INDUSTRIAL UNIVERSITY OF HOCHIMINH CITY

Modern IoT Technology

An Introduction to IoT

Evaluation

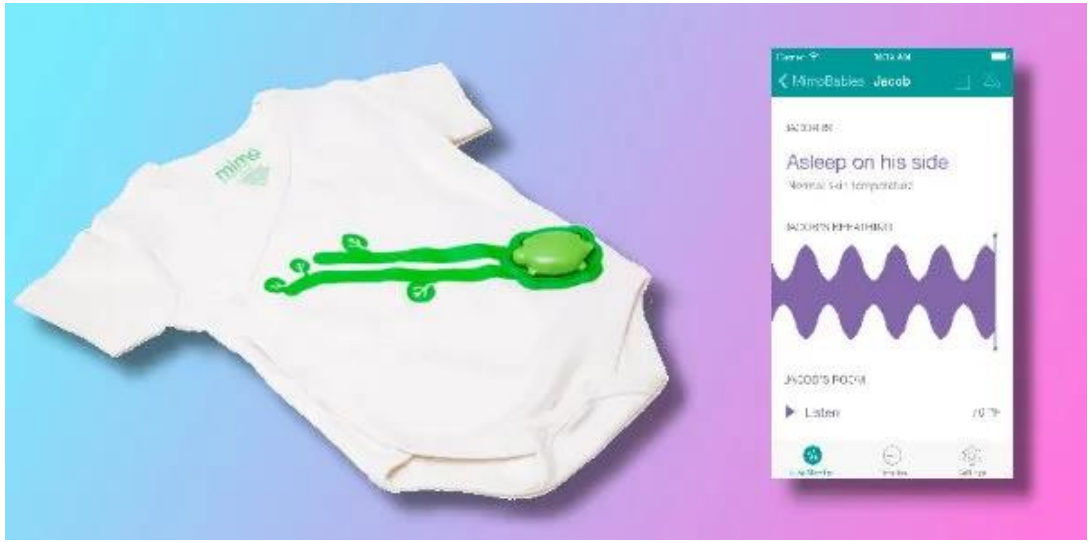
- Take part in class
- Tests
  - *Regular test*
  - *Midterm*
  - *Final Exam*

What is IoT?

- By computer scientist *Kevin Ashton* in 1999
- The Internet of Things (IoT) refers to a system of devices, interconnected with each other, equipped with computational capacity (smart objects), identifiable and enabled to transfer data over a network, without a required human interaction
- Smart object such as smart fridges and mobile phones, to objects spanning entire industries or even cities, such as smart agriculture and smart cities

