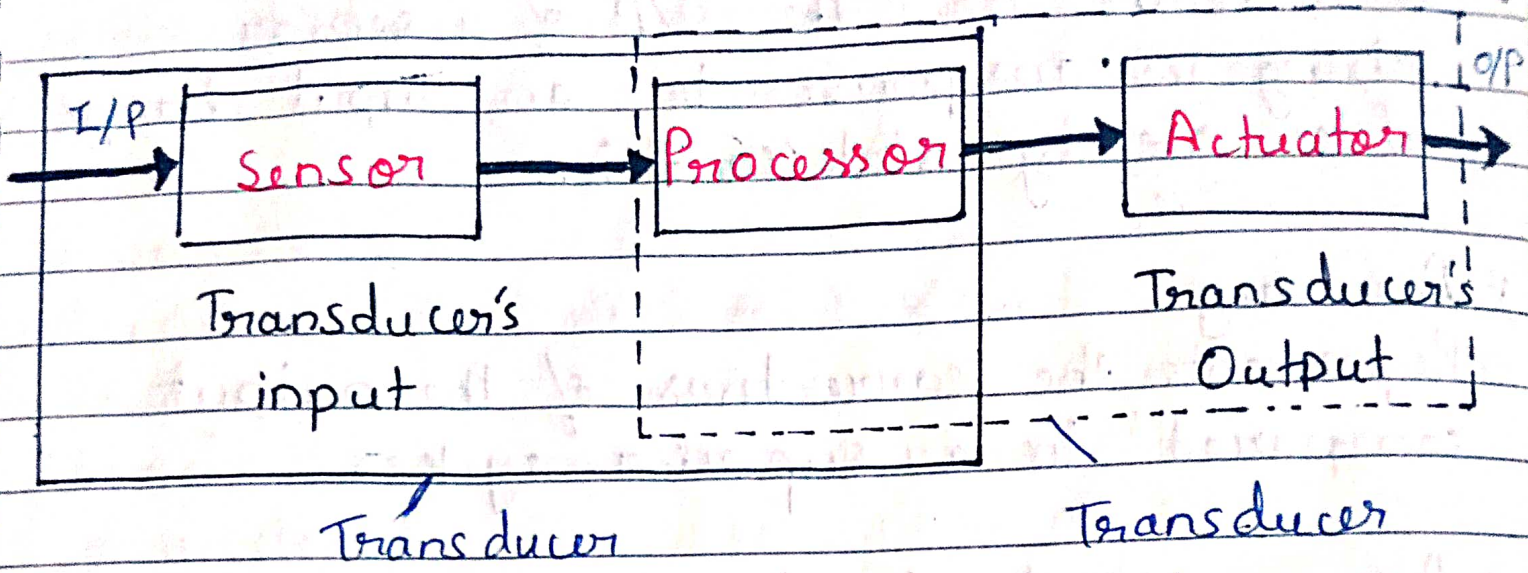
IoT Hardware



Transducer:- Converts a signal from one physical form to another form.

Sensor

- The characteristic of any device or material to detect the presence of a particular physical quantity.
- The output of sensor is signal, which is converted to human readable form like changes in V. characteristics, changes in resistance, capacitance, C. characteristics, impedance etc.
- Sensor characteristics
  - Static
  - Dynamic

Static Characteristics

- It is about how the O/P of a sensor change in response to an input change after steady state condition.

1) Accuracy

→ Represents the correctness of the output compared to a superior system

→ Acc. = Standard value − Measured value.

2) Range

→ Gives the highest and the lowest value of the physical quantity ~~ob~~ within which the sensor can actually sense.

→ Beyond this value there is no sensing or no kind of response.

3) Resolution

→ Provides the smallest change in the input that a sensor is capable of sensing.

→ Resolution is an important specification towards selection of sensors.

→ Higher the resolution better the precision.

4) Errors
The difference between the standard value & the value produced by sensor.

5) Sensitivity
→ Sensitivity indicates ratio of incremental change in the response of the system with respect to incremental change in input parameter.
→ It can be found from slope of output characteristics curve of a sensor.

6) Linearity
→ The deviation of sensor value curve from a particular straight line.

7) Drift
The difference in the measurements of sensor from a specific reading when kept at the value for a long period of time.

8) Repeatability
The deviation between measurements in a sequence under same conditions.

Dynamic Characteristics

Properties of the system's transient response to an input.

1) Zero order System
→ Output shows a response to the input signal with no delay.
→ Does not include energy-storing elements
→ Ex. Potentiometer measures linear and rotary displacements.

2) First order System
→ When the output approaches its final value gradually.
→ Consists of an energy storage and dissipation element.

