

# **IERG 4230/IEMS5721**

## **IoT Mini-Project** **Introduction**

# IoT = Internet of Things

**Q1.**

**What is IoT project?**

**Q2.**

**Things on Internet =?= Internet of Things**

# Example-1: If I have a TV with remote.

IR remote (at home)

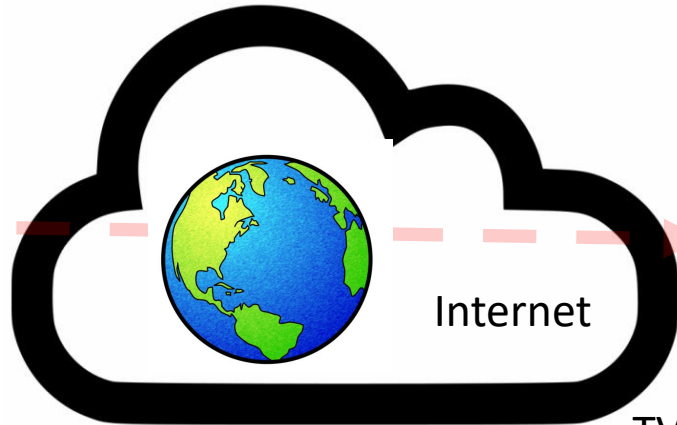


IR signal



TV (at home)

IR remote (in HK)



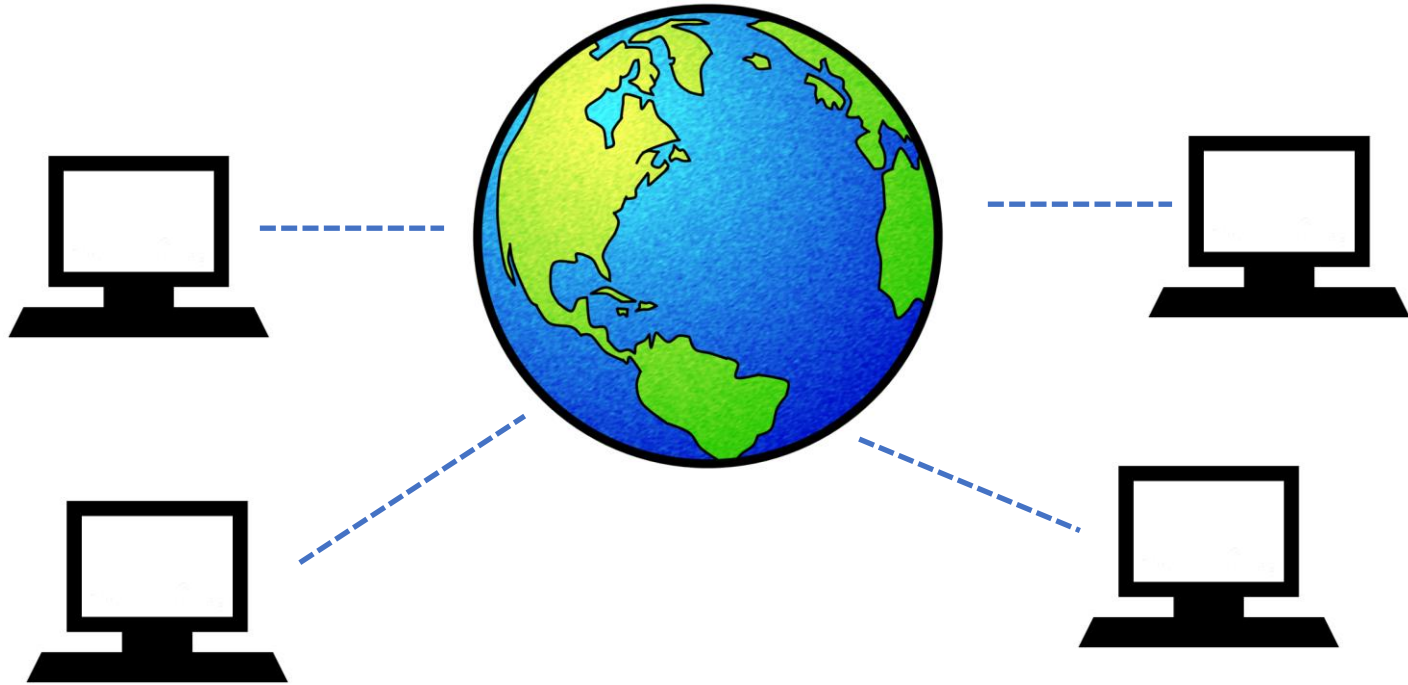
TV (in USA, another side of the world)