Example of IoT

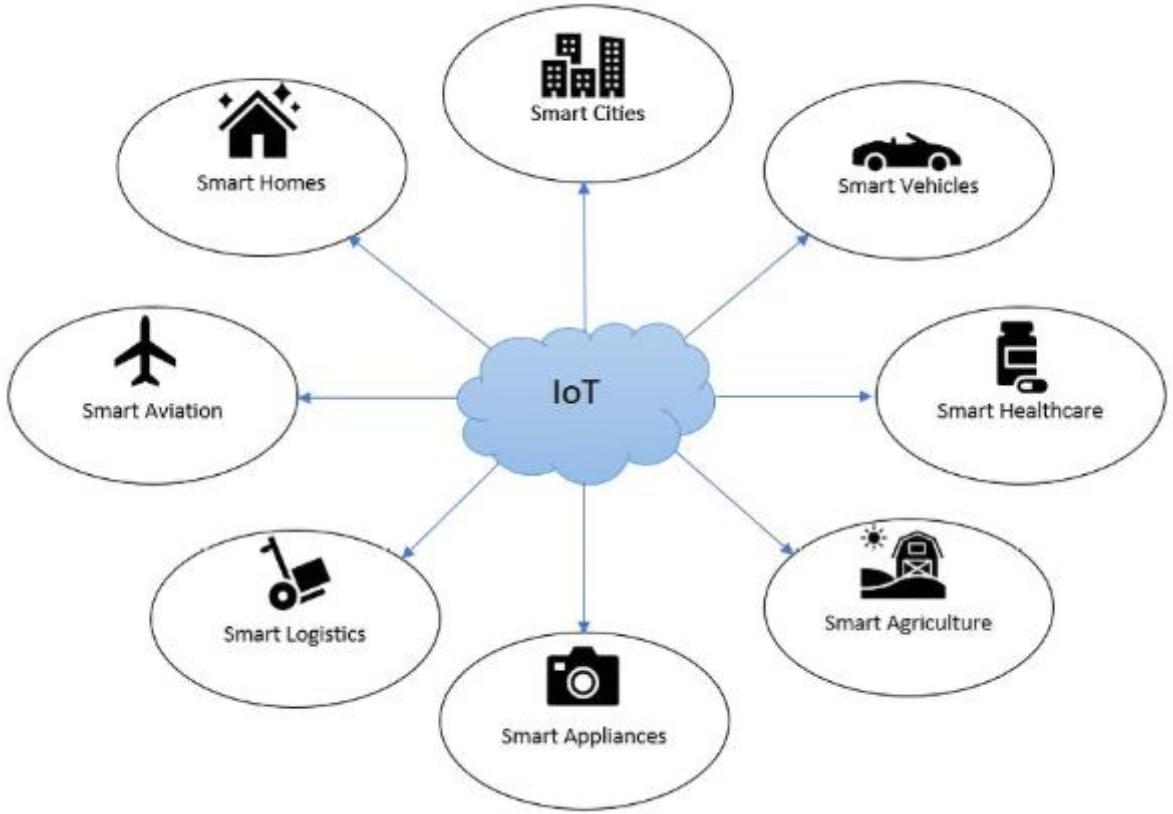
- Imagine when you enter your house, your car send signals to open garage door, turn on air condition/ heat system, lights, TV, Stove, etc. to find everything ready for you, making your life easier and save your money buy saving energy.
- Internet-Connected Bed to track your sleeping pattern and make your bed auto-adjusts itself.
- Internet-Connected onesies to track your baby's respiration, pressure, moisture and temperature



Benefits of IoT

- Increased convenience: Devices can be programmed and controlled remotely.
- Energy efficiency: Smart thermostats or lighting systems
- Safety and security: IoT-enabled security systems and cameras, and smart locks
- Health monitoring: Smart wearables and devices
- Enhanced user experience: Devices can learn and adapt to users' preferences

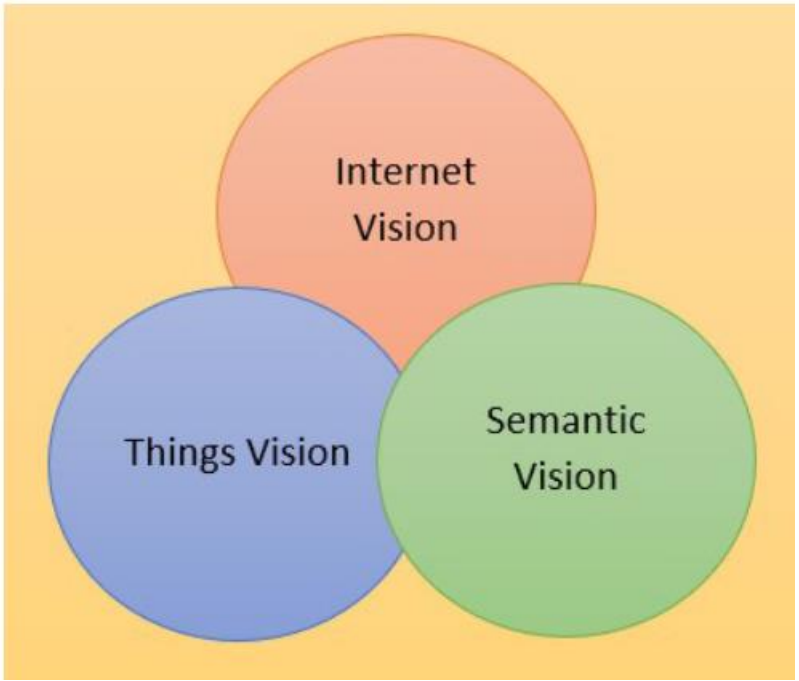
Areas of use for IoT



Visions of IoT

Accelerate the ability and performance of the connectivity **Internet Protocol for Smart Object (IPSO)** communities

