جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

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قسم الانظمة الطبية الذكية

Lecture 3- Sensor types overview

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Sensors overview :

Transducers and sensors are used to convert a physical phenomena into an electrical signal (voltage or current) that will be then converted into a digital signal used for the next stage such as a computer, digital system, or memory board.

The following topics will be discussed:

- What are Sensors?
- Types of Sensors

Introduction :

A sensor is a device that receives and responds to a signal.

- The signal could be heat, light, motion, or chemical.
- A sensor converts the signal into an analog or digital representation of the input signal.
- Sensors detect and/or measure many different conditions.

What are some sensors that you have used?

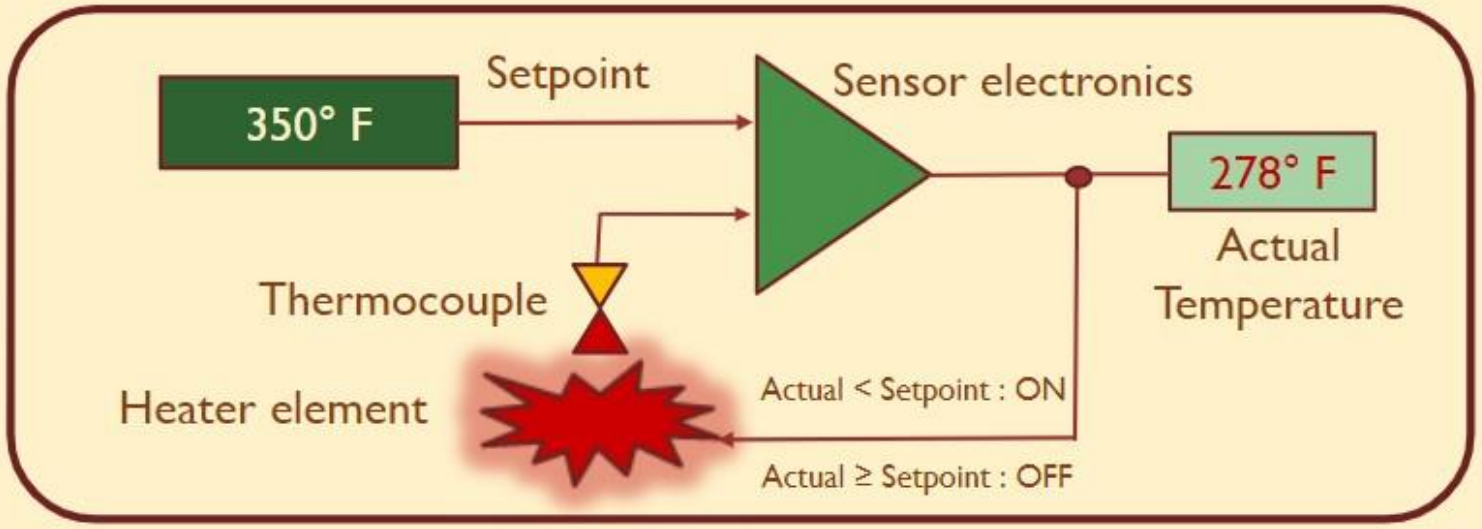
Introduction :

Humans are equipped with 5 different types of sensors.

Human Sensors

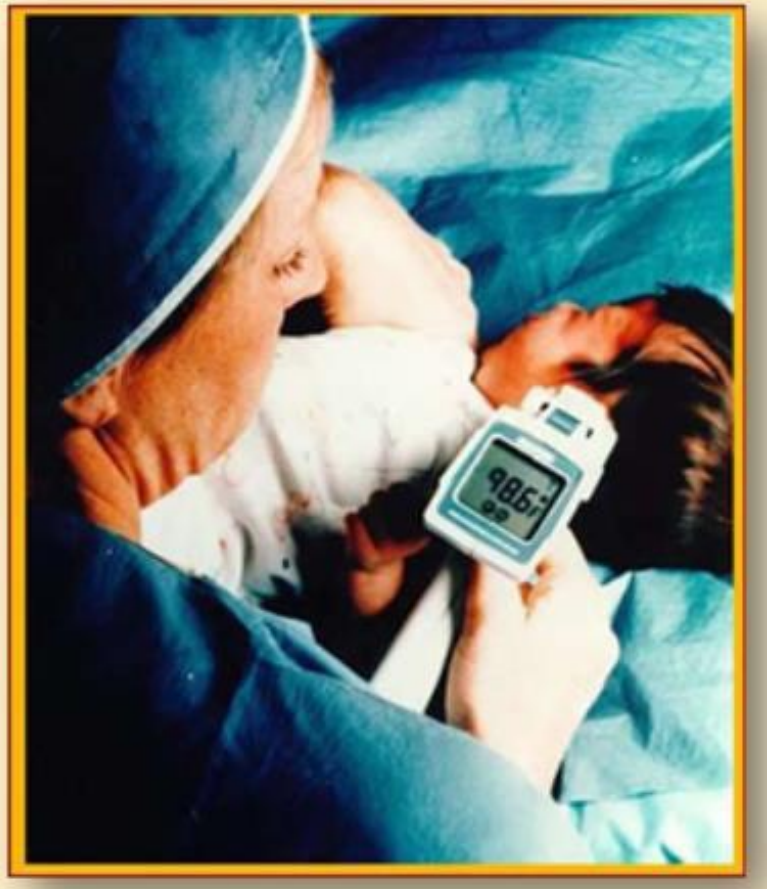
Basic concepts of sensor :

