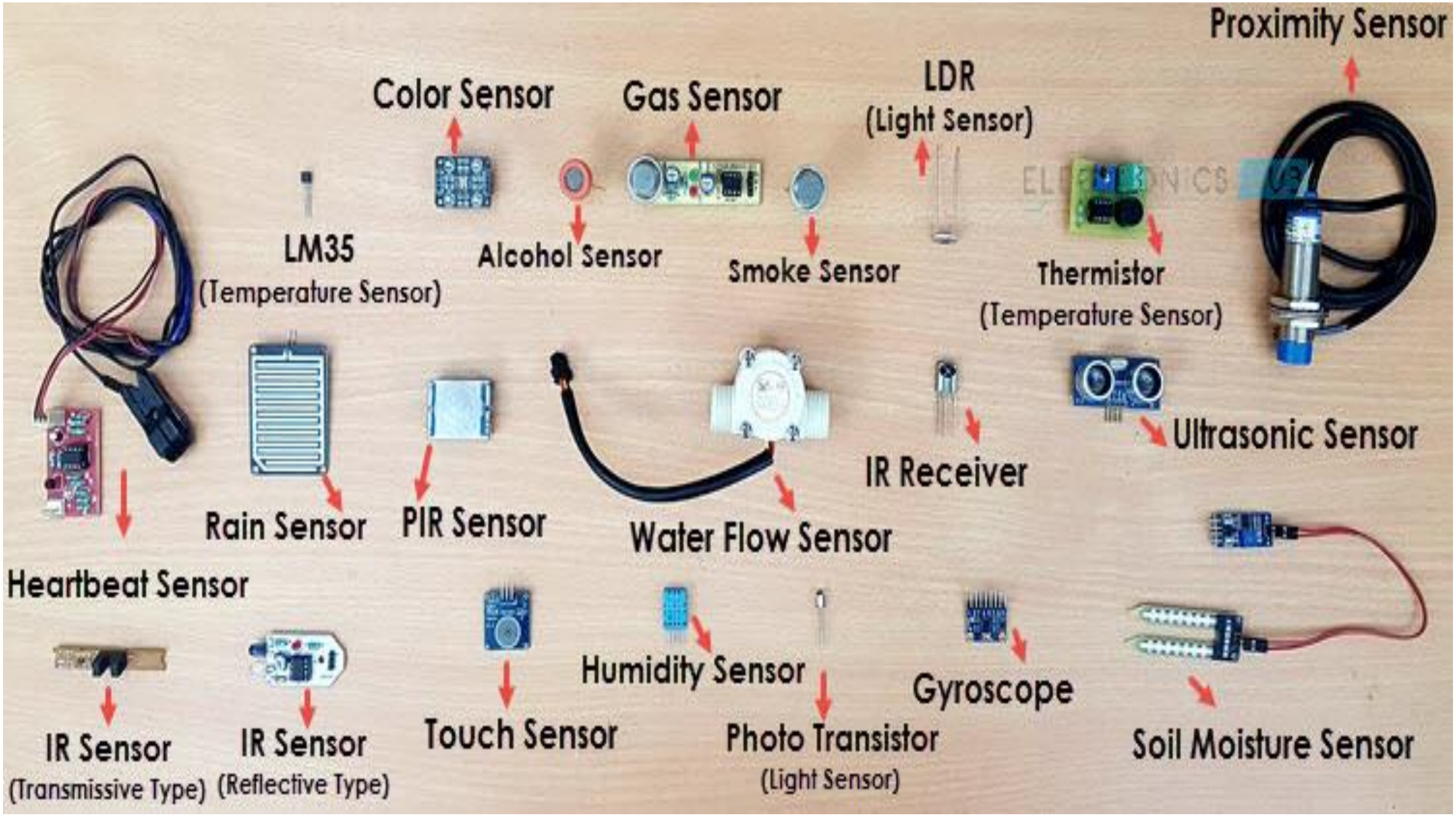
Sensor

Definition

- A sensor is a device that detects and responds to some type of input from the physical environment.

The input can be light, heat, motion, moisture, pressure or any number of other environmental phenomena.

- The output is generally a signal that is converted to a human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.


Proximity Sensor
Color Sensor
Gas Sensor
LDR
(Light Sensor)
LM35
(Temperature Sensor)
Alcohol Sensor
Smoke Sensor
Thermistor
(Temperature Sensor)
Ultrasonic Sensor
IR Receiver
Rain Sensor
PIR Sensor
Water Flow Sensor
Heartbeat Sensor
IR Sensor
(Transmissive Type)
IR Sensor
(Reflective Type)
Touch Sensor
Humidity Sensor
Photo Transistor
(Light Sensor)
Gyroscope
Soil Moisture Sensor

Analog Vs Digital Sensor

- Analog sensor reads physical attributes such as temperature, pressure, or sound level.