Technologies that are related to *making things smarter*



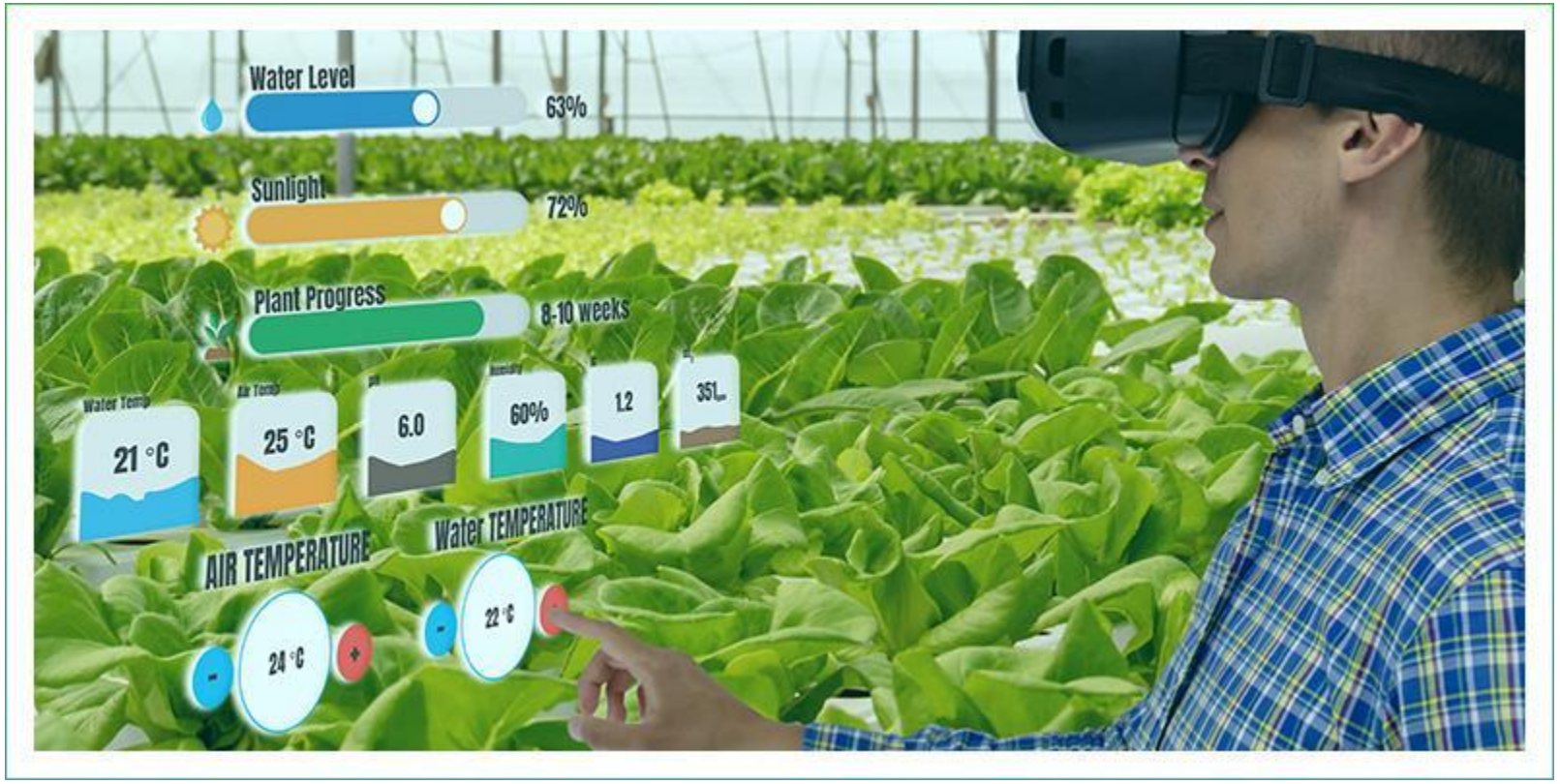
Understanding the meaning of the data that is generated