- Detect the presence of energy
- Detect changes in or the transfer of energy
- Detect by receiving a signal then responding to that signal
- Convert a signal into a readable output



Thermal sensors :

- Thermometer
- Thermocouple gauge
- Resistance Temperature Detectors (RTDs)



Infrared ear thermometer
[Image courtesy of NASA Jet Propulsion Laboratory]

Mechanical sensors :

- Pressure sensor
- Barometer
- Altimeter
- Liquid flow sensor
- Gas flow
- Accelerometer
- Aneroid Barometer

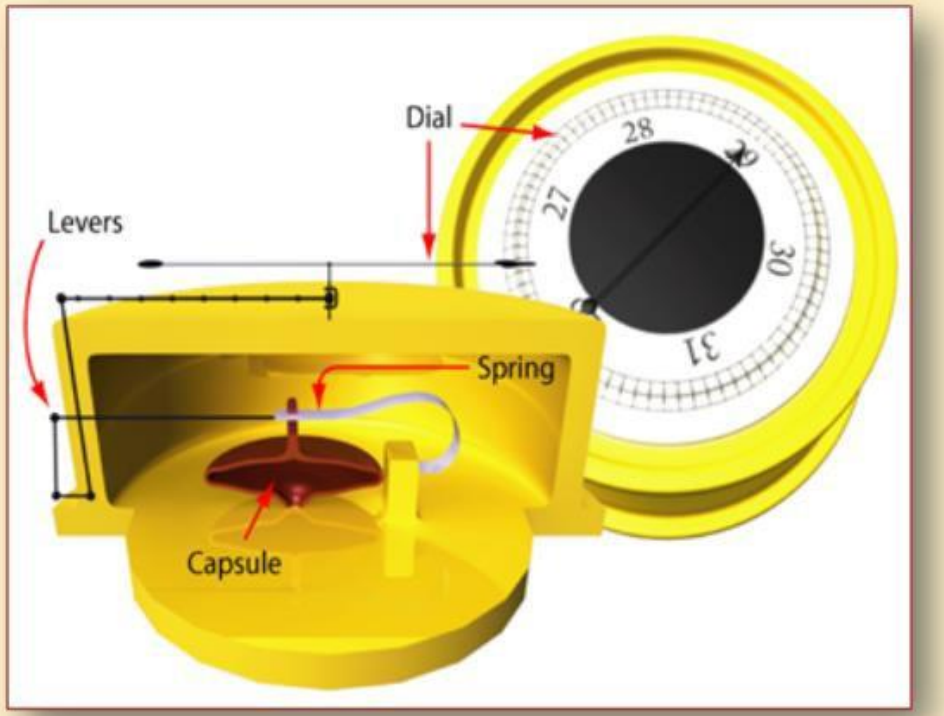


Diagram of Aneroid Barometer

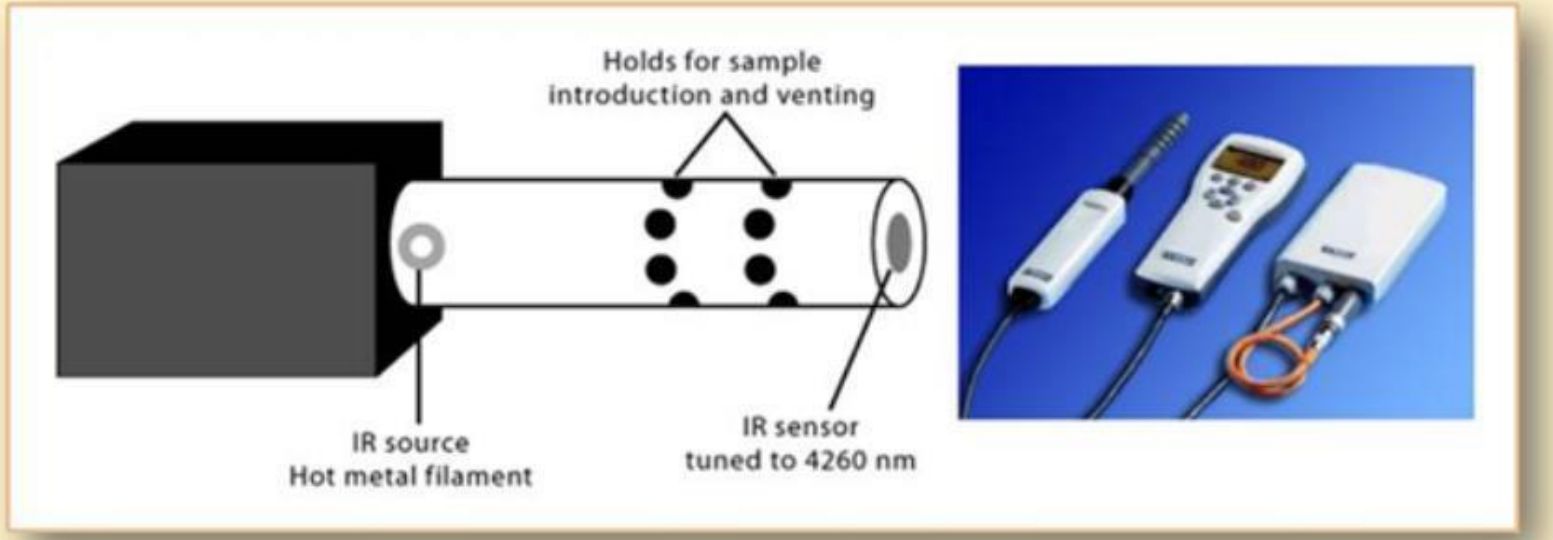
Electrical sensors :

- Ohmmeter
- Voltmeter
