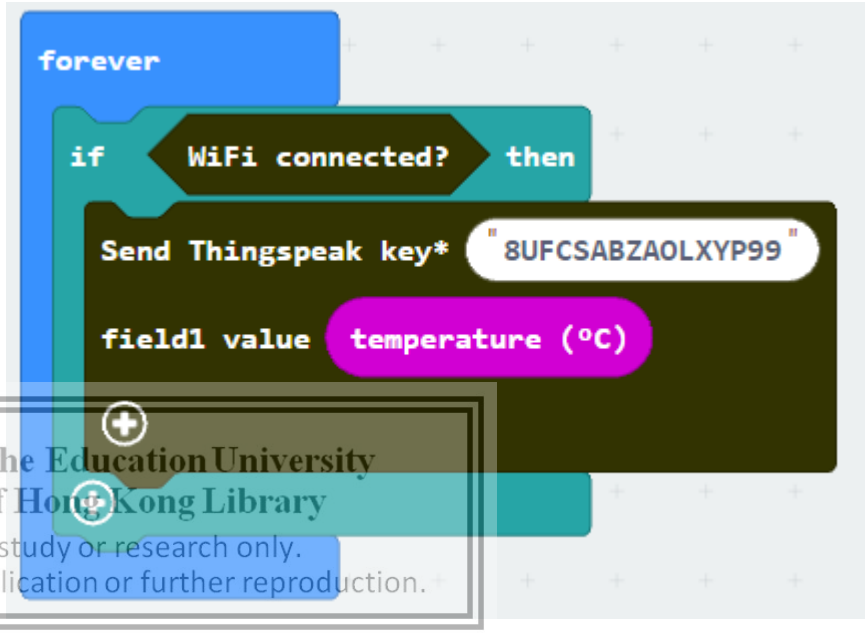


Upload Temperature to online

Coding:

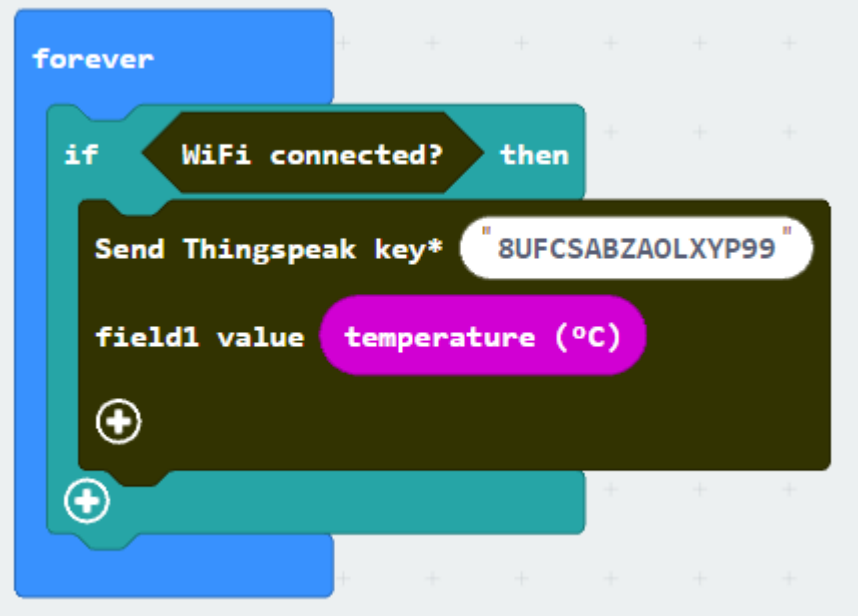
- Step 4: Add the if block to ensure the WiFi is connected
  - Placing “if-statement” in the “Forever”
  - Add “WiFi connected” to the condition
  - Add ThingSpeak block, fill in the “Captured API Key” and “temperature” in field1 value
  - Add “Pause for 10 second(10000ms)”

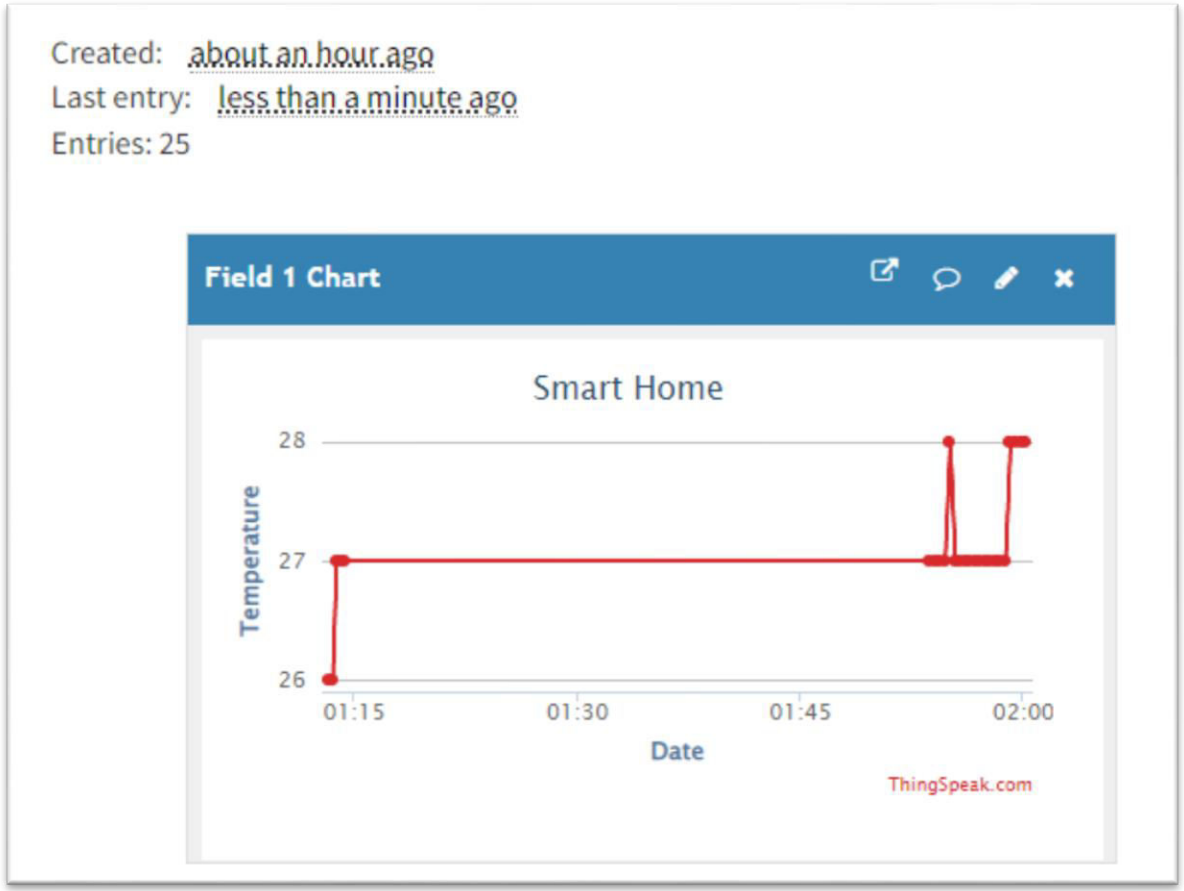


Upload Temperature to online

micro:bit

Demo





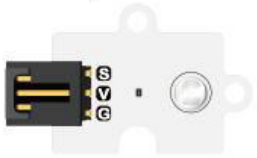
External Sensor

- **Behind all the internal sensor, User can install different sensor**

For example:

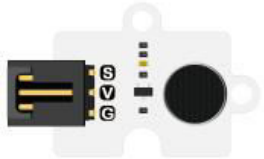
Light sensor

Light sensor is a kind of simulation input element, its output voltage in direct proportion to light intensity.



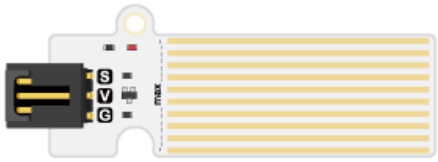
Noise sensor

Noise sensor is a kind of simulation input element which can detect dB.



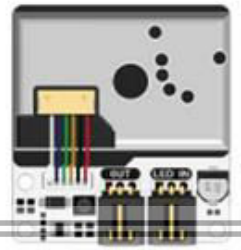
Sonar:bit

Ultrasonic can return the detected distance in cm and mm.



Water level sensor

Put the below line end in water for water level detection.

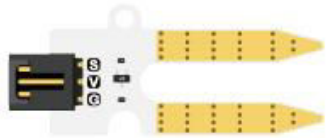


PIR sensor

PIR sensor is to detect the human body infrafe.

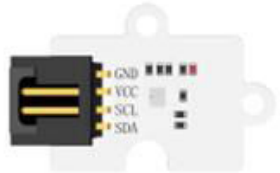
Soil moisture sensor

Soil moisture sensor is a kind of simulation input element. Its resistance between 2 electrodes is soil moisture value.



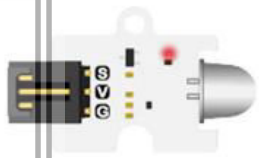
BME 280

BME280 can measure atmospheric pressure, temperature and humidity.



Dust sensor

Dust sensor can detect current air quality.



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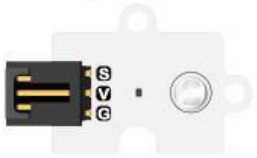

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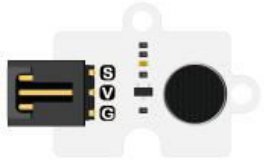

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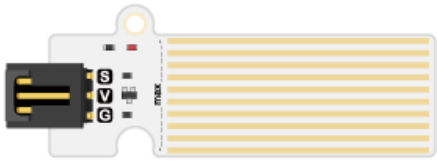

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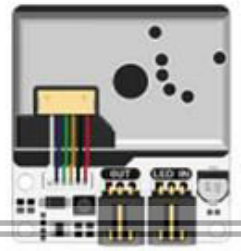

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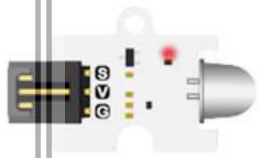

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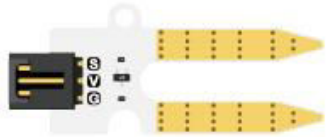

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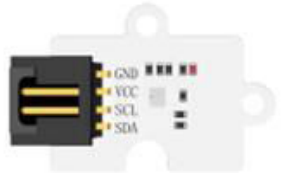


Read the Sensor guide for connection and coding method

External Sensor

To control the Sensor with micro:bit.

1. Connect the Sensor to GVS port
   - Chose one available port (P0-P15)

As the Dupont come with different colors. We need to connect to proper GVS port instead of following the color.

Following the WS(4)

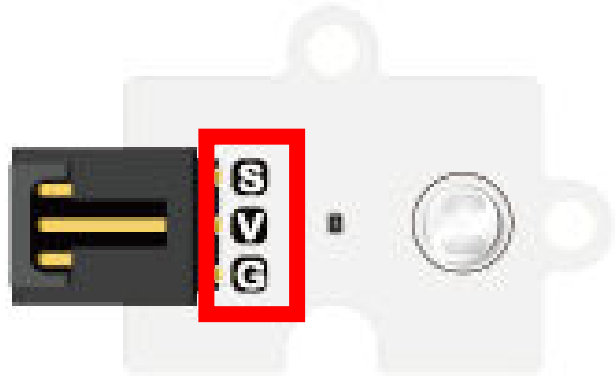
		IoT:Bit (Pin)
S	Signal Port	Data Pin
V	Voltage (+)	3v3
G	Ground (-)	GND

Colors

( )

( )

( )



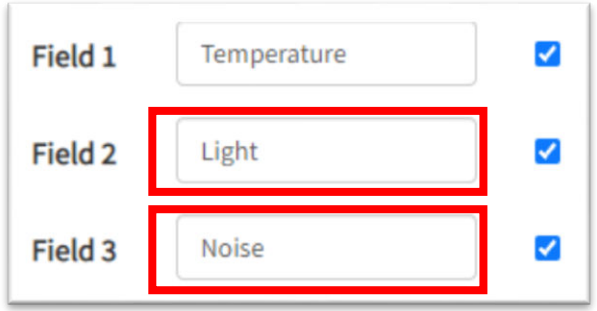
Task - Home Monitoring

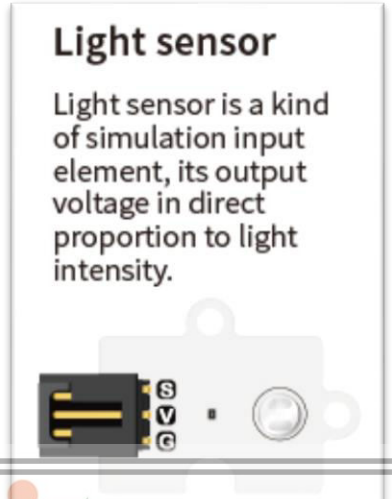
micro:bit

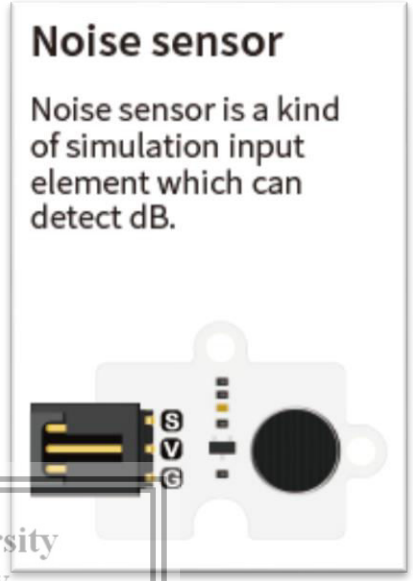
Task:

1. Upload “Light” to field 2
2. Upload “Noise” to field 3

Extra: Connect MORE sensor and upload



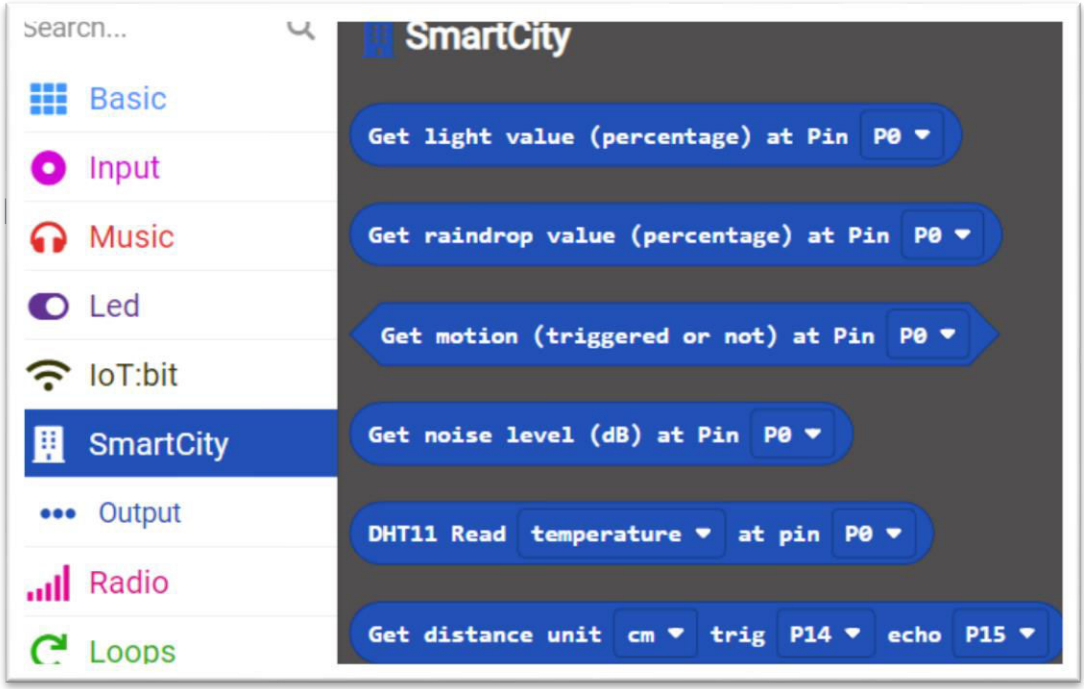




Measure unit: % **Measure unit: dB**

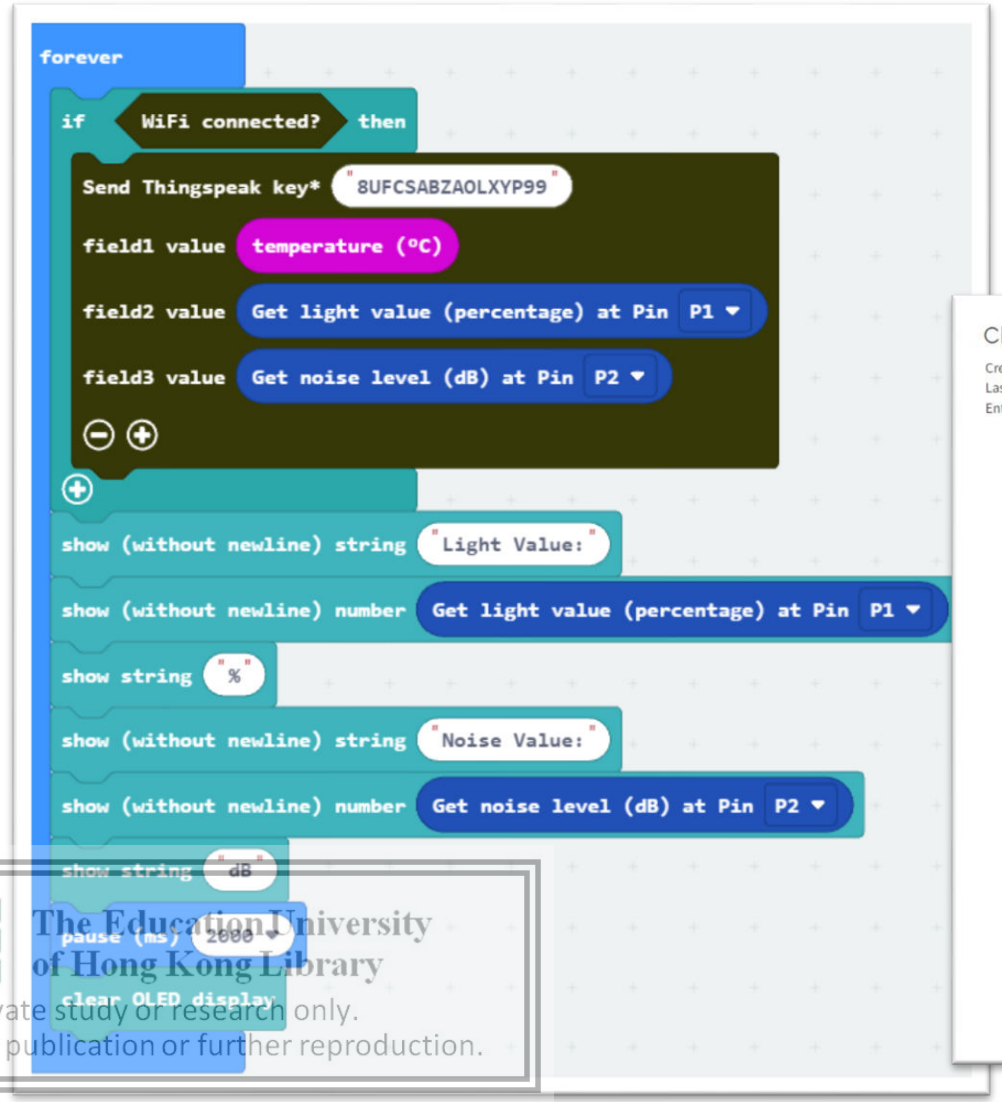
Guide:

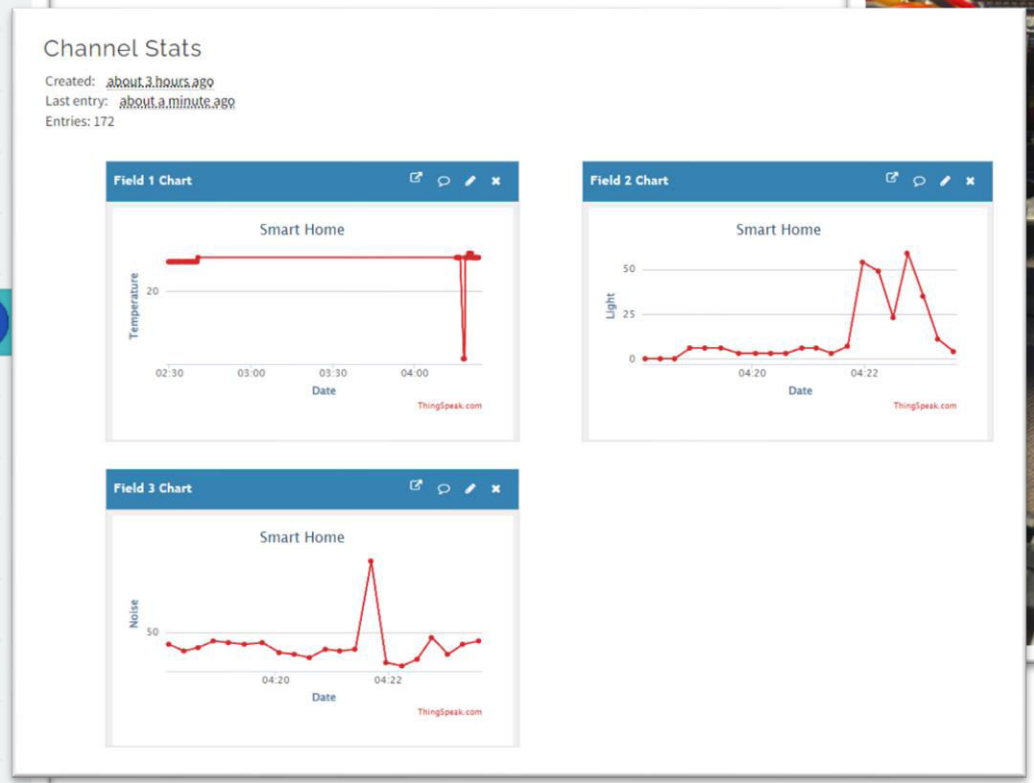
1. Click “SmartCity”
2. Select Correspondi block

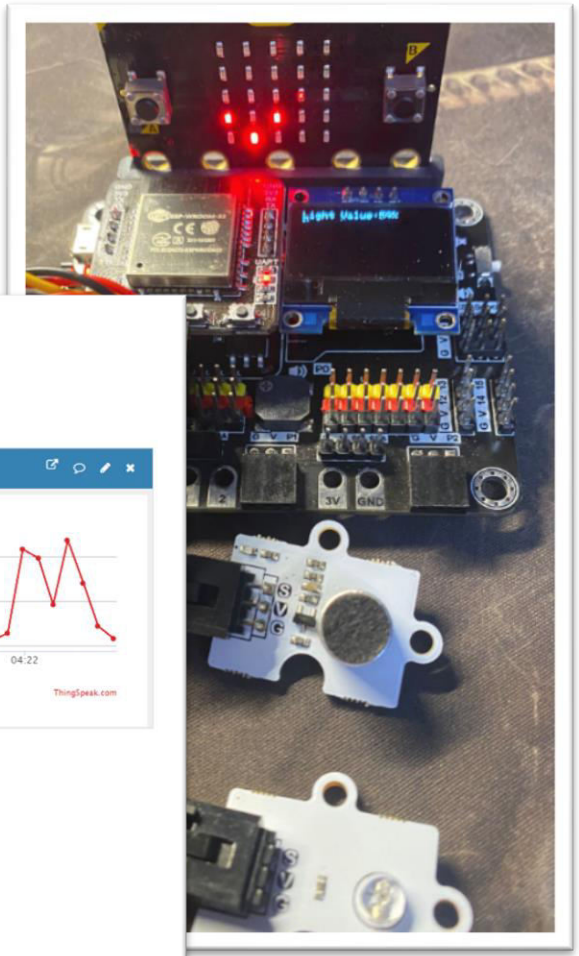


Task - Home Monitoring

Demo







Life cycle of IoT

micro:bit

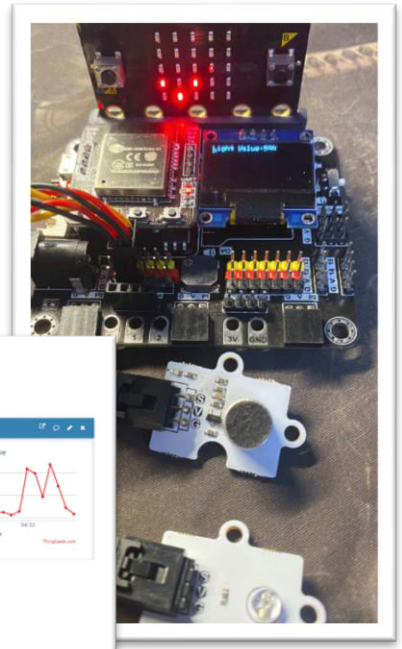
Life cycle	**Home monitoring**
Collect	Collect data from different sensor
Communicate	Connect and send data to ThingSpeak with API Key though WIFI
Analyze	Visualizing the data that need to be analyzed
Action	

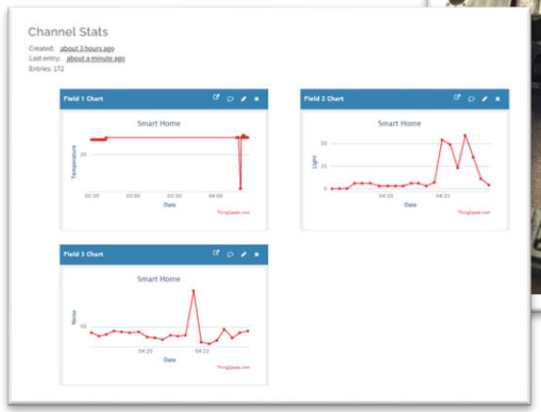
Conclusion

micro:bit

1. **Data Visualization**
   - Represent the data to information can achieve
     - Easier to understand
     - identify patterns, trends in large amount of data
2. **Upload data to ThingSpeak**
   - A Free online application platform provided real-time data aggregation and analytics from your devices data.
3. **Home Monitoring**
   - External Sensor

Revision





1. Data Visualization

- Represent the data to information can achieve
  - Easier to understand
  - identify patterns, trends in large amount of data

2. ThingSpeak

- Provided real-time data aggregation and analytics with using Internet

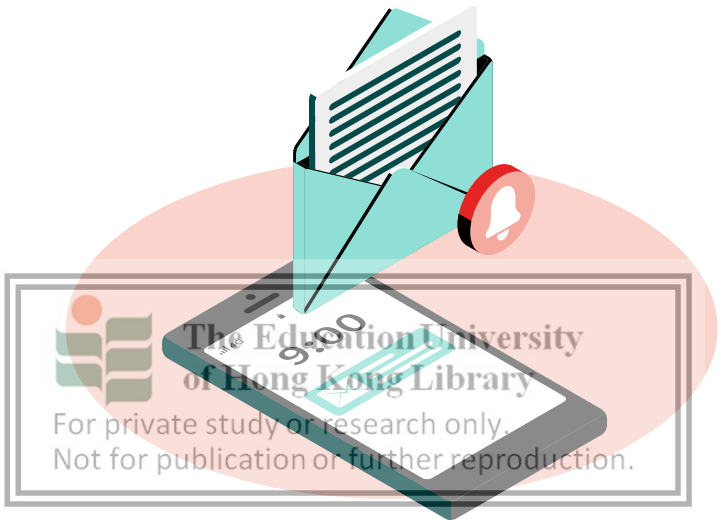
3. Home Monitoring

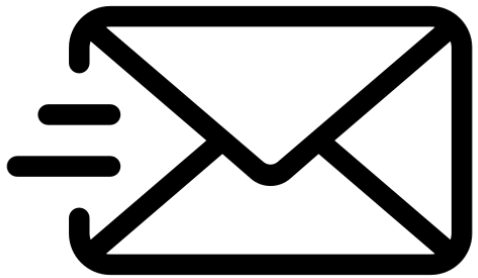
- External Sensor

Lesson 6

Notice with Email

IFTTT

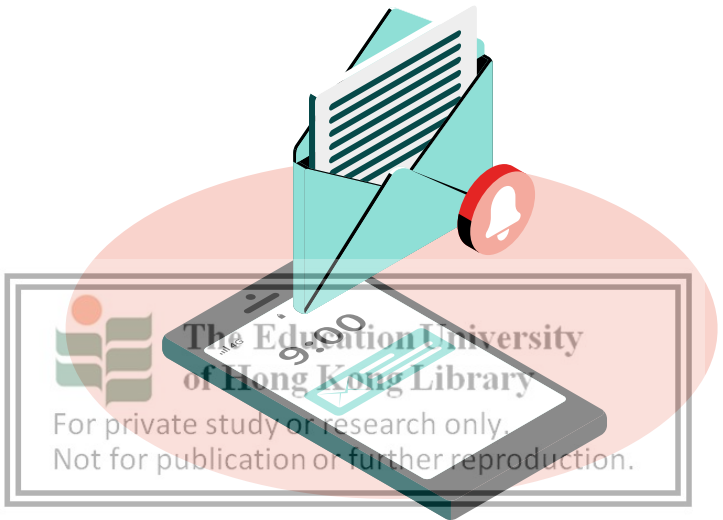


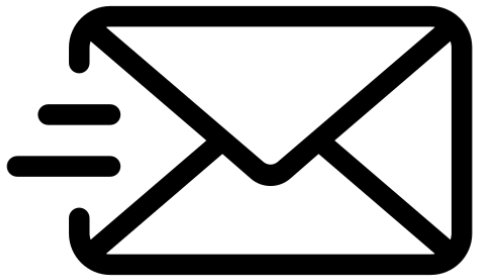


Lesson 6

Notice with Email

IFTTT





Todays Content

micro:bit

1. “Action” stage in IoT life cycle
2. Notification from Home system
    1. IFTTT Applet
    2. ThingHTTP

Life cycle of IoT

micro:bit

We had connected the micro:bit to Internet and upload the data to ThingSpeak. But the Life Cycle still not done yet.

Life cycle	**Home monitoring**
Collect	Collect data from different sensor
Communicate	Connect and send data to ThingSpeak with API Key though WIFI
Analyze	Visualizing the data that need to be analyzed
Action	

The Action stage is still missing.

Notification

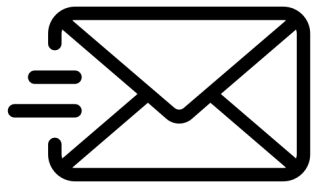
micro:bit

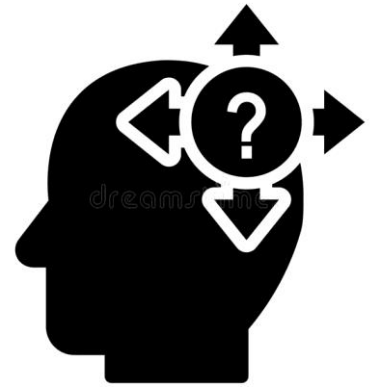
Action is the final and **most important stage** of IoT life cycle. **Proper action** and measures are taken **based on** the analyzed result.

But Last product, We need to keep watching on the data to help us.

Therefore, we hope our system can **automatically notice** the user with email to increase efficiency.

Life cycle	**Home monitoring**
Collect	
Communicate	
Analyze	
Action	Send Email to Notice user





IFTTT

micro:bit

IFTTT

Recipe

if this then that

Trigger

Action

IFTTT stands for “If This Then That.”

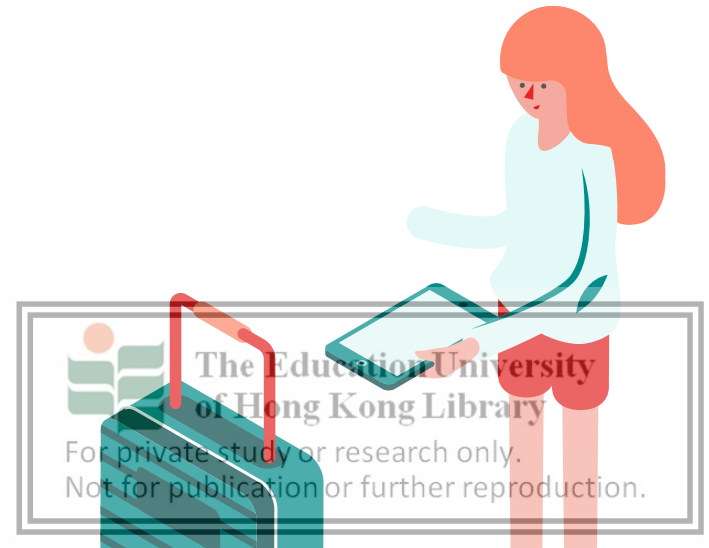
1. A Free web service that helps users automate tasks.
2. High diversity by supporting various devices, services and applets

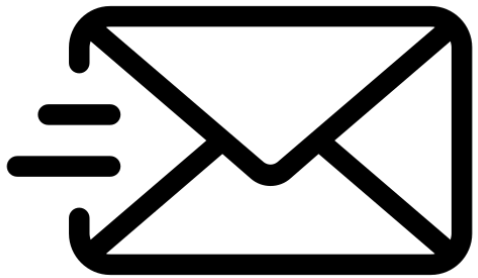
Famous on IoT and Smart Home criteria

IFTTT

micro:bit

Why “Action” still need when we already have Smart Home automatic service?



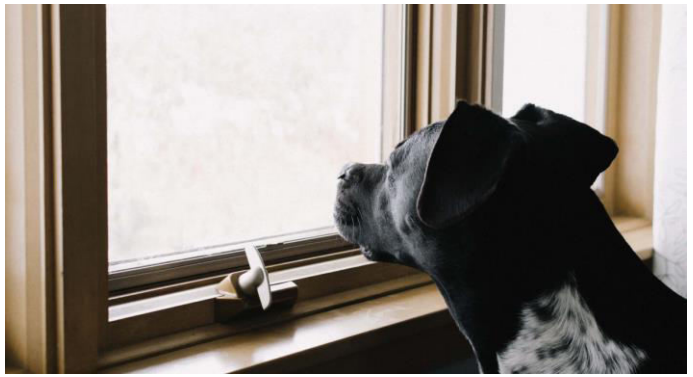


Task 1

micro:bit

Scenario:

You had already installed an automatic climate control system. But you want to make assurance to prevent the system is down. Because you had a pet at home and you need to sure the it is safe to leave them home



Task:

Create an Applet with:

“When the Temperature hit 30, you should get notice by email.”

HOME ALONE PETS

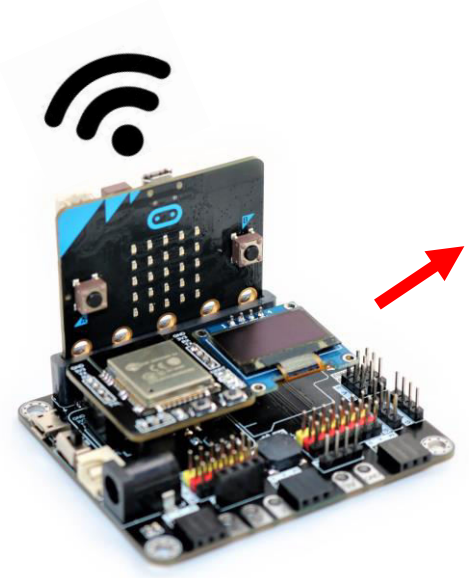
if this then that

Temperature>=30

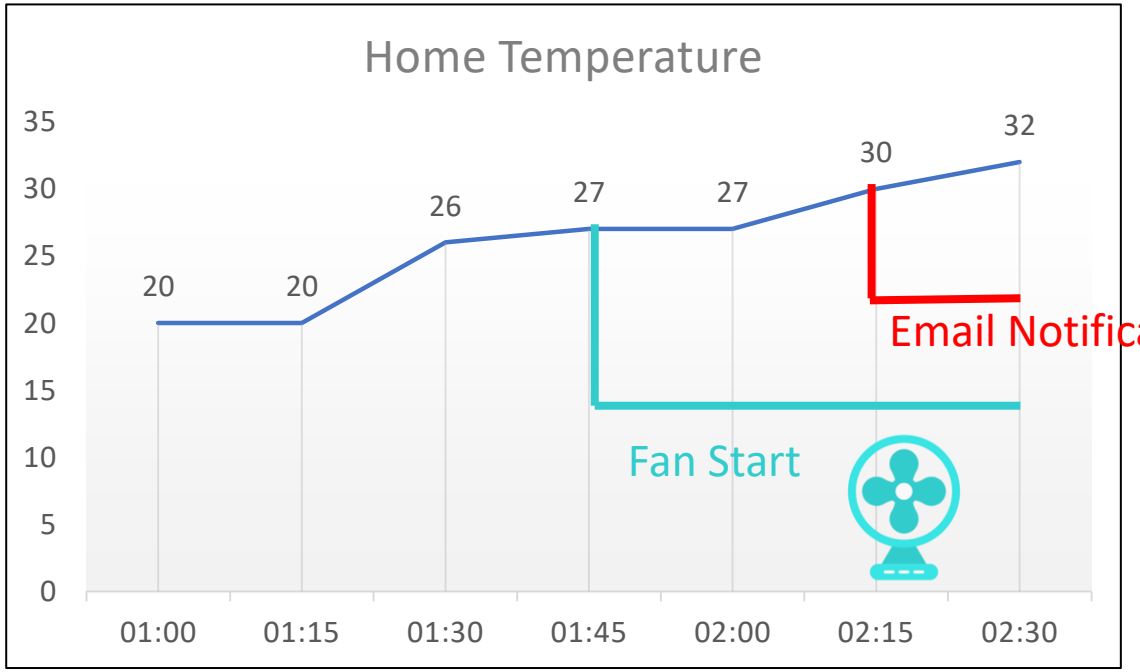
Email you

Task 1

micro:bit



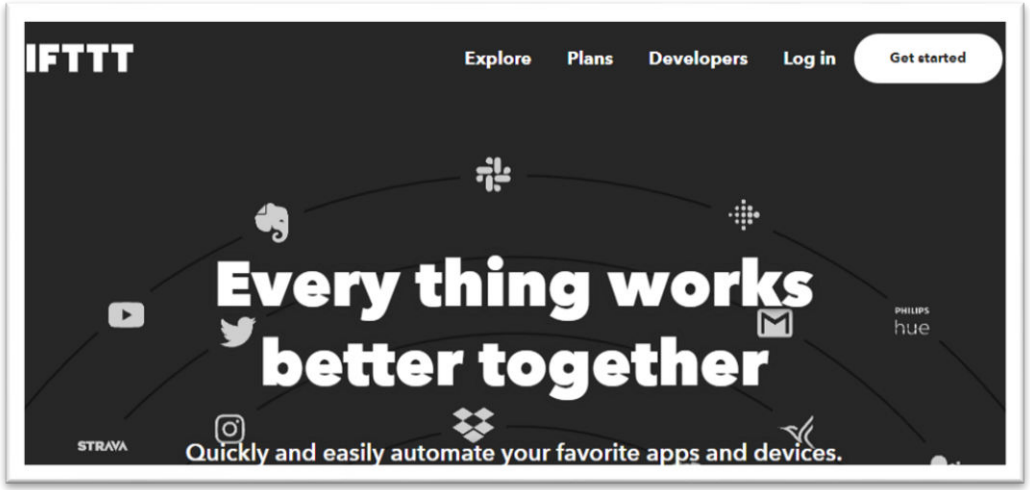
ThingSpeak → IFTTT →



Task 1 – Sign up IFTTT

micro:bit

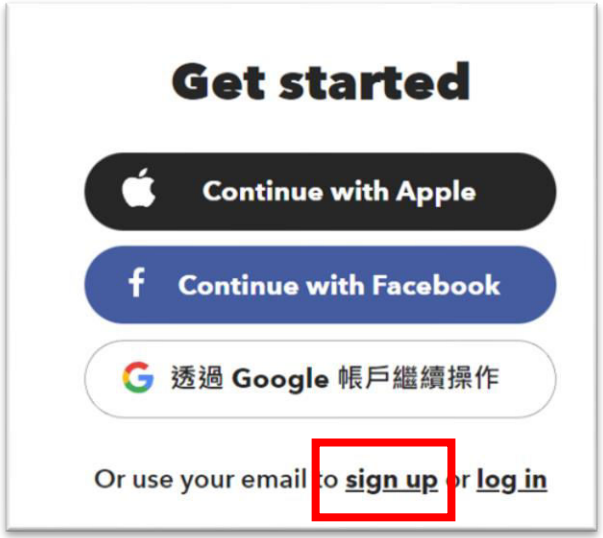
Step1: Go to ifttt.com/



Step2: Click top right 

,

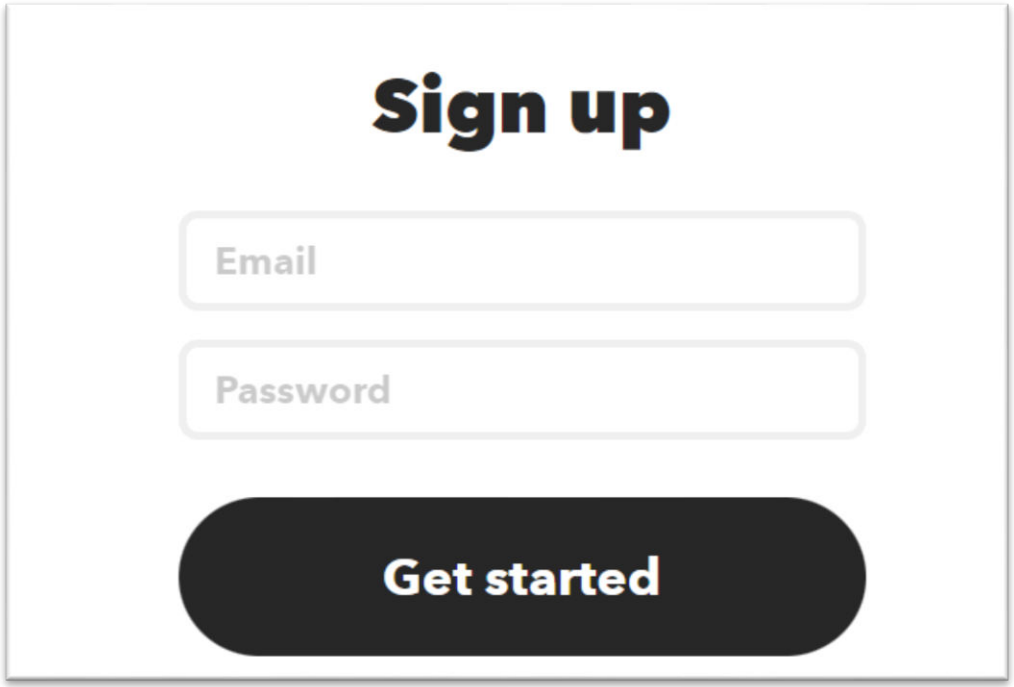
Then Click sign up



Task 1 – Sign up IFTTT

micro:bit

Step3: Enter your email and password



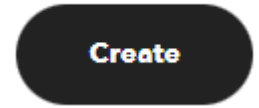
Email: xxxxxx@gmail.com
Pwd: (>6 character)

