SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19OE219 BUILDING AUTOMATION

IV YEAR /VII SEMESTER

Unit 1- HVAC SYSTEM

Topic : Sensor and Transducers & Temperature Sensor

Sensor

- A sensor is a device that detects and measures physical properties or changes in the environment.
- It converts them into electrical signals or other forms of output that can be interpreted and used for various purposes.
- Sensors are often used to monitor things like temperature, pressure, light, motion, and more.
- They are an essential component in various systems, such as automation, control, and data collection.

Transducer

- A transducer is a devices used to convert one form of energy into another.
- In the context of sensors, a transducer is a device that converts a physical quantity (such as temperature, pressure, or strain) into an electrical signal that can be easily measured and interpreted.
- Sensors are a specific type of transducer used to measure physical properties.

Sensor Vs Transducer

- In simpler terms, all sensors are transducers, but not all transducers are sensors.
- A transducer could convert energy between various forms, not necessarily involving the measurement of a physical property.
- For example, a microphone is a transducer that converts sound waves (mechanical energy) into electrical signals.
- This is a transduction process but not necessarily a sensor in the traditional sense.
- So, while there is an overlap between the two concepts, they are distinct. Sensors are a subset of transducers that specifically focus on the measurement and detection of physical properties in the environment.

Difference between Transducer and Sensor

Difference between Transducer and Sensor	
Transducer	**Sensor**
Converts one form of energy into another form.	Senses physical quantities and converts them into signals read by an instrument.
Converts electricity to electromagnetic waves	Senses physical quantity and converts it into an analog quantity
Examples of Transducers: Antenna, microphones, loudspeakers	Examples of a Sensor: LED, touch sensors in automobiles, pressure switches.
Converts the measured quantity into a standard electrical signal like -10 to +10V DC	Measures voltage, capacitance, inductance, and ohmic resistance

Temperature Sensor

- Temperature sensors play an important role for HVAC applications; not only to control indoor room temperatures, but also to measure and control the temperature in installed pipes and ducts that supply buildings with heated water or cold air.
- Many HVAC applications are in the ambient to low temperature range.
- Devices using temperature sensors include thermometers, thermostats, smart valves, indoor controls and control units.
- Furthermore, there are many different equipment types, such as heating furnaces, heat pumps, chillers, cooling towers, air conditioner systems, etc. that are controlled and managed by temperature sensors.

Operation

- **Sensing**: A temperature sensor, often a thermistor or a resistance temperature detector (RTD), is placed in the area where temperature needs to be monitored.
- These sensors are designed to change their electrical properties (resistance) in response to temperature variations.
- **Detection:** As the temperature changes in the HVAC environment, the resistance of the temperature sensor changes accordingly.
- This change in resistance is a direct result of the temperature fluctuations.
- **Signal Conversion:** The change in resistance is converted into an electrical signal, usually a voltage, using appropriate circuitry.
- This signal is then conditioned to provide an accurate representation of the temperature change.

