TRINITY COLLEGE FOR WOMEN
NAMAKKAL
Department of Physics

INSTRUMENTATION

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What is Sensors?

A sensor is a device that detects and responds to changes in the physical environment, such as light, heat, or motion. Sensors convert these changes into a measurable output, such as a voltage, current, or resistance, which can be used for measurement or to operate a control.

Basic principle of Sensors

Sensing Principles

Sensors operate on different physical principles depending on the type of input and required application. Some key sensing principles include:

Mechanical

Sensors using deflection, stress, strain gauge, and changes in frequency or resistance of materials detect mechanical quantities

Thermal

Thermal sensors rely on temperature-dependent characteristics of materials to sense heat or cold. Examples are thermistors and thermocouples.

Electrical

Electric and electrochemical sensors use electrical properties and interactions to detect electric field, voltage, current, charge, and conductivity changes.

Magnetic

Sensors like magnetoresistors, Hall effect sensors, and compass utilize the magnetic field and flux density near magnetic materials.

Radiant

Light, infrared, and radiation sensing are based on photoconductivity, photoemission, and bolometric effects of materials on radiation exposure.

Chemical

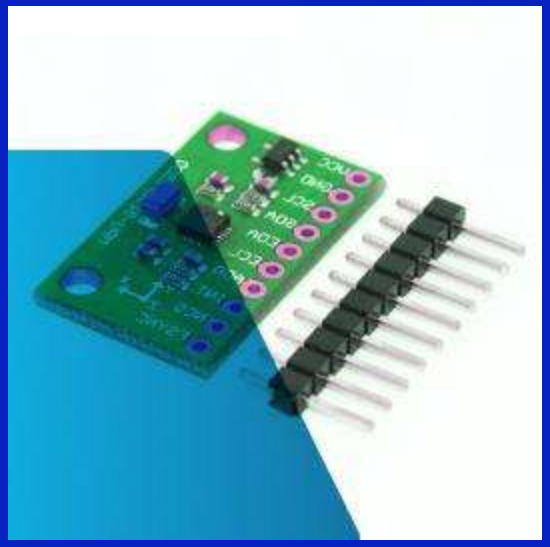
Chemical sensors use electrochemical reactions, selective membrane properties, or catalytic reactions for chemical detection. Ion-selective electrodes are a common example.

Different Types of Sensors

- Accelerometer Sensors
- Gyroscope Sensors
- Temperature Sensors
- Vision and Imaging Sensors
- Proximity Sensors
- Infrared Sensors (IR Sensors)
- Radiation Sensors
- Position Sensors
- Pressure Sensors
- Particle Sensors

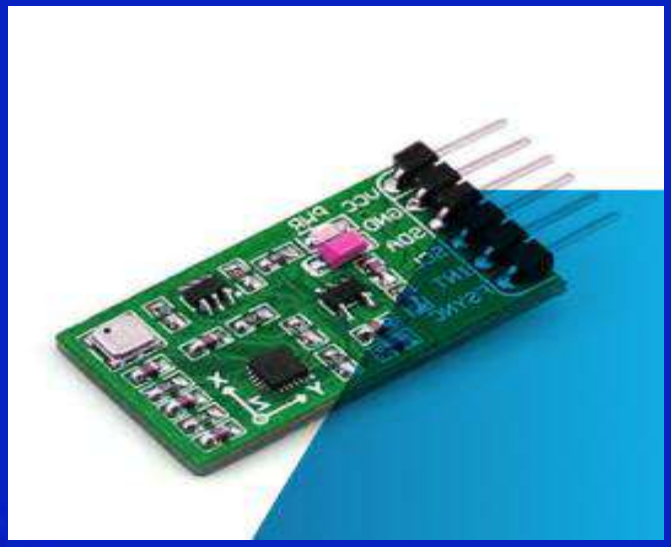
Accelerometer Sensors

These sensors work by measuring either static or dynamic acceleration through an electromechanical sensor. Usually, you can measure the displacement of a mass with a position-measuring interface circuit using these sensors. The accelerometer converts the displacement into a digital electrical signal for processing.