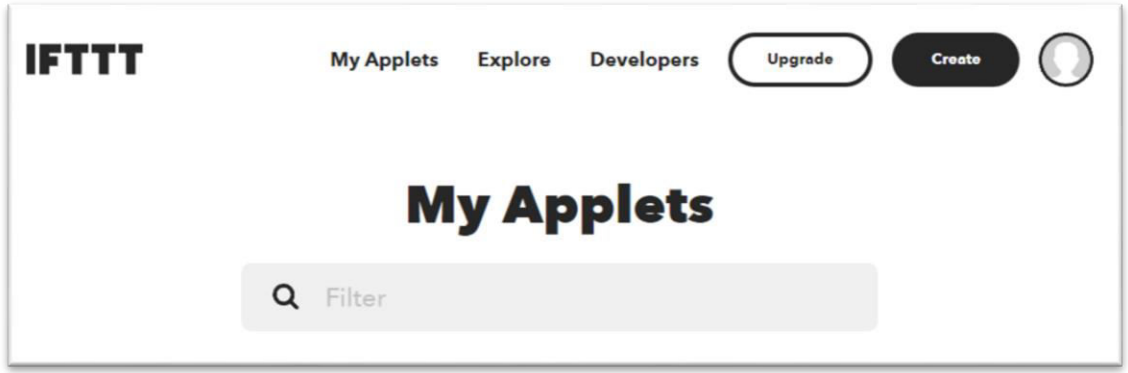
Step4: Click 

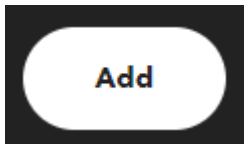
to finish the sign up

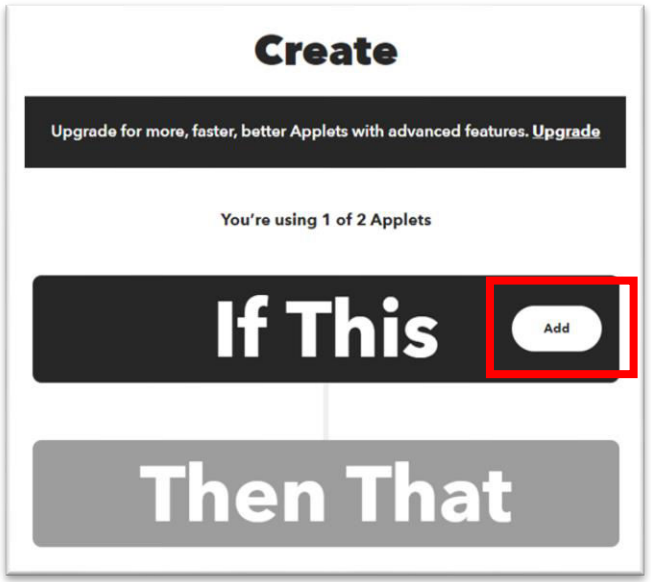
Task 1 – Create Applet

micro:bit

Step1: On the ifttt.com/explore, Click 



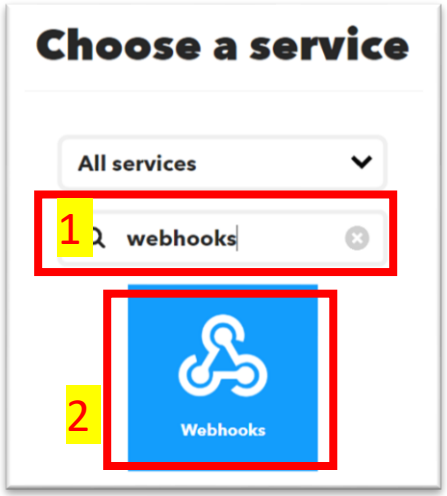
Step2: Click 



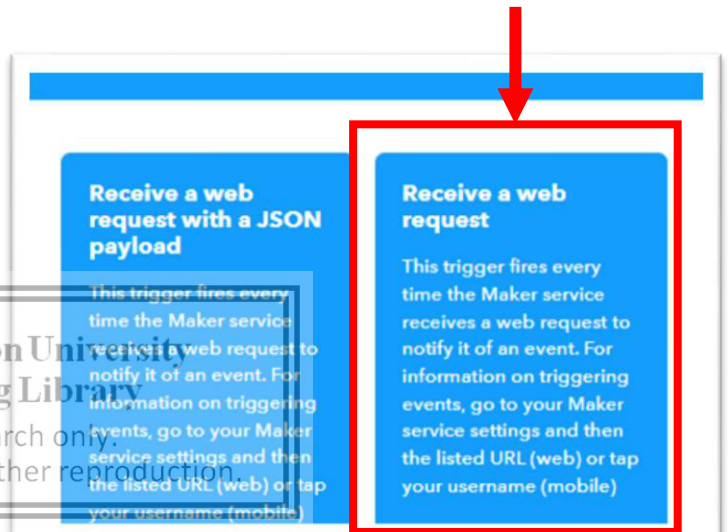
Task 1 – Create Applet

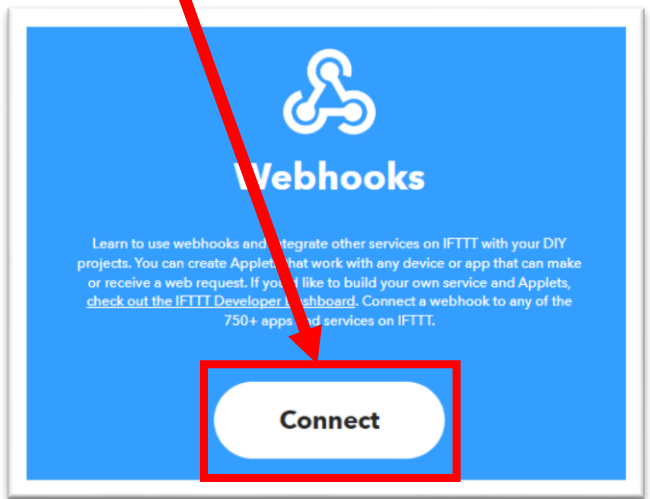
micro:bit

Step3: Search “webhooks, and click 



Step4: Click “Receive a web request” , then “Connect”

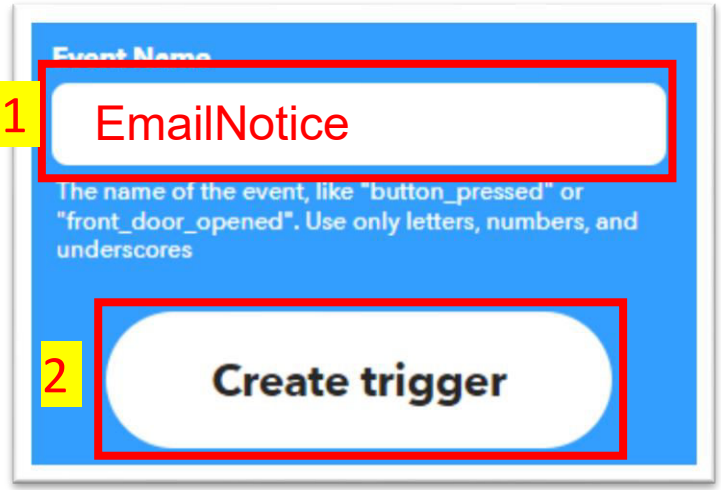




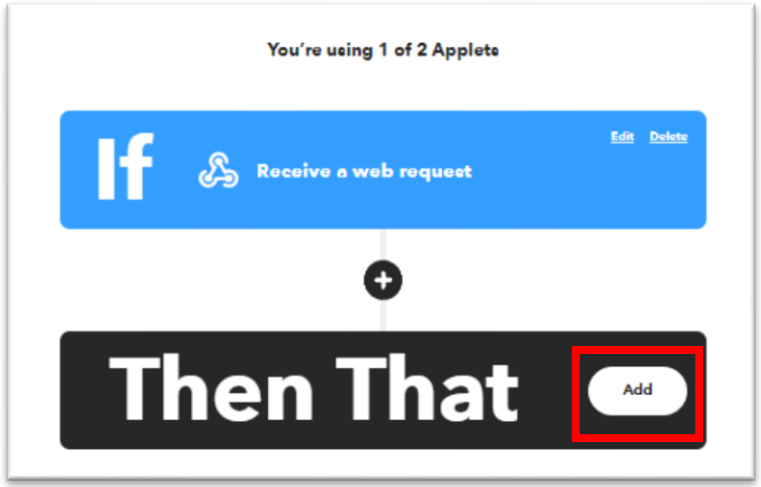
Task 1 – Create Applet

micro:bit

Step5: Complete trigger fields, input even name “EmailNotice”

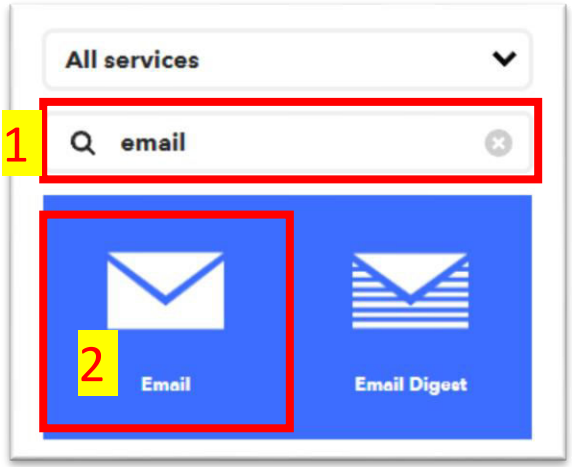


Step6: Click 

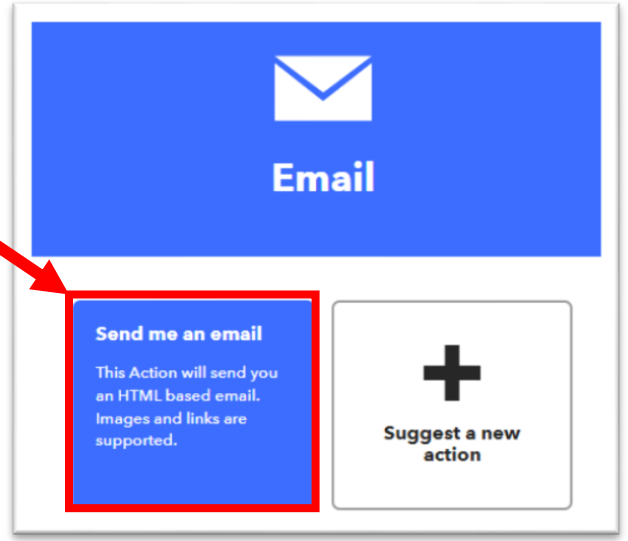


Task 1 – Create Applet

Step7: Search email, Click “Email” service



Step8: Click “Send me me an email”



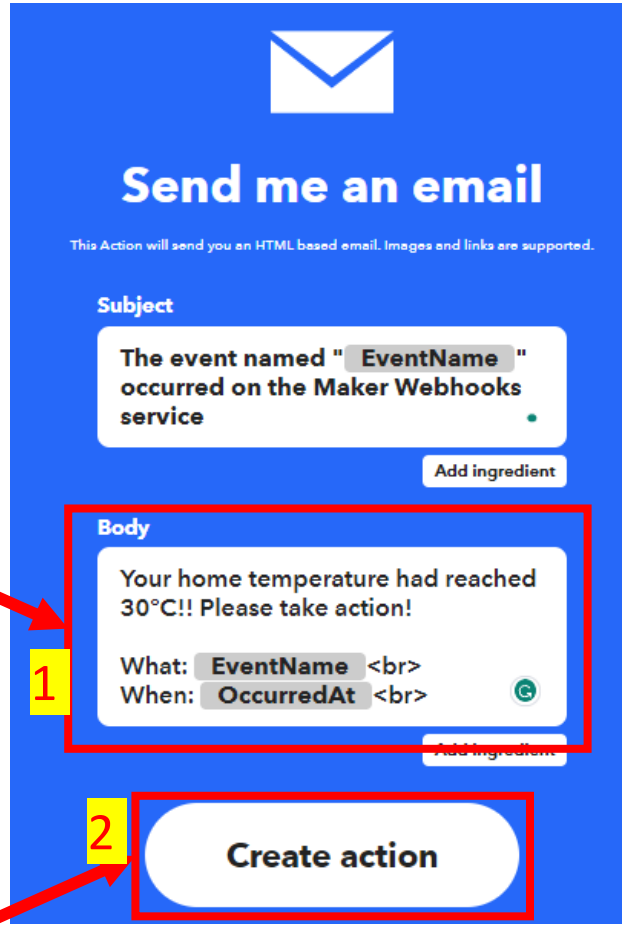
Task 1 – Create Applet

micro:bit

Step9: Complete action fields

Your home temperature had reached 30°C!! Please take action!

What: {{EventName}}
When: {{OccurredAt}}

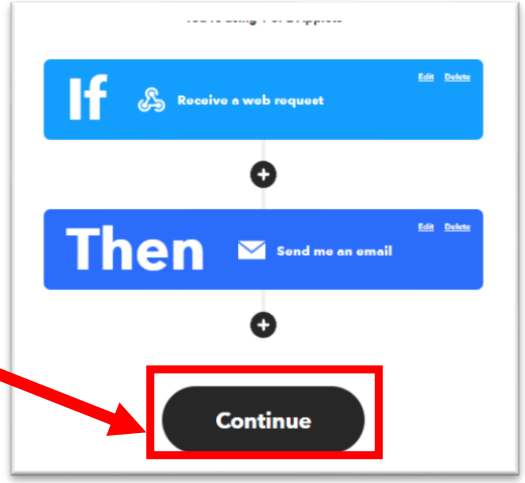


Step10: Click “Create action”

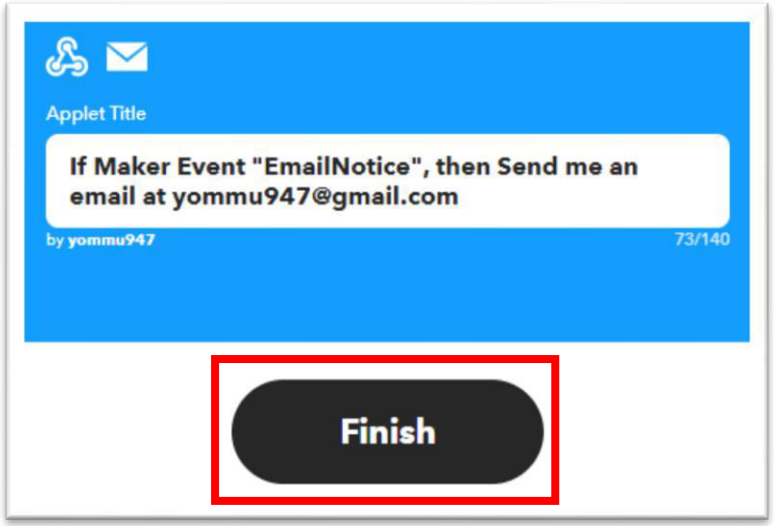
Task 1 – Create Applet

micro:bit

Step11: The page will show the complete Applets. Click “continue”.



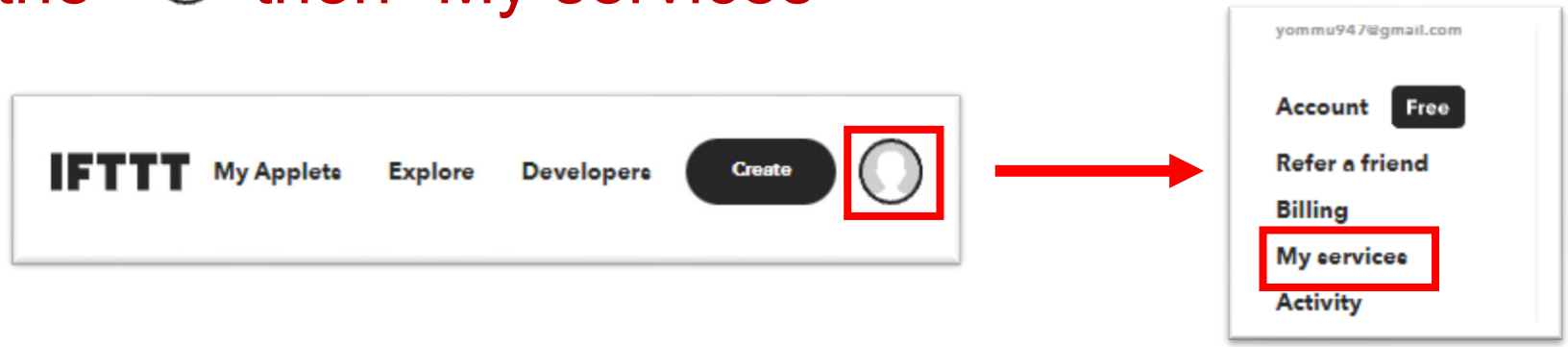
Step12: Click “Finish”



Task 1 – Step up ThingHTTP

micro:bit

Step1: Click the then “My services”

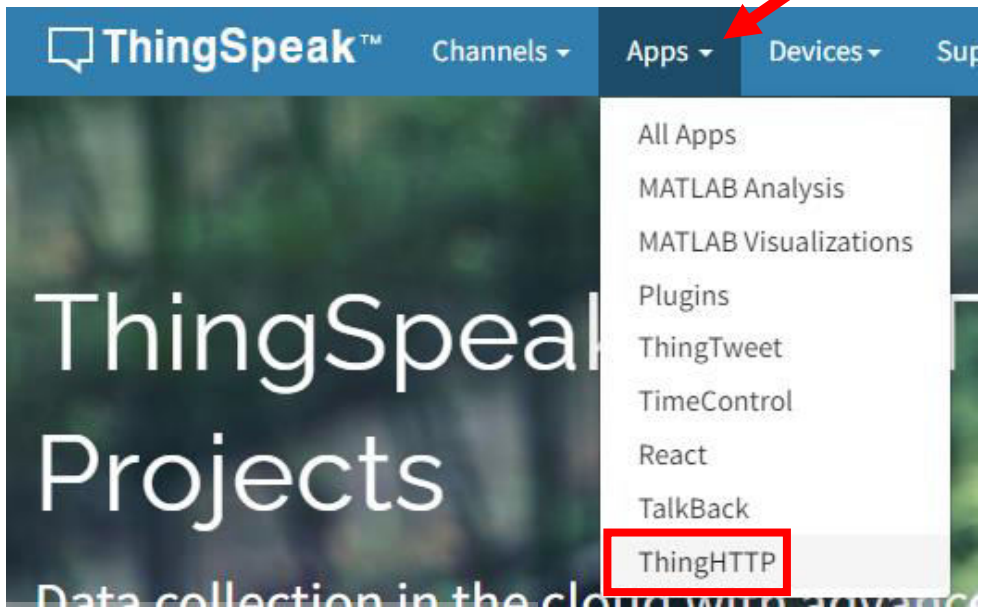


Step2: Click “Webhooks” in the service list, then “Documentation”