Potential Applications

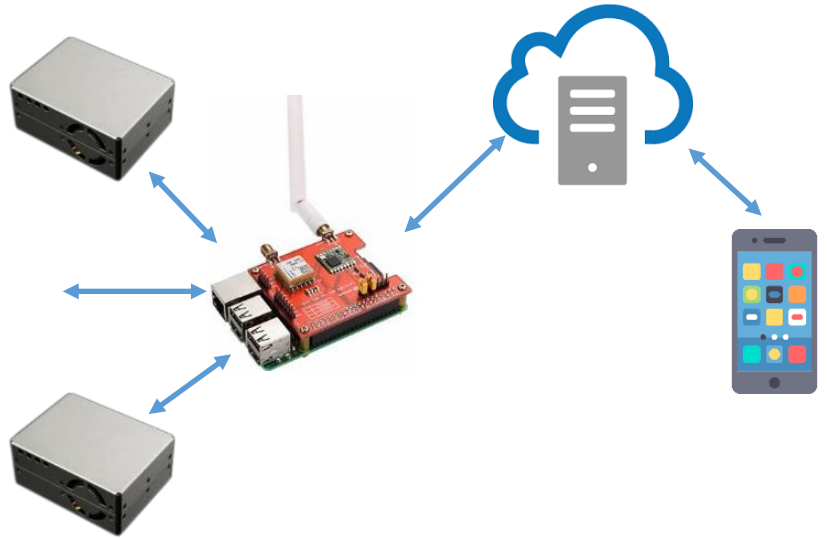
Smart Agricultuare

- Temperature and Humidity
- pH, EC
- Light intensity
- Pump controllers

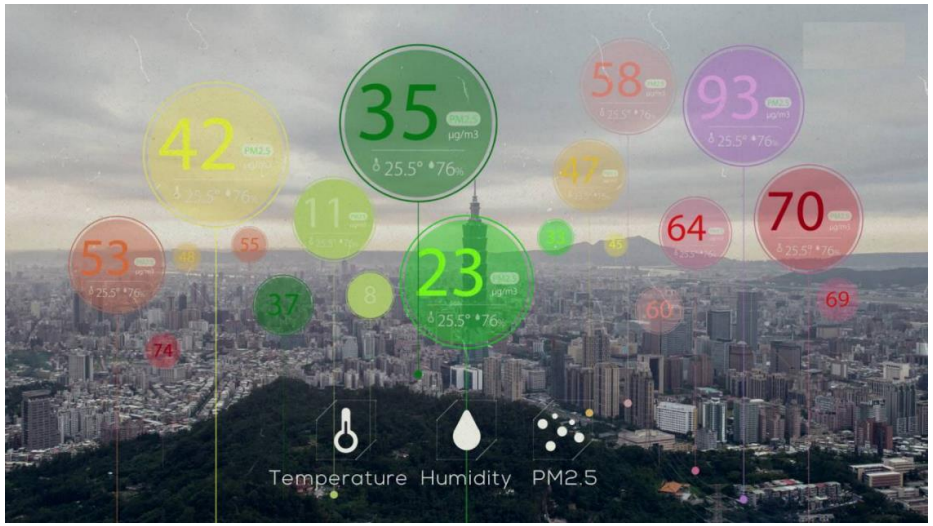
Monitoring system based on AR/VR



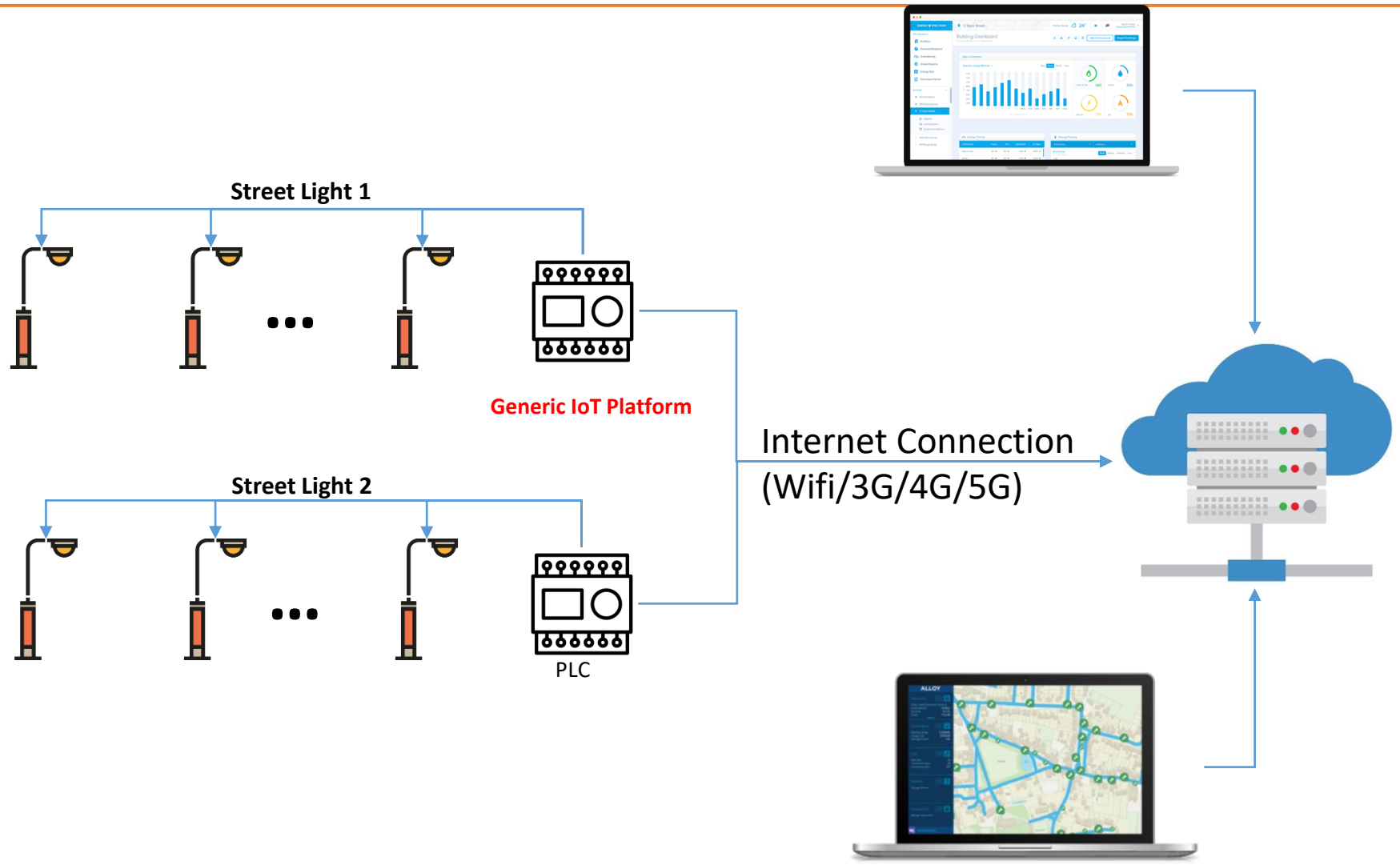
Air Quality Monitoring



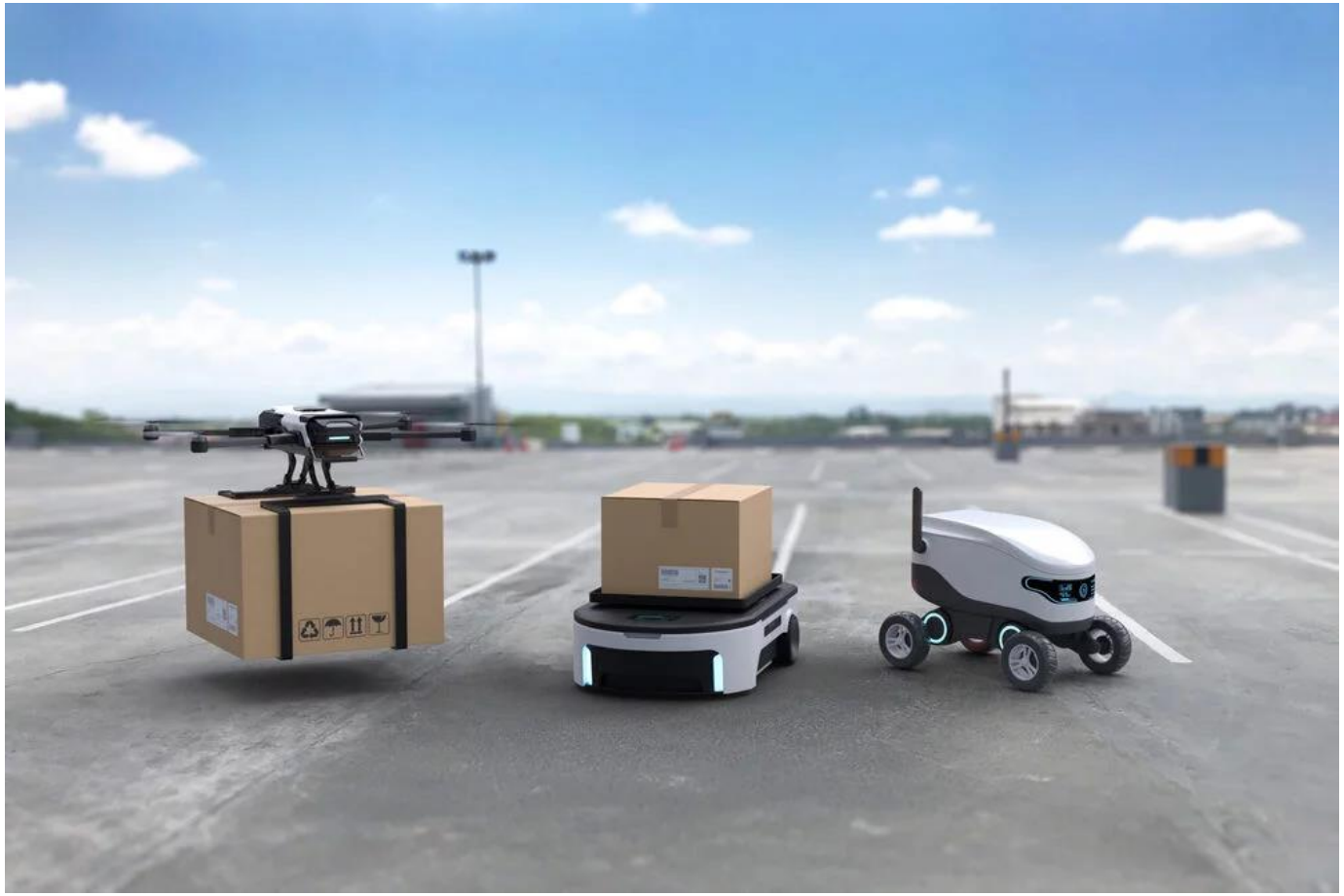
- Air quality monitoring program assists us in improving and **developing air pollution control programs** to reduce the effect of air pollution.
- **PM2.5, PM10, CO2, CO**



Smart Street Light



Autonomous Robots



Choosing between IoT hardware

- Categorized into four different factors:
  - Data acquisition
  - Data processing
  - Connectivity
  - And power management.

Data acquisition

- In the form of sensors
- Function to collect data in the environment to provide real-time results and/or feedback