3) Second order system
→ Complex output response
→ The output response of sensor oscillates before steady state.

Sensor Classification
- Passive & Active
- Analog & digital
- Scalar and vector

- **Passive Sensor.**
  Cannot independently sense the input.
  Example - Accelerometer, soil moisture, water level, and temperature sensors.

- **Active Sensor**
  Independently sense the input
  Example - Radar, sounder and laser altimeter sensors.

- **Analog Sensor**
  The response or output of the sensor is some continuous function of its input parameter
  Example : Temperature sensor, LDR, analog pressure sensor, and analog hall effect.

- **Digital Sensor**
  → Responses in binary nature.
  → Designs to overcome the disadvantages of analog sensors.
  → Along with the analog sensor it also comprises of extra electronics for bit conversion.
  Example: Passive infrared (PIR) sensor and digital temperature sensor (DS1620)

- Scalar Sensor

→ Detects the input parameter only based on its magnitude.

→ The response of the sensor is a function of magnitude of the input parameter.

→ Not affected by the direction of the input parameter.

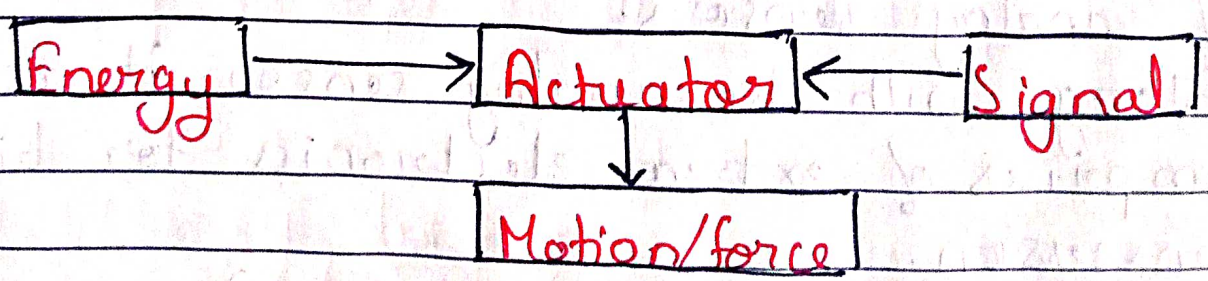
Example - Temperature, gas, strain, color, and smoke sensors.

- Vector Sensor

The response of the sensor depends on the magnitude of the direction and orientation of input parameter.

Example- Accelerometer, gyroscope, magnetic field, and motion detector sensors.

Actuator



- An actuator is part of the system that deals with the control action required

(mechanical action)

- Mechanical or electro-mechanical devices.
- A control signal is input to an actuator and an energy source is necessary for its operation.
- Available in both micro and macro scales. (sizes)

Example - Electric motor, solenoid, hard drive comb drive, stepper motor.

Classification of Actuators

- → Electric Linear
- → Electric Rotary
- → Fluid Power Linear
- → Fluid Power Rotary
- → Linear Chain Actuators
- → Manual Linear
- → Manual Rotary

- **Electric Linear**

→ Powered by electric signal
→ Mechanical device containing linear gu motors, and device mechanisms.
→ Converts electrical energy into Linear

displacement.
→ Used in automation applications including electric bell, opening and closing dampers, locking doors,

• Electric Rotary Actuator
→ Powered by electrical signal
→ Converts electrical energy into rotational motion.
→ Applications including quarter turn valves, windows and robotics

• Fluid Power Linear Actuator
→ Powered by hydraulic fluid, gas or differential air pressure.
→ Mechanical devices have cylinder and piston mechanisms.
→ Produces linear displacement.
→ Primarily used in automation applications including clamping and welding.

• Fluid Power Rotary Actuator
→ Powered by fluid, gas, or
→ Consisting of gearing and cylinder and piston mechanisms.
→ Produces rotational motion.

→ Primarily applications of this actuator are opening and closing dampers doors and clamping

- Linear Chain Actuator.

→ Mechanical devices containing sprockets and sections of chain.
→ Provides linear motion by the free ends of the specially designed chains
→ Primarily used in motion control applications.

- Manual Linear Actuator

→ Provider linear displacement through the translation of manually rotated screws and gears.
→ Consists of gearboxes, and hand operated knobs or wheels.
→ Primarily used for manipulating tools and work pieces.

- Manual Rotary Actuator

→ Provides rotary output through the translation of manually rotated screws, levels or gears.

→ Consists of hand operated knobs, levers, hand wheels and gear boxes.
→ Primarily used for the operation of valves