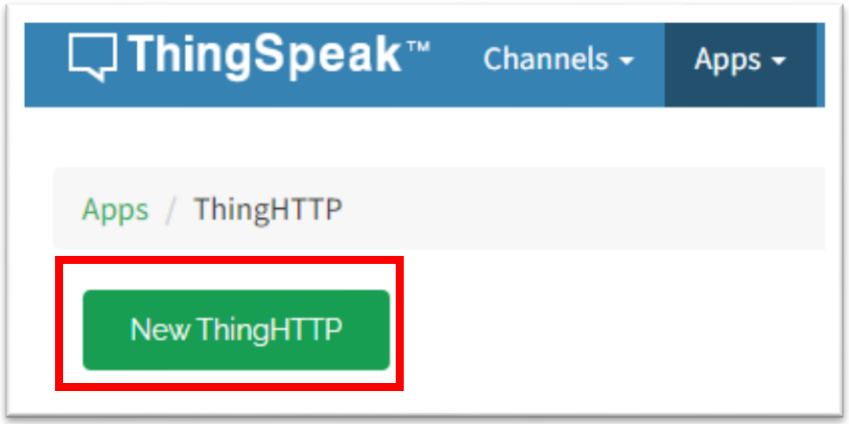
Task 1 – Set ThingHTTP

micro:bit

Step4: Go to ThingSpeak, Click Apps and "ThingHTTP"



Step5: Click "New ThingHTTP"

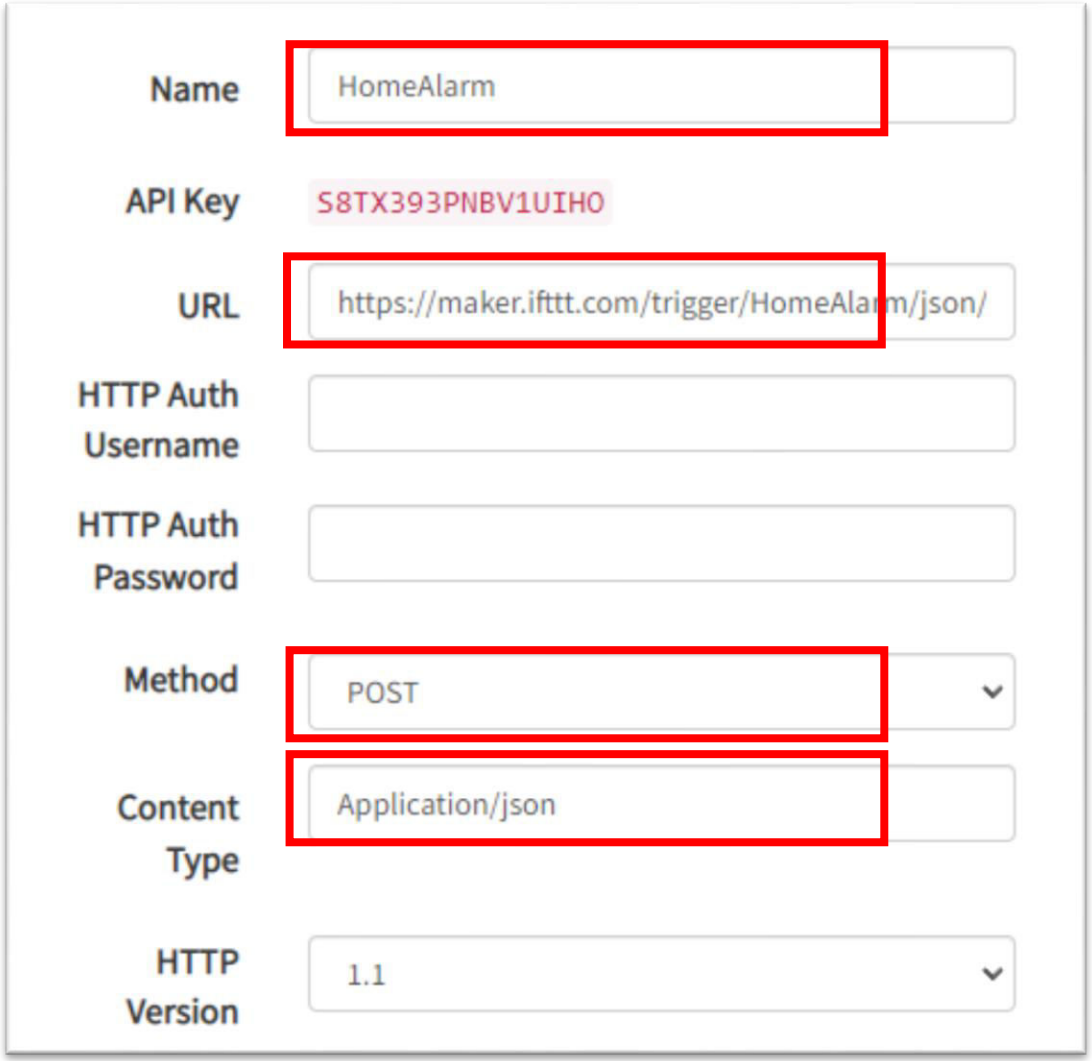


Task 1 – Set ThingHTTP

micro:bit

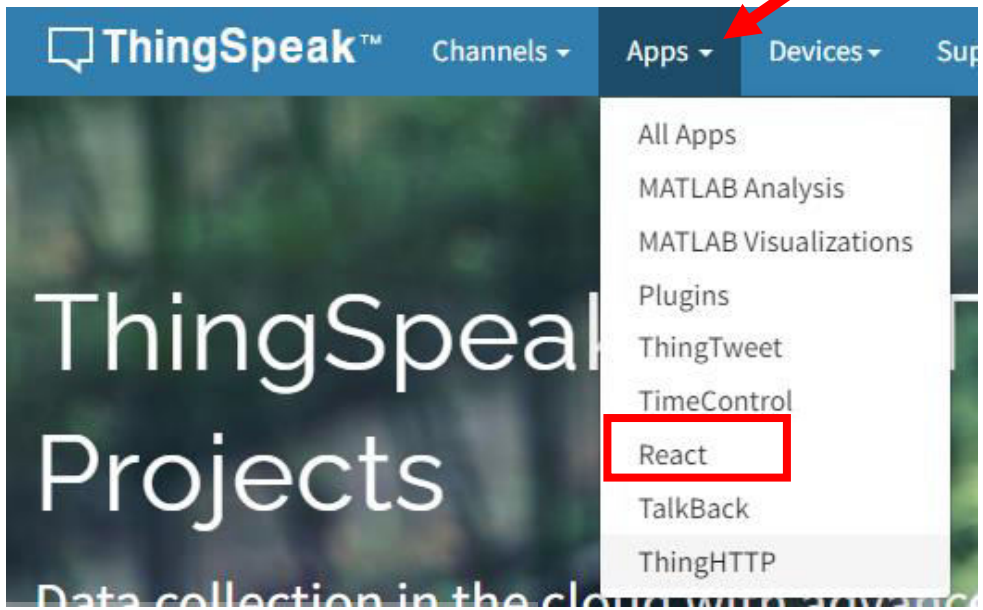
Step6: Edit t

Name	
URL	om/trigge /with/key/ **Your Own Key**
Method	POST
Content Type	Application/json

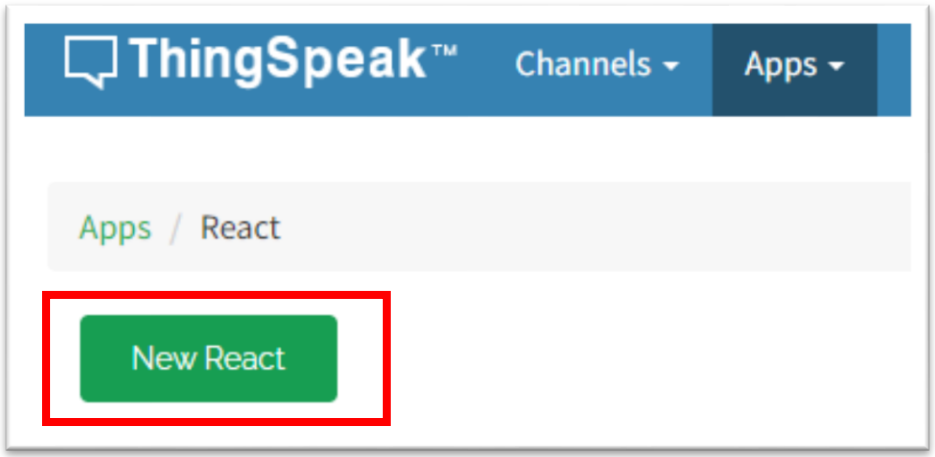


Task 1 – Set React

Step7: Go to ThingSpeak, Click Apps and "React"



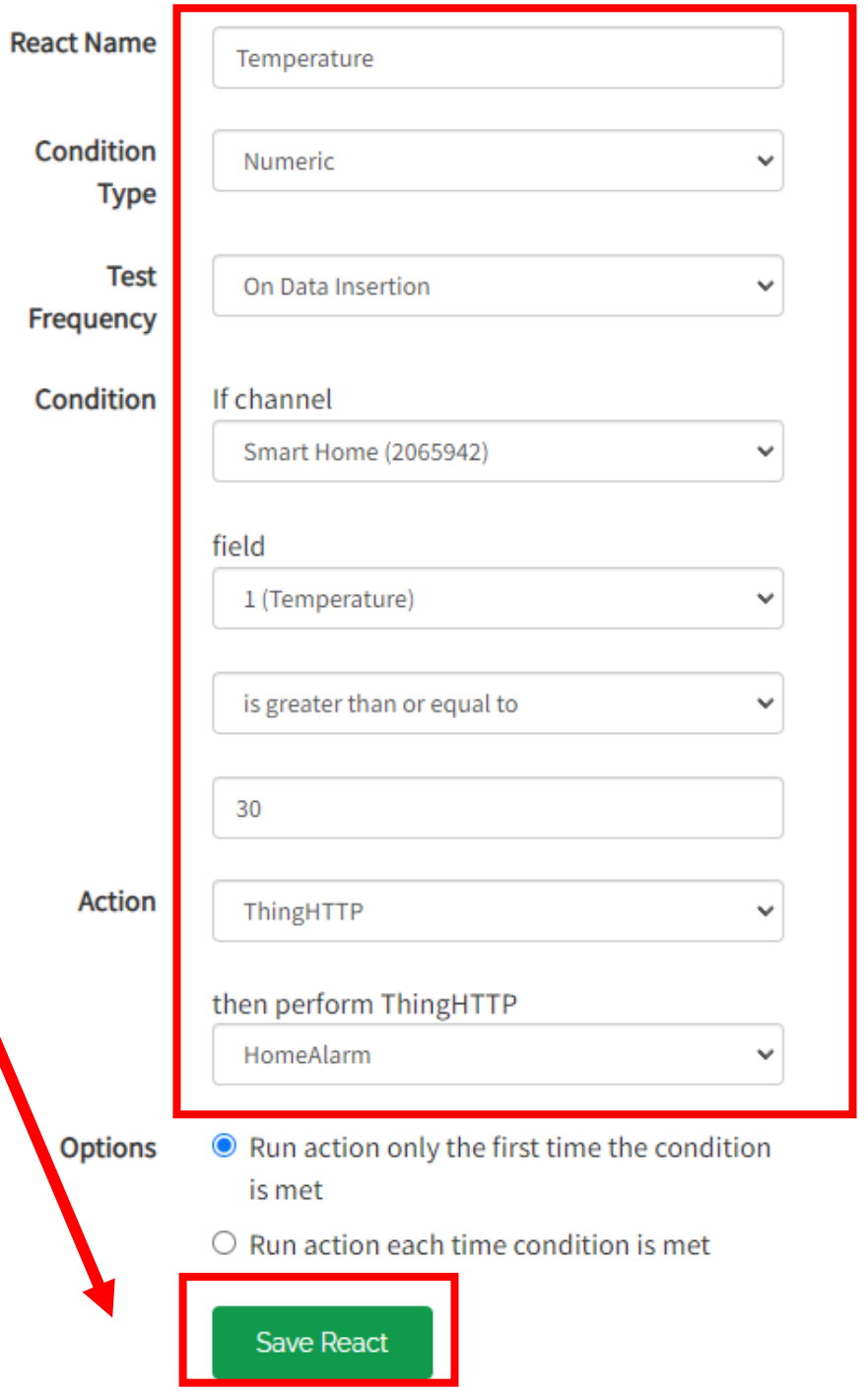
Step8: Click "New React"



Task 1 – Set React

Step9: Edit the textbox then click “Save”

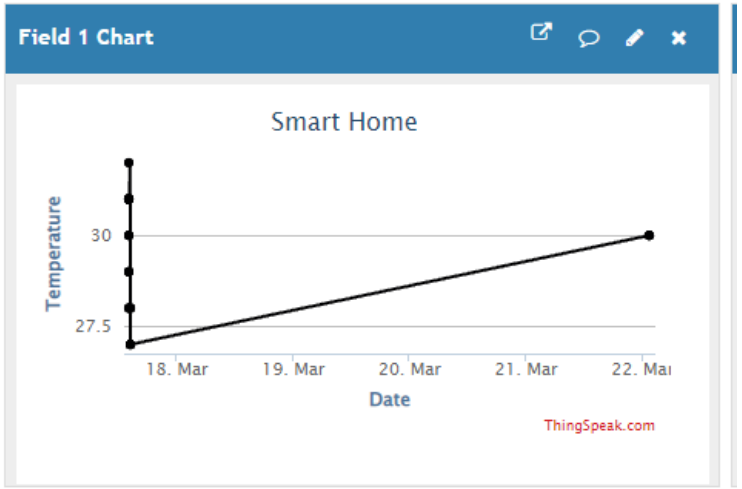
React Name	Temperature
Condition Type	Numeric
Condition Channel	(Your Channel)
Content Type	Application/json
Field	1(Temperature)
	Is greater than or equal to
	30



Task 1 – Trial

micro:bit

Install the last lesson program, Try to make your micro:bit temperature reach 30:



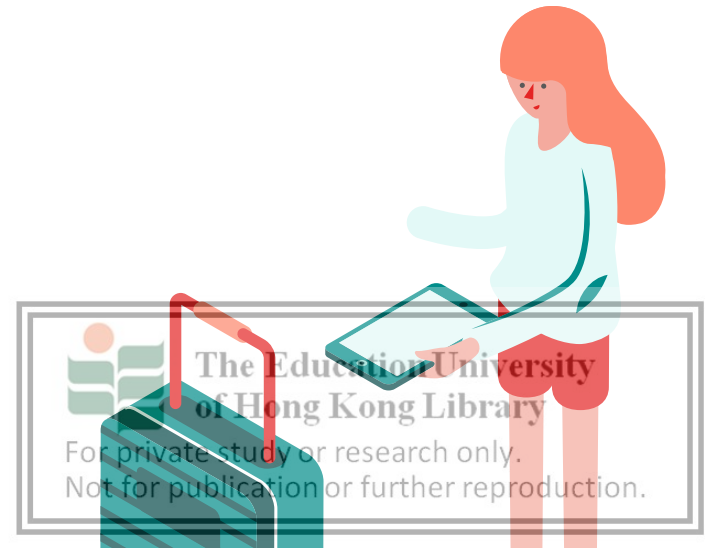
New Email:

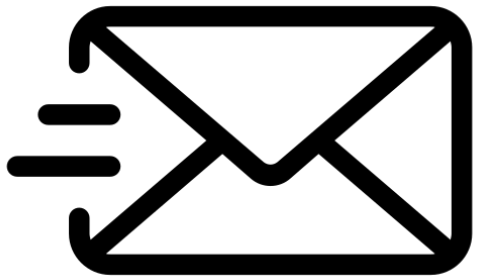
Webhooks via IFTTT — The event named "HomeAlarm" occurred on the Maker Webhooks service

IFTTT

micro:bit

Why “Action” still need when we already have Smart Home automatic service?



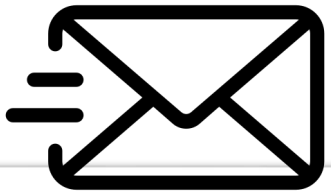


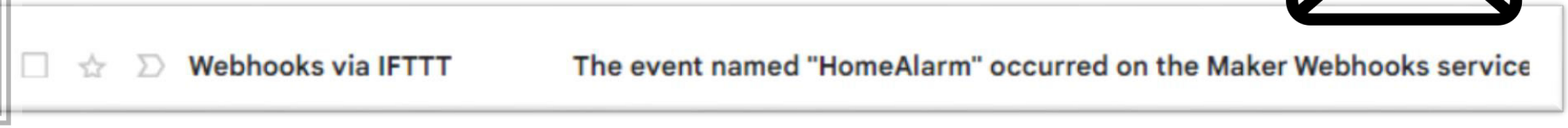
Conclusion

micro:bit

1. **“Action” stage in IoT life cycle**
   - Proper action based on the analyzed result
2. **Notification from Home system**
   - IFTTT Applet
   - ThingHTTP

ThingSpeak → IFTTT →

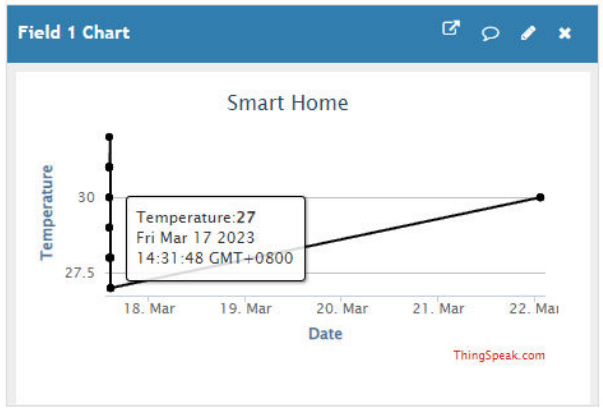


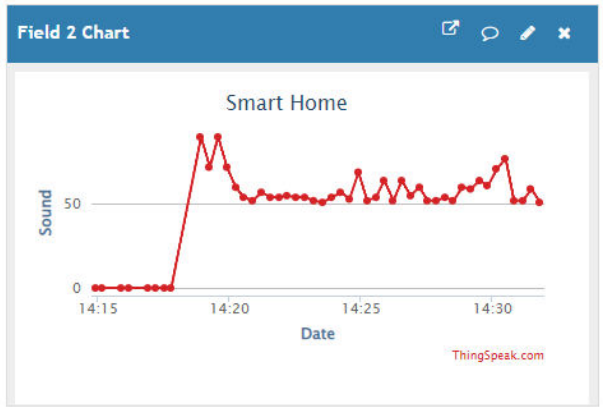


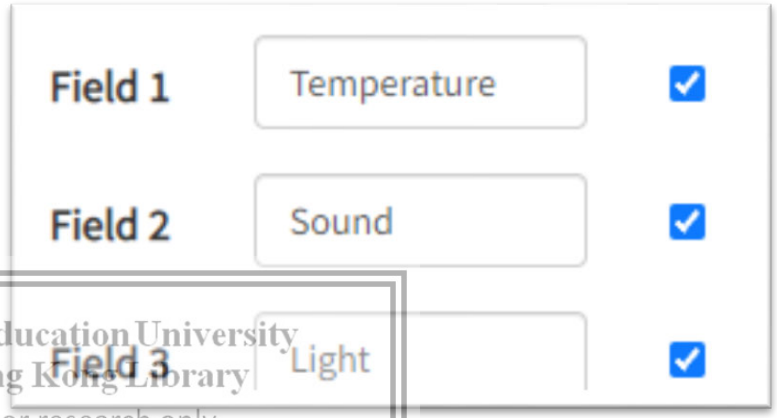
Homework

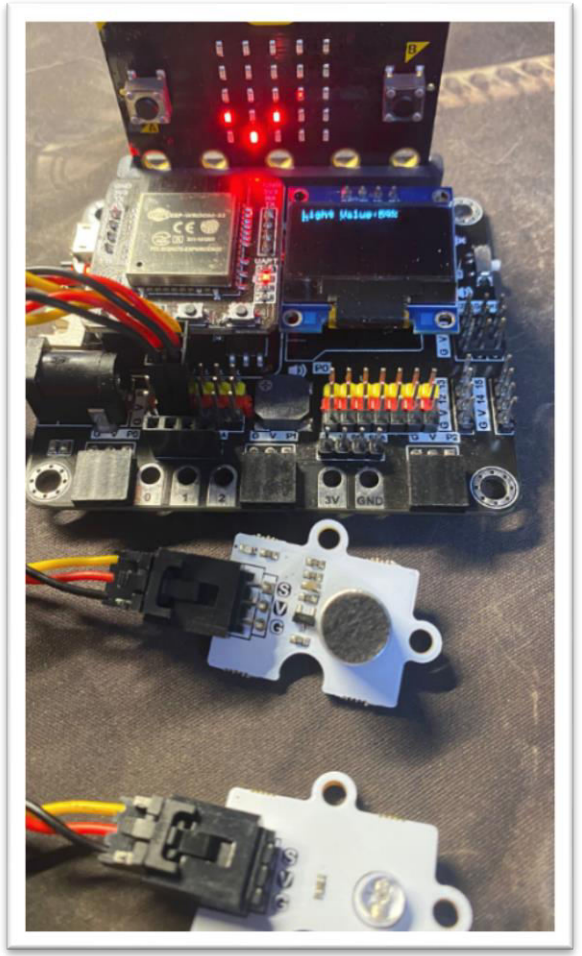
micro:bit

Setting up 2 Applets for other sensor









Revision

micro:bit

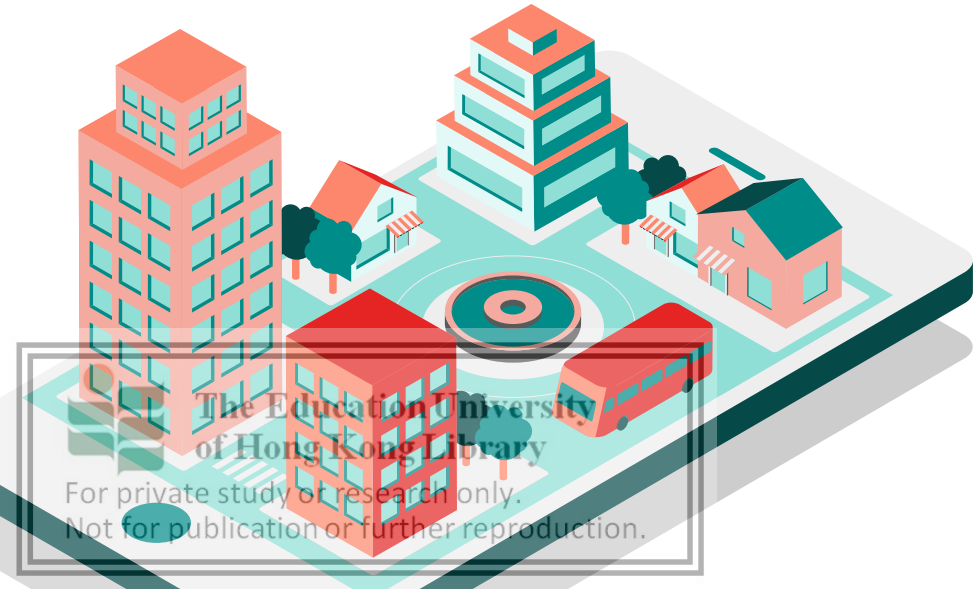
1. **“Action” stage in IoT life cycle**
   - Proper action based on the analyzed result
2. **Notification from Home system**
   - IFTTT Applet
   - ThingHTTP

ThingSpeak → IFTTT →

Webhooks via IFTTT The event named "HomeAlarm" occurred on the Maker Webhooks service

Lesson 7

NTP Clock



Today's Content

micro:bit

1. Network Time Protocol(NTP)
    - NTP Clock
2. Smart Light with NTP Clock

Lesson 7

micro:bit

What kind of data can be collected from the internet?