It typically outputs an analog electrical signal which can then be processed to interpret the measurement.

Example- Analog pressure sensor, sound sensor, temperature sensor, and light sensor (LDR)

- Digital sensors are physical sensors that measure a physical quantity and convert it into a usable digital signal.

They work by detecting changes in the environment, such as temperature, pressure, or sound waves, and converting this information into a digital format.

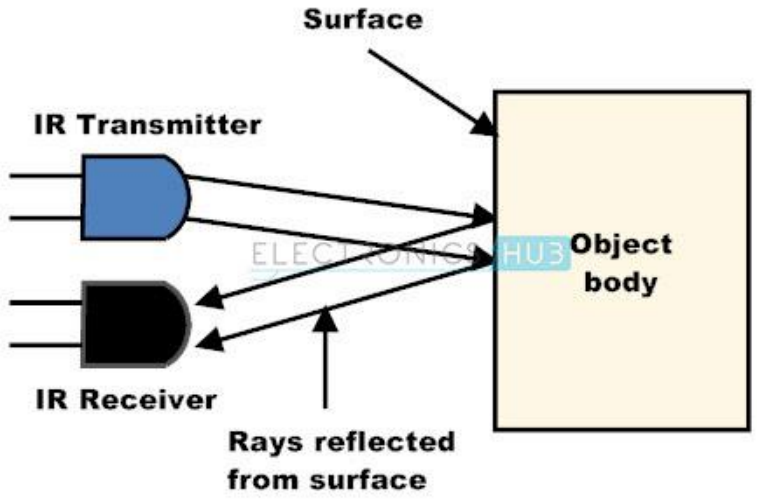
Infra Red (IR) Sensor

- IR sensor consists of two parts, emitter circuit and receiver circuit. This is collectively known as a photo-coupler or an opto-coupler.

- The emitter is IR LED and detector is IR photodiode.
- The IR photodiode is sensitive to the IR light emitted by an IR LED.

Principle:

The photodiode's resistance and output voltage change in proportion to the IR light received. This is the working principle of the IR sensor.



Types

There are several types of IR sensors, each with different characteristics and applications. Some common types include:

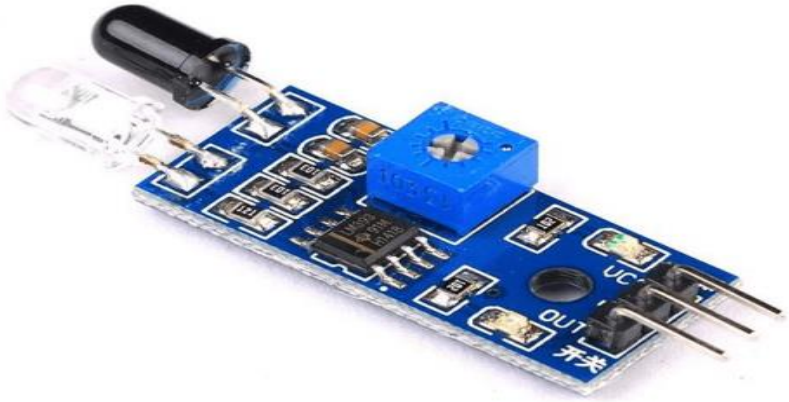
Passive Infrared (PIR) Sensor: To detect motion by sensing changes in infrared radiation. They are commonly used in security systems, lighting control, and automatic doors.

IR proximity Sensor: To detect presence of an object without making physical contact. They are commonly used in mobile devices, robotics, and automation systems.

IR Imaging sensor: These sensors use infrared radiation to create images, they are used in thermal imaging, night vision, and surveillance cameras.

IR temperature Sensor: It measures temperature of an object by detecting the infrared radiation emitted by it. They are used in industrial, HVAC, and medical applications.

