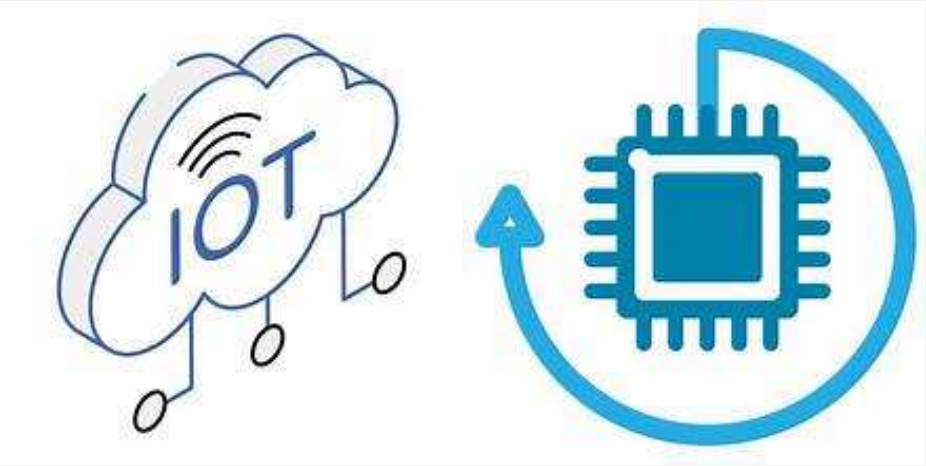
한국외국어대학교
HANKUK UNIVERSITY OF FOREIGN STUDIES

Internet of Things (IoT) Systems



Lecture 02

Course Overview & Introduction to IoT systems

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History of the Internet of Things

1989
The first IoT device is created

1993
The first online webcam is used at Cambridge

1994
Steve Mann creates WearCam

1999
Kevin Ashton coins the term Internet of Things

2008
The number of connected devices overtakes the number of people in the world and IoT is 'born'

2007
First iPhone is launched

2005
UN publishes its first report on the Internet of Things

2000
LG announces the first smart refrigerator

2009
The original Fitbit activity tracker is released

2011
IIoT comes into being

2014
Seoul becomes the world's first smart city

2015
IoT goes Mobile with smartphones

2022
World Economic Forum names IoT as one of the three most impactful technological advancements

2021
More than 10 billion active IoT devices active

2020
The number of IoT device connections increased more than 50% of the active connected devices

2016
AWS IoT core is launched

BYTEBEAM

Benefits of IoT

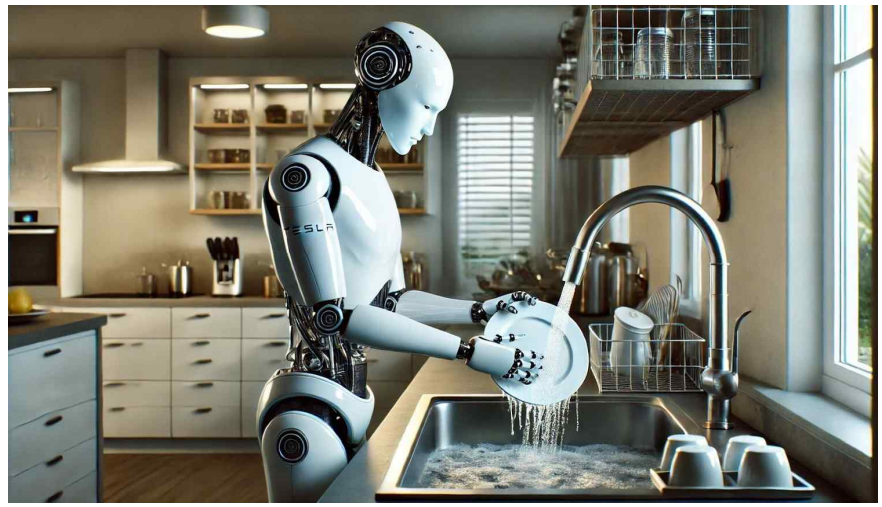
1- Efficient Resource Utilization

- If we have a smart platform system which can interact with everything, the usage of the available resources will be more efficient.
- **Example:** If the car connected to IoT, the tracker system can guide you into short and simple paths, leads to saving car's gasoline! Also, the speed limit system can keep you away from overspeed violations → save money!

2- **Minimize human efforts**

If my IoT platform is smart enough to interact with things, then users do not need to get involved and the interventions going to be minimum.

Example: If the IoT for home automation can do most of my work at homes, then users RELAX!

