MEASUREMENTS AND INSTRUMENTATION/SENSORS AND TRANSDUCERS

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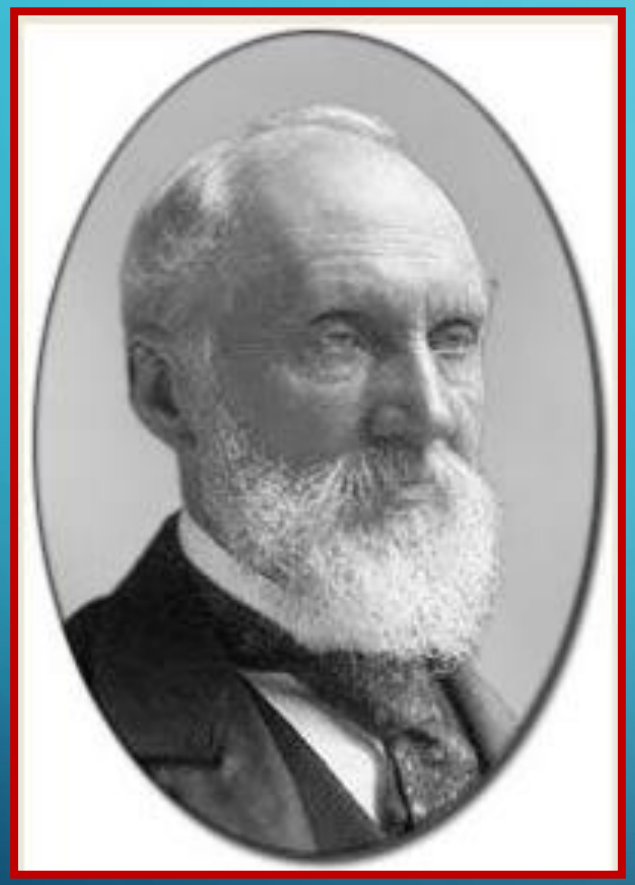
MEASUREMENTS AND INSTRUMENTATION

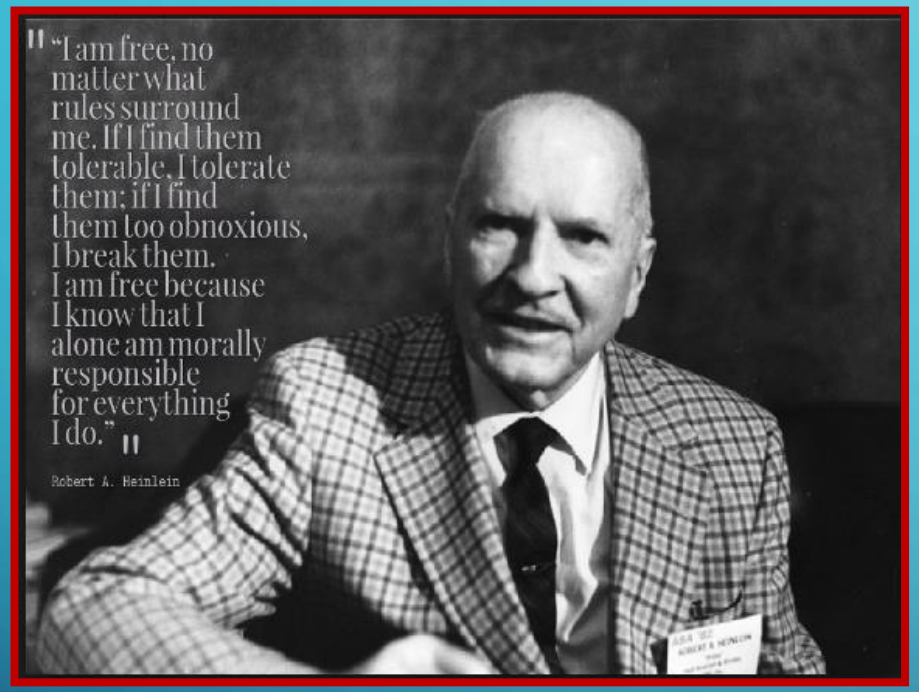


When you can measure what you are speaking about, and express it in numbers, you know something about it. But when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre kind. It may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the stage of science.