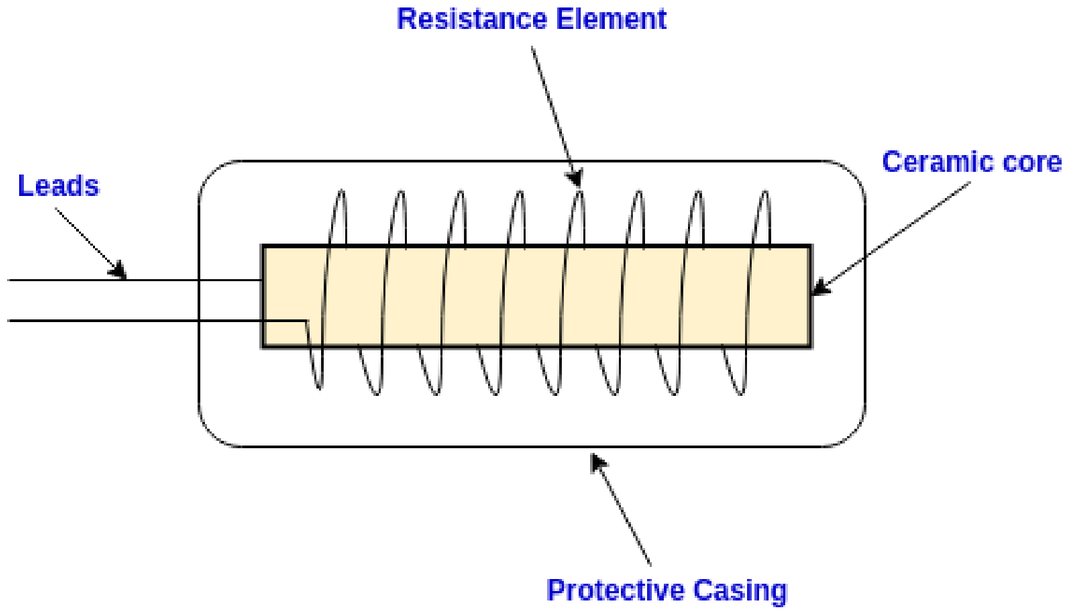
Operation

- **Signal Transmission:** The conditioned signal is transmitted to the HVAC control system, which processes the signal to determine the current temperature.
- **Control:** Based on the temperature reading, the HVAC control system makes decisions about whether to activate heating, cooling, or ventilation systems to achieve the desired temperature set point.
- **Feedback Loop:** Temperature sensors continuously monitor the environment, and the control system adjusts the HVAC system's operation as needed to maintain the desired temperature, creating a feedback loop.

- Different types of temperature sensors can be used depending on the specific requirements of the system.
- For instance, **thermistors** are highly sensitive to temperature changes and are commonly used for indoor temperature monitoring, while **RTDs** offer higher accuracy and stability for critical applications.
- It's worth noting that modern HVAC systems might also incorporate digital temperature sensors, which provide more precise measurements and can communicate directly with digital control systems for improved efficiency and automation.

The Resistance Temperature Detector (RTD)

- The working principle of an RTD sensor is rather simple. All forms of metal have a resistivity factor when the temperature of the metal rises. The resistance can be measured and used to supply temperature readings.



Advantages

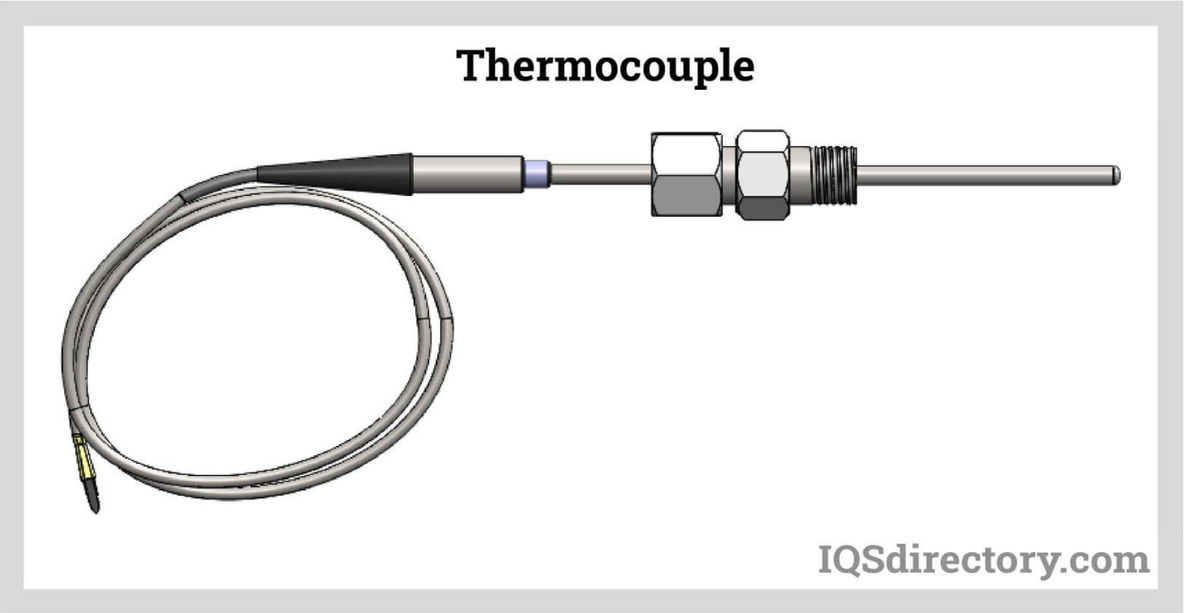
- Can be operated in a wide temperature range.
- Good stability at high temperature.
- High accuracy.