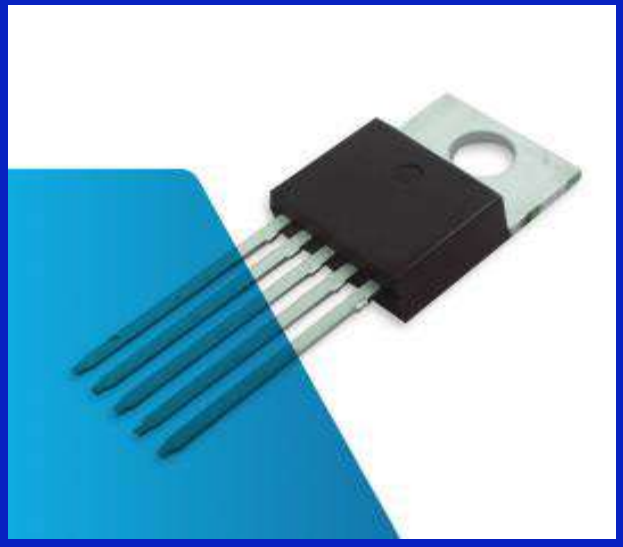
Gyroscope Sensors

A gyroscope sensor operates on the principle of angular momentum and gravity. It uses these forces to determine orientation and measure rotational motion. This type of sensor has a spinning rotor to provide angular momentum. Also, there is a set of gimbals or pivoted supports to allow the rotor to rotate about a single axis.



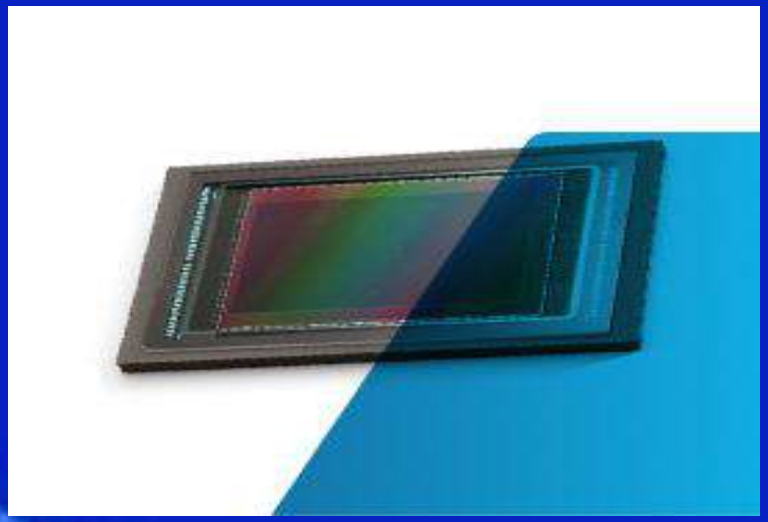
Temperature Sensors

Like the name, temperature sensors can detect thermal parameters. After detection, they provide signals to the inputs of used devices. However, these sensors are available in different types depending on their applications. Some technologies where you can use temperature sensors are AC and heating systems, microwaves, industrial machines, and aircraft.



Vision and Imaging Sensors

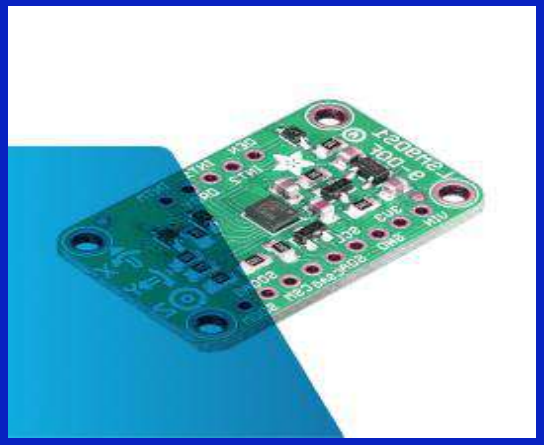
Vision sensors detect the presence of objects or colors within their fields of view. After that, they convert this information into a visual image for display. However, these sensors use a combination of image acquisition and image processing. They can perform multi-point inspections using a single sensor.