And how they assist you?

“Internet” of Things

micro:bit

Is the data only collect from your sensor count as IoT?

Absolutely Not!

Beside all the sensor we set, we can also connect and **collect the data from the public Internet**.

Network Time Protocol

micro:bit

Network Time Protocol(NTP)

- Founded in 1978
- Internet Protocol for computer clock synchronization
- All participating computer's time offset with in milliseconds (0.001s)

NTP inventor - David L. Mills

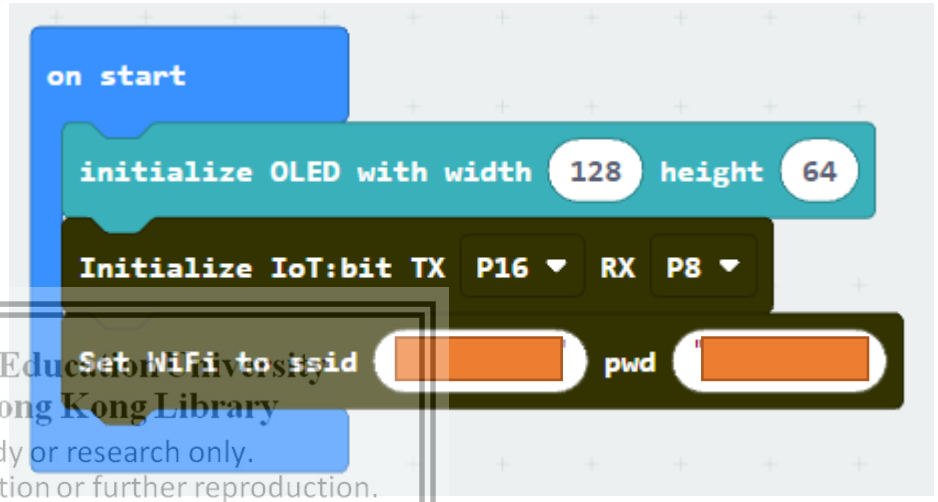
NTP clock

micro:bit

Create a Clock that is sync to NTP protocol

Step 1:

1. Install the IoT:bit extension
2. Connect Micro:bit to Wi-Fi
3. Initialize the OLED



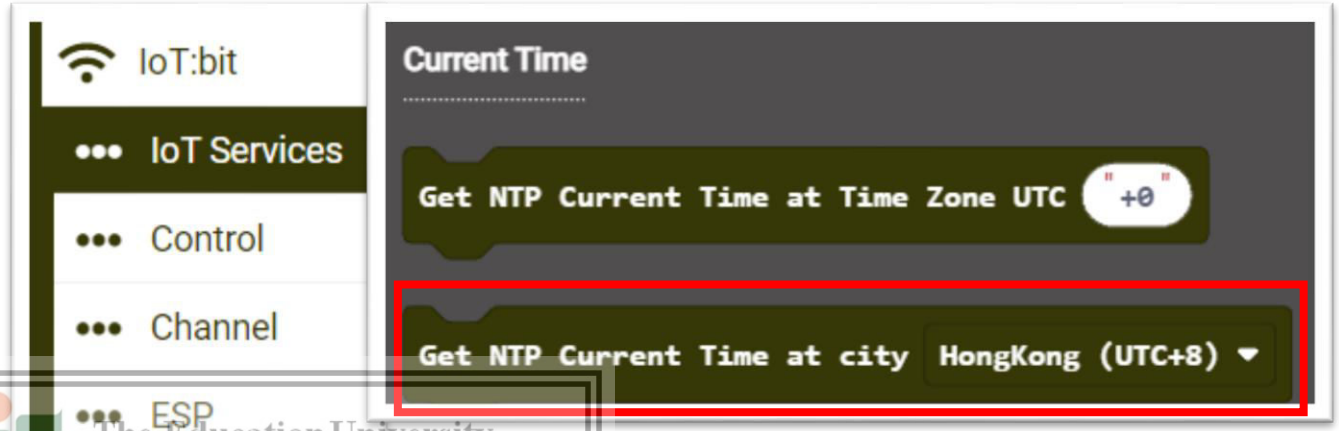
NTP clock

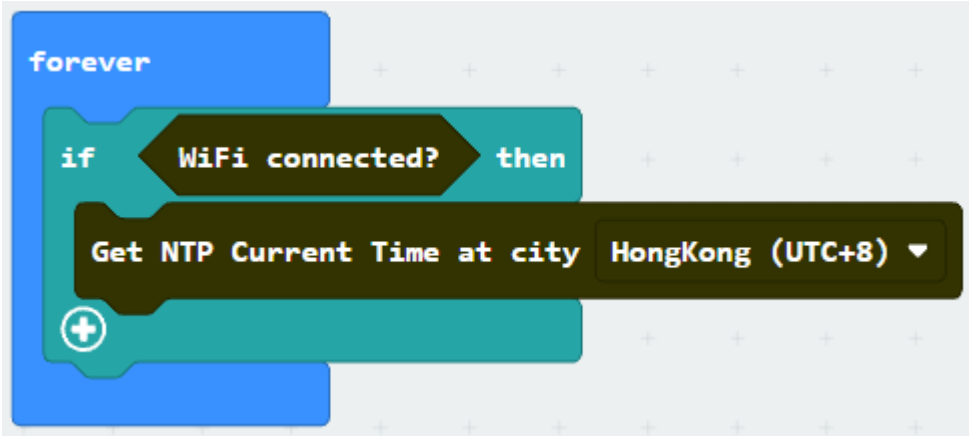
micro:bit

Step 2:

In forever:

1. If “WiFi connected” then “Get NTP Time at Hong Kong”



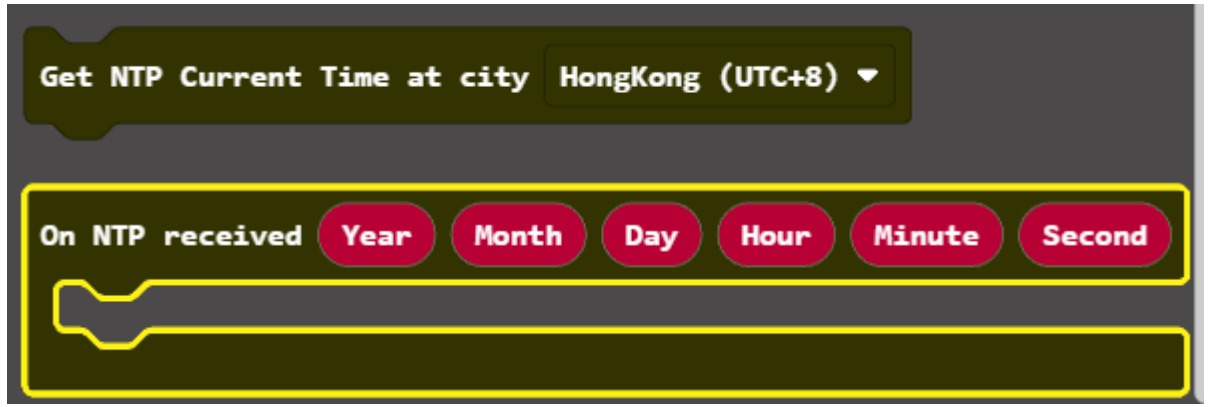


NTP clock

micro:bit

Step 3:

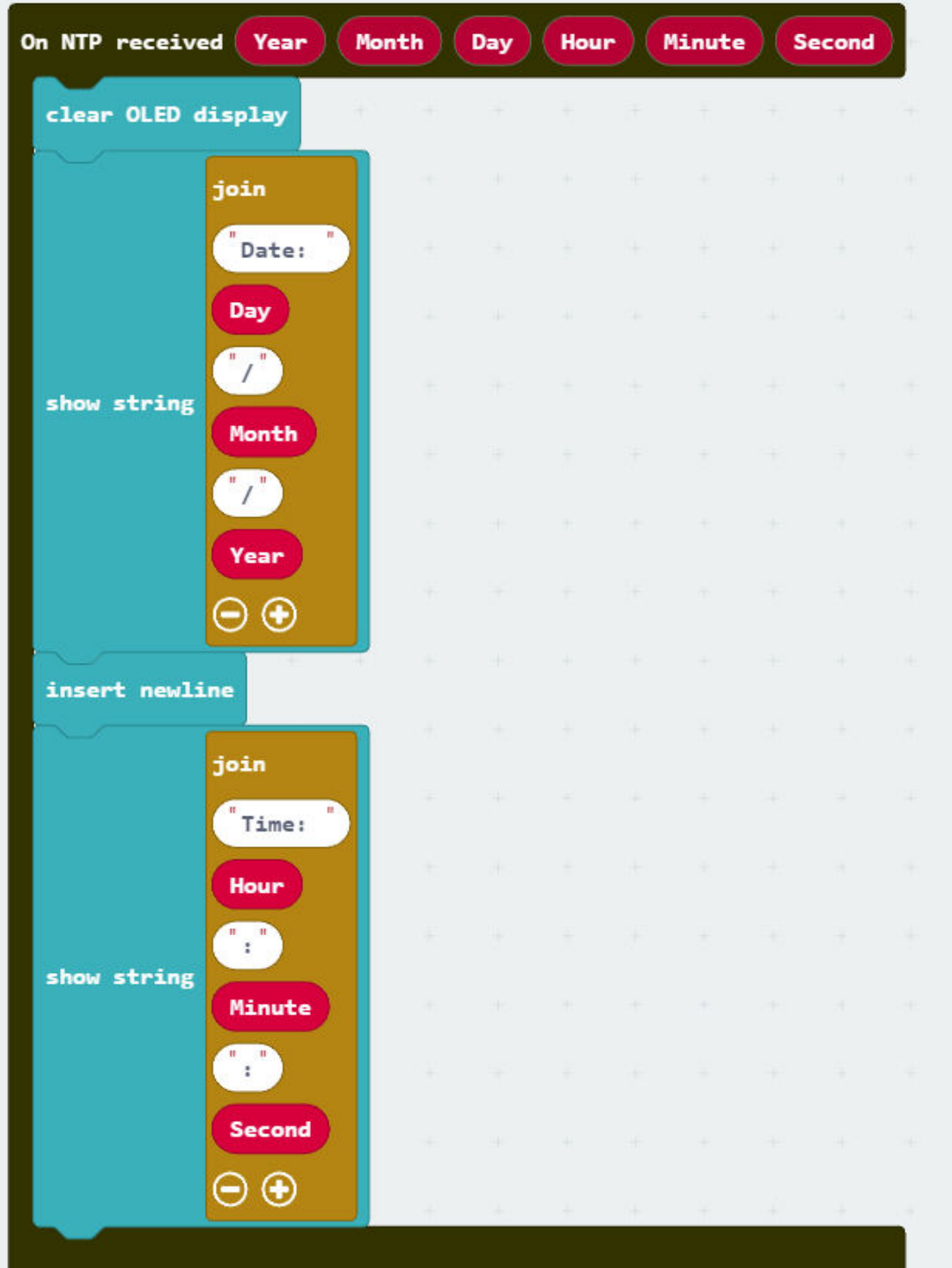
Get the “On NTP received” block



NTP clock

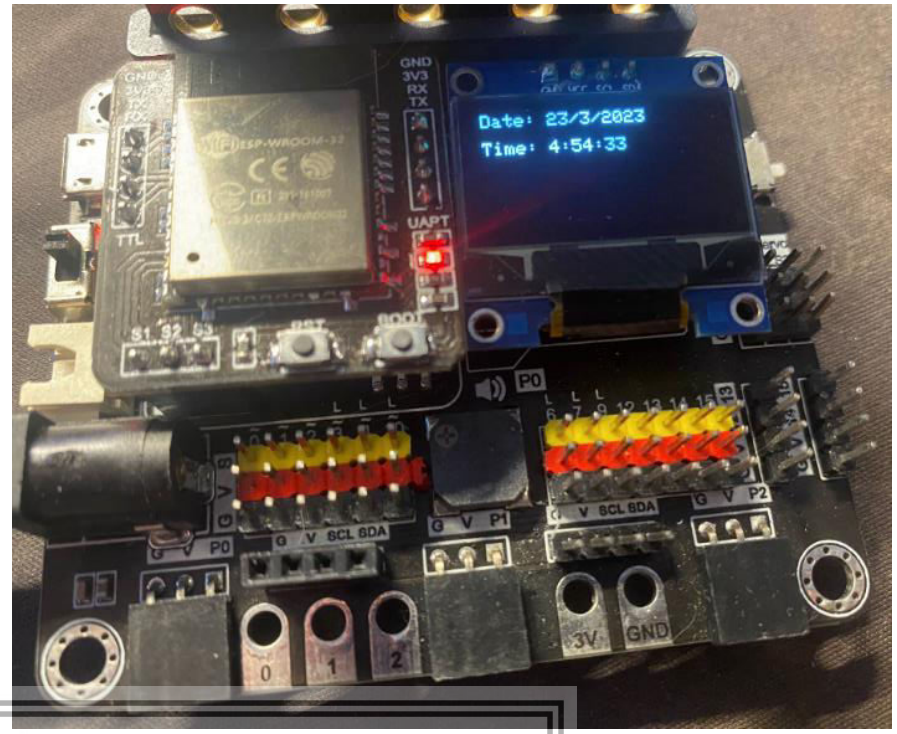
Step 4:

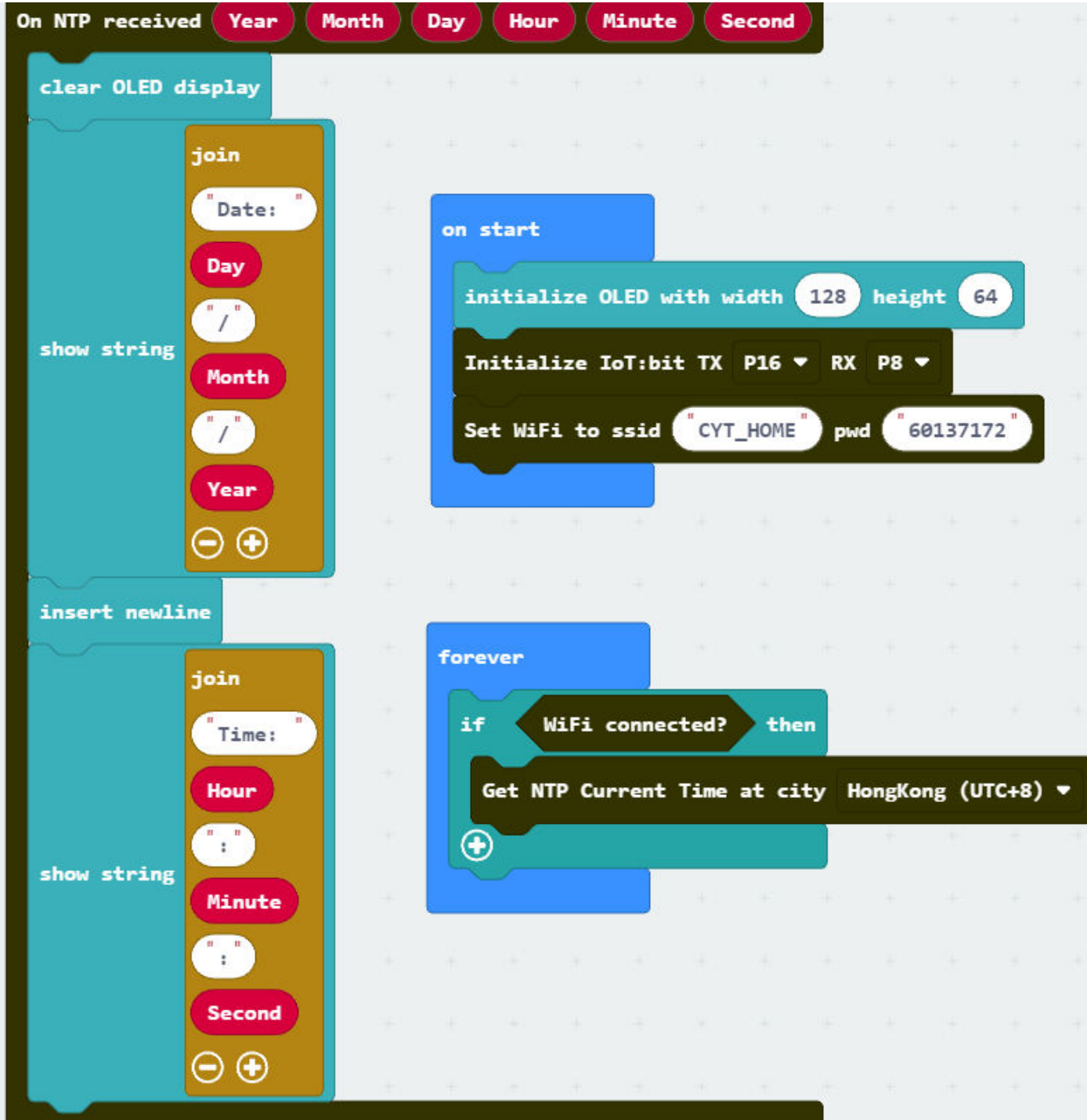
1. Clear screen before new string
2. Show string with “Date: ” + **Day** + “/” + **Month** + “/” + **Year**
3. Skip a line
4. New line with String: “Time: ” + **Hour** + “:” + **Minute** + “:” + **Second**



NTP clock

DEMO





Fun Fact

micro:bit

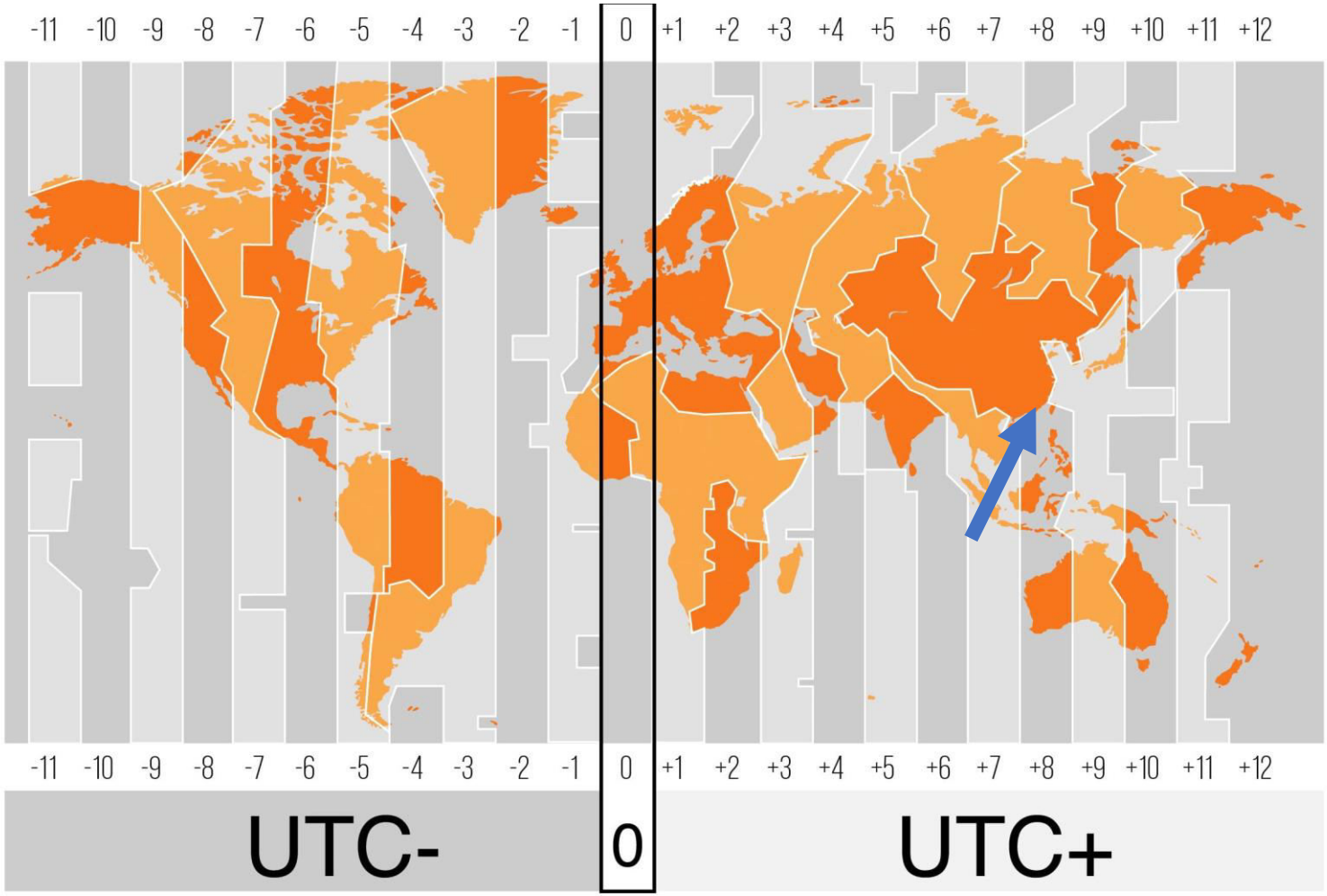
What (UTC+8) mean?

