IoT
Sensors and Actuators

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CS698T, Lecture 3

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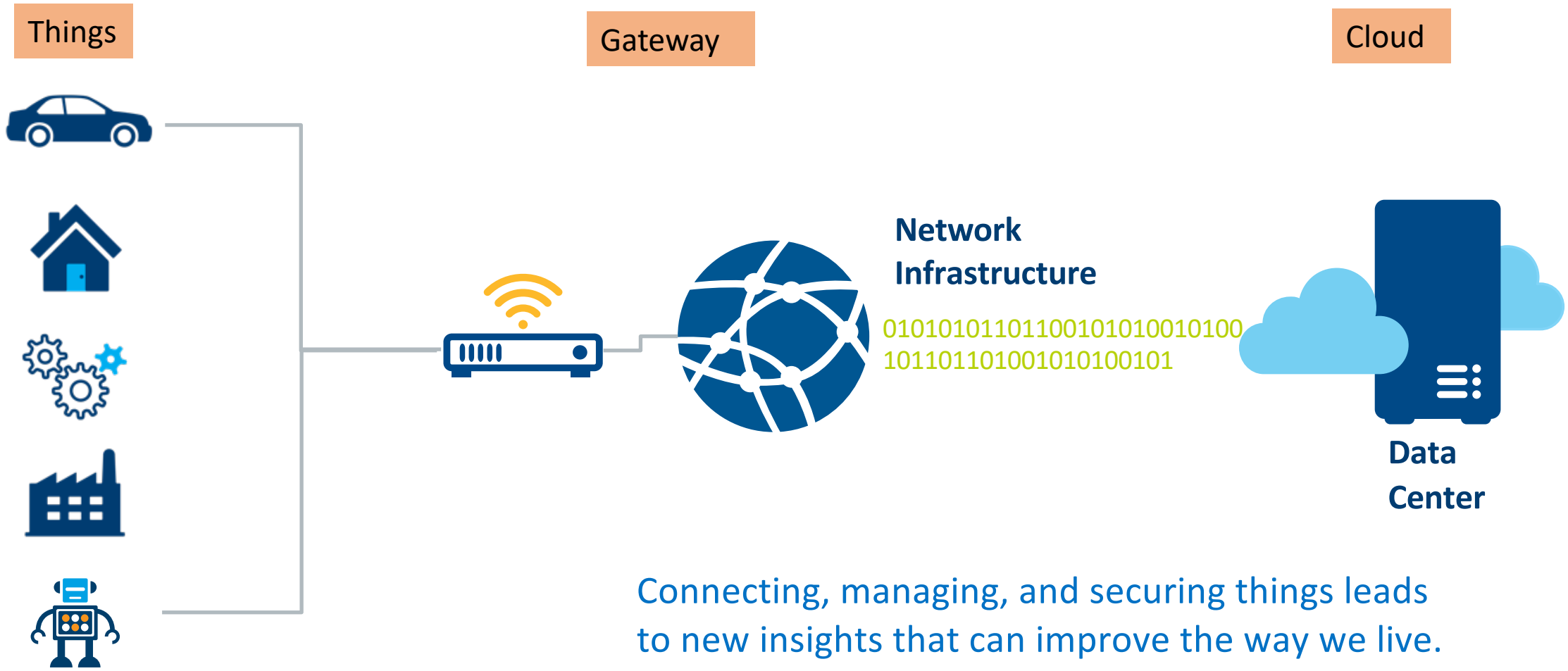
IoT Overview

83B devices will be connected to the Internet by **2024**[1]



Connecting, managing, and securing things leads to new insights that can improve the way we live.

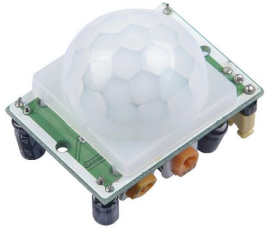
1. https://www.saftbatteries.com/energizing-iot/how-iot-world-shaping-2021-and-what-trends-will-influence-future-iot-infographic

Sensors

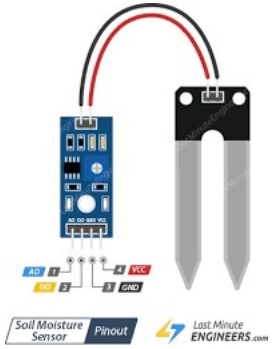
- Senses context from the physical system or environment
- Transforms analog signal into digital signal using sensors
- e.g. temperature, humidity, camera, light, hall effect, piezo-electric, sound, touch, soil moisture sensor, EEG sensor, ECG sensor, pulse oximeter