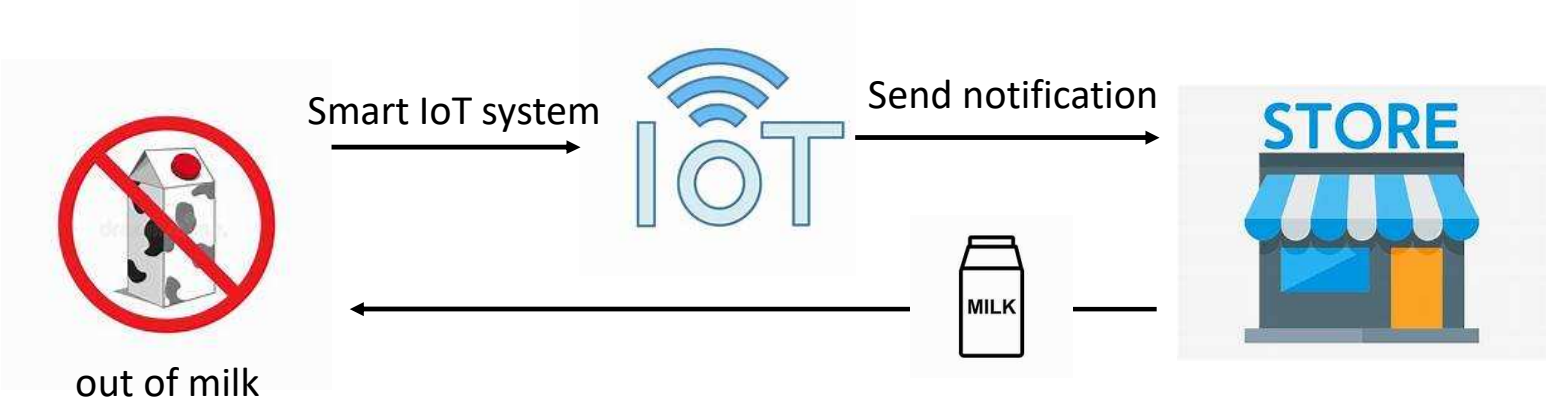


3- Save Time: If the interconnected IoT system reduces human effort, then it definitely it is going to save my time! Time is the major factor that can be save on an IoT platforms.

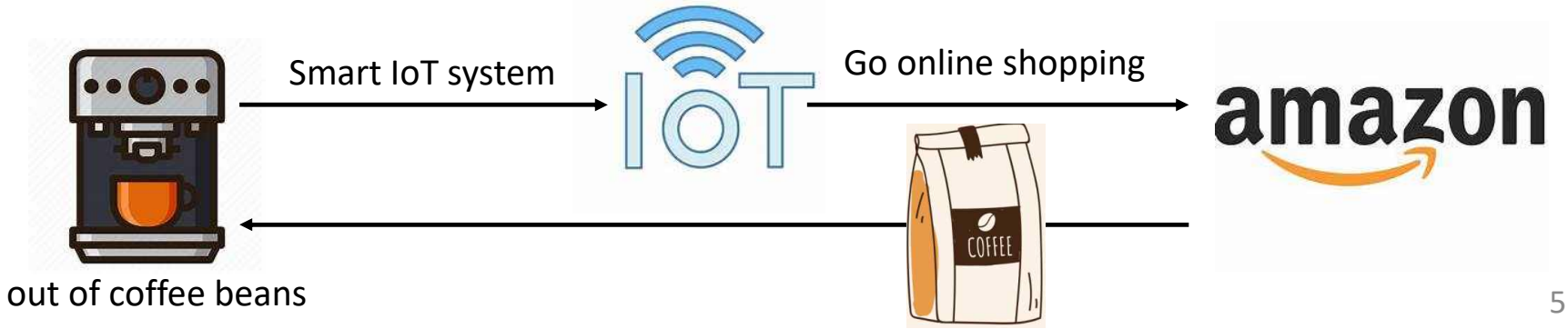
Benefits of IoT

- The system could be connected to one of the providers such as Amazon, Flipkart, or retail store next to me!