Coordinated Universal Time

UTC

Can you find Hong Kong?

- Hong Kong is in the +8 district



Task - Smart Light

micro:bit

Scenario:

A scheduled light can follow user's daily routine and events. Which is an automatic task that assist human. Design a light that will on/off automatically

Reference

Time	Events	Light Status
07:00	Wake up	On
08:00	Go out	Off
18:00	Back Home	On
22:30	Sleep	Off

Task - Smart Light

micro:bit

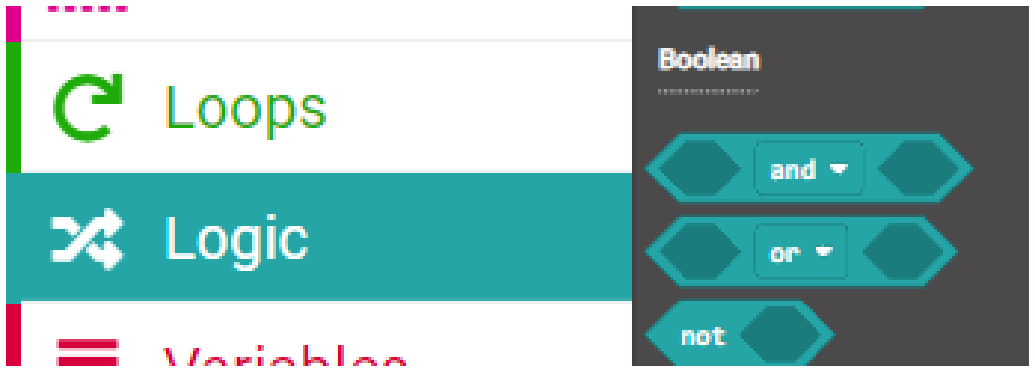
Scenario:

A scheduled light can follow user's daily routine and events. Which is an automatic task that assist human.

For example:

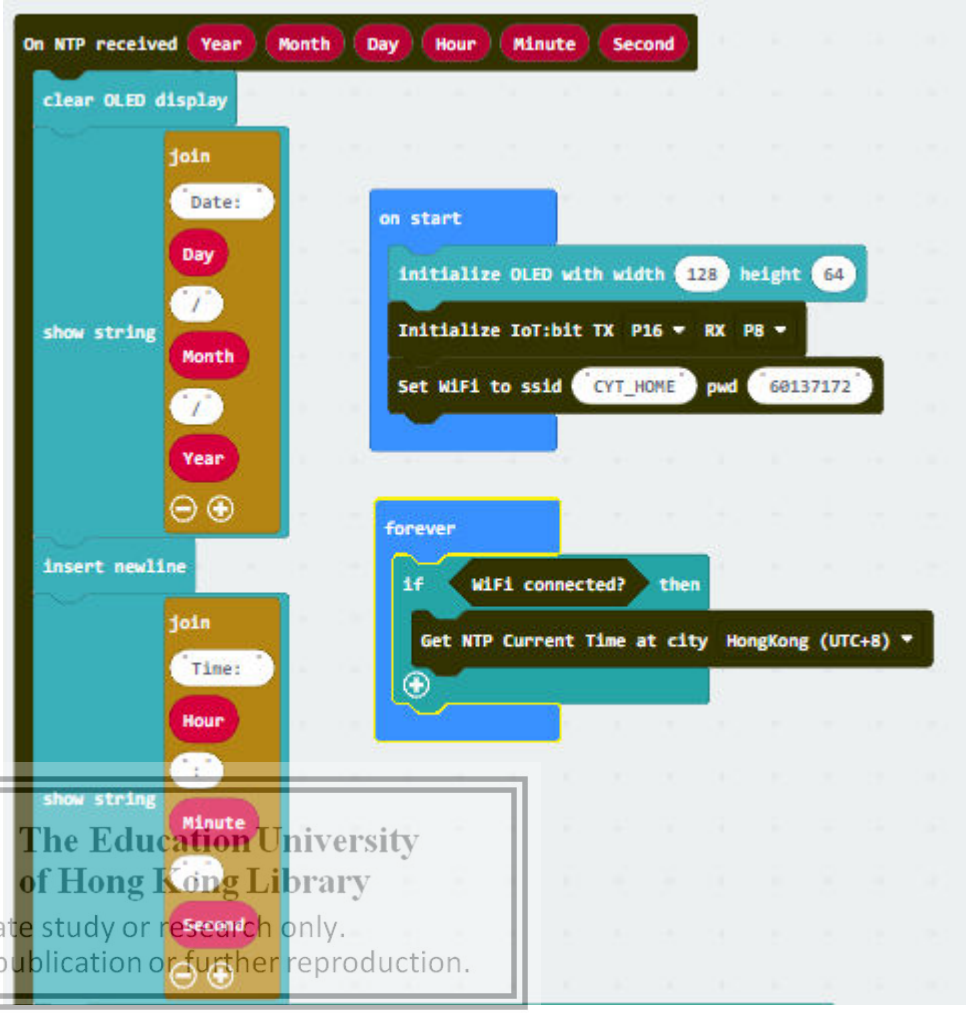
Time	Events	Light Status
07:00	Wake up	On
08:00	Go out	Off
18:00	Back Home	On
22:30	Sleep	Off

Hints:



Task – Smart Light

Demo:



Task 2 – Adv Smart Light

micro:bit

Scenario:

The user should have different schedule in Day 1, 15 and 20 in each month. Design the Smart light for the whole month.

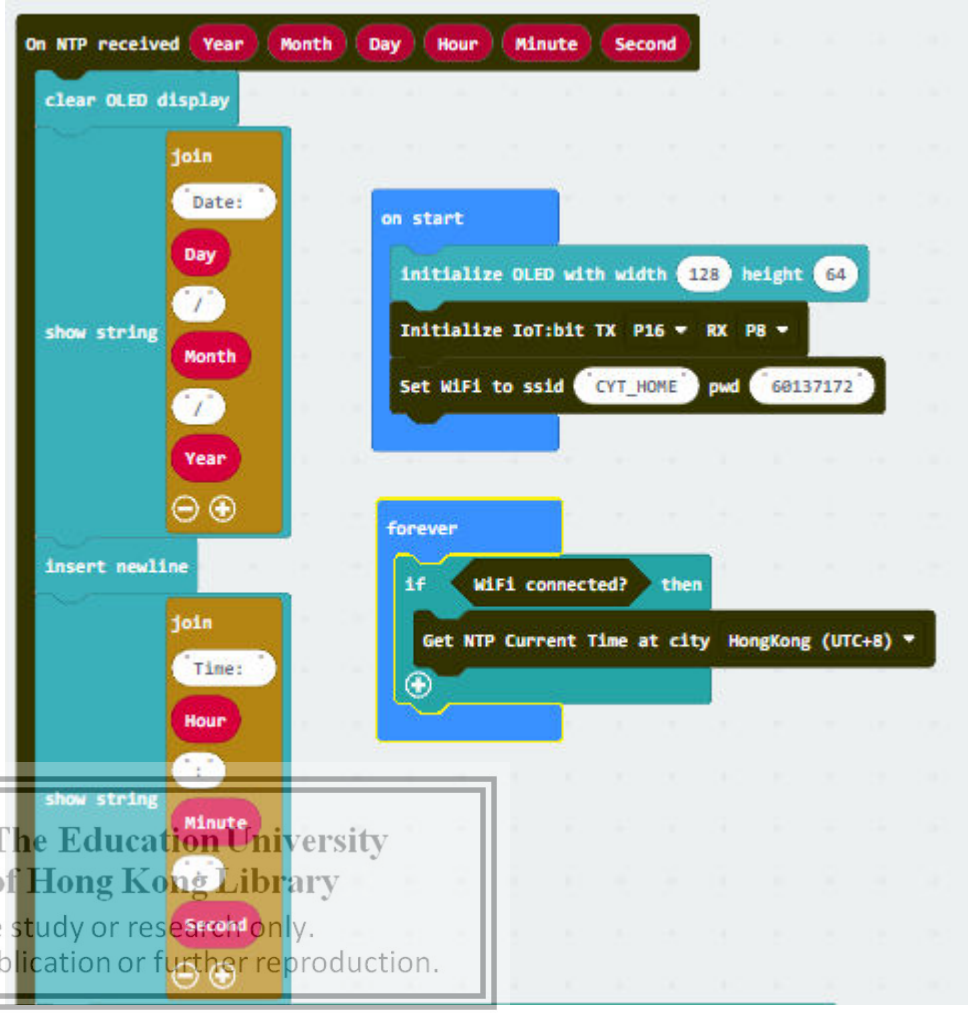
For example:

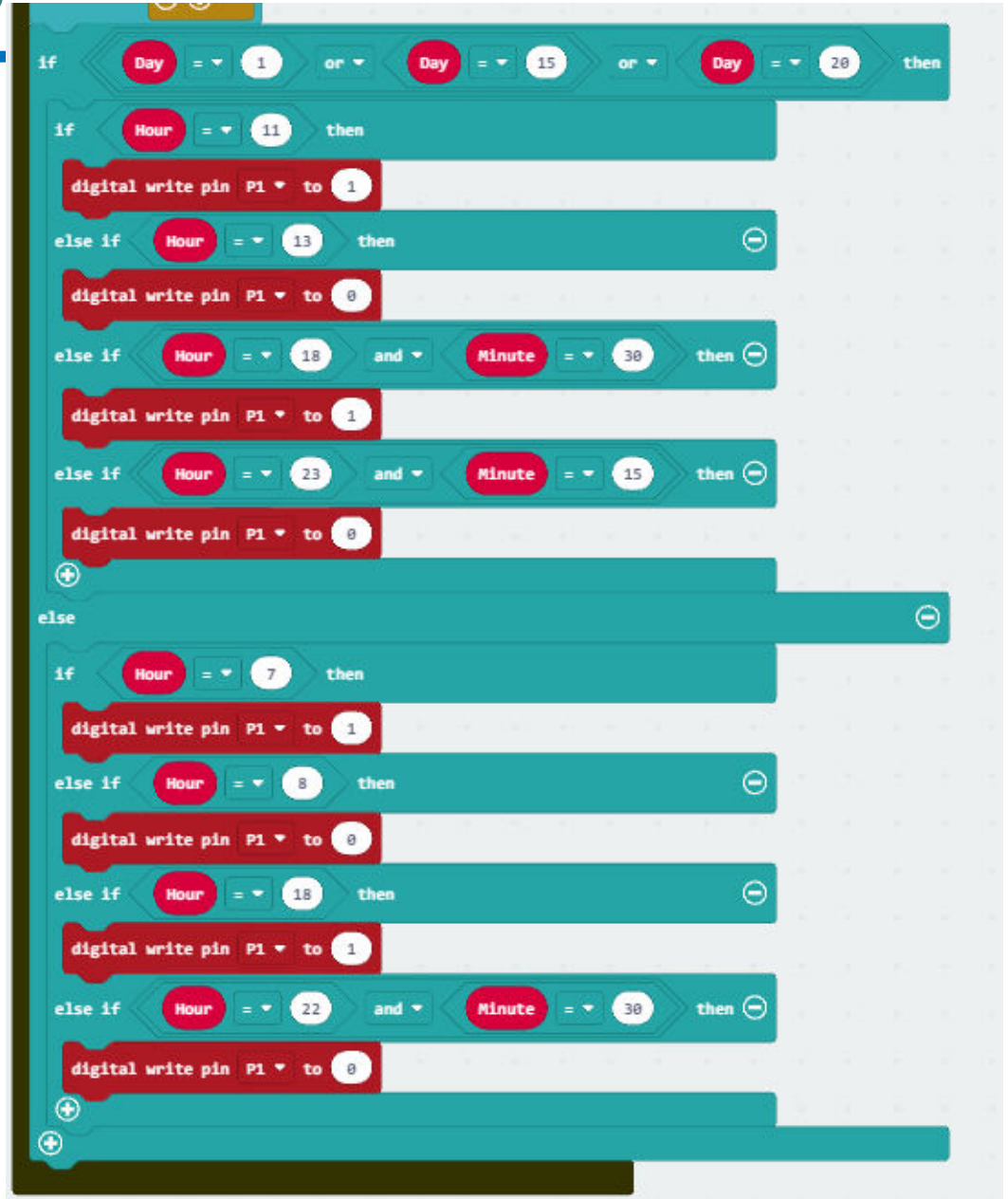
Weekday		
Time	Events	Light Status
07:00	Wake up	On
08:00	Go out	Off
18:00	Back Home	On
22:30	Sleep	Off

Day 1, 15 and 20		
Time	Events	Light Status
11:00	Wake up	On
13:00	Go out	Off
18:30	Sun set	On
23:15	Sleep	Off

Task – Adv Smart Light

Demo:





Lesson 7

micro:bit

What kind of data can be collected from the internet?

And how they assist you?

Conclusion

micro:bit

1. Network Time Protocol(NTP)
    - Internet Protocol for computer clock synchronization with offset less then millisecond
2. Smart Light with NTP Clock

IoT life cycle

micro:bit

Homework:

Fill in the below table with IoT life cycle of smart light

Life cycle	Smart light
Collect	
Communicate	
Analyze	
Action	

Revision

micro:bit

1. Network Time Protocol(NTP)
    - Internet Protocol for computer clock synchronization with offset less then millisecond
2. Smart Light with NTP Clock

IoT data life cycle

micro:bit

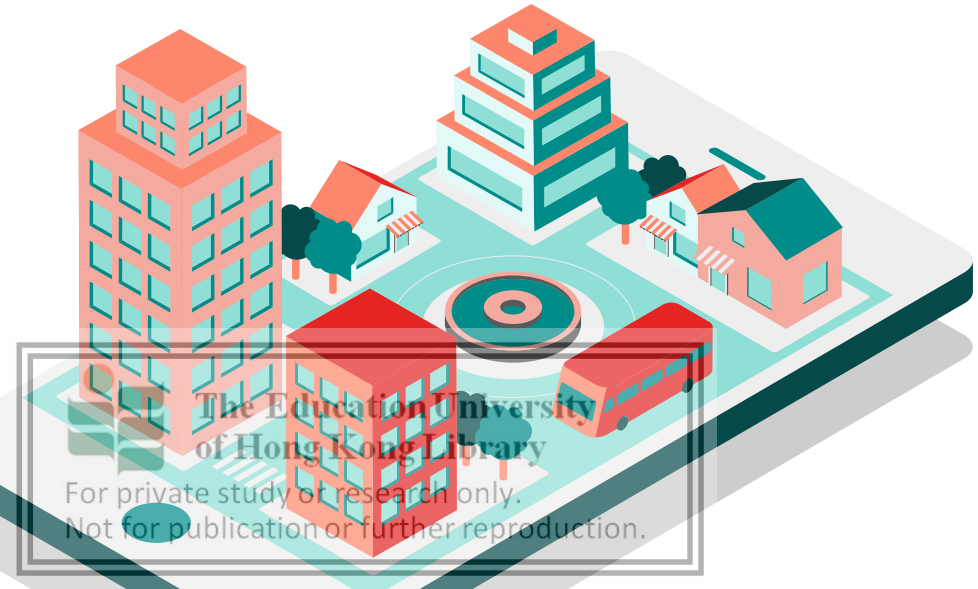
Homework:

Fill in the below table with data life cycle of smart light

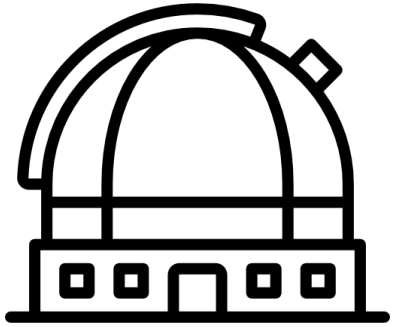
Life cycle	Smart light
Collect	The data is collected from the NTP server
Communicate	Data was sent though Wi-Fi from server to client
Analyze	The collected data is analyzed to determine the housing light on and off
Action	Action is taken based on the time sent by NTP server

Lesson 8

IFTTT – Shared Sensor



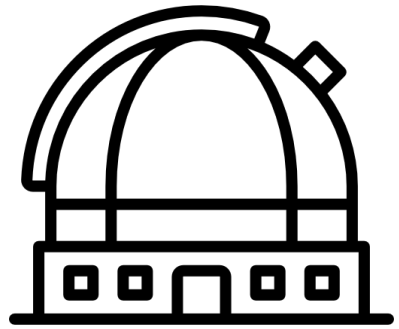
IFTTT



Today's Content

micro:bit

1. IFTTT – Internet service
2. Automatic Light
3. Automatic Window



“Internet” of Things

micro:bit

We can connect and **collect the data from the public Internet** from different public service.

For example, **Weather Underground** from IFTTT provide weather info and data to user. Create an Applet for IoT service.

Weather Underground:

A commercial weather service providing real-time weather information over the Internet.

Lesson 7

Why we used the shared online data instead of our sensor

What are their different?