- Galvanometer and ammeter
- Watt-hour meter

Schematic and photograph of a Galvanometer used for sensing electrical currents

Chemical sensors :

- Carbon dioxide detector
- Oxygen sensor



Schematic and Photo of a Carbon Dioxide Sensor

Optical sensors :

- Photodetectors
- Proximity Detectors
- Infra-red sensor

Solar cell and the solar cells on the International Space Station
[Public Domain]

Sensors

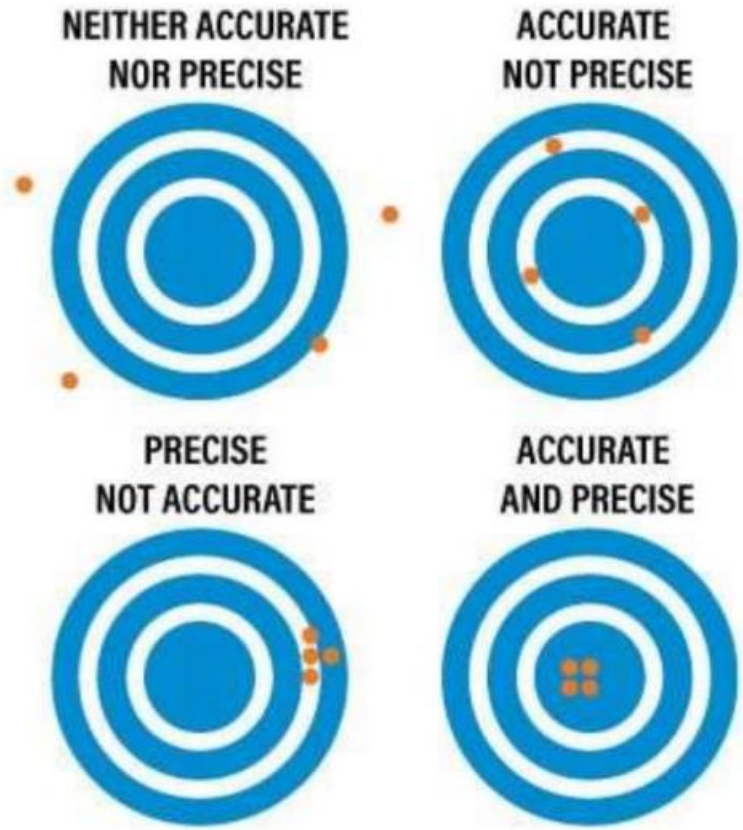
Sensors are sophisticated devices that are frequently used to detect and respond to electrical or optical signals.

A **Sensor** converts the physical parameter into a signal which can be measured electrically.

