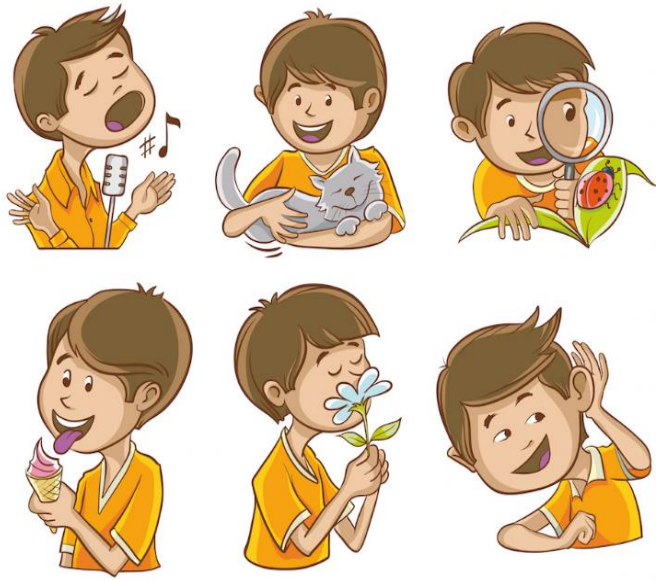
SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING



Guess Today's Topic????

Why Sensor

- conventional wall socket switchboards for switching on industrial appliances or home appliances such as fan, cooler, industrial motors, and so on
- it is very difficult to operate the switches regularly
- Automation developed for ease of controlling all the required electrical and electronics loads.
- This automation in a power system can be designed using various types of sensors and sensor circuits