Task 1 – Automatic light

micro:bit

Scenario:

Build an Automatic light that determine by sunset and sunrise with using Weather Underground and IFTTT service. The light can be use for home, garden, door.

if this then that

Sunset
Sunrise

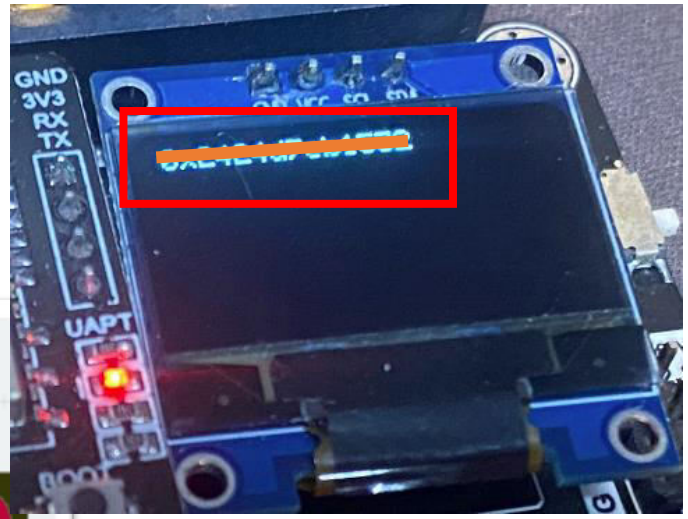
Light On
Light Off

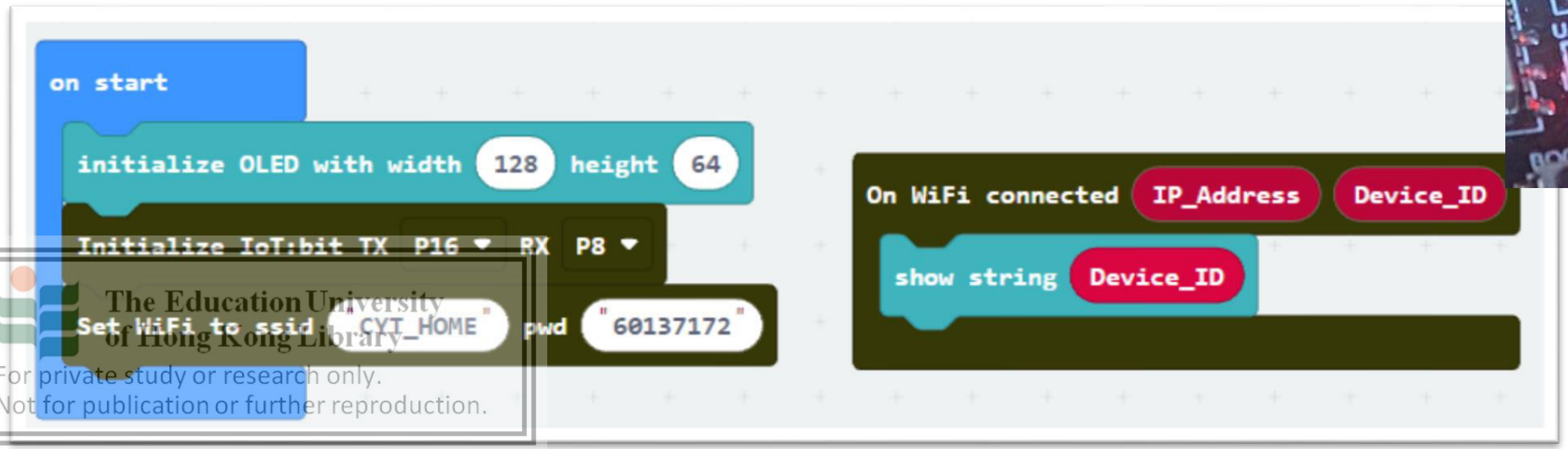
Task 1 – Get Device ID

micro:bit

Step1: Makecode program

1. Call IoT:bit extension 0x2424d7eb1532
2. Initialize Wi-Fi
3. Initialize OLED
4. Show “Device ID” after connected
5. Save youe **“Device ID”**



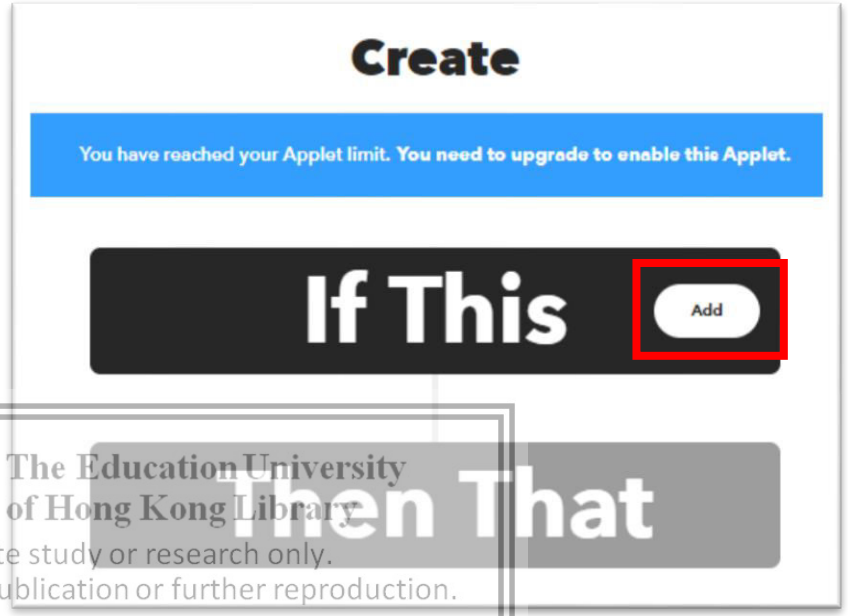


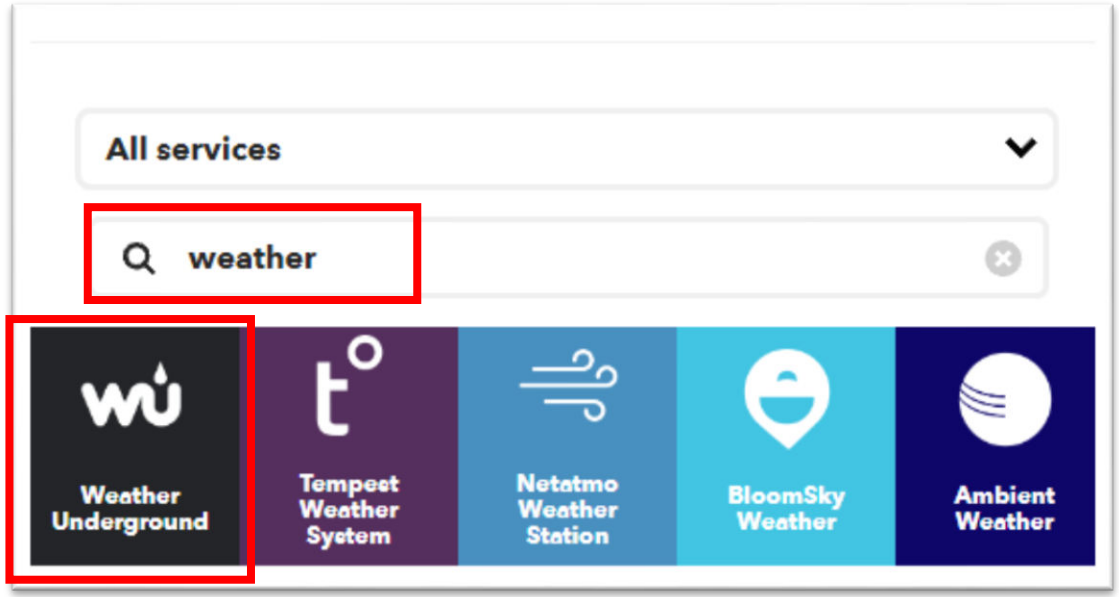
Task 1 – Automatic light

micro:bit

Step1: Login IFTTT, Create an Applet

Step2: Click “Add”, search “weather” and select

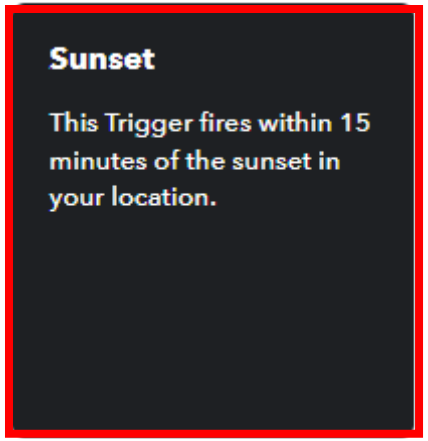


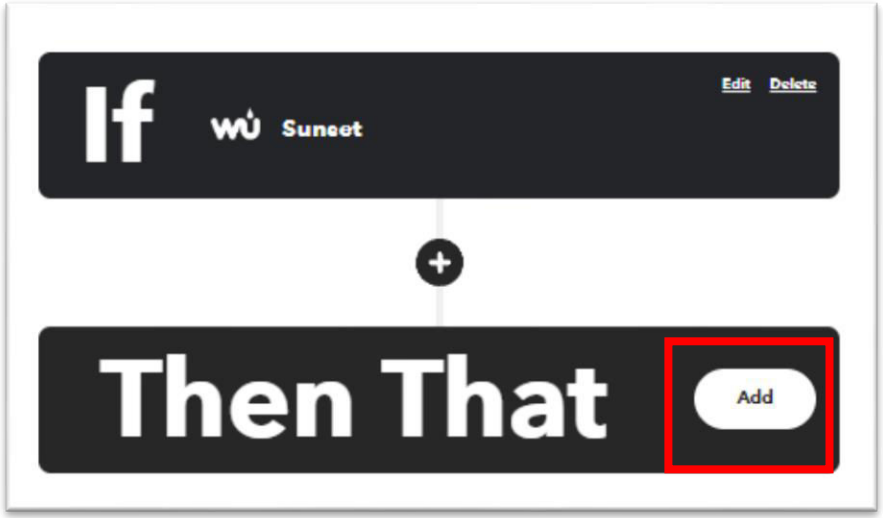


Task 1 – Automatic light

micro:bit

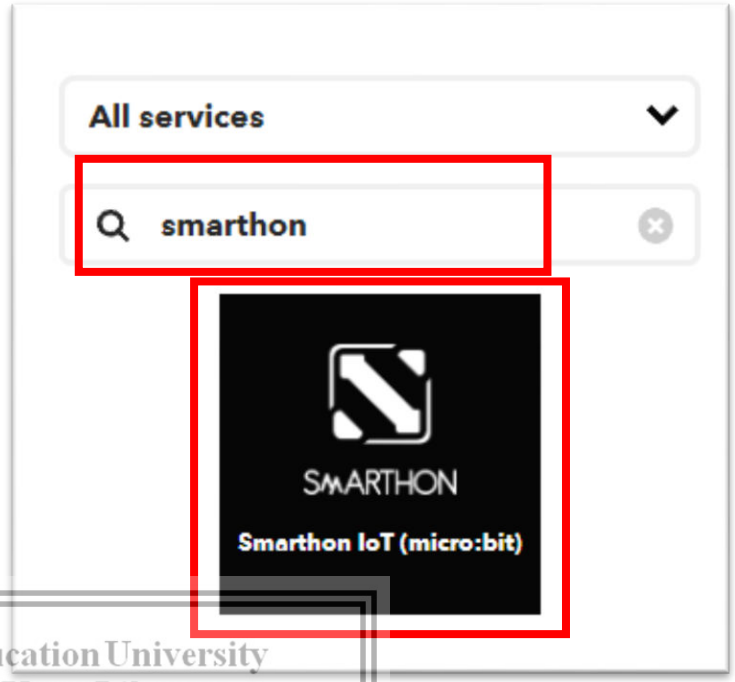
Step3: Select “Sunset” from Applet, Select current location, click “Create trigger”, then “add”

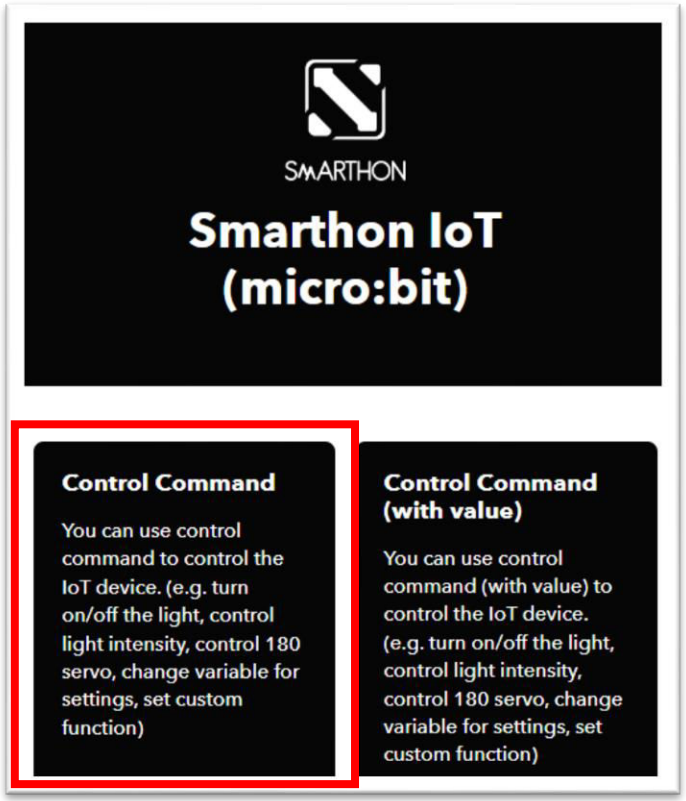




Task 1 – Automatic light

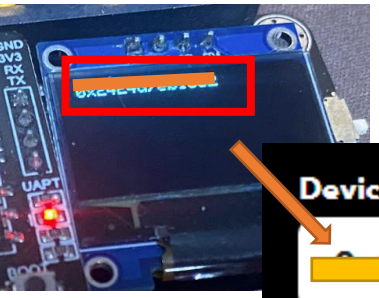
Step4: Search and select “Smarthon”, then “Control Command”

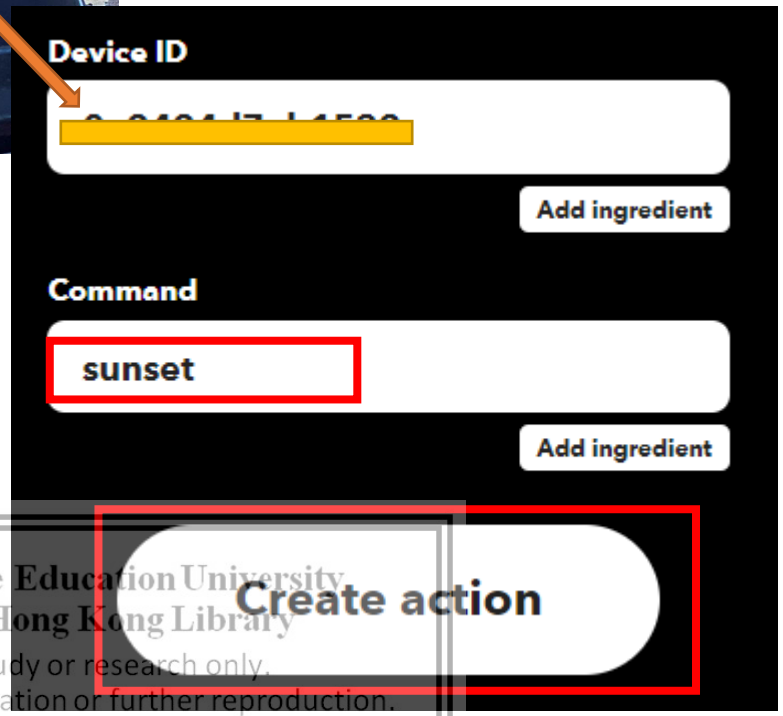




Task 1 – Automatic light

Step5: Input the saved “Device ID” and sunset for “Command”. Then click “Create action” and “continue”