Infra Red (IR) Sensor

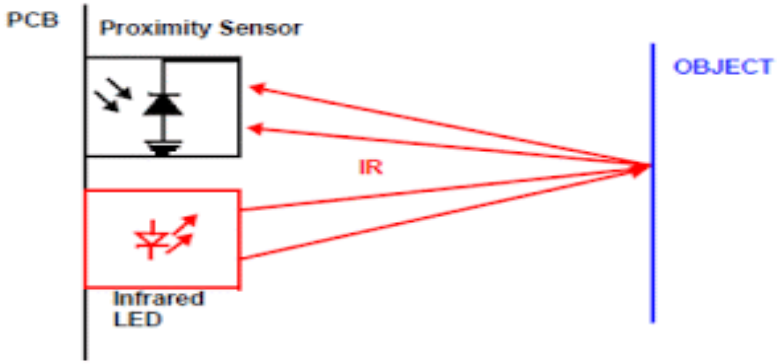


Features-

- Can be used for obstacle sensing, fire detection, line sensing, etc
- Input Voltage: 5V DC
- Comes with an easy to use digital output
- Can be used for wireless communication and sensing IR remote signals

IR Sensor have three Pins

1. VCC = +5V DC
2. GND
3. D0 or OUT (Digital Output)



Ultrasonic Sensor

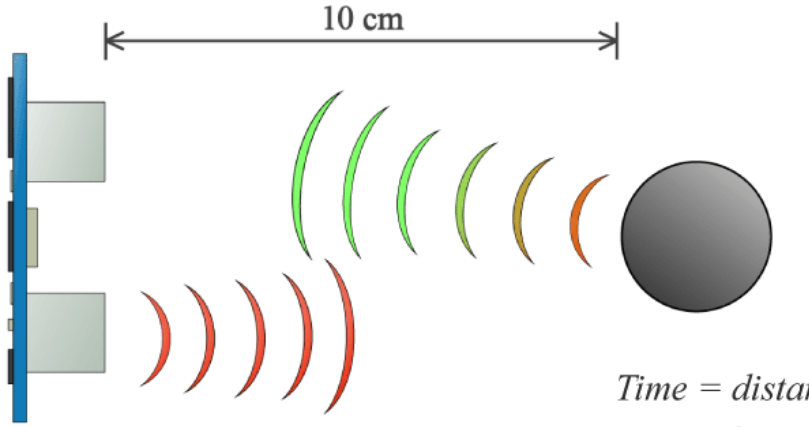
What is an Ultrasonic Sensor?

- An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves.
- Measuring distance is an essential factor in many applications such as robotic obstacle detection systems and vehicle detection.

Ultrasonic principle

- It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.
- By recording elapsed time between sound wave being generated and sound wave bouncing back.

$$distance = \frac{speed\ of\ sound\ \times time\ taken}{2}$$



speed of sound:

v = 340 m/s

v = 0,034 cm/µs

Time = distance / speed:

t = s / v = 10 / 0,034 = 294 µs

Distance:

s = t · 0,034 / 2

Working principle

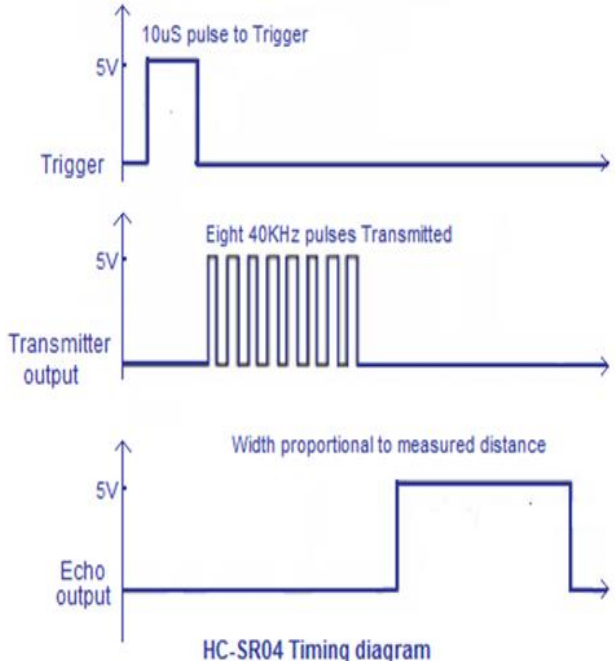
The Trig pin will be used to send the signal and

the Echo pin will be used to listen for returning signal

(1) Using IO trigger for at least 10us high level signal, Trig -> Pin-9 (o/p) of Arduino

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.



HC-SR04 Timing diagram

HC-SR04 Pinout

$$distance = \frac{speed\ of\ sound \times time\ taken}{2}$$

Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
MeasuringAngle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

Applications

- Used as a level sensors to detect, monitor, and control liquid levels in closed vessels (such as chemical plant drums).