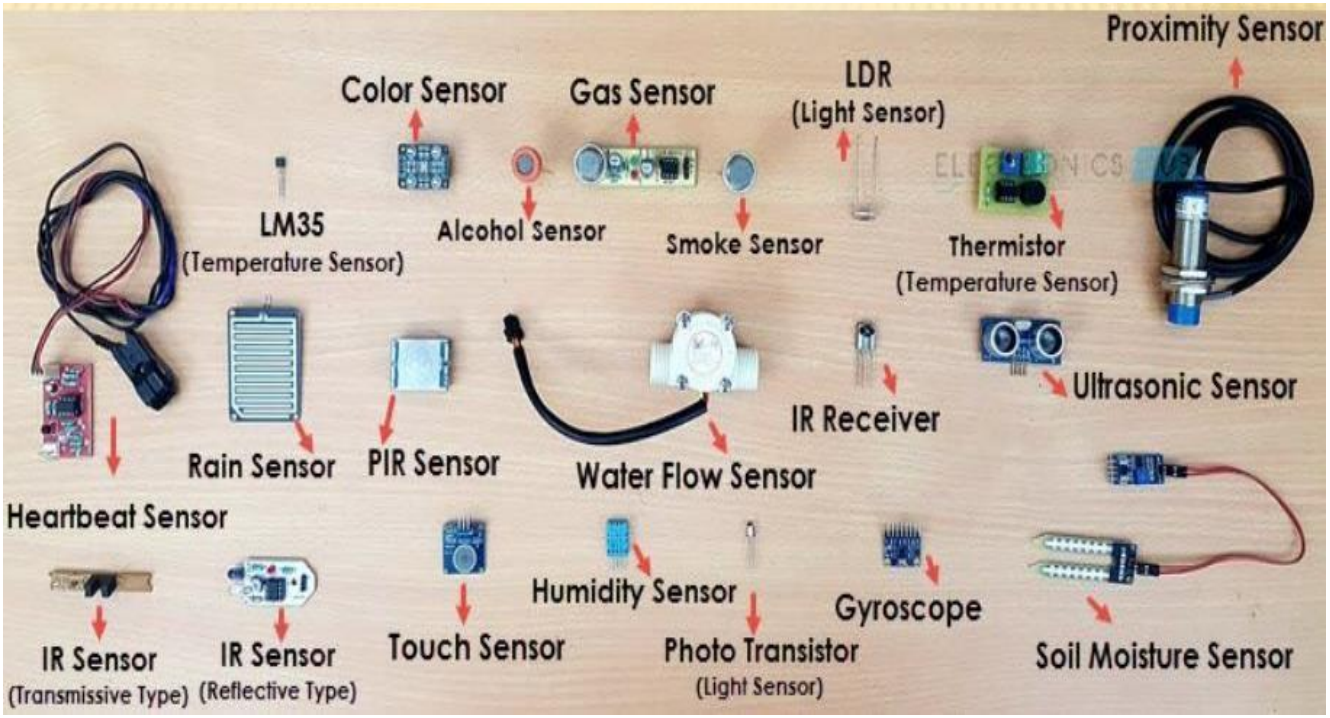
Sensor

- Sensors are a part of everyday life at home and work
- A sensor is a device that can See, Feel, Hear, Smell, and even Taste.
- **A sensor can be defined as an appliance that detects changes in physical or electrical or other quantities and by this means, generally, produces an electrical or optical signal output as an acknowledgement of the change in that specific quantity.**
- In-process control, sensors are classified as

Passive – requiring an external excitation to produce an electrical output

Active – producing a voltage output without any external excitation

Sensor Types



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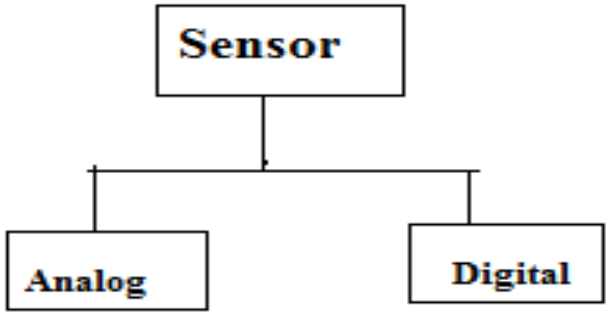
Sensor Types

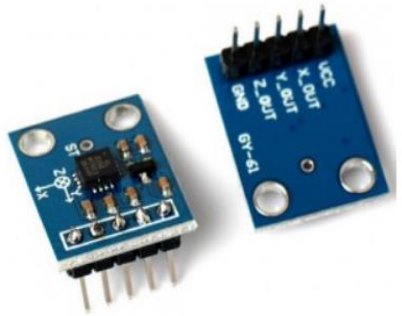


➢***Analog***: produce continuous analog output signal and these sensors are considered as analog sensors. Output is proportional to measurement.

➢various types of analog sensors are as follows: accelerometers, pressure sensors, light sensors, sound sensors, temperature sensors, and so on.

Analog Sensor

Accelerometers:



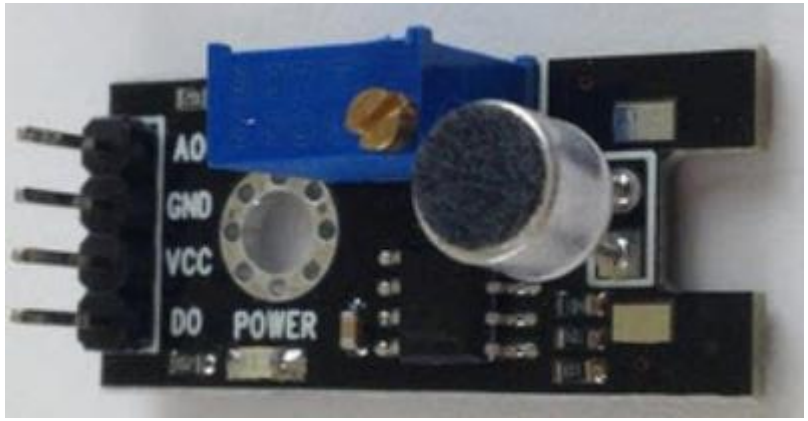
➢Analog sensors that detect changes in position, velocity, orientation, shock, vibration, and tilt by sensing motion are called as accelerometers.
➢Its available in both analog and digital

***Light Sensors*:**

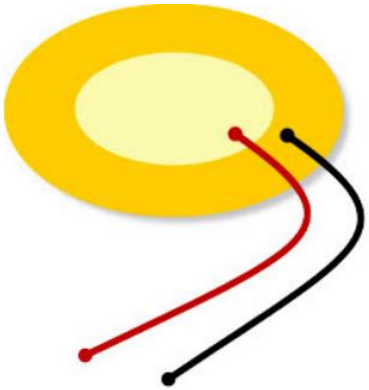
➢Classified into various types like photo-resistor, Cadmium Sulfide (CdS), and, photocell
➢ Light dependent resistor (LDR) can be used as analog light sensor