Proximity Sensors

Proximity sensors operate on various scientific principles to detect the presence or absence of objects without physical contact. They convert the detected information into an electrical signal.

You can find some common types of proximity sensors like capacitive, inductive, ultrasonic, optical, and acoustic sensors. However, the object’s surface color does not affect them. These sensors are applicable in a wide temperature range for versatile applications.

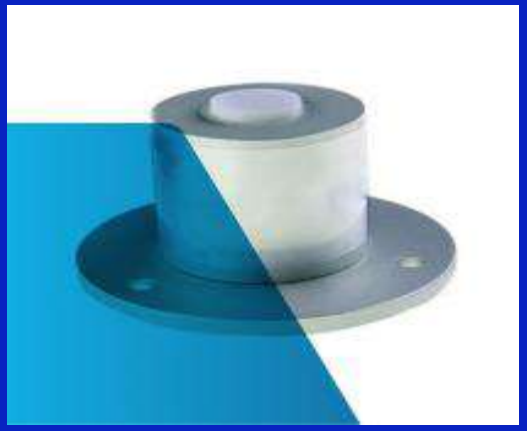


Infrared Sensors (IR Sensors)

Objects above absolute zero (0°) temperature emit heat energy in infrared radiation form. This is the core principle of IR sensors. Using these sensors, you can emit or detect infrared radiation to sense specific characteristics of their surroundings. It includes the motion and heat of the objects.

Radiation Sensors

You may know it as radiation detectors, too. These sensors measure radiation emissions or levels of radiation that a source produces.
Radiation sensors can detect different radiations like gamma and x-radiation. The uses of these sensors are present in tasks including measurement, protection, and search.



Pressure Sensors

These sensors work by following the principle of piezoresistance or piezoelectric effect. In this principle, a change in pressure leads to a change in electrical resistance or generation of an electrical charge.

Particle Sensors

Depending on the applications, these particle sensors are categorized into aerosol, solid, and liquid particle sensors. For instance, aerosol particle sensors can determine air quality. They can count and size the number of air particles. In food packaging, businesses use metal-based nano particles in their sensors.

What are the applications of Sensors?

Internet of Things

Sensors collect and process data about an environment, making it easier to monitor, manage, and control. sensors are used in homes, automobiles, airplanes, and industrial settings.

Process control

Sensors are often connected to a transmitter to condition or amplify their output.

Everyday life

Microphones, speakers, and webcams are all sensors that are an essential part of our lives.

There are many different types of sensors, including:

Temperature sensors, Strain gages, Load cells, LVDT sensors, Humidity sensors, Fluid velocity or flow sensors, Pressure sensors, Optical sensors, Position sensors, and Chemical sensors.

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Advantages of Sensors:

- Sensors can automate responsibilities and methods, growing performance and accuracy.
- Sensors may be used to screen situations and collect records in real-time, taking into account brief and knowledgeable choice-making.
- Sensors may be used to screen and manipulate structures remotely, permitting faraway operation and maintenance.
- Sensors may be used to enhance protection by detecting fuel line leaks or the presence of human beings or items in dangerous regions.
- Sensors may be used to preserve resources, adjust the construction temperature based totally on occupancy or turn off lighting while a room isn't in use.

Disadvantages of Sensors:

- Sensors may be expensive, in particular, if they're excessive-precision or specialized.
- Sensors may be fragile and can want to be covered from bodily harm or severe temperatures.
- Sensors may be tormented by interference from different sources, electromagnetic fields, or sensors.
- Sensors also require ordinary calibration to make certain accuracy.
- Sensors might also have restrained ranges, which means they'll no longer be capable of degree very excessive or very low values.

THANK YOU

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