LORD WILLIAM THOMSON KELVIN

ENRICO FERMI

There are two possible outcomes: if the result confirms the hypothesis, then you've made a measurement. If the result is contrary to the hypothesis, then you've made a discovery.



ROBERT HEINLEIN

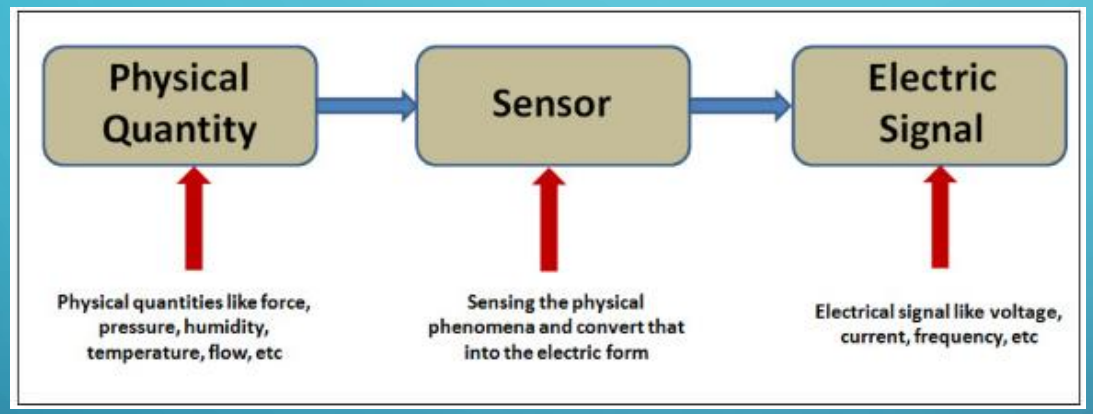
If it can't be expressed in figures, it is not science; it is opinion.

MEASUREMENT

- Measurement is the process of obtaining the magnitude of a quantity relative to an agreed standard
- Measurable quantity is called as Measurand
- We compare this measurand with standard unit

SENSORS

1. A sensor is a device that measures physical input from its environment and converts it into data that can be interpreted by either a human or a machine.



Typically, sensors converts a recognized signal into an electrical signal (analog or digital) output that is readable and suitable for processing.

HOW DOES A SENSOR WORK

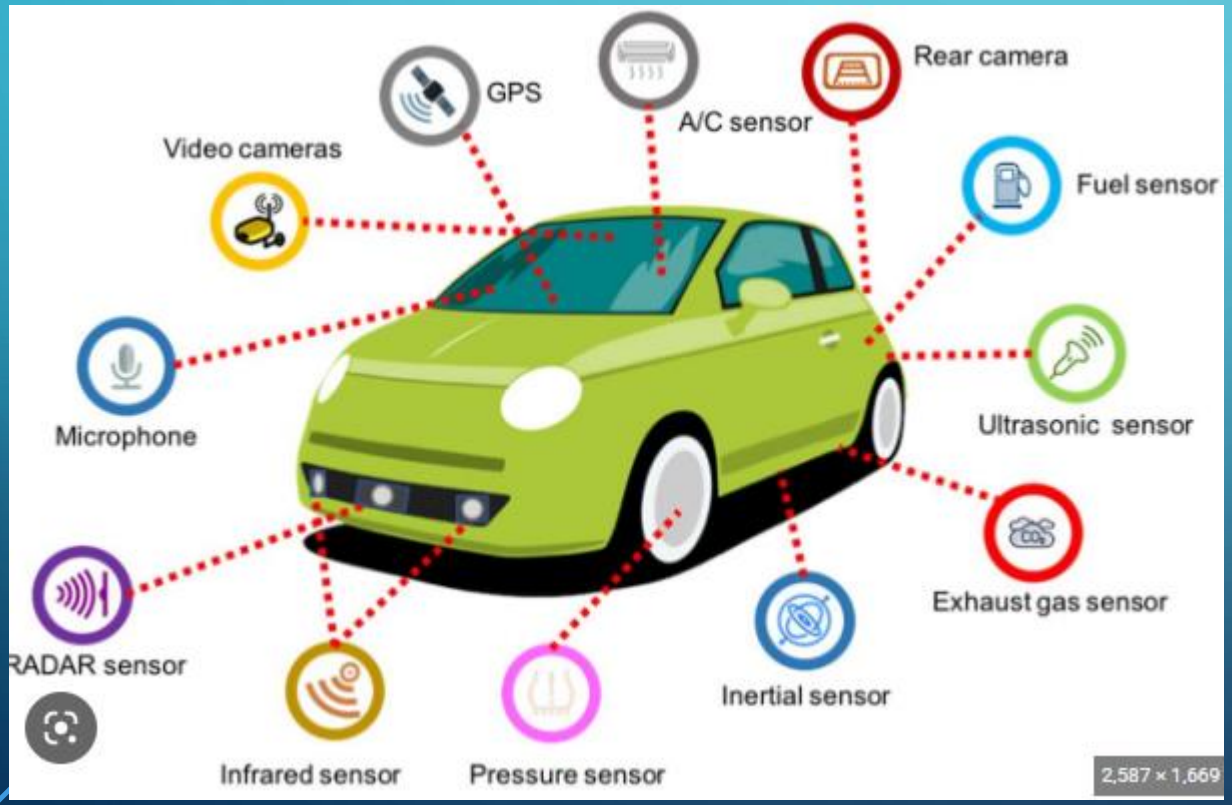
Put simply, a sensor **converts stimuli such as heat, light, sound and motion into electrical signals**.