Analog Sensor

Sound Sensors:



Pressure Sensor:

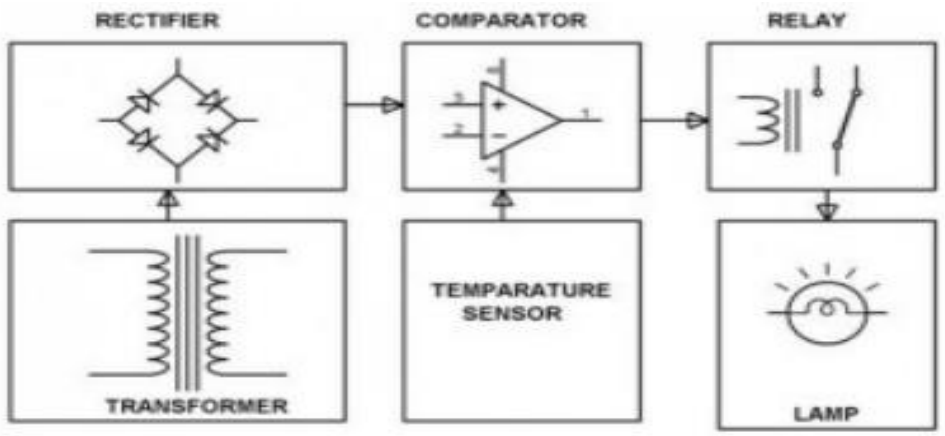


- The analog sensors that are used to measure the amount of pressure applied to a sensor are called as analog pressure sensors.
- Pressure sensor will produce an analog output signal that is proportional to the amount of applied pressure.

Analog Sensor

Analog Temperature Sensor:

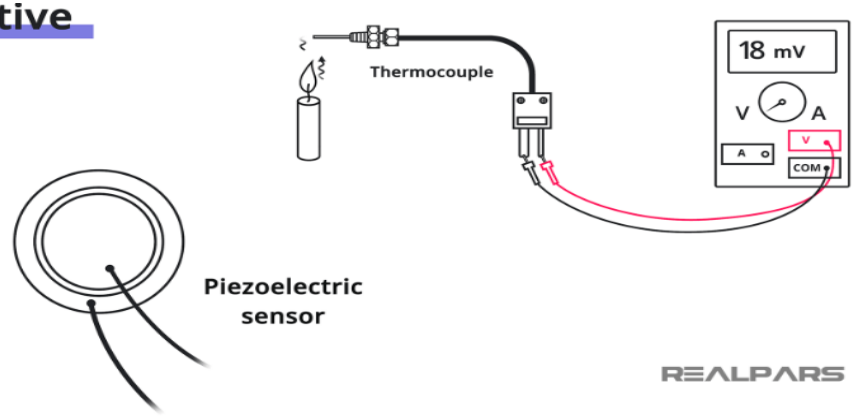
- Eg: Thermistor ,
- There are different types of thermistor that are used for different applications. Thermistor is a thermally sensitive resistor that is used for detecting changes in temperature.



- Practical example of analog temperature sensor is thermistor based temperature control system.
- Maintain constant temperature in an enclosed area.

