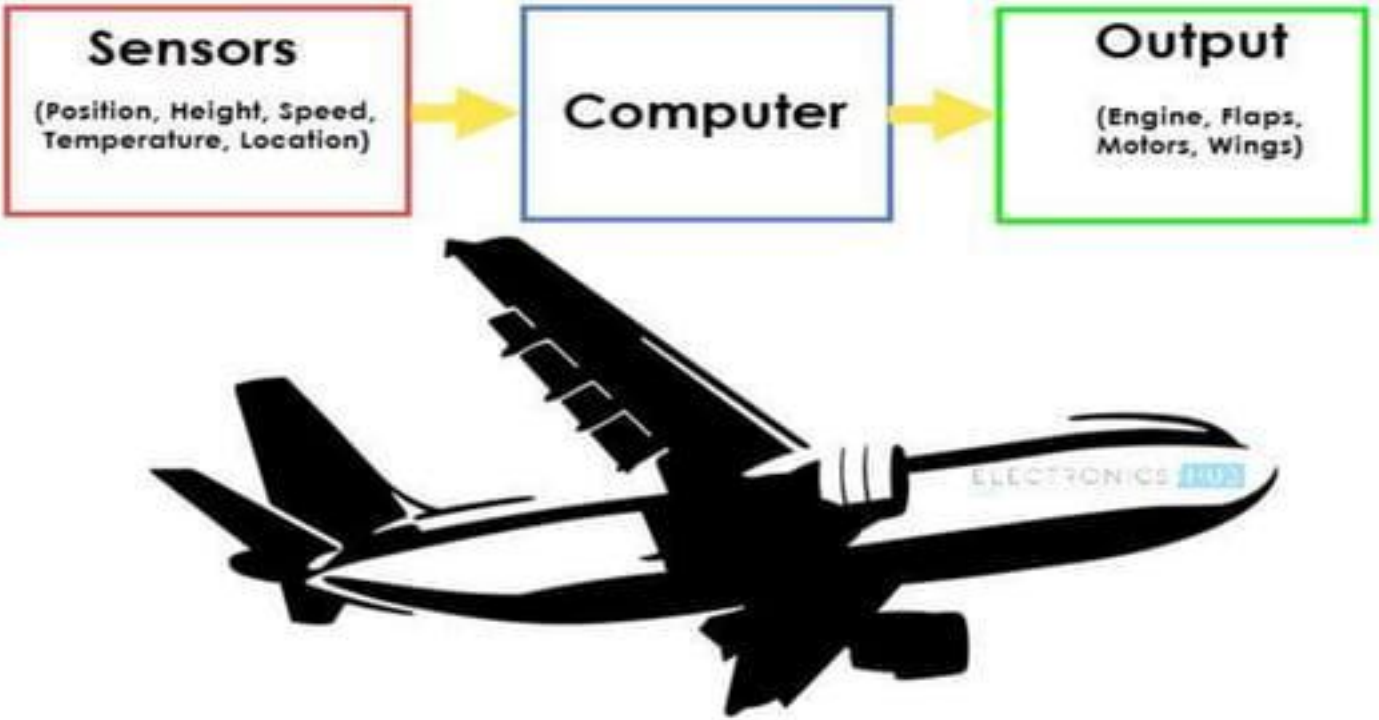
Real Time Application of Sensors

Autopilot System in aircrafts



An Automatic Flight Control System consists of several sensors for various tasks like speed control, height, position, doors, obstacle, fuel, maneuvering and many more. A Computer takes data from all these sensors and processes them by comparing them with pre-designed values.

The computer then provides control signal to different parts like engines, flaps, rudders etc. that help in a smooth flight. The combination of Sensors, Computers and Mechanics makes it possible to run the plane in Autopilot Mode.

All the parameters i.e. the Sensors (which give inputs to the Computers), the Computers (the brains of the system) and the mechanics (the outputs of the system like engines and motors) are equally important in building a successful automated system.