WHY DO WE NEED SENSORS

1. Sensors also produce vital information and exchange data with other connected devices and administration systems when linked to a network.
2. When you are at work, the lights may turn on using a motion sensor. Public toilet flushes often use a push button or an infrared switch. You may also use a computer which uses many different sensors

Sensors are omnipresent. They are embedded in our bodies, automobiles, airplanes, cellular telephones, radios, chemical plants, industrial plants and countless other applications

Without the use of sensors, there would be no automation !!



Classification of Sensors

- Principle of transduction.
- Primary & Secondary sensors.
- Passive & Active sensors.
- Analog & Digital sensors.

Classification based upon principle of transduction

- Resistive
- Inductive
- Capacitive

Primary and Secondary Sensors

- Primary- Pressure to displacement (bourdon tube)
- Secondary-Displacement into analogous voltage (LVDT).

Active and Passive Sensors

Active Sensors:

Also known as self generating type, develop their own voltage or current from the physical phenomenon being measured.

Ex: Thermocouple, Photovoltaic cell, Solar cell, PZT

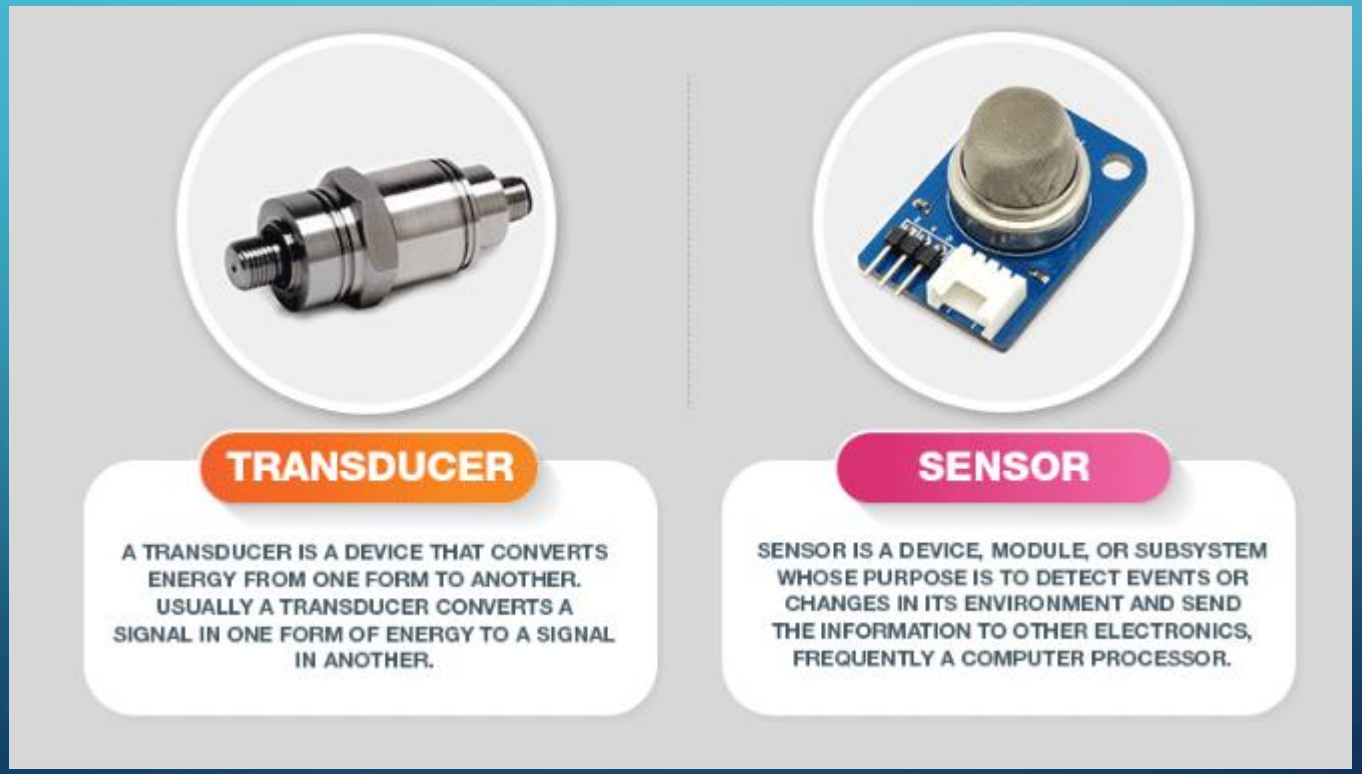
Passive Sensors:

Also known as externally powered sensors, i.e., derive the power required for energy conversion from an external power source.

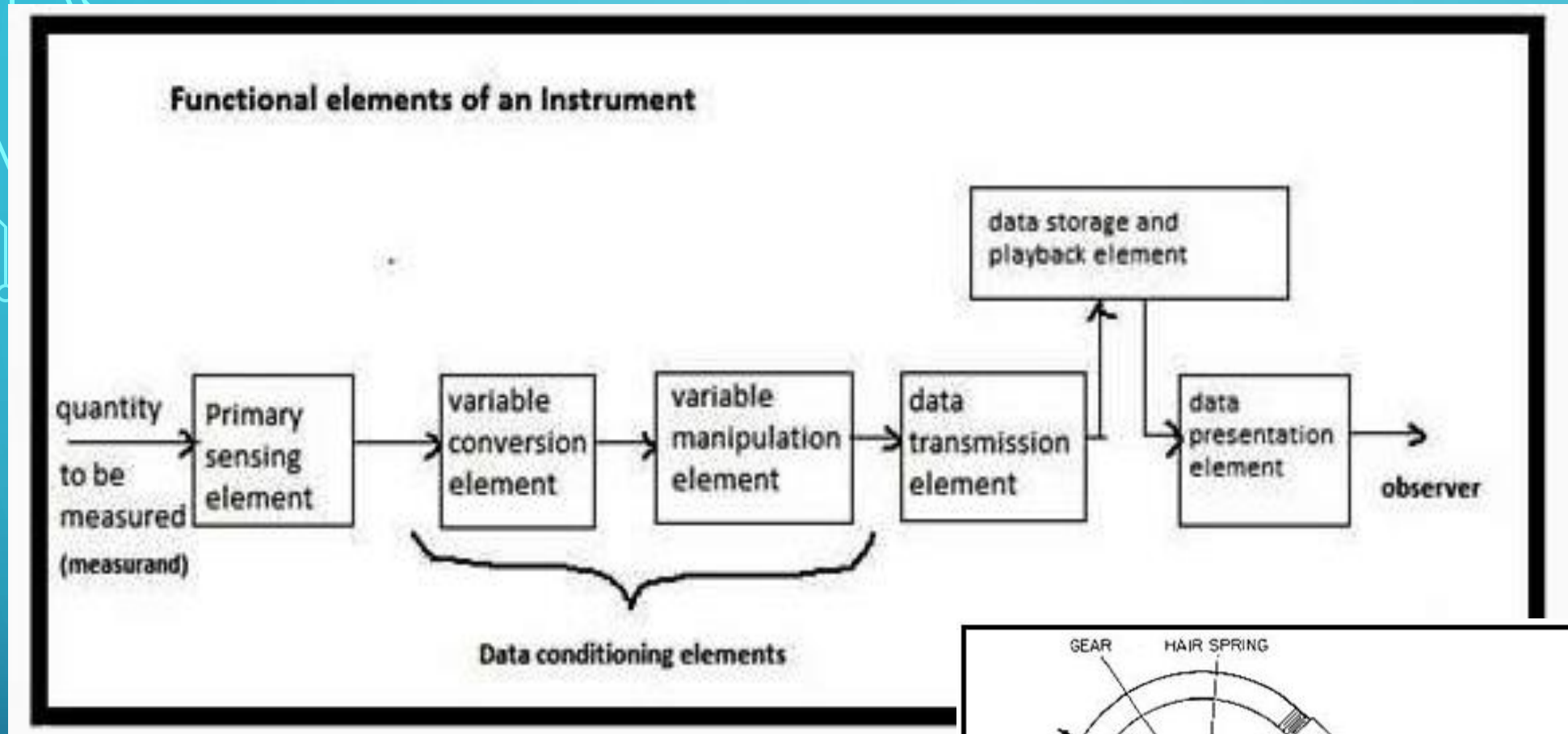
Ex. POT (Potentiometer)- used for the measurement of displacement, Strain gauge, LVDT etc