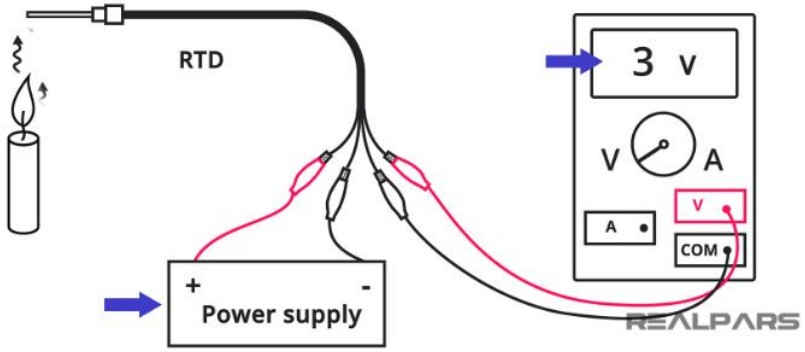
Sensor

Active



➢ ***Active – Eg:Thermocouple***

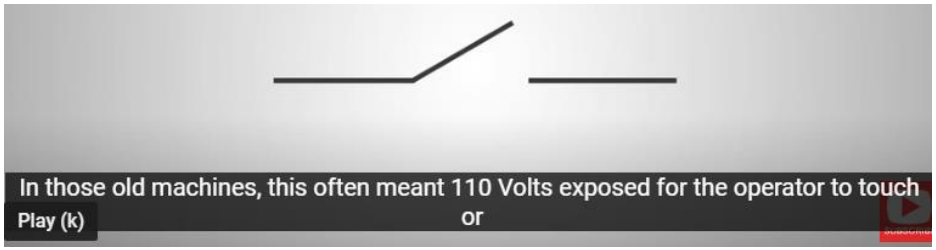
Passive

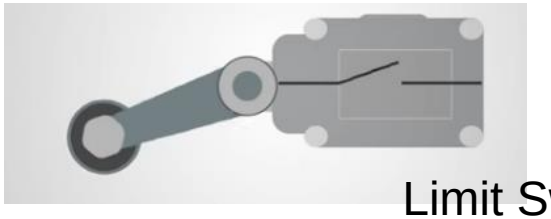


➢ ***Passive-Eg:Strain Gauge***

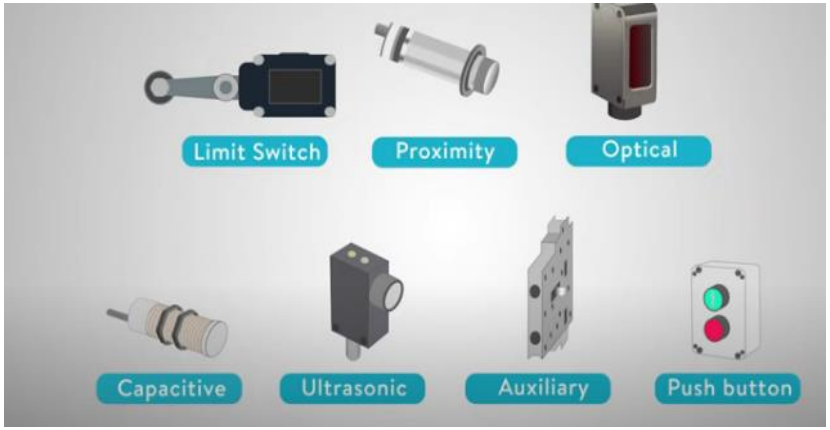
Sensor Types

- Digital Sensor are used in industry
- In theoretical we refer one or more bits of information per sensor

