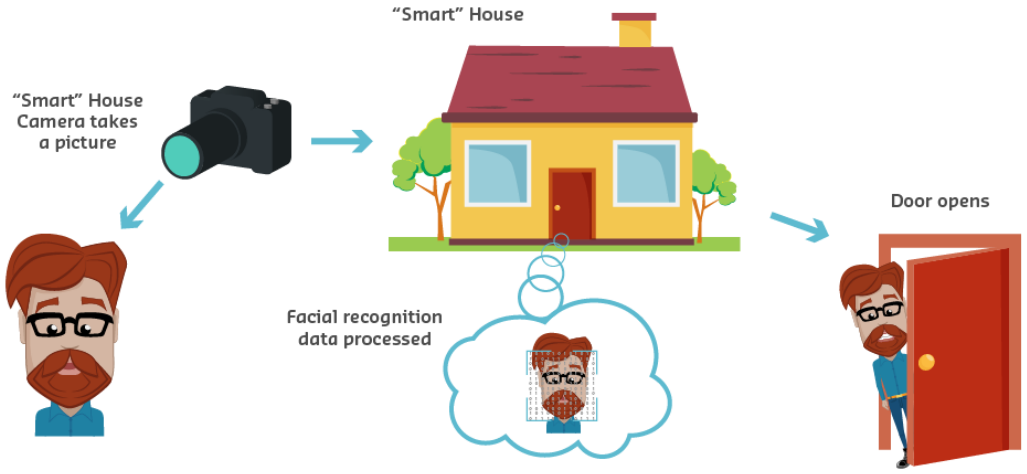
Session 4
Sensors and Actuators

Common IoT system characteristics



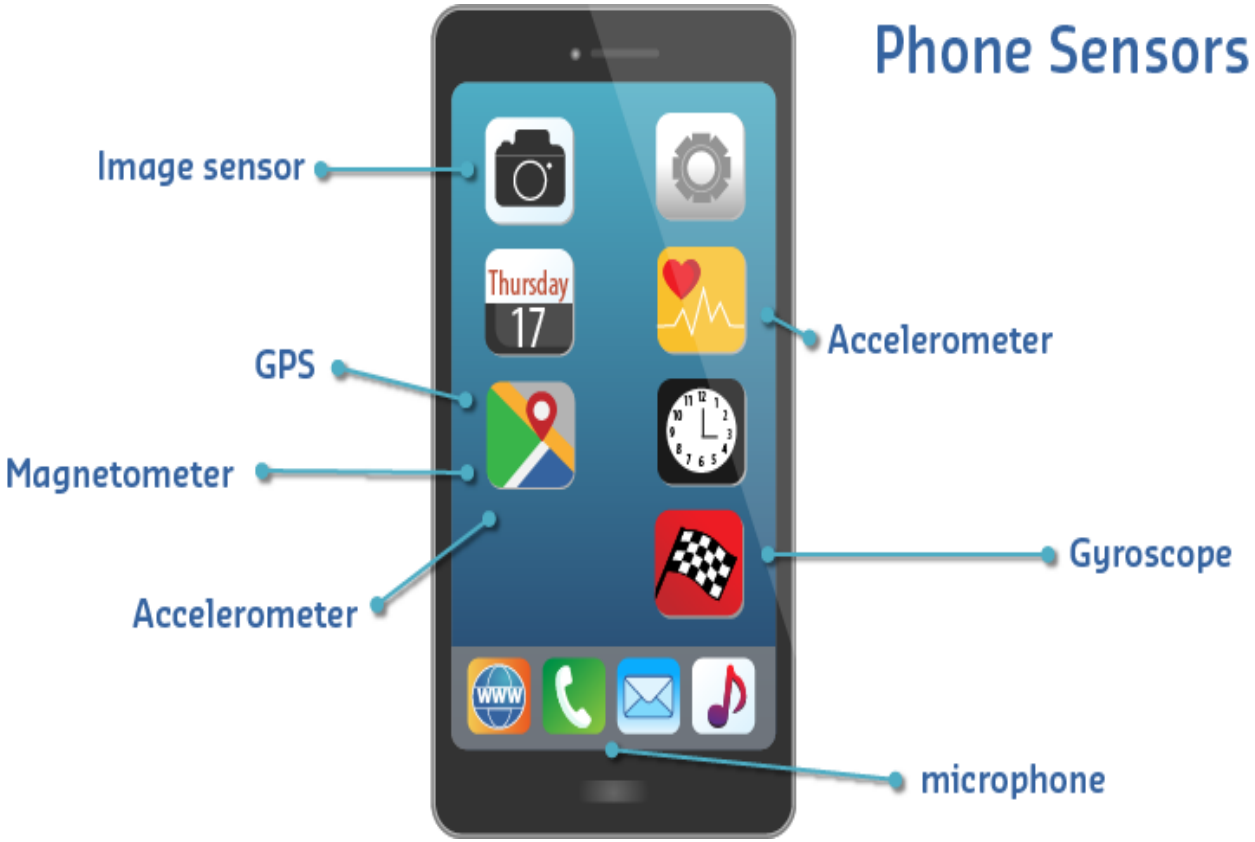
- They can **perceive** one or more aspects of the world; i.e. they can hear, see, feel, smell or taste something.
- They can **produce an action** in the world; i.e. they can move, turn on, or activate something.
- They have a bit of '**intelligence**', that uses sensed information to make decisions about when and how to produce an action.