TV Remote + Internet =?= **IoT**

purpose? *Meaningful / Meaningless ?*

## Example-2: Computer with Internet capability.

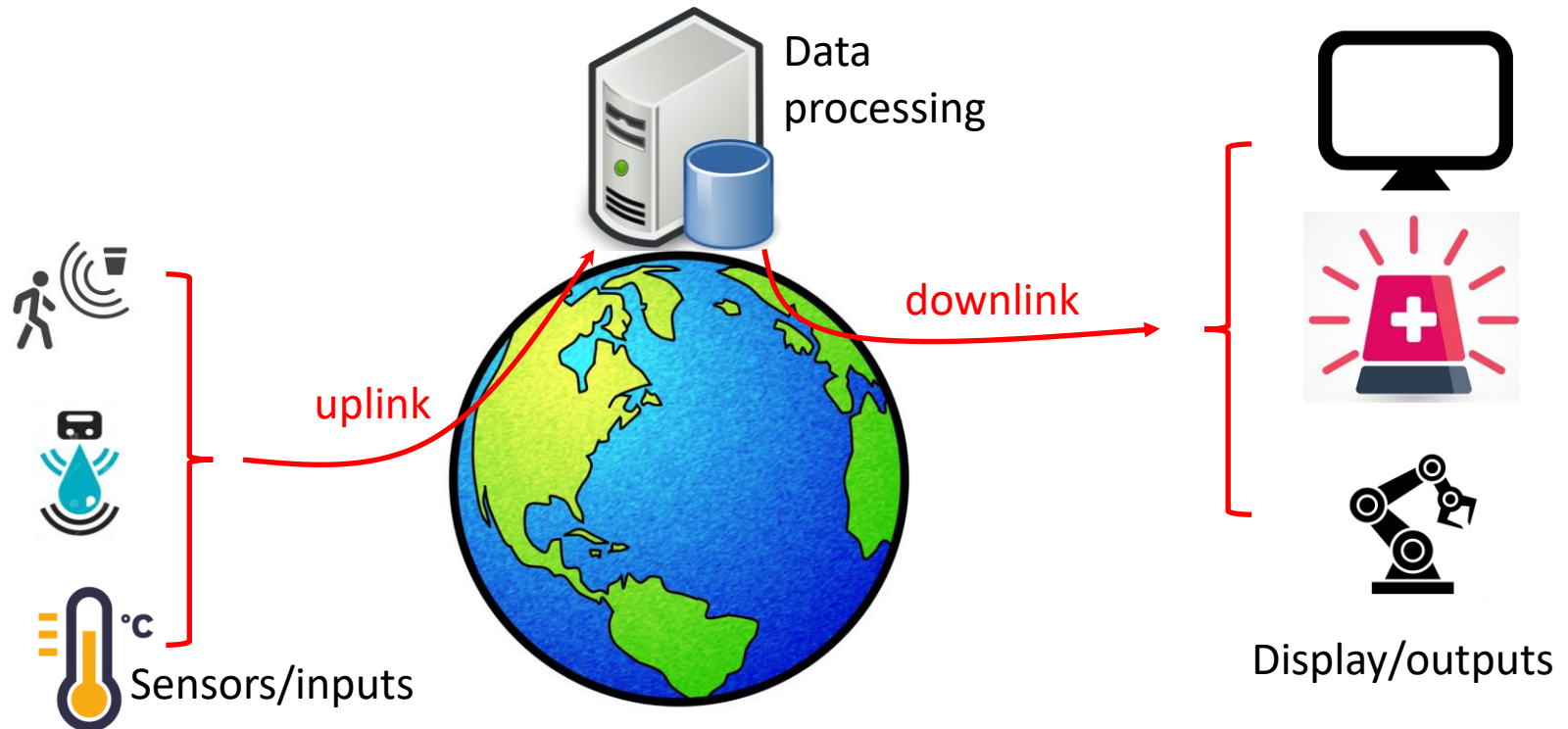
- Internet started from 199x.
- Will you say that your desktop/notebook/smartphone is **IoT**?
- I will say that they are **Things on Internet**.



# Internet of Things $\neq$ Things + Internet

IoT should/may include:

- **Uplink**; from sensors (inputs) to server.
- **Processing**; convert raw data to information (meaningful).
- **Downlink**; server to (outputs) indicator / human interface.