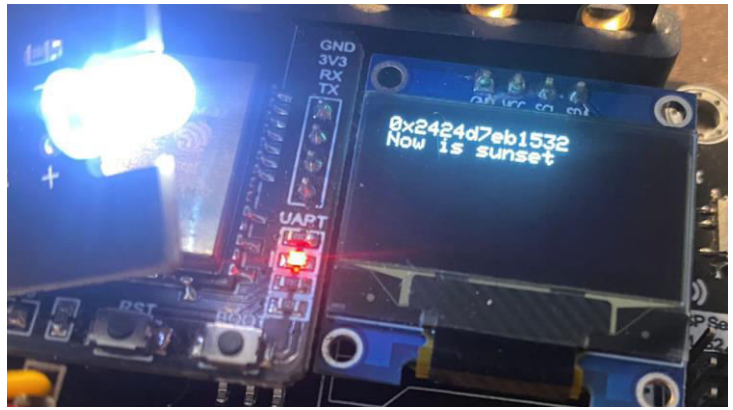


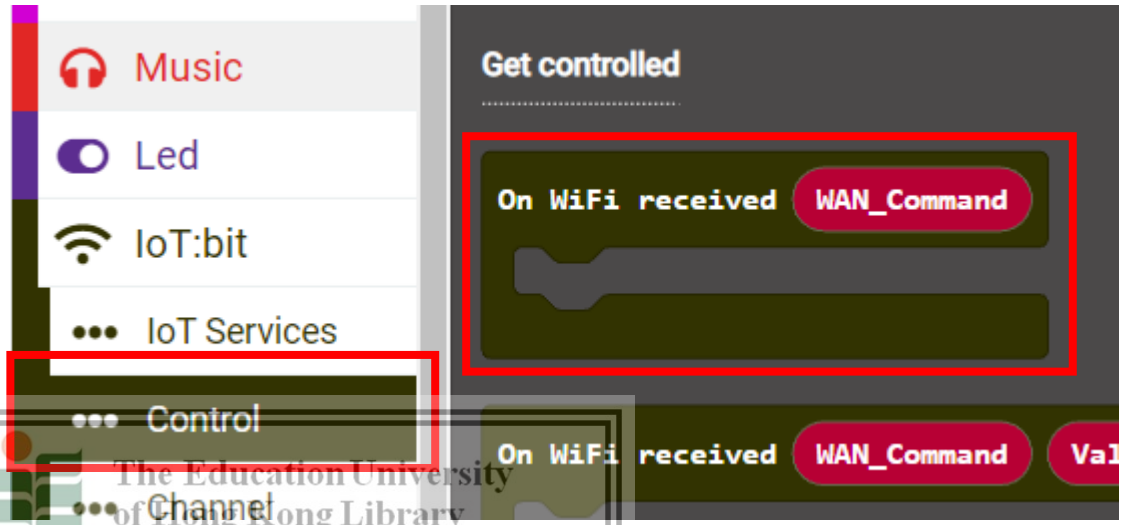
Task 1 – Automatic light

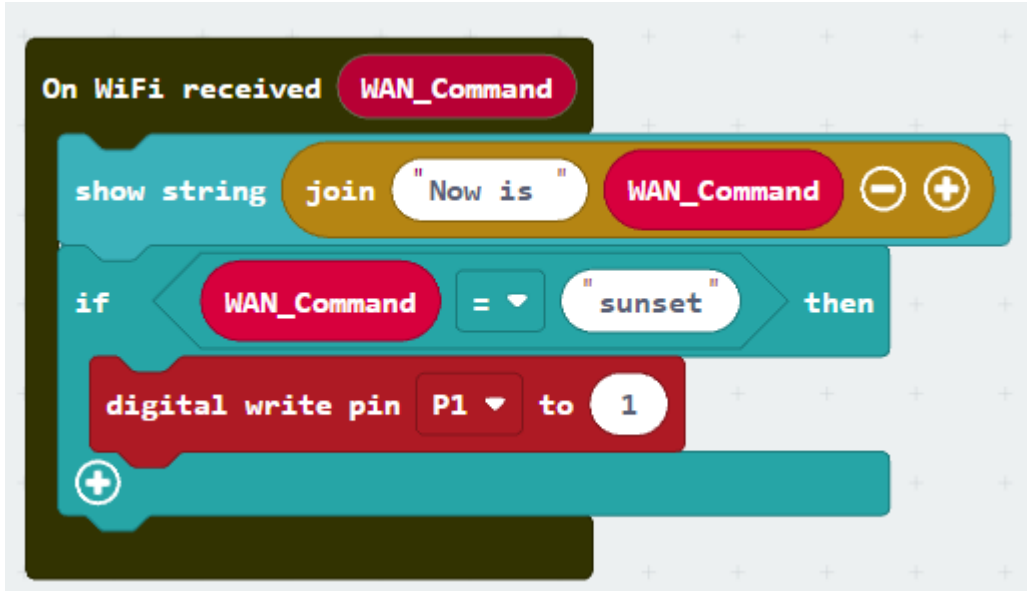
micro:bit

Step6: Continue with Micro:bit

1. On Wi-Fi received
2. Show string “Now is “ + “Wan Command”
3. If “Wan Command” = “sunset”, then Pin 1 On



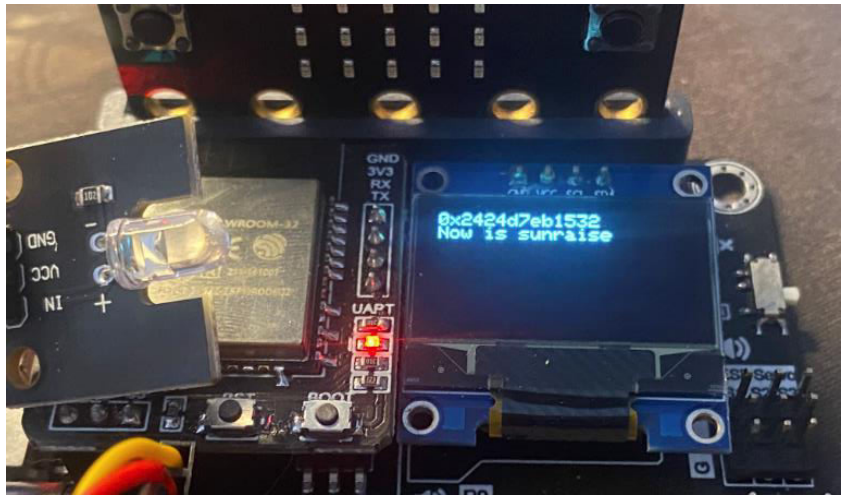




Task 1 – Automatic light

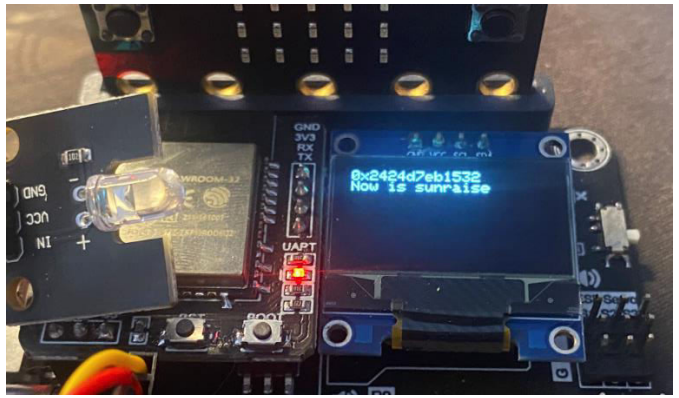
micro:bit

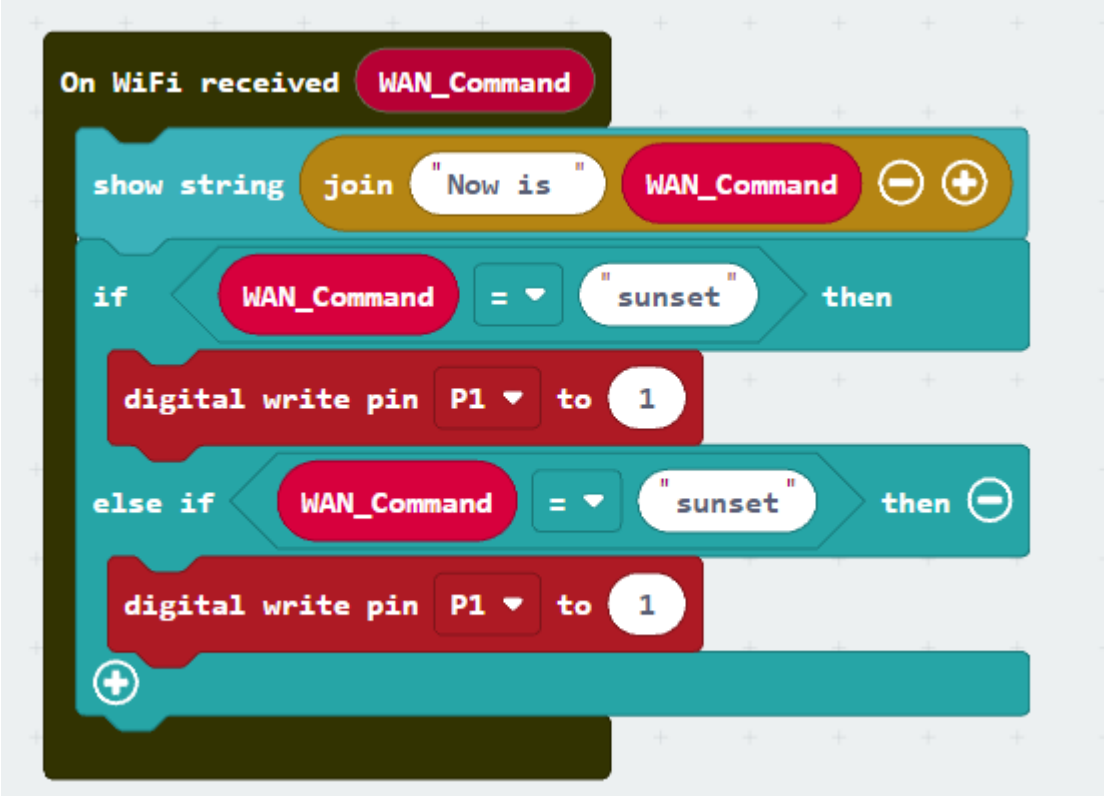
Try to use the same step to add the sunrise applet



Task 1 – Automatic light

DEMO





Task 2 – Automatic window

micro:bit

Scenario:

Build an Automatic window that determine by rain. Help user close window automatically to prevent water.

Hints:

Use “Current Condition changes to”

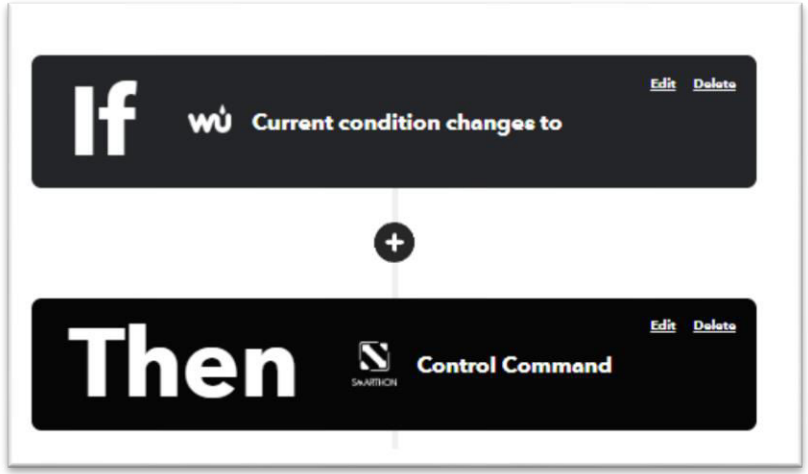
if this then that

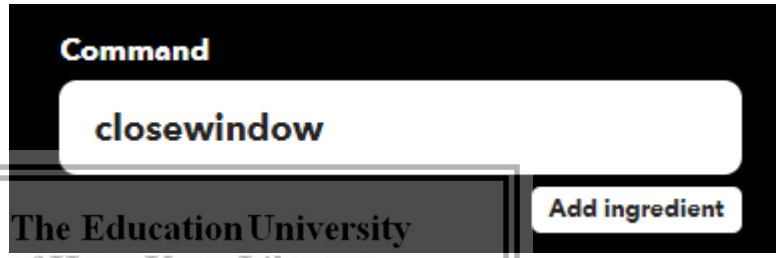
Rain

Window Close

Task 2 – Automatic window

Demo





Lesson 8

micro:bit

Why we used shared online data instead of our sensor

What is their different?

Advantage

micro:bit

Using online shared data, We can benefit from

1. **Accurate**
   - Advance technology and equipment
2. **Cost saving**
   - No need to set up own sensor
3. **Diversity of function**

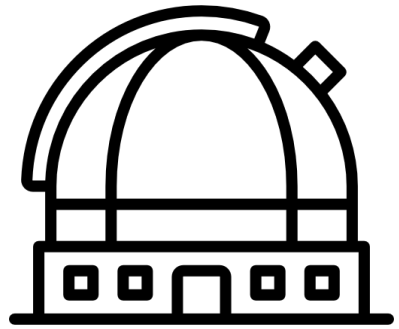
IFTTT

WEATHER UNDERGROUND

Conclusion

micro:bit

1. IFTTT – Internet service
    - Internet shared data can save cost, provide diversity of function and accurate data
2. Automatic Light
3. Automatic Window



Project

micro:bit

Outline:

4 students as a group. Build a smart home using IoT technology. Extra marks would be given for creativity and originality.

Necessarily task:

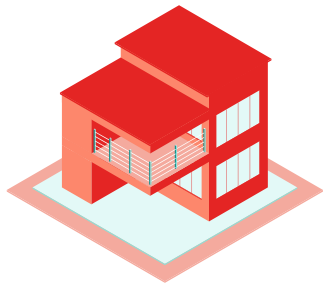
5 or more Function, at least:

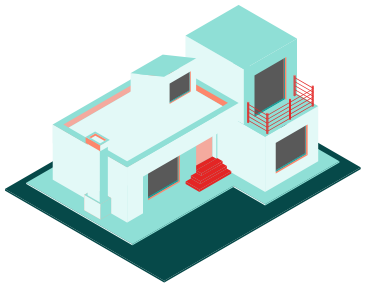
1. 2 IFTTT applet
2. 2 Thing Speak data
3. 2 Smart Home products with automatic task

Present your home in Next lesson

Lesson 9

Smart Home Tour





Project

micro:bit

Outline:

4 People as a group. Build a smart home with using IoT technology. Extra mark would be given by creative and originality.

Necessarily task:

1. 5 or more Function, at least:
    1. 2 IFTTT applet
    2. 2 Thing Speak data
    3. 2 Smart Home product with automatic task

Present your home in Next lesson

xxxxxxx College

S2 Computer Literacy Simulating smart home IoT with Micro:bit

Worksheet 1 – What are Smart Home and IoT

Name: _____( ) Class: _____ Date: _____

Part A: Class exercise

1. The Internet of Things (IoT) is the platform that connects devices to the Internet enabling them to exchange data and command.

2. How IoT technology helping people?

Reasonable answer

3. List out the four stages of IoT life cycle.

Collect > Communicate > Analyze > Action

4. Smart Home involves a system connected with controllable home attributes which work automatically by regulating.

Part C: Inquiry-based questions

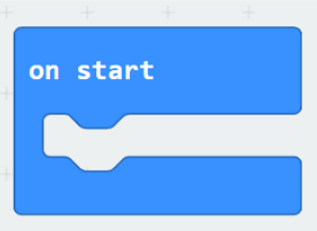
How has IoT impacted the way we live?

xxxxxxx College

S2 Computer Literacy Simulating smart home IoT with Micro:bit

Worksheet 2 – Micro:bit - Basic

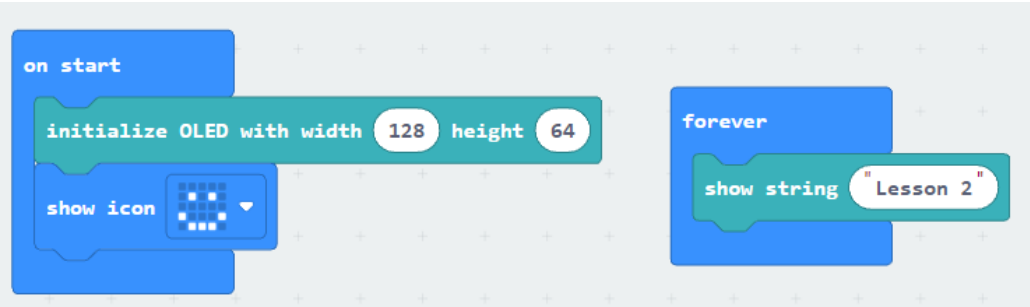
Name: _____( ) Class: _____ Date: _____

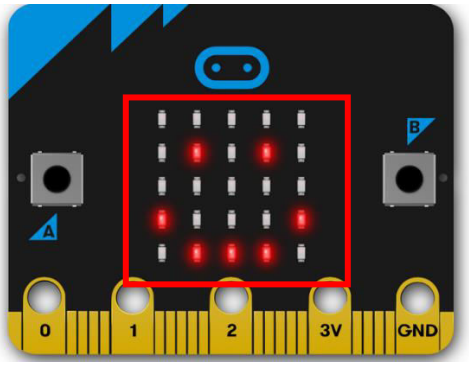


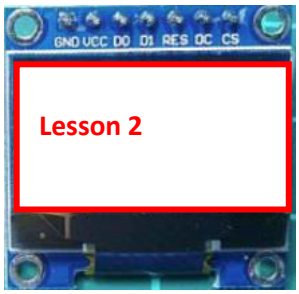
1. What is the difference between these two block?

Only do once after boot/start	Loop all the time

2. What will be shown while running this program? Draw the result in the blank.







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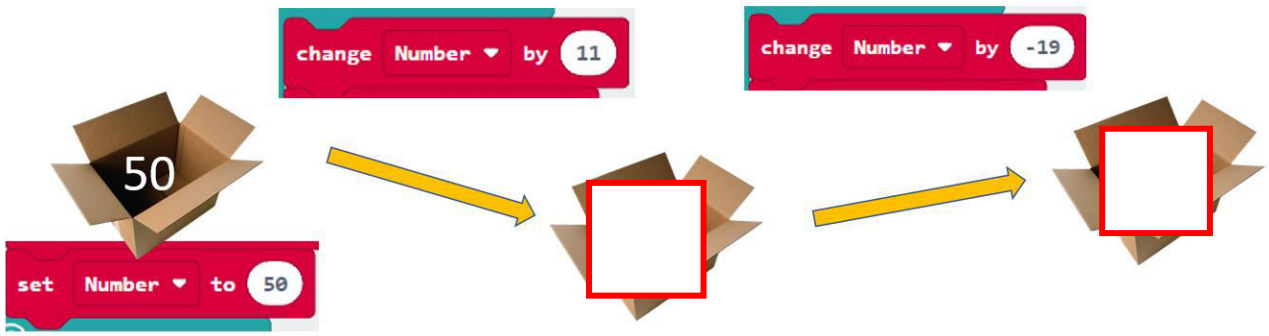
Worksheet 3 – Micro:bit - Advanced

Name: _____( ) Class: _____ Date: _____

Part A: Class exercise

1. What is the number of step2 and 3?



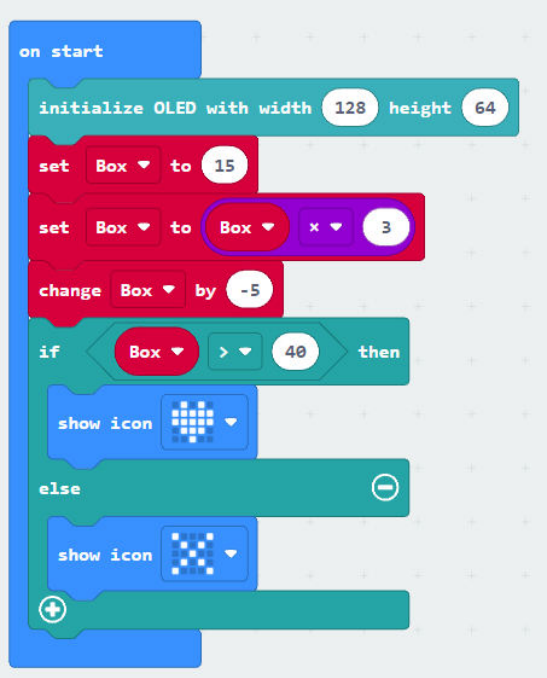
2. Micro:bit can measure the processor(CPU) temperature to calculate the surrounding temperature.

3. Build a Temperature Alarm with the following function:

- Showing current Temperature in OLED
- Description of the Temperature.
- Buzzer will ring if the temperature is higher than 30

Capture and upload your answer to the Google Classroom

Part B: Home exercise



1. What will be shown on the LED?

2. What is the value of the variable “Box”.

_____

Part C: Inquiry-based questions

1. What type of feature from Micro:bit can be implemented on Smart Home?

_____

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Worksheet 4 – Micro:bit - Advanced

Name: _____( ) Class: _____ Date: _____

Part A: Class exercise

1. Complete the following table

		IoT:Bit (Pin)
S	Signal Port	Data Pin
V	Voltage (+)	3v3
G	Ground (-)	GND

2. Build an Automatic Temperature Control with a fan and motor.

Capture and upload your answer to the Google Classroom

Part B: Home exercise

1. Why does sometimes the pressing on AB won't respond?

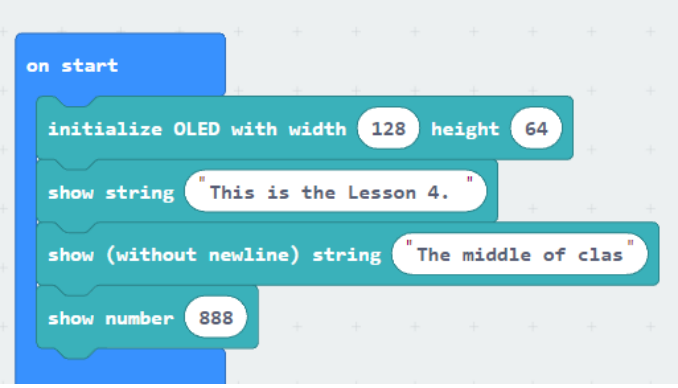
Because the value 181-360 is not functional on the 180" servo.

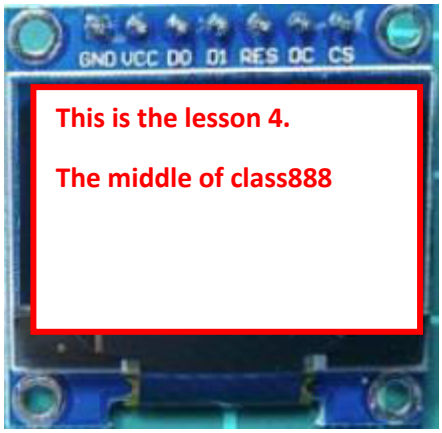
2. If the LED is attached to Pin 3, how can I let it spin when pressing B

3. What is the function of "Clear OLED display" block.

Clear the text on the OLED display.

4. What is the output? Draw the OLED display





Part C: Inquiry-based questions

What products of Smart Home can be made by Micro:bit?

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Worksheet 5 – Data Visualization

Name: _____( ) Class: _____ Date: _____

Part A: Class exercise

1. What are the benefits of visualizing data

Easier to understand, and identify patterns, and trends in large amounts of data

2. Capture and upload your code and Thingspeak's graph on Google Classroom.

Part B: Home exercise

1. Which of the following is an incorrect description of ThingSpeak?

a. Provide free service to users
b. Provide smart home control services
c. Allow sending data though API write key
d. Everyone have different and unique API key

2. What type of data from home can be sent to ThingSpeak?

Any reasonable answer that data can be collected and meaningful with an explanation

_____

_____

Part C: Inquiry-based questions

Why is visualized and online data important to home?

_____

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_____

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Worksheet 6 – IFTTT- Notice with Email

Name: _____( ) Class: _____ Date: _____

Part A: Class exercise

1. How analyzed data help "Action" stage in IoT data life cycle?

It helps decide the proper action based on the analyzed data.

2. Complete the following IoT life cycle from the **Temperature alarm**

Life cycle	**Home monitoring**
Collect	Collect data from the temperature sensor
Communicate	Connect and send data to ThingSpeak with API Key though WIFI
Analyze	ThingSpeak analyzed the data in real time
Action	Send Email to Notice user when 30 degree hit

Part B: Home exercise

1. Which of the following is an incorrect description of IFTTT?

a. Provide free service to users
b. Provide smart home control services
c. Provide data analyzed and visualize services
d. Everyone has a different and unique API key

2. Setting up 2 Applets for other sensor.

Upload the capture of your email to Google Classroom

Part C: Inquiry-based questions

Why “Action” still need when we already have Smart Home automatic service?

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Worksheet 7 – NTP Clock

Name: _____( ) Class: _____ Date: _____

Part A: Class exercise

1. What is Network Time Protocol(NTP) use for?

Internet protocol for synchronize the compluter clock with offset in millisecond.

2. Build a **Advanced smart light** with following requirements:

The user should have different schedule in Day 1, 15 and 20 in each month. Design the Smart light for the whole month.

Weekday		
Time	Events	Light Status
07:00	Wake up	On
08:00	Go out	Off
18:00	Back Home	On
22:30	Sleep	Off

Day 1, 15 and 20		
Time	Events	Light Status
11:00	Wake up	On
13:00	Go out	Off
18:30	Sun set	On
23:15	Sleep	Off

Upload your answer to Google Classroom

3. Complete the following IoT life cycle from the **Advanced smart light**

Life cycle	**Smart light**
Collect	The data is collected from the NTP server
Communicate	Data was sent though Wi-Fi from server to client
Analyze	The collected data is analyzed to determine the housing light on and off
Action	Action is taken based on the time sent by NTP server

Part B: Inquiry-based questions

1. What kind of data can be collected from the internet?

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Worksheet 8 – Shared Sensor

Name: _____( ) Class: _____ Date: _____

Part A: Class exercise

1. Build an Automatic Light with sunrise and sunset control.

Upload your answer to Google Classroom

2. What are the advantages of using data that is shared from online?

Provide accurate data, cost saving and diversity of function .

3. Complete the following IoT life cycle from the **Automatic window**

Life cycle	**Automatic window**
Collect	The data is collected from the underground weather service
Communicate	Data was sent though Wi-Fi from server to client
Analyze	The collected data is analyzed to determine the weather is clear or rainning
Action	Action is taken based on the darta sent by weather service. If rain, window will be closed automaticly

Part B: Inquiry-based questions

1. Why we used shared online data instead of our sensor? What are their differences?

Part C: Smart Home Project

Outline:

4 students as a group. Build a smart home using IoT technology. Extra marks would be given for creativity and originality.

Necessarily task:

5 or more Functions, at least:

i. 2 IFTTT applet
ii. 2 Thing Speak data
iii. 2 Smart Home products with automatic task

Present your home in the next lesson. Each group has 5min to introduce your home.

Flow of your present:

1. What are the functions of your home?
2. How did you build it?
3. What technology/sensor/components you used?
4. The personal view of the future smart home.

PartD: Your Smart Home

1. Complete the following IoT life cycle from your product

Life cycle	
Collect	
Communicate	
Analyze	
Action	

Life cycle	
Collect	
Communicate	
Analyze	
Action	

Life cycle	
Collect	
Communicate	
Analyze	
Action	