Open-loop control system

Overview of Sensors

- A sensor is a device that detects and responds to some type of input from the physical environment.
- The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena.
- The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

smart phone sensors



Sensors in your smart phone

- A smart phone touch screen works through one of these sensor types:
  - capacitive
  - resistive
  - surface acoustic sensor.
- A typical smart phone contains many sensors of various types, and is generally internet capable. A few of the most common sensors include:
  - **Magnetometer**: Detects magnetic fields
  - **Accelerometer**: Detects the movement of the phone
  - **Gyroscope**: Detects a change in the phone's orientation

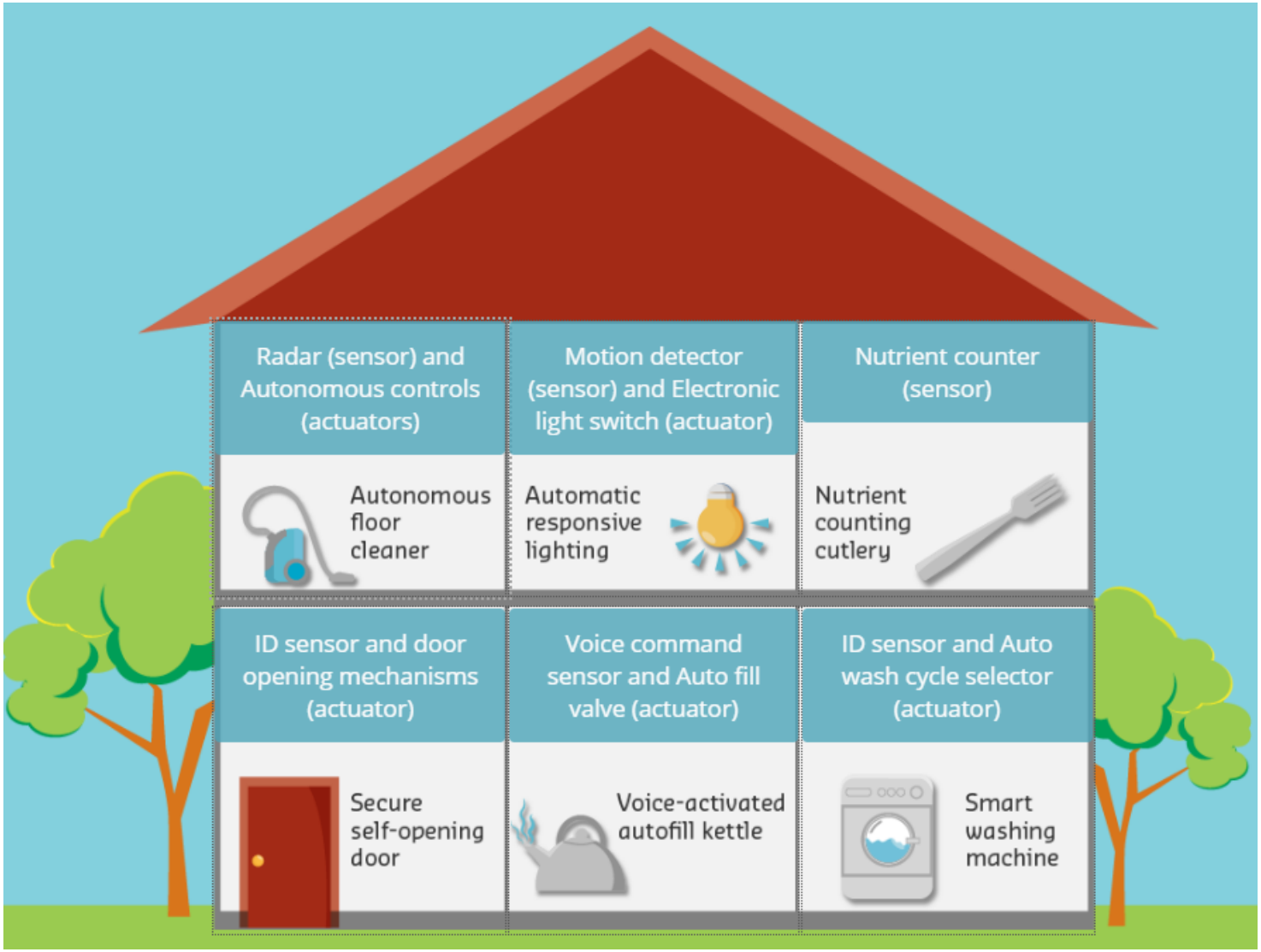
Actuators

- An **actuator** is a device that moves or controls some mechanism. An **actuator** turns a control signal into mechanical action such as an electric motor. **Actuators** may be based on hydraulic, pneumatic *(thủy lực, khí nén*), electric, thermal or mechanical means, but are increasingly being driven by software

Actuators in your house

- **an actuator is a simple mechanism that moves or controls something** – it makes things happen. We are surrounded by them in our daily lives, and would be a bit lost without them. Actuators operate in one of several ways. They are either:
    - **Electrical**
    - **Pneumatic** (uses air pressure)
    - **Hydraulic** (uses fluid pressure)
    - **Mechanical**
- Actuators take a source of power: electric current - and convert the energy to create motion or control a system. Eg, they can make things move up or down, switch things on or off, or push or pull an object into a particular position - and they can do it all without human interference.

Sensors & Actuator examples



Interactions

- IoT solutions often involve **machines** talking to each other and making smart decisions based on software and/or machine learning.
- At other times, sensors and data analysis provide **people** with information to make good decisions and facilitate planning. The IoT can also increase the potential for collaboration by connecting remotely located people.
- These three different types of interactions are described by the following acronyms:
    - **M2M**: Machine to machine
    - **M2P**: Machine to people
    - **P2P**: People to people

Transducers

- **Transducers**: Materials or devices that have the property of converting one kind of energy into another.