Characteristics of sensors

- Accuracy
- Precision
- Errors
- Sensitivity
- Linearity
- Hystheresis (backslash)

Accuracy and Precision



ERRORS

- Accuracy
- Precision
- Errors
- Sensitivity
- Linearity
- Hystheresis (backslash)

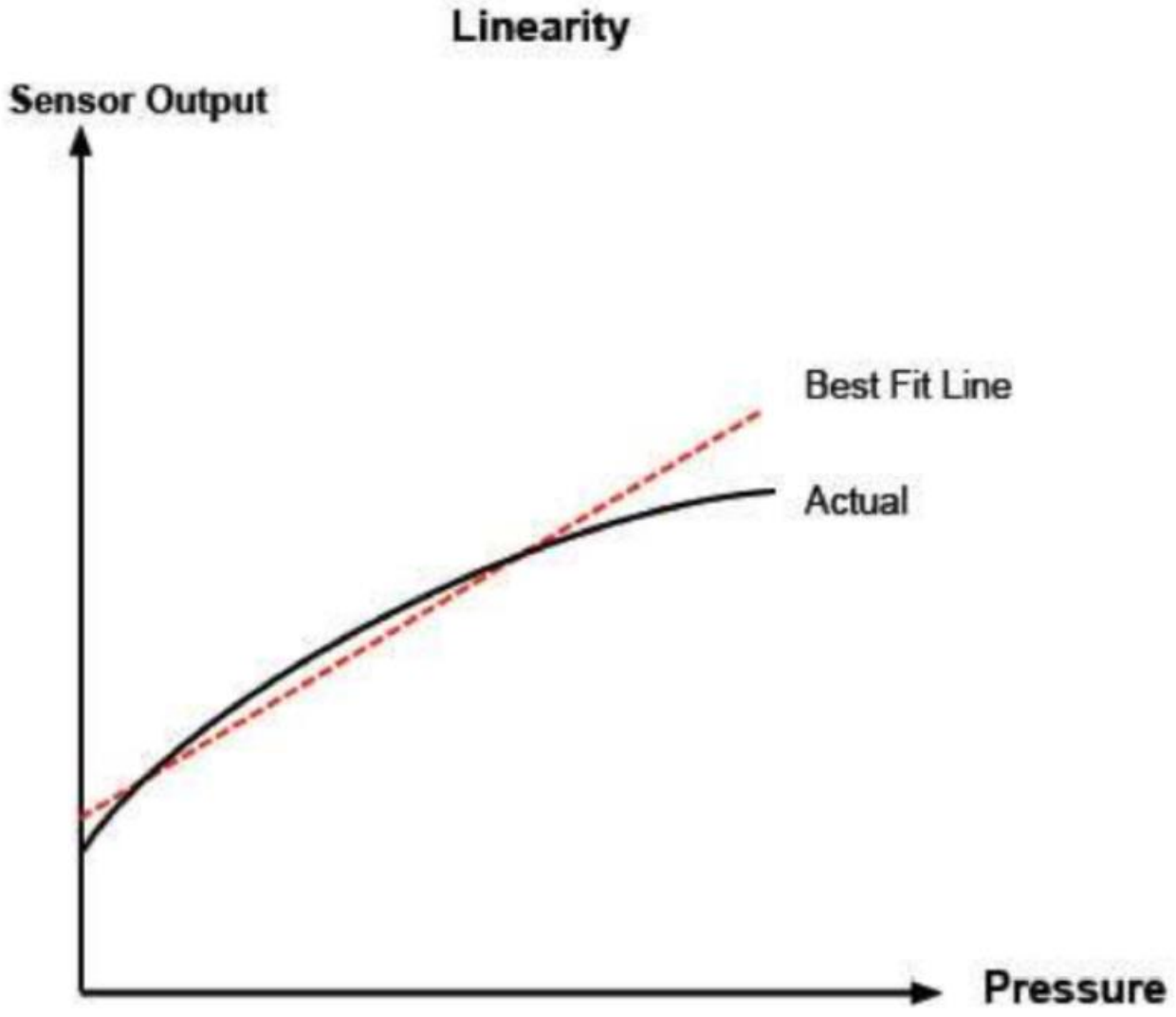
Sensitivity

An ideal sensor will have a large and constant sensitivity

Sensitivity-related errors are saturation and "dead-bands"

Linearity

- The closeness of the calibration curve to a specified straight line.



Hystheresis (backslash)

The difference between two output values that correspond to the same input depending on the trajectory followed by the sensor (i.e., magnetization in ferromagnetic materials).

Backslash: Hysteresis caused by looseness in a mechanical joint.

Criteria to choose a Sensor

Accuracy

Environmental condition - usually has limits for temperature/ humidity

Range - Measurement limit of sensor

Calibration - Essential for most of the measuring devices as the readings changes with time

Resolution - Smallest increment detected by the sensor

Cost

Repeatability - The reading that varies is repeatedly measured under the same environment