Sensor Classification:

Different classification criteria may be selected.

All sensors may be of two kinds: passive and active.

1. **Passive sensor:** it does not need any additional energy source and directly generates an electric signal in response to an external stimulus. That is, the input stimulus energy is converted by the sensor into the output signal. Most of passive sensors are direct sensors as we defined them earlier.

Example: a thermocouple, a photodiode, and a piezoelectric sensor.

2. **Active Sensor:** it requires external power for its operation, which is called an excitation signal. That signal is modified by the sensor to produce the output signal. **Example:** a thermistor is a temperature sensitive resistor. It does not generate any electric signal, but by passing an electric current through it (excitation signal) its resistance can be measured by detecting variations in current and/or voltage across the thermistor.

Sensor Classification:

Depending on the selected reference, sensors can be classified into absolute and relative.

1. **Absolute sensor:** it detects a stimulus in reference to an absolute physical scale that

is independent of the measurement conditions.

Examples:

- Thermistor is an absolute sensor, it is a temperature-sensitive resistor. Its electrical resistance directly relates to the absolute temperature scale of Kelvin.
- An absolute pressure sensor produces signal in reference to vacuum – an absolute zero on a pressure scale.

2. Relative sensor: it produces a signal that relates to some special case.

Examples:

- Thermocouple is a relative sensor that produces an electric voltage, which is a function of a temperature gradient across the thermocouple wires. The sensor output signal cannot be related to any particular temperature without referencing to a known baseline.
- A relative pressure sensor produces signal with respect to a selected baseline that is not zero pressure, for example, to the atmospheric pressure.

Sensor Classification:

Sensors can be classified depending some of its properties that may be of a specific interest.

Sensor Specifications

Sensitivity	Stimulus range (span)
Stability (short- and long-term)	Resolution
Accuracy	Selectivity
Speed of response	Environmental conditions
Overload characteristics	Linearity
Hysteresis	Dead band
Operating life	Output format
Cost, size, weight	Other

Sensor Material

Inorganic	Organic
Conductor	Insulator
Semiconductor	Liquid gas or plasma
Biological substance	Other

Detection means used in sensors

Biological
Chemical
Electric, magnetic or electromagnetic wave
Heat, temperature
Mechanical displacement or wave
Radioactivity, radiation

Classification:

Conversion Phenomena

Physical	Thermoelectric	Electroelastic
	Photoelectric	Thermomagnetic
	Photomagnetic	Thermooptic
	Magnetoelectric	Photoelastic
	Electromagnetic	Other
	Thermoelastic	
Chemical	Chemical transformation	
	Physical transformation	
	Electrochemical process Spectroscopy	
	Other	
Biological	Biochemical transformation, Physical transformation	
	Effect on test organism Spectroscopy	
	Other	

Field of Applications

Civil engineering,	Domestic, appliances
Distribution, commerce, finance	Environment, meteorology, security
Energy, power	Information, telecommunication
Health, medicine	Marine
Manufacturing	Recreation, toys
Military	Space
Scientific measurement	Other
Transportation	

Sensor Classification

Stimulus

Acoustic	Wave amplitude, phase, polarization
	Spectrum
	Wave velocity
Biological	Biomass (types, concentration, states)
	Other
Chemical	Components (identities, concentration, states)
	Other
Electric	Charge, current
	Potential, voltage
	Electric field (amplitude, phase, polarization,
	Conductivity
	Permittivity
Magnetic	Magnetic field (amplitude, phase, polarization,
	Magnetic flux
	Permeability
Optical	Wave amplitude, phase, polarization, spectrum
	Wave velocity
	Refractive index
	Emissivity, reflectivity, absorption

Mechanical	Position (linear, angular)
	Acceleration
	Force
	Stress, pressure
	Strain
	Mass, density
	Moment, torque
	Speed of flow, rate of mass transport
	Shape, roughness, orientation
	Stiffness, compliance
	Viscosity
	Crystallinity, structural integrity
Radiation	Type
	Energy
	Intensity
Thermal	Temperature
	Flux
	Specific heat
	Thermal conductivity

E-mail:Zeyad.Taha.yaseen@uomus.edu.iq