- In medical industry, to detect the image of internal organs, identify tumours, and ensure the health of babies in the womb.

- Used as a proximity sensors and can be found in parking technology and anti-collision safety systems.

Temperature Sensor

What is Temperature Sensors?

- Temperature sensors are devices that detect and measure coldness and heat and convert it into an electrical signal.

- Temperature sensors are utilized in our daily lives, be it in the form of domestic water heaters, thermometers, refrigerators, or microwaves.

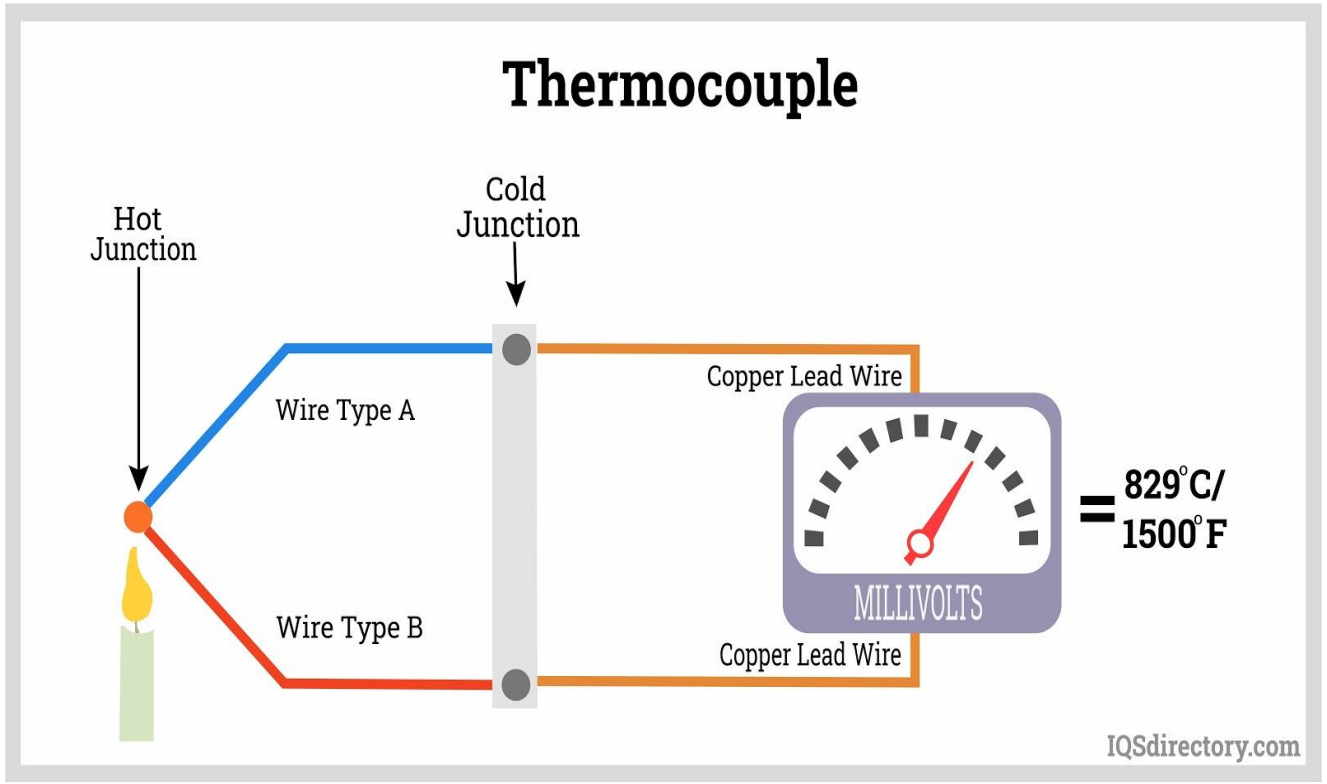
Types

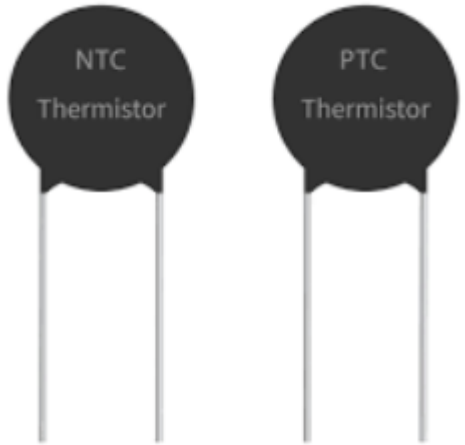
Types depends on mode of connection that includes contact and non-contact temperature sensors.