# Uplink:

- **Inputs:** Sensors, machines, switches, human interface (web surfing).
- **Processor:** get data from sensors, send data to network.
  - **Low cost**, (very important, many devices) .
  - **Small size, light weight** (very important).
  - **Low energy**, (very important, can be operated months or years with a battery).
  - **Wearable**, (may be).
  - **Network capable**, (connect to Internet directly/indirectly with security protocols).
- **Network:**
  - **Protocol:** security (encrypted), low overhead, fast response time, connection oriented/connectionless, point-to-point/broadcast, network size, network range, power, frequency, operation cost, QoS quality of service.
  - **Architecture:** number of hierarchy, local network, Internet network, gateway.
  - **Topology:** star, mesh, plain, daisy chain.

# Processing:

- **Data:**
  - Raw.
  - Source: from sensors/public domains/other suppliers.
  - Characteristics: meaningful/meaningless, extract easily.
  - Time life: real time/historical.
  - Size: storage cost.
  - Privacy.
- **Information;** dig from raw data, convert to meaningful.
  - Creative: compare to existing technologies.
  - Cost effective: compare to existing technologies.
  - Algorithms.
  - Analysis time: response time.

## Down link:

- **Network:**
  - Same as uplink.
- **Display:** outputs, visualization
  - **Human interface;** user friendly, interactive.
  - **Hardware:** machine, robot, fault tolerance and self recovery capability, safety.
  - **Power:** energy saving.



# Overall:

- **Creative:**

- Is it unique solution?
- What are the advantageous features of your project?
- What the information does your project discover?
- Algorithms?

- **Improve human life:**

- What the problems do your project solve?
- Save life / save money / save time / comfortable ?
- Against ethics?
- Protect privacy ?

- **Others:**

- Is it cost effective? Setup cost? Operating cost?
- Value added? Extendable services, make money, a business?

If a student project is .....

1. TV Remote + Internet = **Internet TV Remote**.
2. Thermal meter + Internet = **Internet thermal meter**.
3. *Things* + Internet = *things* on **Internet**.

Base on the criteria,  
what grade should the student get?

Do you agree the following topics  
are **IoT projects** ?

# Project-1: An application of on-line map

- New information; ***Real Time Traffic Condition.***
- Outcome: save time, save life (on accident)
- *The original function of GPS is simple ... Know your current location.*



Electronic map



Drivers' GPSs



# Project-1: Application of on-line map

- Outcome: Real time traffic condition.
  - Before this project, Traffic Dept. has to setup a lot of cameras (*sensors*), employ people at control centre (*setup and running cost*) to monitor the traffic status. Build a lot of electronics real time electronics signs (*setup cost*) on the roads. A lot of blind points cannot be monitored due to limited cost. The system is affected by weather.
  - This project
    - Setup cost (nearly 0); individual driver owns his GPS and electronics map to prevent getting lost.
    - Network cost (nearly 0); individual driver gets online map for his GPS navigation system.
    - .....

# Project-1: Application of on-line map

- This project **needs**
  - Drivers send their current locations from time to time.
- This project **does**
  - Analyse individual driver's location, speed (time to time data), ...
  - Conclude the current traffic condition (new information).
- The **advantages** of this project and it **can realize**
  - Real time traffic condition; **save time**.
  - To know traffic accident occurrence (abnormal data); **save life**.
  - Data sent by anonymous drivers; **not against privacy**.
  - Extreme **low cost**. (compare to Traffic Dept. solution).
  - Based on new information, provide extendable service; **value added**.
  - ..... *Could you think more .....*

## Project-2: Hiking helper

### Problem:

A few people lost their way and got accidents when they were hiking every year in Hong Kong. Seeking for the lost guys is very difficult.

### Objective:

Use IoT to help seeking the lost guys.

### Difficulties:

- Mobile phone networks cannot cover the trails.
- The casualties cannot send message to call for help.

## Possible solutions:

- Use other facilities of other hikers to form network.
- A RF network that does not depend on mobile network. (BLE /LoRa ?)
- A network topology that can setup/build automatically. (mesh/star ?)
- RF modules that is built-in on smart phone. (BLE? Other will be built-in in next generation)
- Extendable hardware that can cascade/daisy-chain/propagate message to mobile phone network. (through gateway, BLE → WAN)
- Network protocol (built-in or extended devices) that can support long range, low energy.
- Data protocol is simple and suitable for this application. (MQTT?)
- If some devices can be set up by government, what kinds of the devices are suitable? (low cost, min. maintenance required, low energy, etc ....)
  - Pre-install check points (low-cost hardware) to help positioning. (data → information)
- Measure acceleration to calculate motions and positions (data → information).
- 
- Value added (→ make money, a business)
  - Insurance premium discount.
  - Promote sports ware to target customers.