- Detect and measure physical quantities such as humidity, pressure, speed, light, and temperature.

Data processing and storage

- Battery-powered devices: The simpler the design, the lower the power consumption and costs.
- Externally powered devices: reduces service latency but also conserves wireless backhaul bandwidth

Connectivity

- Wired communication is usually used for stationary devices and connected via the Ethernet, such as with smart buildings or home automation
- wireless communication: Wi-Fi, Bluetooth, WAN technologies (such as LoRa), NB-IoT, and cellular networks.
- methods of communication: serial and parallel

Connectivity

- With serial communication, data is transmitted one bit at a time over a singular communication line
  - Long distance, data rate is relatively low
  - Protocols such as the RS-232 or the RS-422
- In parallel communication, multiple bits are transmitted at the same time through multiple communication lines
- Distance is short and the data rate is high
- Protocol: IEEE, 1284, and PCI.

Power management

- Cloud computing: Letting the cloud handle processing and storage
- Sleep modes: configure the device to sleep and wake at certain times
- Power-efficient hardware: on the specifications of the microcontroller, sensor, or other peripherals
- Power management integrated circuits (PMICs): PMICs are chips that are used to manage the power consumption of a device
- Energy harvesting: solar panels; However, this would depend on the environment.

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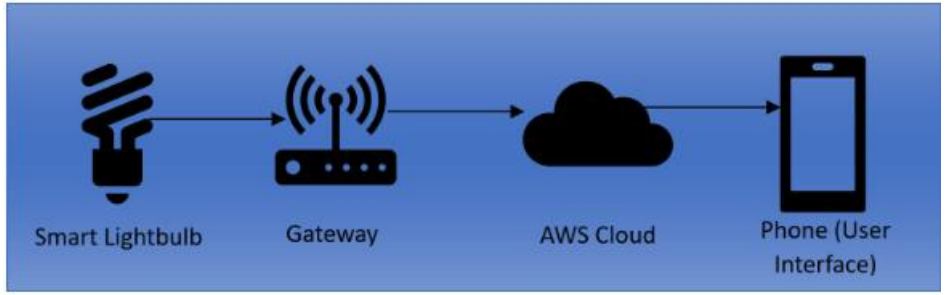
A high-level design flow for a smart lightbulb