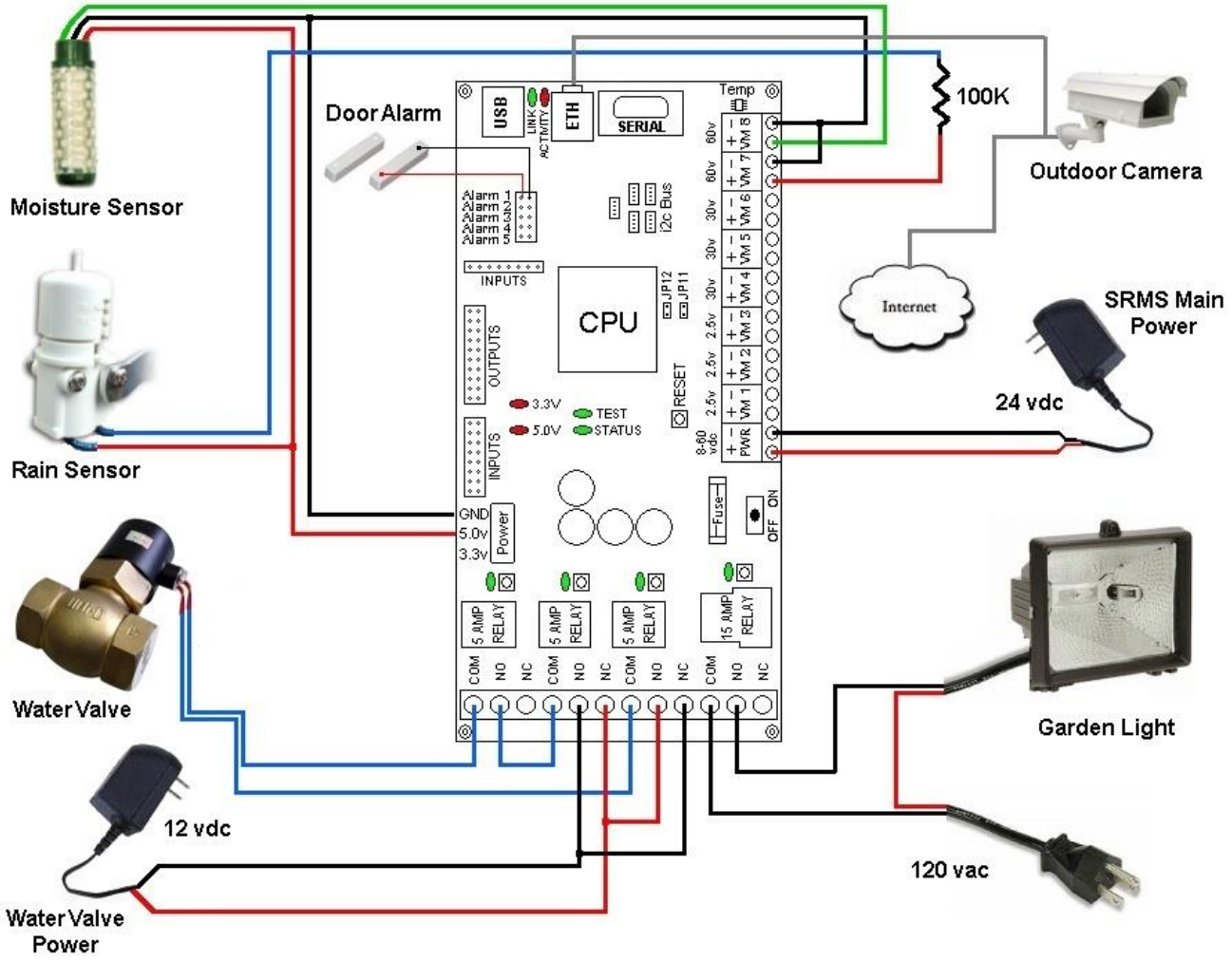
Input and Output Transducers

PHYSICAL PHENOMENON	INPUT DEVICE	OUTPUT DEVICE
Temperature	Thermocouple Thermistor; Thermostat Resistive Temperature Detectors (RTDs)	Heater Fan Peltier pumps
Speed	Tacho-generator Reflective/Slotted Opto-coupler Doppler Effect Sensors	AC and DC Motors Stepper Motor Brake
Position	Potentiometer; Encoders Reflective/Slotted Opto-switch Linear Variable Differential Transformers (LVDTs)	Motor Solenoid Panel Meters

Input and Output Transducers (cont…)

PHYSICAL PHENOMENON	INPUT DEVICE	OUTPUT DEVICE