Magnetic Hall Effect Sensor

PIR (Passive Infrared) motion detector



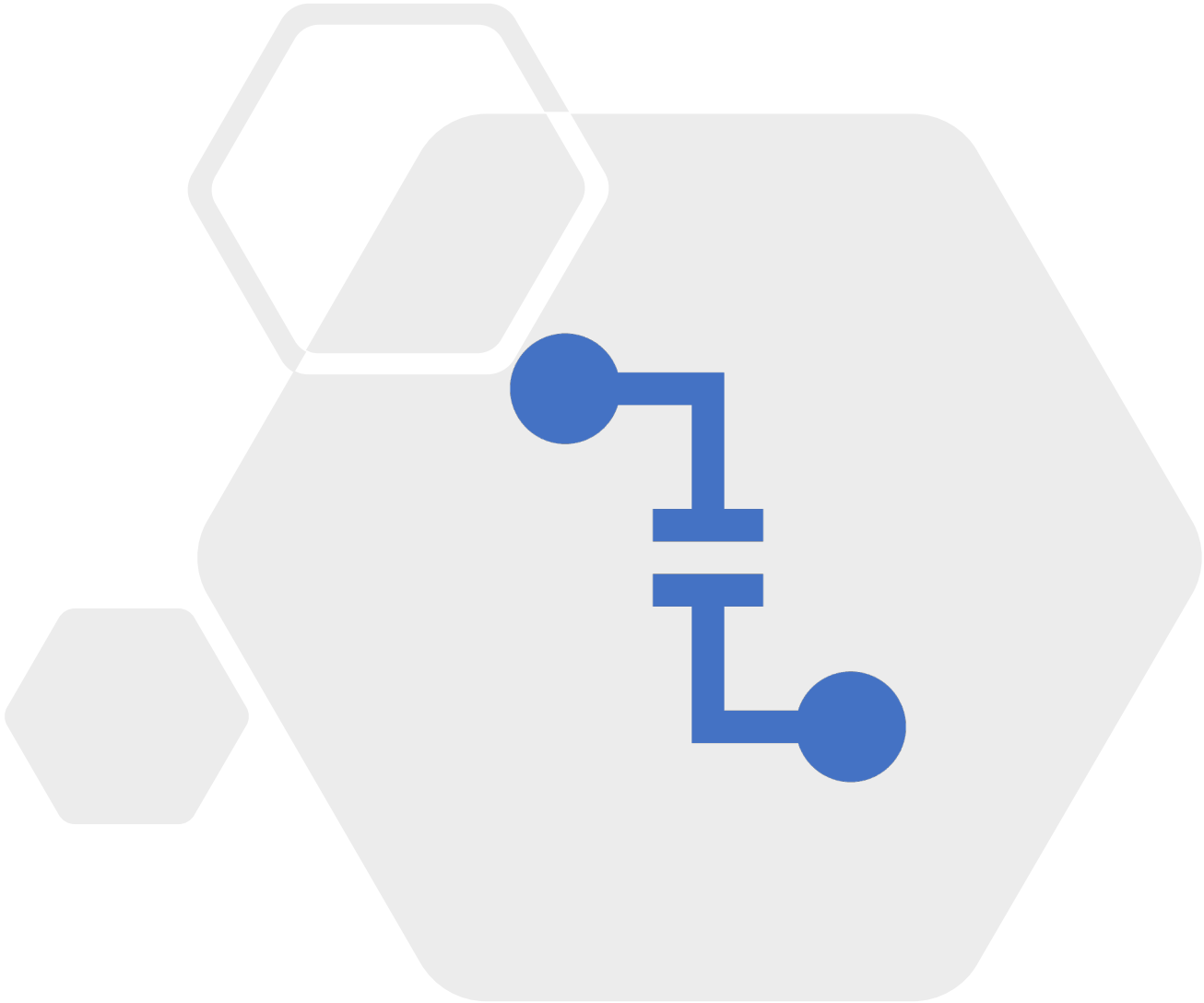
Soil moisture sensor



Sensors Classification

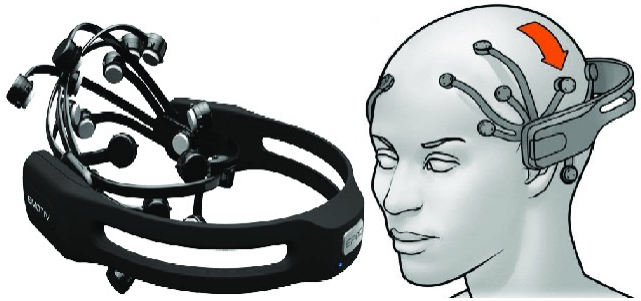
- Based on output
  - Analog – e.g. temperature sensor
  - Digital – on off output

- Based on data type
  - Scalar – temperature sensor
  - Vector – accelerator, camera



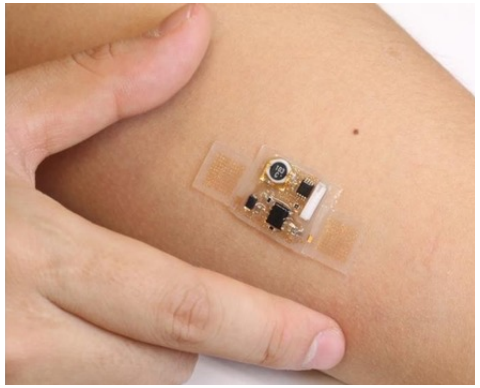
Medical Sensors

EEG – emotive sensor



Pulse oximeter

ECG sensor



Flexible skin patches[1]
- Used for monitoring physiological signals e.g. ECG, brain signal, EMG (electromyography) for monitoring muscle activity, wound monitoring etc