- Example 1:



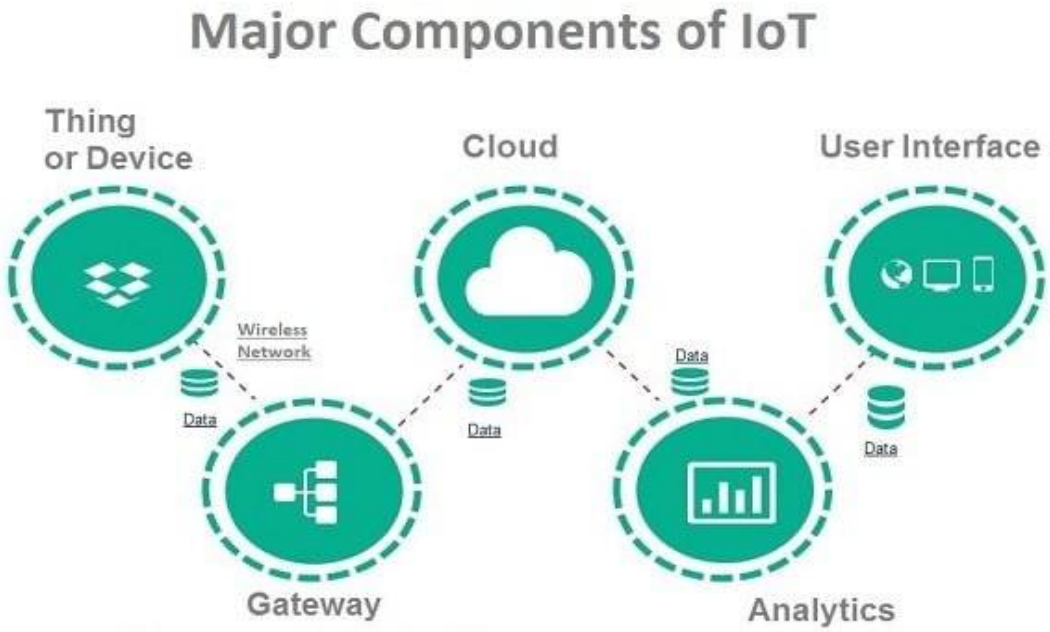
- Example 2:



IoT System

The **Internet of Things (IoT)** refers to a network of **interconnected devices** that can **collect, exchange, and process data** over the internet without human intervention.
- Automation, monitoring, and remote control

1. **Sensing & Data collection Layer**
   - Sensors, Actuators
   - IoT devices
2. **Connectivity & communication Layer**
   - Wifi, Bluetooth, Zigbee, 4G, 5G
3. **Data Processing & Analytics Layer**
   - AI/ML
4. **Data Storage and Management Layer**
   - Cloud computing, Edge Computing
5. **Application & User interface layer**
   -web based & Mobile App



Sensors and Actuators

- Sensors are devices that detect and measure physical properties (e.g., temperature, pressure, motion, light) and convert them into electrical signals or digital data that can be processed by a microcontroller or microprocessor.

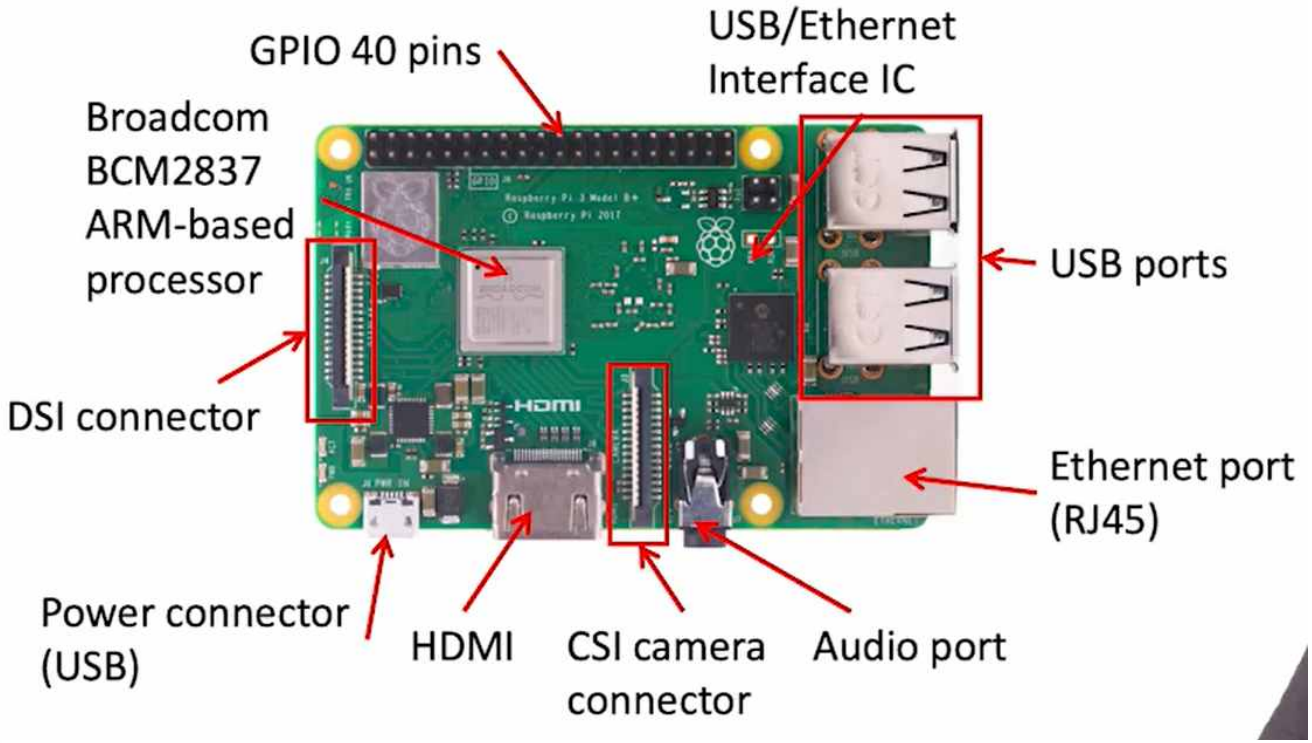
  Temperature Sensors, Humidity Sensors, Motion Sensors, Light Sensors