Sound	Carbon Microphone Piezo-electric Crystal	Bell Buzzer Loudspeaker
Force/Pressure	Strain Gauge Pressure Switch Load Cells	Lifts and Jacks Electromagnet Vibration
Light level	Light Dependant Resistors (LDRs) Photodiode Photo-transistor Solar Cell	Lights and Lamps LEDs and Displays Fibre Optics

Example: Water irrigation system

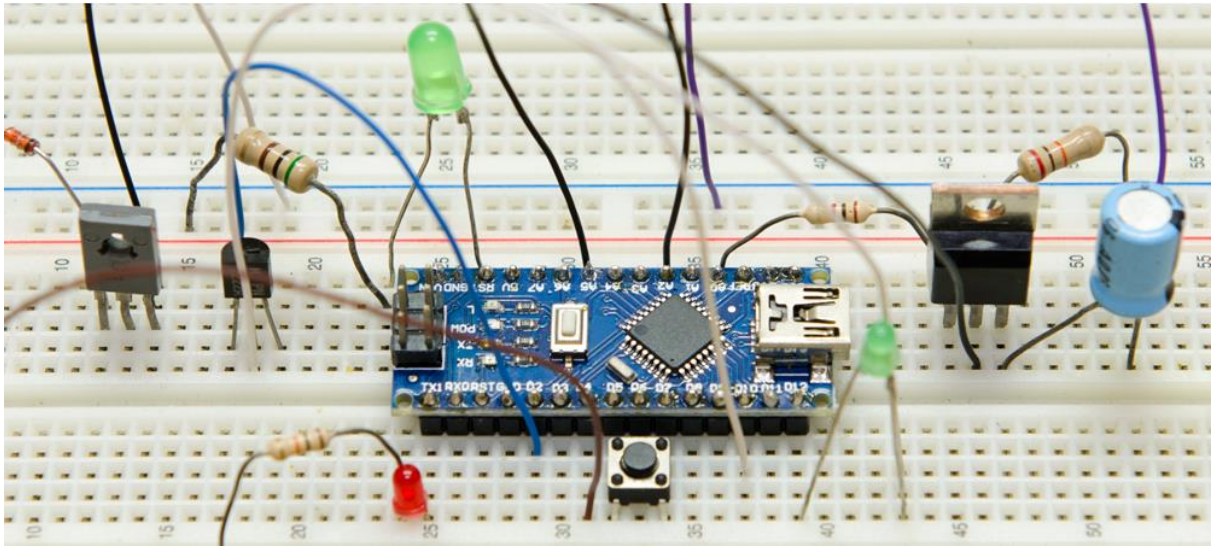


TinkerCad

- Tinkercad is an easy, browser-based 3D design and modeling tool for all. Tinkercad allows users to imagine anything and then design it in minutes.