The contents of Lecture sessions can help you to make decisions.





## *Same in your project, you should*

- *Suggest suitable solutions, include ...*
  - *Research*
  - *Comparison*
  - *The best solution that fulfill the requirements of IoT.*
    - *Low cost*
    - *Low energy*
    - *Small and light*
    - *User friendly*

Not just know, please think more.....

# **Labs** and **Mini-project**

# IERG4230/IEMS5721 lab contents and arrangement.

1. Lab-1: Sensors & Arduino (processor).
  - A simple OS is provided that can run multi-task easily.
  - All sensors are like modules.
2. Lab-4: ESP8266 (Arduino like) + Internet
  - Connect ESP8266 to WiFi with http protocol as Web Server & Client.
  - Connect to the server in campus (behind firewall).
  - Connect to Internet data server (ThingSpeak).

***Up to here, you can start your mini-project with INTERNET.***

3. Lab-2,3: Zigbee, one of local network protocols.
  - The device, XBee and its tools.
  - Communicate to Arduino.
4. Lab-5,6,7,8: Bluetooth, one of local network protocols.
  - CC2540 and its IDE.
  - Beacon function of BLE4.0.
  - Bluetooth to UART module.

***You can add local networks into your project.***

## IERG4230/IEMS5721 Mini-project

- Design a IoT application to solve a problem you are interested.
- Base on IoT criteria to think details about IoT elements; sensor, network, data processing, etc.
- Do comparisons, make decision of which network protocol (network protocol and data protocol) is the suitable/best solution for your project. (Why).
- What information can be dug from the data you collected. (What and How)
- Makeup your idea and prepare a power point to sell you idea.
- Implement the part you can implemented (base on lab-1 to lab-8). A project with physical demo is better than theoretical.

## You have to submit:

- Project **Proposal** (optional):
- **Power Point file** (= project report) & **Demo** (15-min)
- **Source code** & final version **Power Point file**

# Submit:

- Project **Proposal** (optional):
  - TA/Technicians will give you some comments/suggestions.
- **Demo**
  - The demo will be held on the last week of the semester.
  - **Demo**, this is **your show time** to sell your project.
  - Q&A, professor and tutors will ask some questions to clarify your idea (the last chance to defend and get marks)
  - Do demo, if any part of your project has been implemented (hardware, software, human interface). It helps graders to understand your project, no need to imagine, help you to get higher marks.
  - On-line (real time) demo is preferred (non-arguable).

# Submit:

- **Power Point file**

- The first part of the PPT
  - Show your idea , what your project can do. (what the expected results are)
  - The reasons of your selections. (let graders know what you know).
  - Included captured screens. (incase your on-line demo out of service, you can get part of the mark)
- The second part of the PPT
  - Which parts have you implemented?
  - Instead of other network protocols, you can only use WiFi (ESP8266).
  - Instead of number of sensors or historical data, you can use dummy data.

- **Source code**

- Prevent plagiarism and cheating.

- **The Final version Power Point file**

- You can modify your PPT after getting suggestion during demo.
- Keep a perfect mind of your project.
- The last time to get marks (a little bit).
- This file will be kept in department as course records.

# What the efforts will be counted?

- You can buy/add other hardware on your project, only the effort you did will be counted.
- You can consult advice from technicians, but they are not your team members. Technicians will report the case and the efforts by technicians will not be counted.
- Do not say the information can be calculated/dug by AI (artificial intelligence). You have to point out the characteristics of your collected data. Full algorithm is not needed.
- Do more in Research, Comparisons, Creatives will get higher marks easily.
- Show the knowledge you have learnt about IoT.
- Only the efforts by you will be counted.
- Plagiarism is not allowed.



## Suggest readings:

- <https://www.rs-online.com/designspark/eleven-internet-of-things-iot-protocols-you-need-to-know-about>
- <https://www.koombea.com/blog/iot-protocols/>
- <https://www.sam-solutions.com/blog/internet-of-things-iot-protocols-and-connectivity-options-an-overview/>
- <https://www.oracle.com/internet-of-things/what-is-iot/>
- <https://www.softwaretestinghelp.com/best-iot-examples/>