- Actuators are devices that perform actions in the physical world based on signals received from a controller. They are responsible for carrying out physical tasks in response to input data from sensors.

  Motors, Heaters, LED, Speakers, etc.

Raspberry Pi 3 B+ Hardware Specs

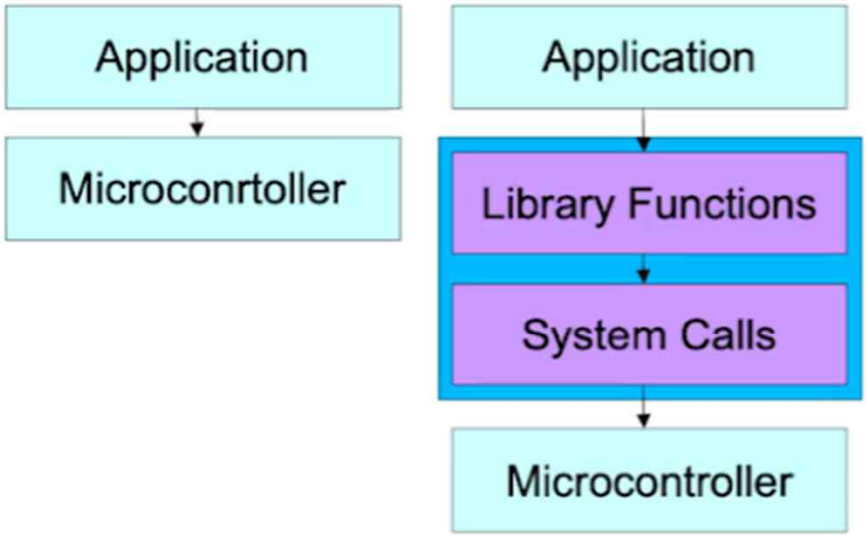
- Broadcom BCM2837 SoC
  - 1.4GHz, 1Gb SRAM
- Quad Core
- 40 GPIO pins
- 4 USB ports
  - only 2 on the Raspberry Pi B
- Micro SD card slot
  - full-sized SD card slot on previous Raspberry Pis
- Bluetooth 4.2 / BLE
- Integrated Wi-Fi
- Power over Ethernet (PoE)



Feature	Arduino Uno	Raspberry Pi
Type	Microcontroller Board	Single-board Computer (SBC)
Processor	ATmega328P (8-bit, 16 MHz)	ARM-based processor (varies by model)
Operating System	No OS (runs firmware directly)	Runs Linux-based OS (Raspberry Pi OS, Ubuntu, etc.)
RAM	2 KB SRAM	Varies (512 MB to 8 GB, depending on model)
Storage	No built-in storage (uses flash memory)	Uses microSD card for OS and storage
Connectivity	USB, UART, SPI, I2C	Wi-Fi, Bluetooth, Ethernet, USB, HDMI
Power Consumption	Low (5V, ~50mA)	Higher (~5V, 2.5A)