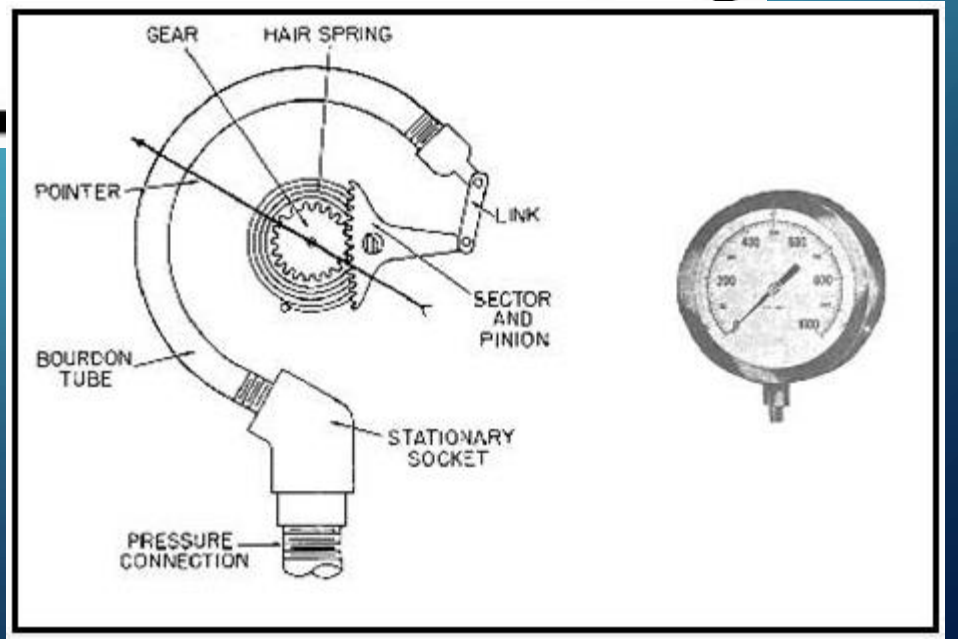
Transducers

A transducer is an electronic device that converts energy from one form to another. Common examples include microphones, loudspeakers, thermometers, position and pressure sensors, and antenna



Difference between Transducer and Sensor	
Transducer	**Sensor**
It helps in converting one form of energy into another form.	It senses physical quantities and converts them into signals read by an instrument.
It converts electricity to electromagnetic waves.	It senses physical quantity and converts it into analog quantity.
The antenna is one type of transducer. Microphones and loudspeakers are also of one type.	One type of Sensor is LED. Sensors are used in automobiles to detect touch and activate the siren.
It converts the measured quantity into a standard electrical signal like -10 to +10V DC	It measures voltage, capacitance, inductance, and ohmic resistance.
Examples: Strain gauge, piezoelectric transducer, linear transducer, and microphone.	Examples: Temperature sensor, thermistor, proximity sensor, and pressure switch.