Dis-advantages

- Low sensitivity.
- More Expensive.
- Affected by shock or vibration.

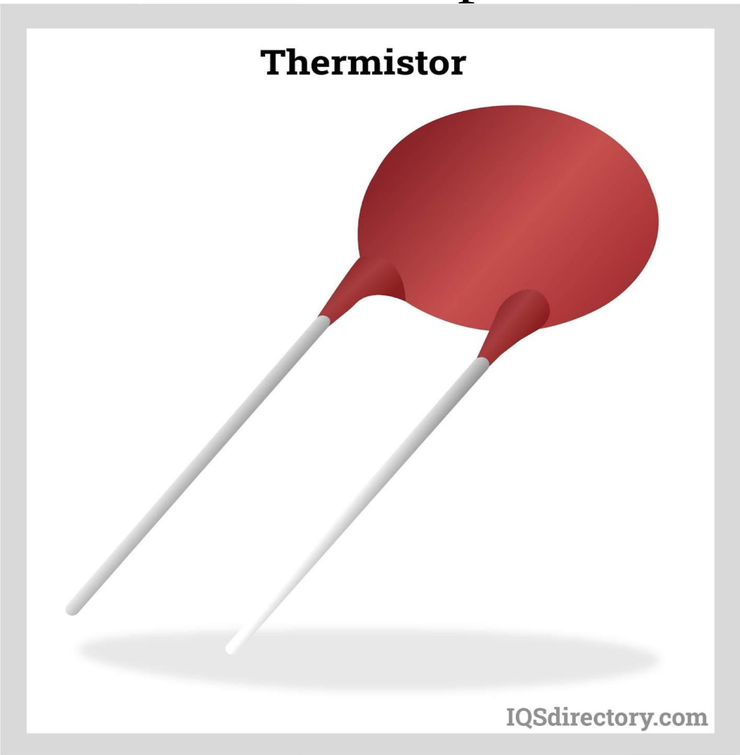
Thermocouple Sensor

- Thermocouple sensors have two wires made of different metals connected at two points. The voltage between the two wires reflects the change in temperature.



Thermistor Sensor

- This type of temperature sensor displays a change that is precise, predictable, and large in the alteration of different temperatures. With a change this large, it means that the reflection of the temperatures occurs rapidly and accurately.



Thermistor Sensor

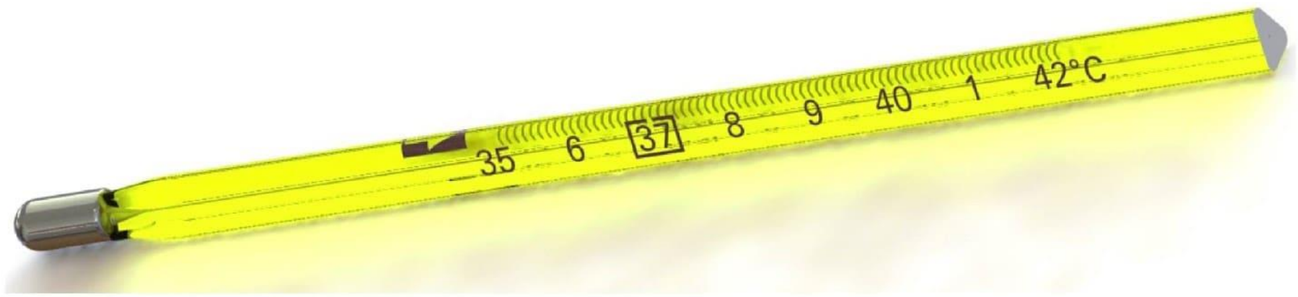
Advantages of thermistors

- Less expensive.
- More sensitive than other sensors.
- Fast response.
- Small in size.