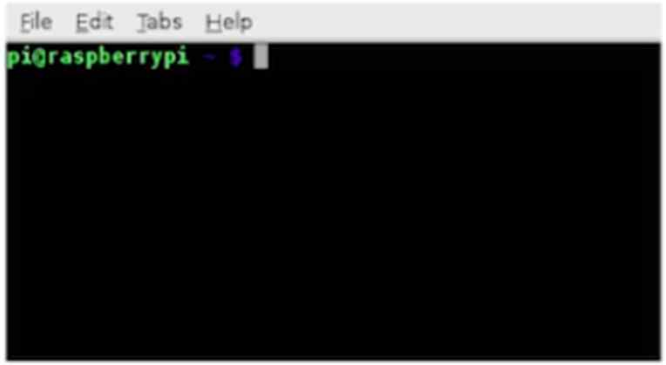
Feature	Arduino Uno	Raspberry Pi
GPIO Pins	14 digital, 6 analog	40 GPIO (all digital, no analog)
Programming	C, C++ (via Arduino IDE)	Python, C, Java, Node.js, many others
Multi-tasking	No (single-task execution)	Yes (runs multiple programs in parallel)
Best For	Real-time embedded systems, sensor applications	Full-fledged computing, IoT, AI, media applications
Price	Generally cheaper (~$10-$20)	More expensive (~$35-$100, depending on model)

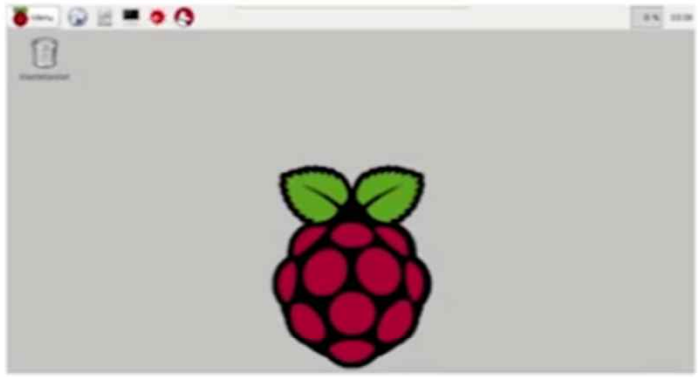
Using an Operating System



- Raspberry Pi can support an operating system
- Enables a range of features

User Interface

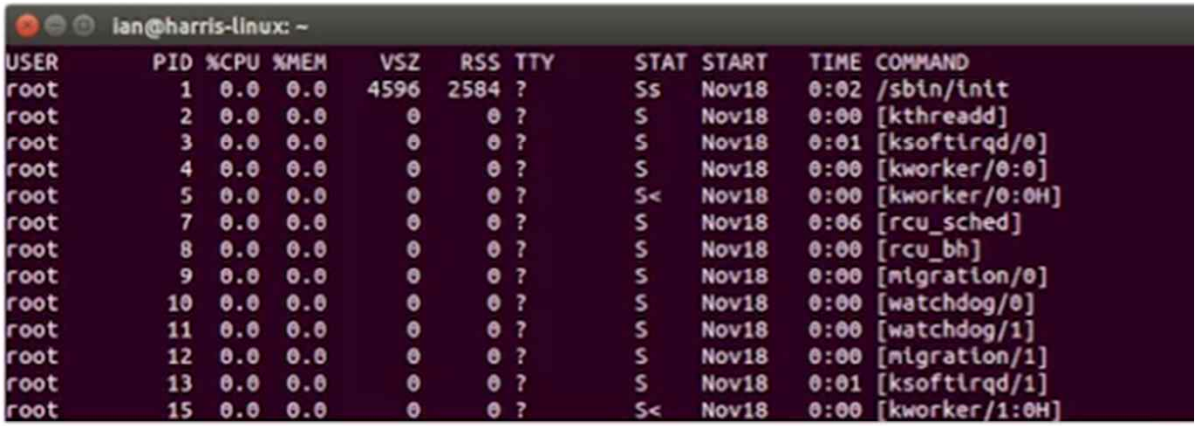




Text-based interface **Graphic interface**

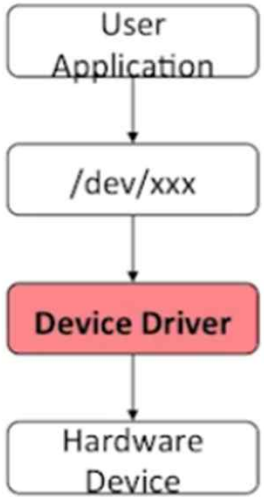
- Type commands directly into text-based console
- Use point –and-click interface

Multiple Processes



- Can download and run multiple programs
- Can execute many processes concurrently

Using Hardware Devices



- Any application running in user space
- File associated with a hardware device
- Convert file accesses to device accesses
- HW device: keyboard, monitor, etc.

1. Understand the components on the board and their functions
2. Install the Raspbian Linux distribution
3. Configure Raspbian for the Raspberry Pi
4. Set up boot options for Raspbian

Any Questions!