Functional elements of an Instrument
quantity
to be measured
(measurand)
Primary sensing element
variable conversion element
variable manipulation element
data transmission element
data storage and playback element
data presentation element
observer
Data conditioning elements


GEAR
HAIR SPRING
POINTER
LINK
SECTOR AND PINION
BOURDON TUBE
STATIONARY SOCKET
PRESSURE CONNECTION

Humidity Sensor

A humidity sensor is **a device that detects and measures water vapor**

Humidity sensors work by detecting changes that alter electrical currents or temperature in the air.

There are three basic types of humidity sensors: capacitive, resistive and thermal.

All three types will monitor minute changes in the atmosphere in order to calculate the humidity in the air. Humidity sensors usually contain a humidity sensing element along with a thermistor to measure temperature.

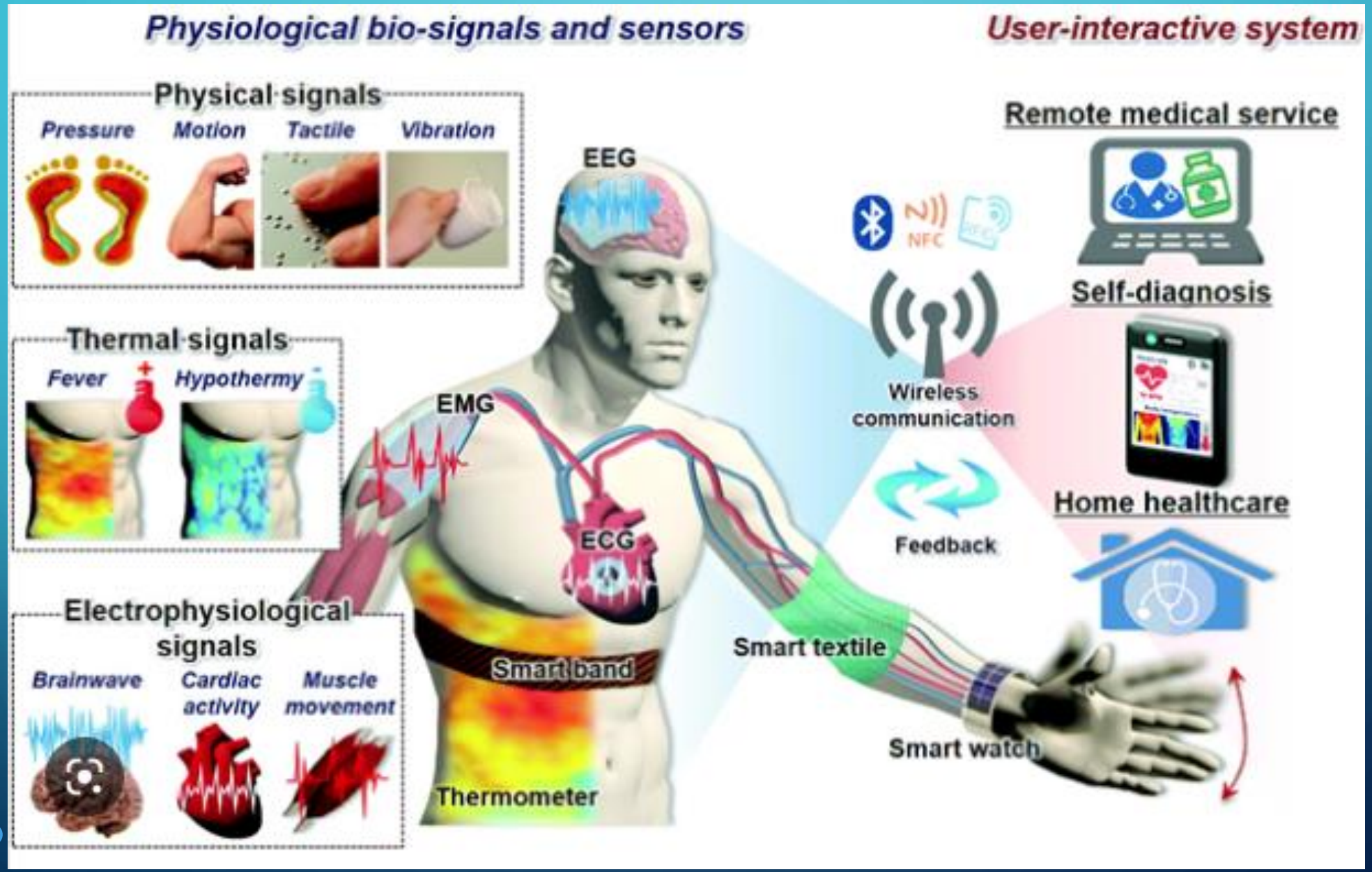
For a capacitive sensor, the sensing element is a capacitor. Here the change in electrical permittivity of the dielectric material is measured to calculate the relative humidity values.