1. https://www.healthcareradius.in/technology/27400-flexible-sensors-required-for-wearable-skin-patches-idtechex

Smartphone sensors

- Accelerometer
- Gyroscope
- Camera and microphone
- GPS
- Light sensor
- Proximity sensor

Sensing errors

Offset error or bias – sensor value deviation from the actual value, usually by a constant value

Sensitivity

Limits on max and min value measured by the sensor

error – varies with operating conditions

Hysteresis error

Typically observed in analog sensors, magnetic sensors

The sensor value depends on the previous input value

Non-linear deviation of sensor values from actual sensors

Ideally sensors values change linearly with the the sensed context

Drift – change in sensor values over time (months or years) by physical changes in the sensor

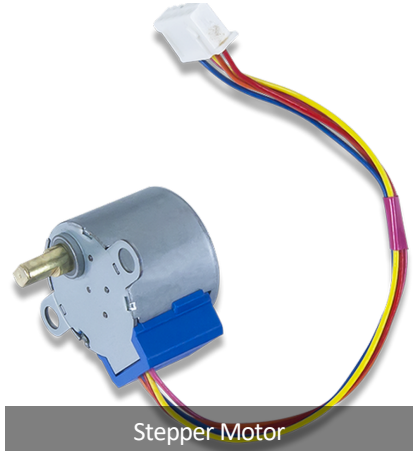
Noise – random deviation in the sensor values over time

Quantization error – for digital outputs

Sensors can be sensitive to other environment properties

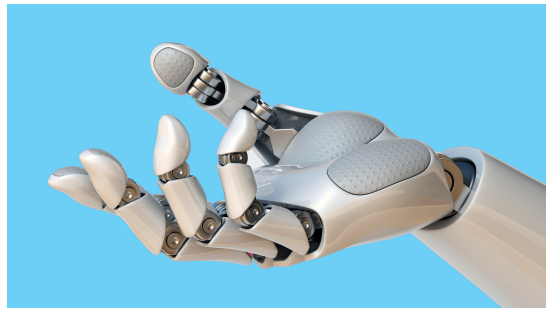
Actuators

Water Control electric valve



Stepper Motor

Infusion Pump

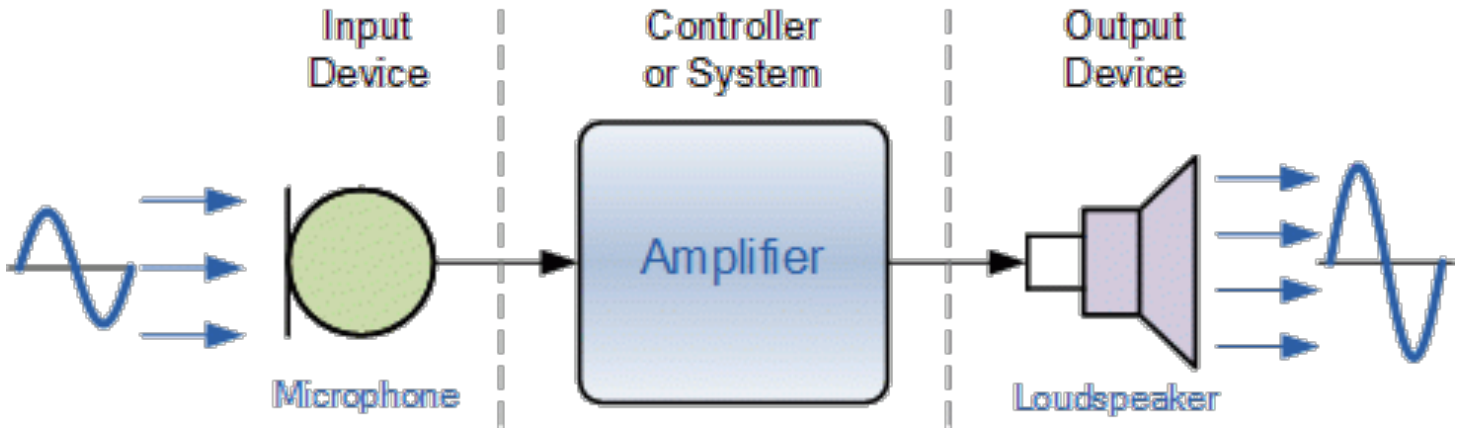


Robotic Hand

- Transforms digital signal into analog signal using sensors
- E.g. stepper motor, electric motor, infusion pump, temperature valves, relay switch, robotic hand (e.g. controlling robotic arm with the brain signal)

Transducers

- Includes both sensors and actuators
- Converts energy from one form to another
- E.g. sound system, mobile phone. The microphone (input) converts the sound signal into electric signal. The amplifier amplifies the signal and produces loud sound with a loudspeaker (output)



Questions?