Dis-advantages of thermistors

- Limited Temperature range.
- Resistance to temperature ratio correlation is non-linear.
- An inaccurate measurement may be obtained due to the self-heating effect.
- Fragile.

Thermometer



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Bi-Metal Thermometer

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Gas-filled and Liquid Thermometer

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Digital Thermometer

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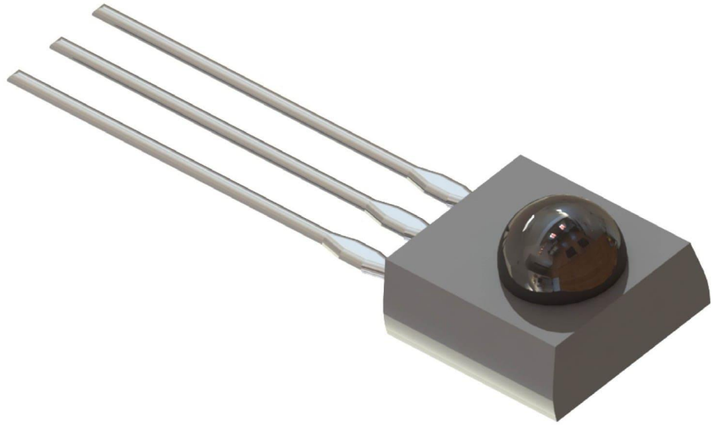
Infrared Sensors