Low resistivity materials are used for the construction of a Resistive sensor. This resistive material is placed on top of two electrodes. Change in the resistivity value of this material is used to measure the change in humidity.

Applications of Humidity sensors

Automobiles, food processing systems, printers, and domestic appliances such as refrigerators, ovens, and laundry machines, Agriculture

Bio Medical Sensor

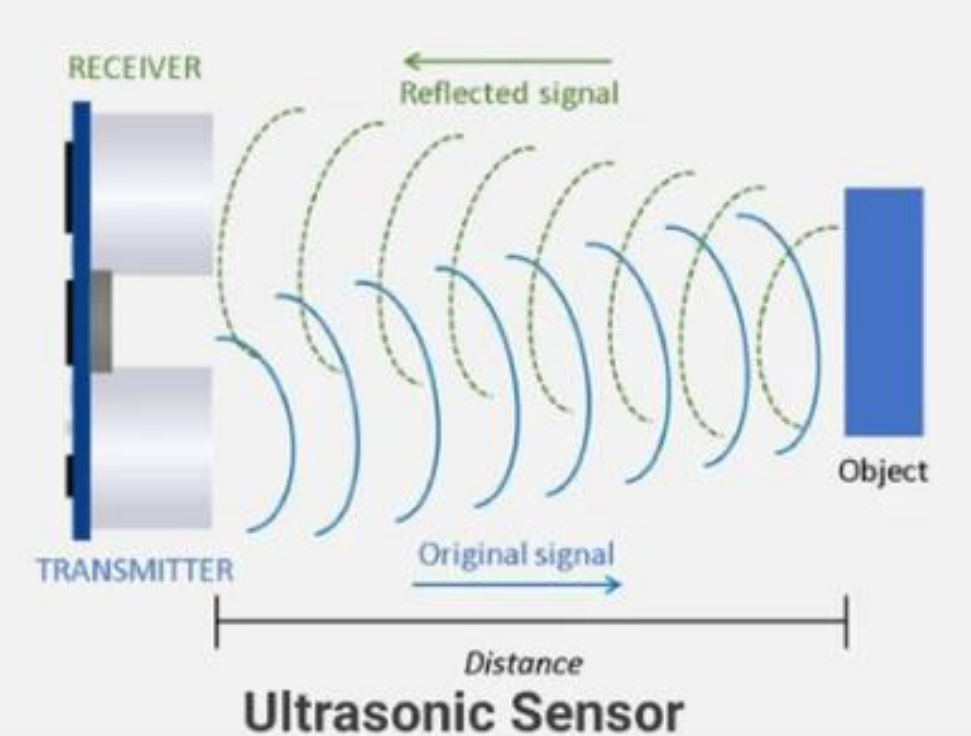


Biomedical sensors are a special type of sensors that **detect specific biological, chemical, or physical processes, then report these data and use them for medical applications**

Applications of Bio Medical Sensors

Several types of physical sensors are used in biomedical applications, such as blood pressure, muscle displacement, blood flow, core/external body temperature, bone growth, and cerebrospinal fluid pressure measurements.