A high-level design flow for a smart lightbulb

- Have a smart lightbulb that is able to detect a change to its state: On/Off
- communicates its ON status to the gateway
- Wi-Fi router
- Transmits the status to the AWS cloud
- Amazon Simple Notification Service (SNS)

Exercises

- Draw a diagram that illustrates the flow of a smart fridge alerting a user's laptop that it is currently empty
- Tools:
  - Draw.io and Lucidchart
  - Draw by hand
  - Microsoft Word and PowerPoint

Exercises

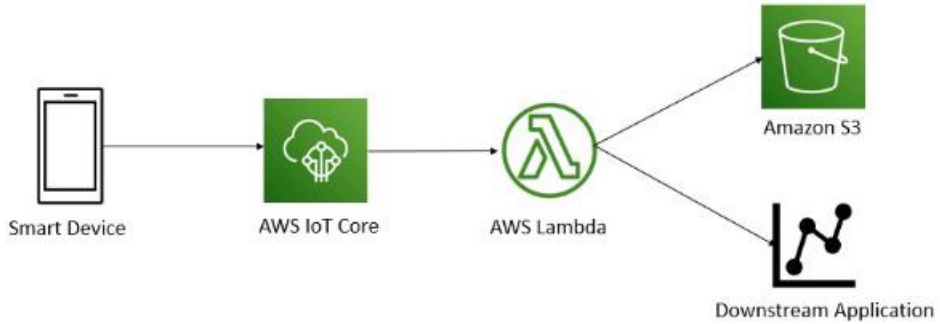
- Draw a diagram that illustrates a user's phone alerting another phone through AWS that it is lost
- Tools:
  - Draw.io and Lucidchart
  - Draw by hand
  - Microsoft Word and PowerPoint

A high-level design flow for AWS

- a smart device sending data to AWS IoT Core, which is a service that allows multiple IoT devices to connect at one time
- a lambda function route the messages accordingly
- The function runs analytical workloads before storing the data in Amazon S3 and sends some that require further processing to a downstream application to be reported on

A high-level design flow for AWS

https://aws.amazon.com/architecture/icons/



Defining systems and processes for smart objects

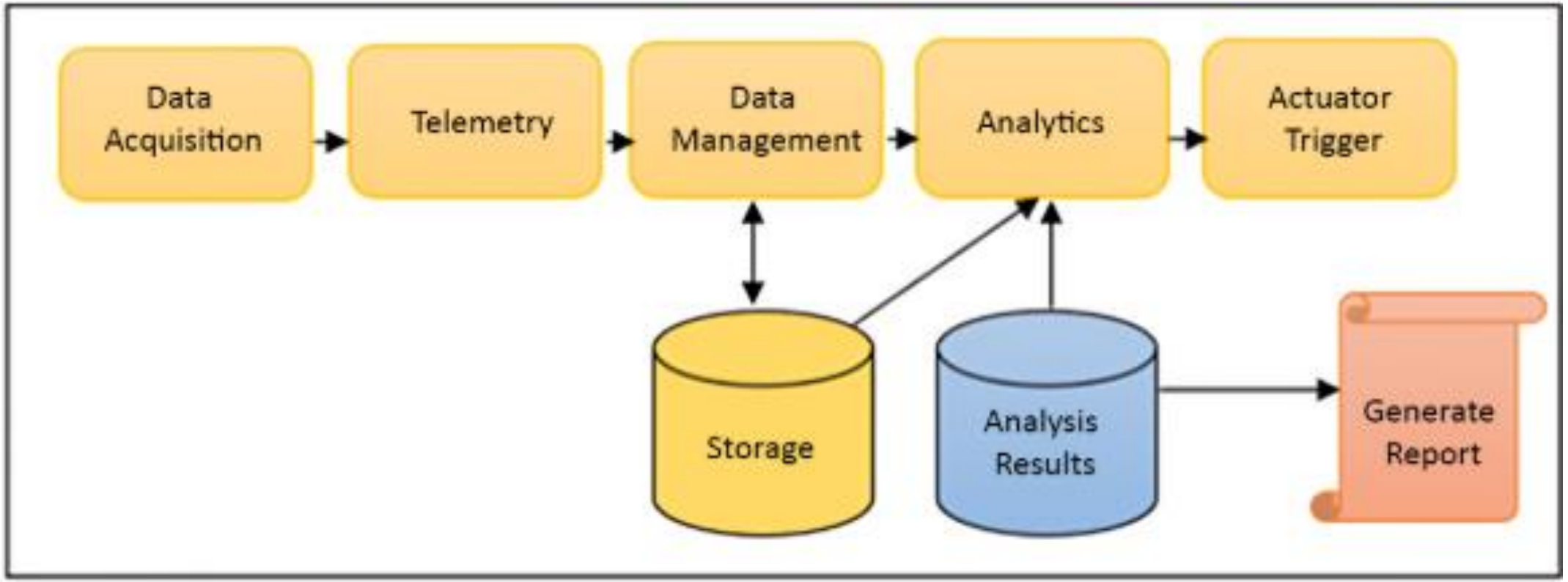
- Show how we can properly define flows to transfer information from one part of the system to another
- Ensuring that our use case's goals are met