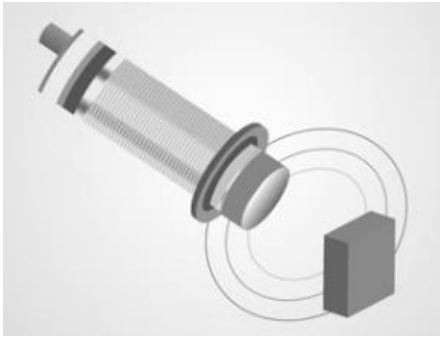




Limit Switch



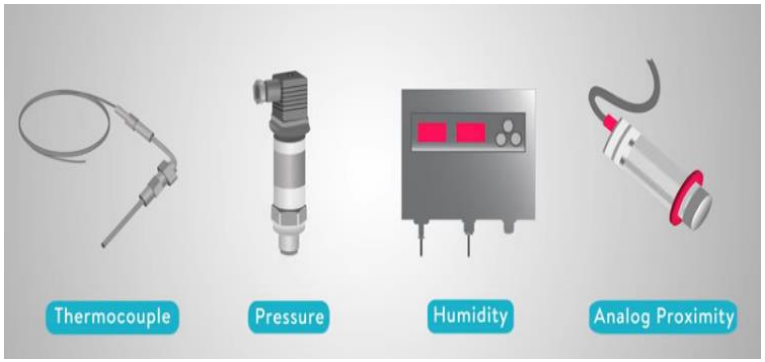
- Digital Sensors

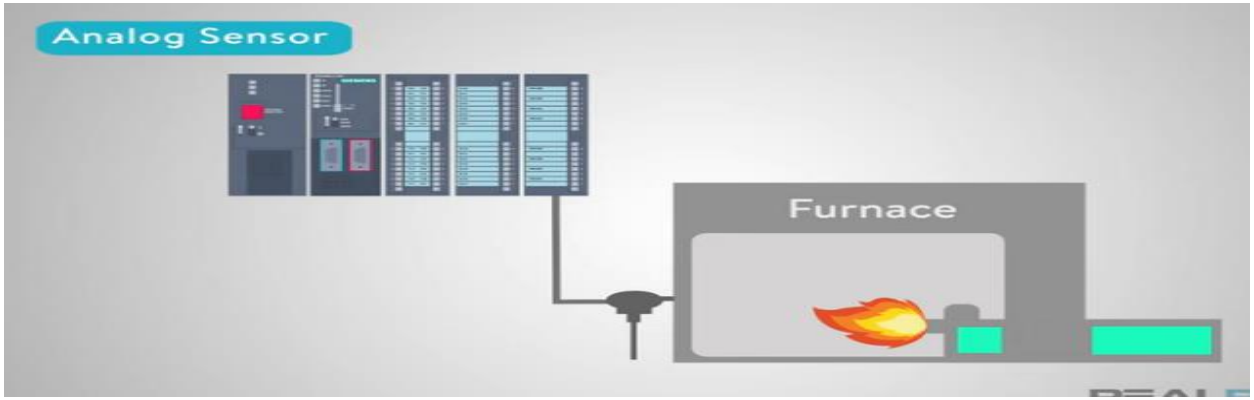


Proxes

Sensor Types

- Passive Sensor
- Analog Sensor that return a range of values

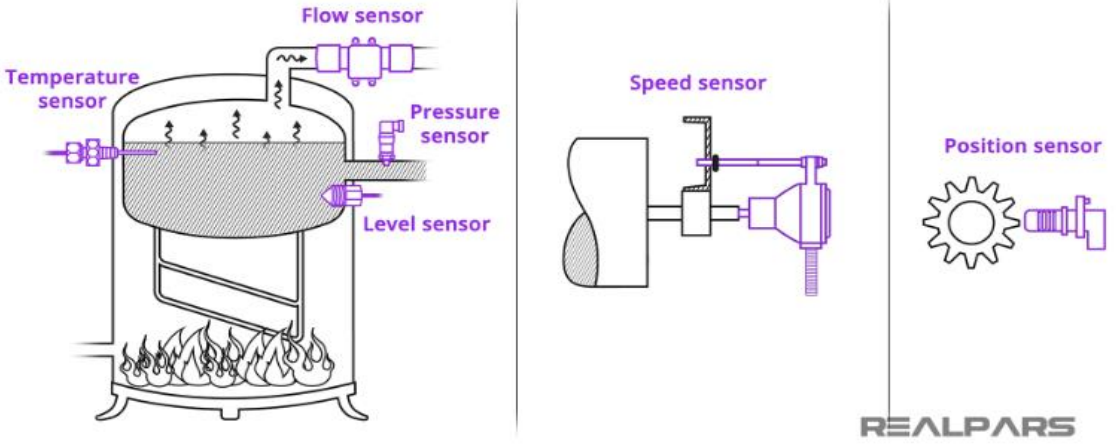




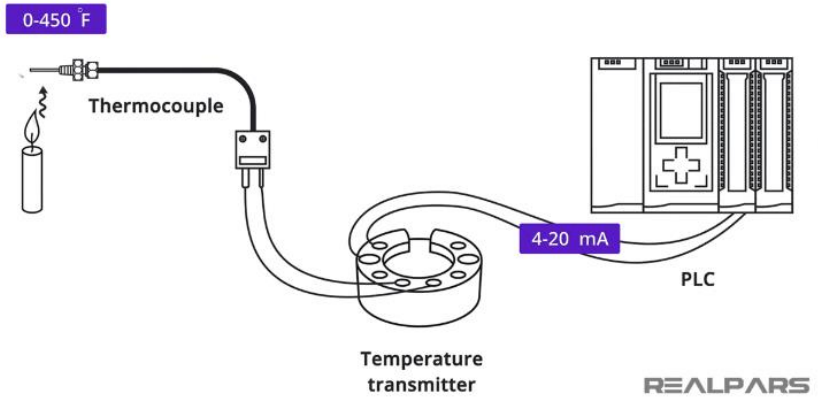
Industrial Sensor

Pressure Sensor

➢we define a Sensor as a device that detects changes in physical, electrical, or chemical properties and produces an electrical output in response to that change.