An environmental suit, also known as an EV suit, is **a special form of clothing designed to be used for protection or life support in inhospitable environments**



Ultrasonic Sensor

A device that uses sound waves to detect the presence and proximity of objects. It sends out high-frequency sound waves that bounce off objects and then measures the time it takes for the sound waves to return

Range of Ultrasonic sensors:

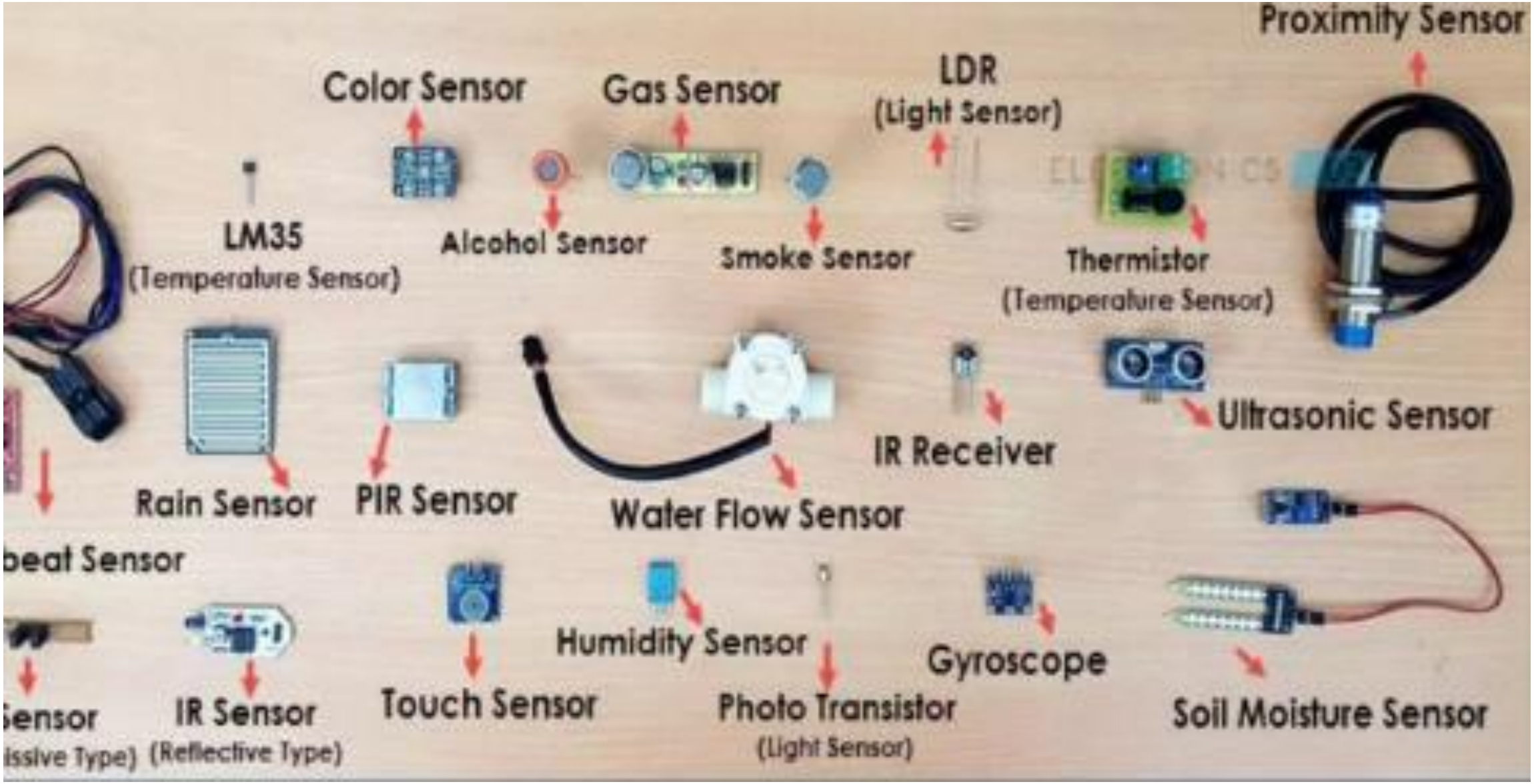
1. Ultrasonic transducers operate at frequencies in the range of **30–500 kHz** for air-coupled applications.

2. As the ultrasonic frequency increases, the rate of attenuation (loss of signal strength) increases.

3. Thus, low-frequency sensors (30–80 kHz) are more effective for long range.

Application of Ultrasonic sensors are used primarily as proximity sensors. They can be found in automobile self-parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems, as well as manufacturing technology

TYPES OF SENSORS



THANK YOU