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Thermal Imaging Camera For Body Temperature
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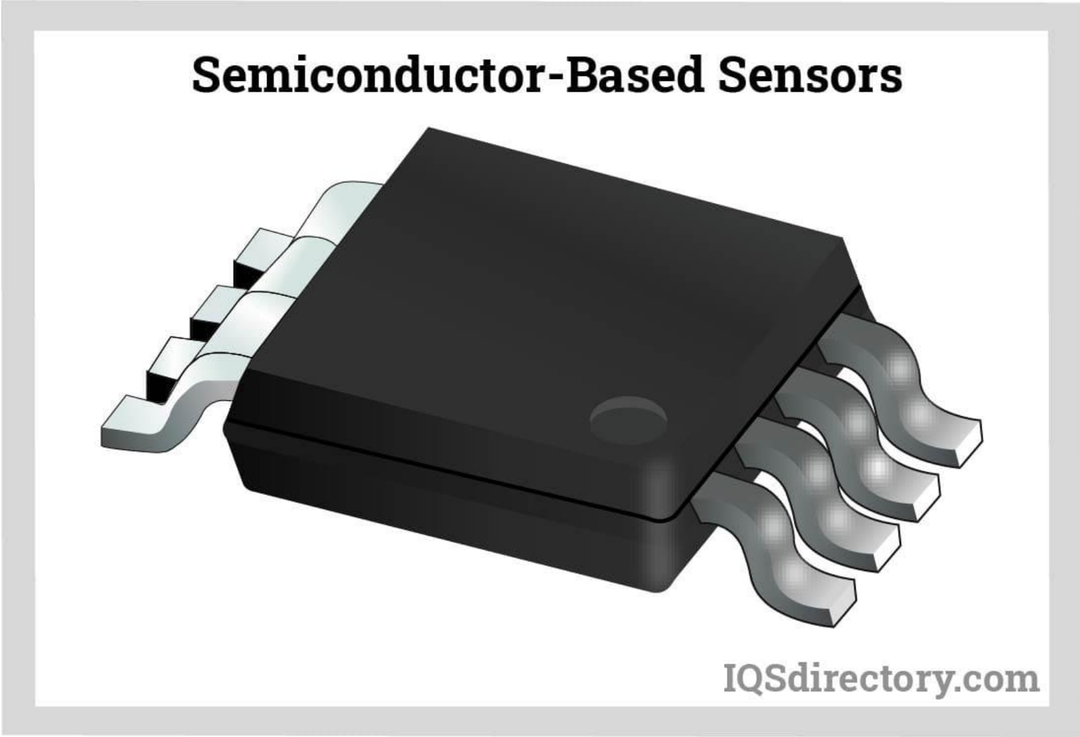
Semiconductor-Based Sensors
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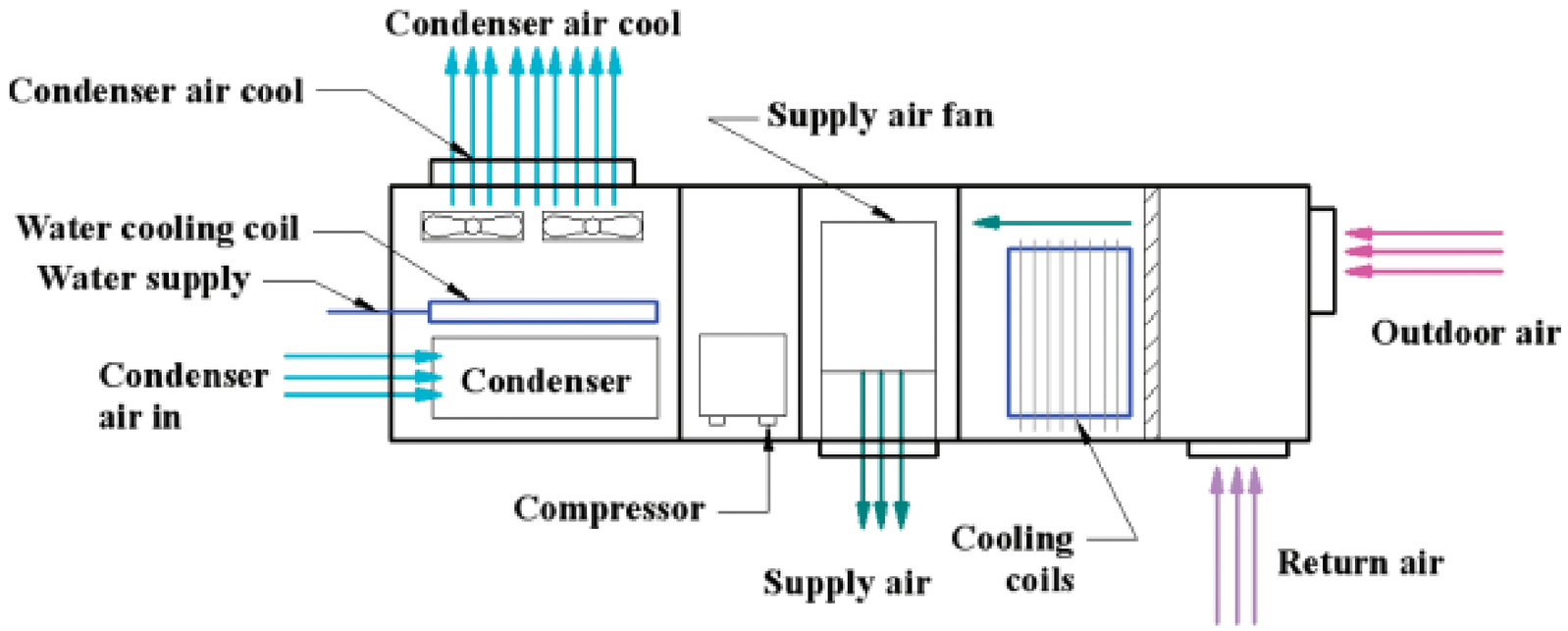
Assessment

1. Can you say this shown in fig. is the example of which method of HVAC?



References

1. Shengwei Wang, “ Intelligent Buildings and Building Automation”, Routledge 2010.
2. Reinhold A, Carlson Robert A, Di Giandomenico, “Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lightning, Building”, R. S Means company limited, 1st edition, 1991.

Thank You