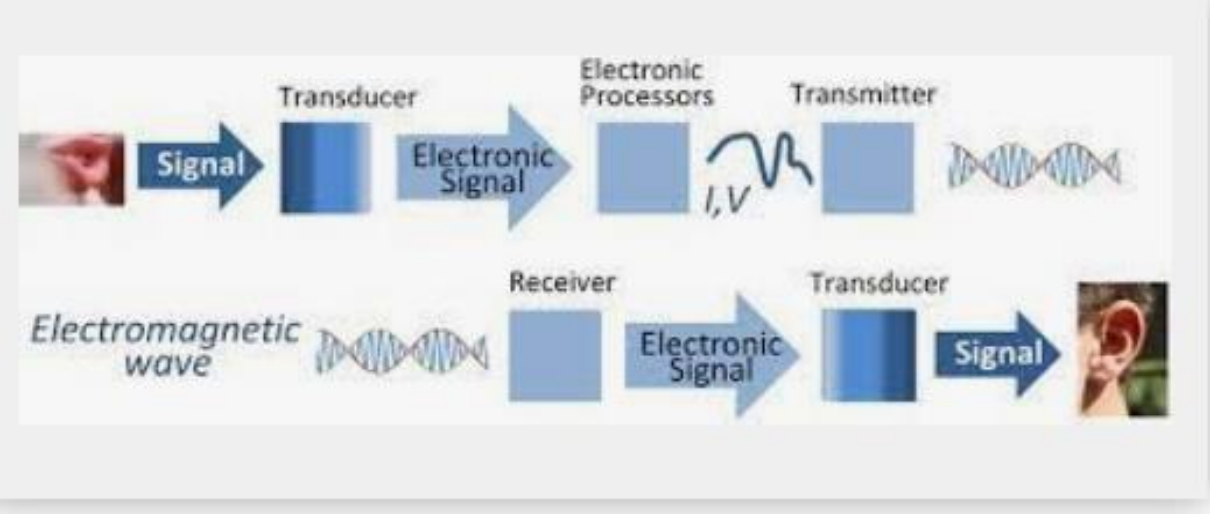


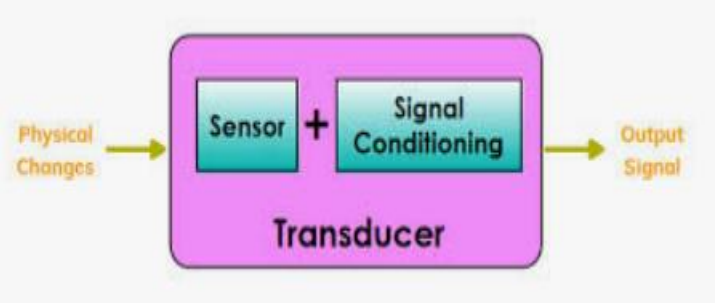
Why Transmitter in sensor

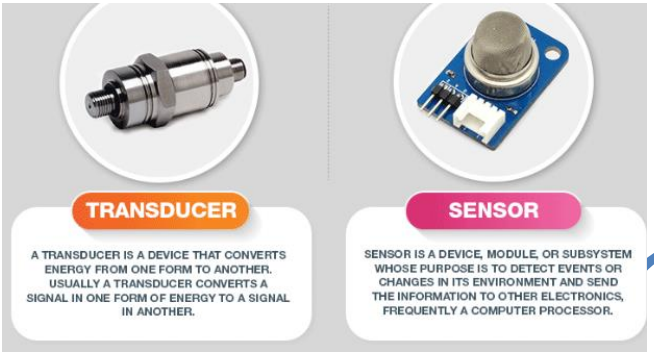


➢Almost every sensor used in process control will be connected to a Transmitter because a sensor's output needs to be conditioned or amplified.