1. Contact temperature sensors- Direct contact with the object

Example- thermistors, thermocouples, resistance temperature detectors (RTD)

- Thermocouple- voltage difference is created by temperature difference between two dissimilar wires..
- Thermistors are typically made from ceramic or polymers and differ from thermocouples by measuring a resistance change.
- RTD are similar to thermistors and are often made of platinum.


Thermocouple
Hot Junction
Cold Junction
Wire Type A
Wire Type B
Copper Lead Wire
Copper Lead Wire
MILLIVOLTS
= 829°C/ 1500°F
IQSdirectory.com


NTC Thermistor
PTC Thermistor

2. Non-contact temperature sensors- Measure the degree of hotness or coldness from the radiation that is emitted by the heat source.

Example- optical pyrometers, radiation thermometers, thermal imagers, and fiber optic sensors.

Optical pyrometers - Optical system and a detector, measuring temperatures that are too bright to see with the naked eye.

Radiation thermometers- Measure the radiation emitted from an object to gauge temperature differences.

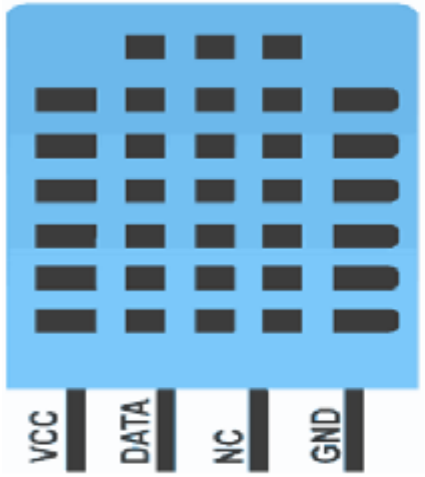
Fiber-optic temperature sensors are variants of radiation thermometers.

Radiation is sensed by an active sensing device, and the system processes and converts it into a temperature readout.

Example-

DHT11 Sensor :

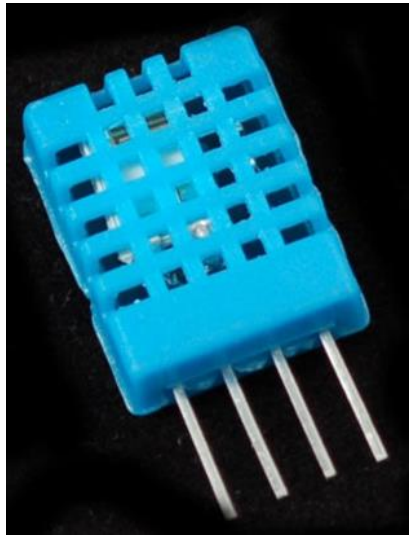
- DHT11 sensor measures and provides humidity and temperature values serially over a single wire.
- It can measure relative humidity in percentage (20 to 90% RH) and temperature in degree Celsius in the range of 0 to 50°C.
- It has 4 pins; one of which is used for data communication in serial form.
- DHT11 sensor uses resistive humidity measurement component, and NTC temperature measurement component.



Pin diagram of DHT11

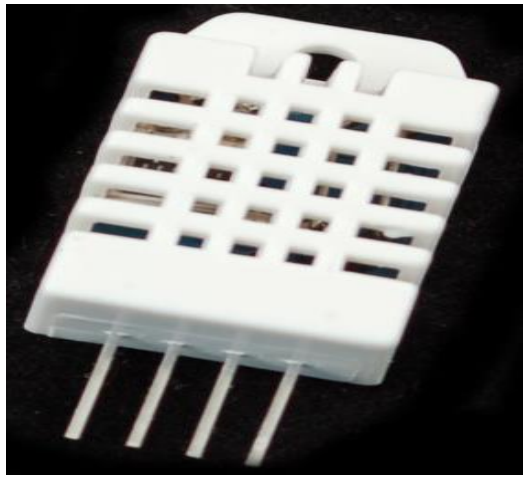
Pin No.	Pin Name	Pin Description
1	VCC	Power supply 3.3 to 5.5 Volt DC
2	DATA	Digital output pin
3	NC	Not in use
4	GND	Ground

DHT11 Specifications



- Ultra-low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 20-80% humidity readings with 5% accuracy
- Good for 0-50°C temperature readings ±2°C accuracy

DHT22 Specifications



- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 0-100% humidity readings with 2-5% accuracy
- Good for -40 to 125°C temperature readings ±0.5°C accuracy