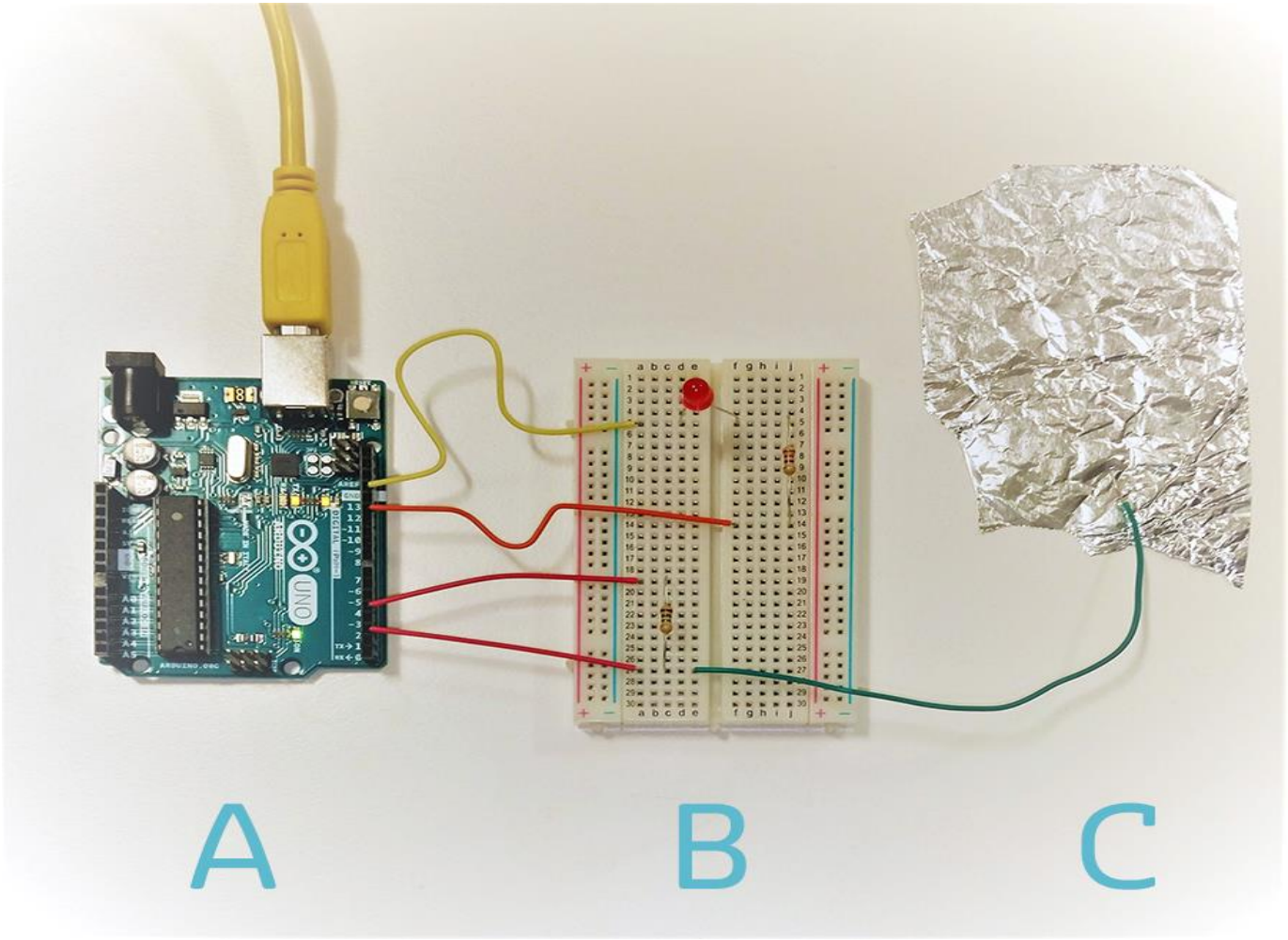
- www.tinkercad.com

Electronics Kits



- The Arduino Uno starter kit;
- Raspberry Pi (recommend the Pi 3 model B)
- Iduino's 37 in 1 Sensor Kit
- http://www.atdtech.com/index.php/vi/product/arduino-board
- https://youtu.be/RwH2CyXsE5c

ACTIVITY: Touchy-feely lamp



Practices

- **Tinkercad® demo - sensor outputs**