Sensor and Tranducer

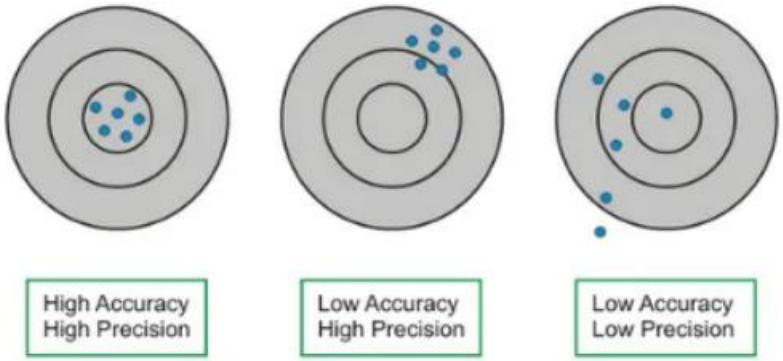


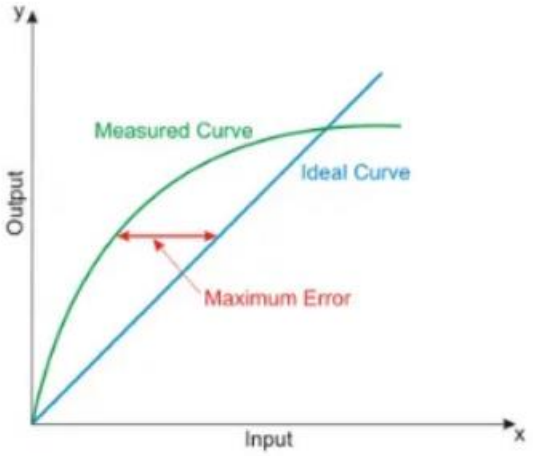




Characteristics of Sensors

What are the Characteristics of Sensors?





Characteristics of Sensors

1. ***Range***: It is the minimum and maximum value of physical variable that the sensor can sense or measure. For example, a Resistance Temperature Detector (RTD) for the measurement of temperature has a range of -200 to 800^{o}C.
2. ***Span:*** It is the difference between the maximum and minimum values of input. In above example, the span of RTD is 800 – (-200) = 1000^{o}C.

Characteristics of Sensors

3. ***Accuracy*:** The error in measurement is specified in terms of accuracy. It is defined as the difference between measured value and true value. It is defined in terms of % of full scale or % of reading.

$$Absolute\ Error = |Measured\ value - True\ value|$$

$$\Rightarrow E_a = |X_m - X_t|$$

X_t is calculated by taking mean of infinite number of measurements.

$$Relative\ error = \frac{Absolute\ error}{True\ value}$$

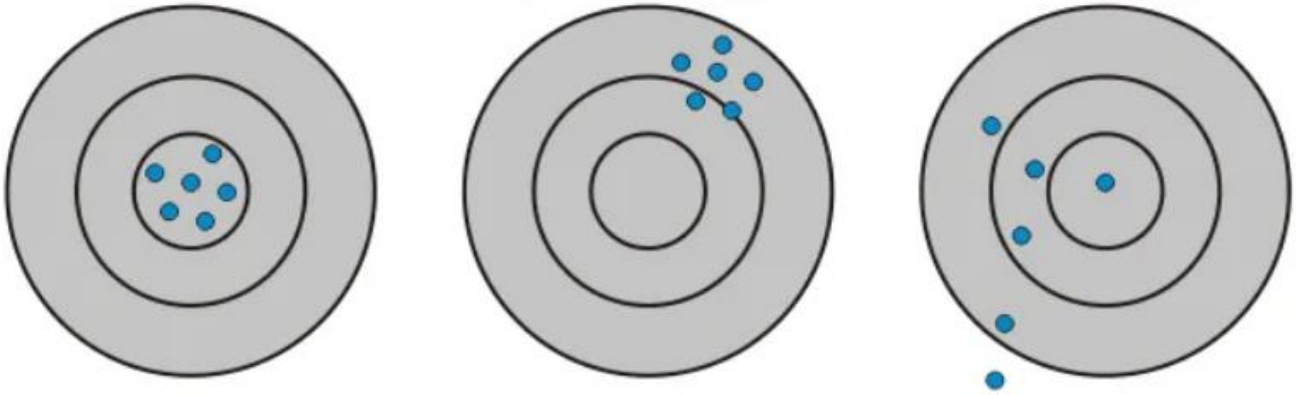
$$\Rightarrow E_r = \frac{|X_m - X_t|}{X_t}$$