Defining a problem

- Encounter different kinds of problems that require you to understand your environment and make appropriate decisions

I want to automate my home's lighting system to turn on from 9:00 to 18:00 and turn off/on every other hour when I am not at home

Creating the flow

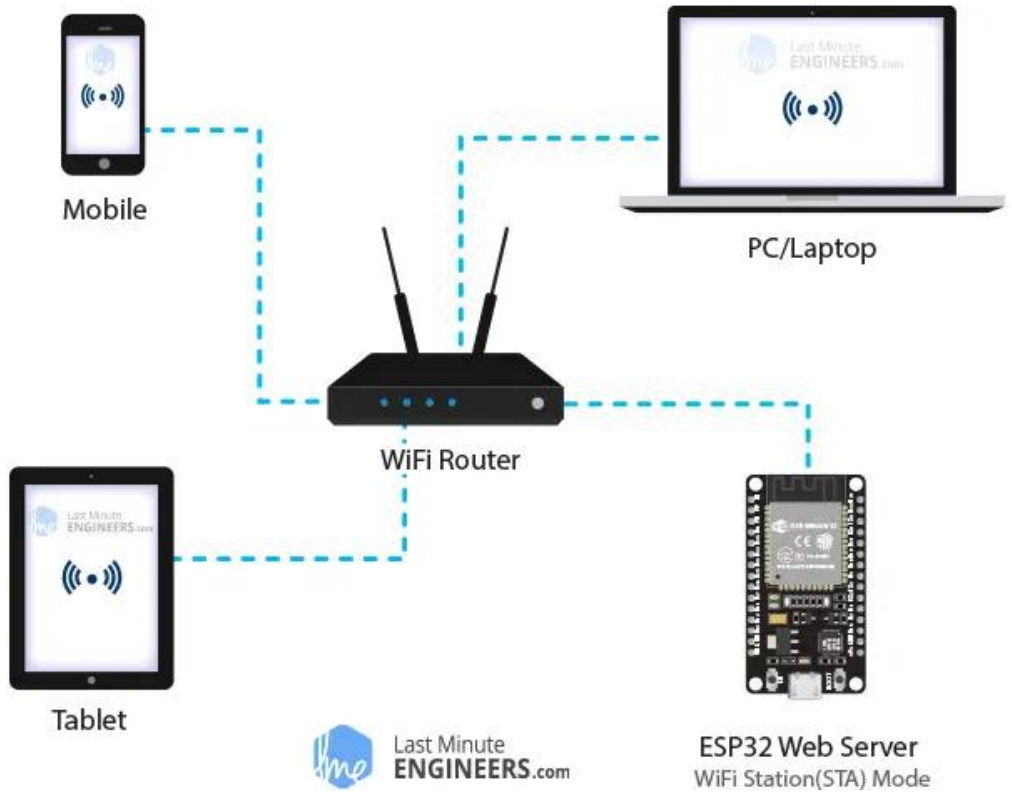


Practical exercise

- Creating a mini weather station

Station (STA) Mode

- The ESP32 connects to an existing WiFi network (the one created by your wireless router)
- ESP32 obtains an IP address from the wireless router to which it is connected



Access Point (AP) Mode

- ESP32 sets up its own WiFi network and acts as a hub
- No more than five stations can connect to it at the same time