Characteristics of Sensors

4. ***Precision***: It is defined as the closeness among a set of values. It is different from accuracy. Let X_t be the true value of the variable X and a random experiment measures X_1, X_2, …. X_i as the value of X. We will say our measurements X_1, X_2,… X_i are precise when they are very near to each other but not necessarily close to true value X_t. However, if we say X_1, X_2,… X_i are accurate, it means that they are close to true value X_t and hence they are also close to each other. Hence accurate measurements are always precise.

Characteristics of Sensors

Precision



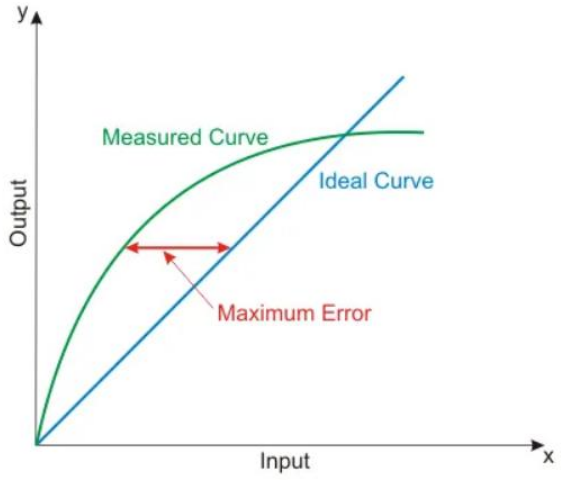
High Accuracy High Precision	Low Accuracy High Precision	Low Accuracy Low Precision

Characteristics of Sensors

5. ***Sensitivity:*** It is the ratio of change in output to change in input. If Y be the output quantity in response to input X, then sensitivity S can be expressed as

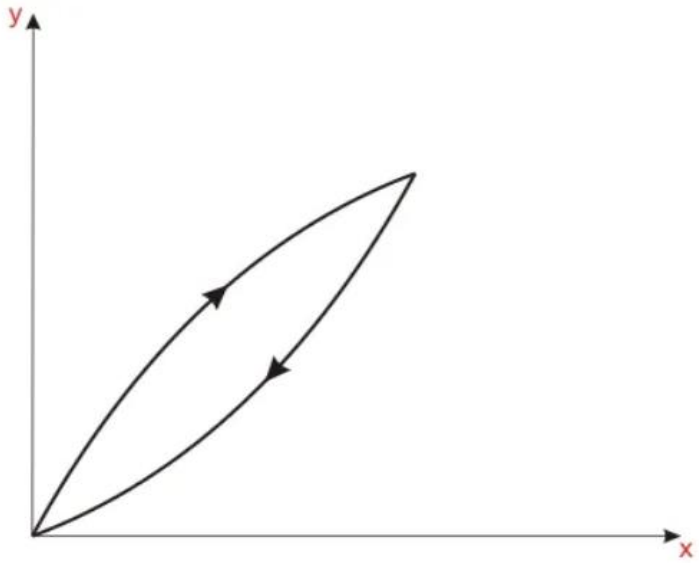
$$S = \frac{dY}{dX} = \frac{\Delta Y}{\Delta X}$$

6. ***Linearity:*** Linearity is the maximum deviation between the measured values of a sensor from ideal curve.



Characteristics of Sensors

7. ***Hysteresis:*** It is the difference in output when input is varied in two ways- increasing and decreasing.



Characteristics of Sensors

8. ***Resolution:*** It is the minimum change in input that can be sensed by the sensor.
9. ***Reproducibility:*** It is defined as the ability of sensor to produce the same output when same input is applied.
10. ***Repeatability:*** It is defined as the ability of sensor to produce the same output every time when the same input is applied and all the physical and measurement conditions kept the same including the operator, instrument, ambient conditions etc.
11. ***Response Time***: It is generally expressed as the time at which the output reaches a certain percentage (for instance, 95%) of its final value, in response to a step change of the input.


Thank
you