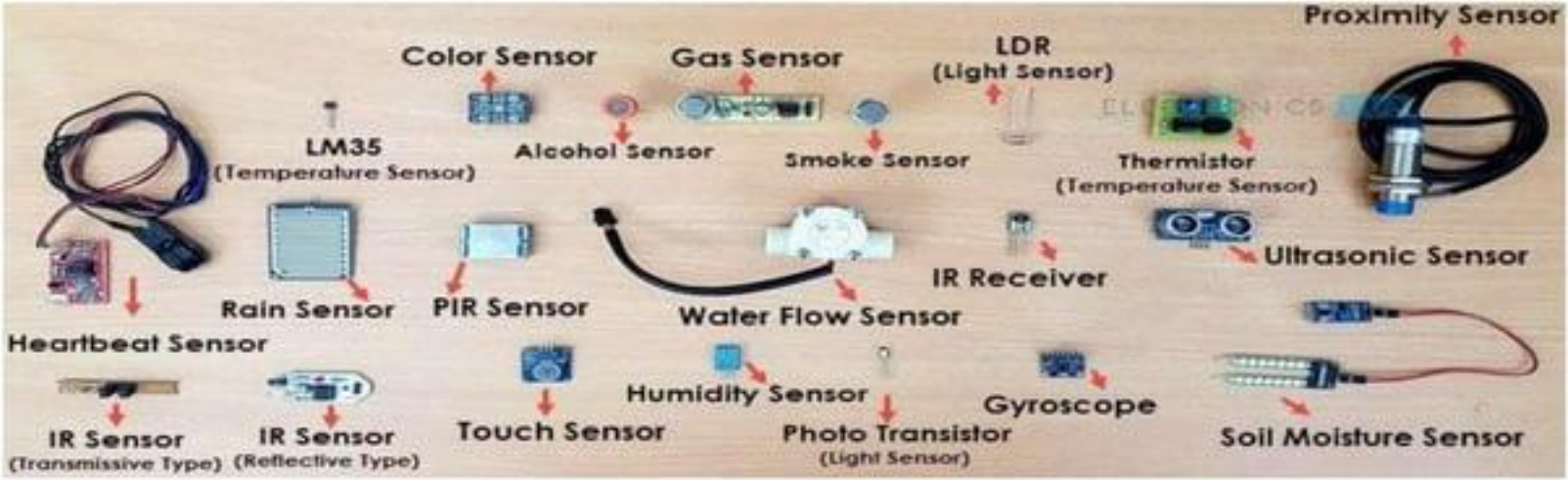
What is a Sensor?

- Sensor as an input device which provides an output (signal) with respect to a specific physical quantity (input).
- The term "input device" in the definition of a Sensor means that it is part of a bigger system which provides input to a main control system (like a Processor or a Microcontroller).
- Another unique definition of a Sensor is as follows: It is a device that converts signals from one energy domain to electrical domain

Example of a sensor is an LDR or a Light Dependent Resistor

It is a device, whose resistance varies according to intensity of light it is subjected to. When the light falling on an LDR is more, its resistance becomes very less and when the light is less, well, the resistance of the LDR becomes very high.

We can connect this LDR in a voltage divider (along with other resistor) and check the voltage drop across the LDR. This voltage can be calibrated to the amount of light falling on the LDR. Hence, a Light Sensor.



Classification of Sensors

- In the first classification of the sensors, they are divided in to Active and Passive. **Active Sensors** are those which require an external excitation signal or a power signal.
- **Passive Sensors**, on the other hand, do not require any external power signal and directly generates output response.
- The final classification of the sensors are **Analog and Digital Sensors. Analog Sensors** produce an analog output i.e. a continuous output signal with respect to the quantity being measured.
- **Digital Sensors,** in contrast to Analog Sensors, work with discrete or digital data. The data in digital sensors, which is used for conversion and transmission, is digital in nature.

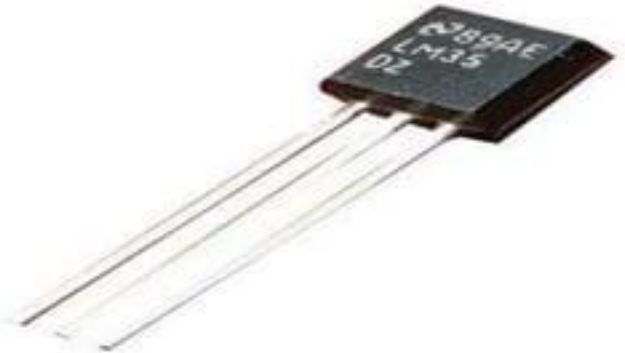
Different Types of Sensors

All these sensors are used for measuring one of the physical properties like Temperature, Resistance, Capacitance, Conduction, Heat Transfer etc.

- Temperature Sensor
- Proximity Sensor
- Accelerometer
- IR Sensor (Infrared Sensor)
- Pressure Sensor
- Light Sensor
- Ultrasonic Sensor
- Smoke, Gas and Alcohol Sensor
- Touch Sensor
- Color Sensor
- Humidity Sensor
- Tilt Sensor
- Flow and Level Sensor

Temperature Sensor

- One of the most common and most popular sensor is the Temperature Sensor. A Temperature Sensor, as the name suggests, senses the temperature i.e. it measures the changes in the temperature. Temperature Sensor, the **changes in the Temperature** correspond to **change in its physical property like resistance or voltage.**
- **Thermistor**
- **Thermocouple**
- A **thermistor** can be used to ***detect the variation in temperature.*** It has a negative temperature coefficient that means when the temperature increases the resistance decreases. So, the thermistor's resistance can be varied with the rise in temperature which causes more current flow through it.



LM35 - Temperature Sensor IC

10KΩ NTC Thermistor

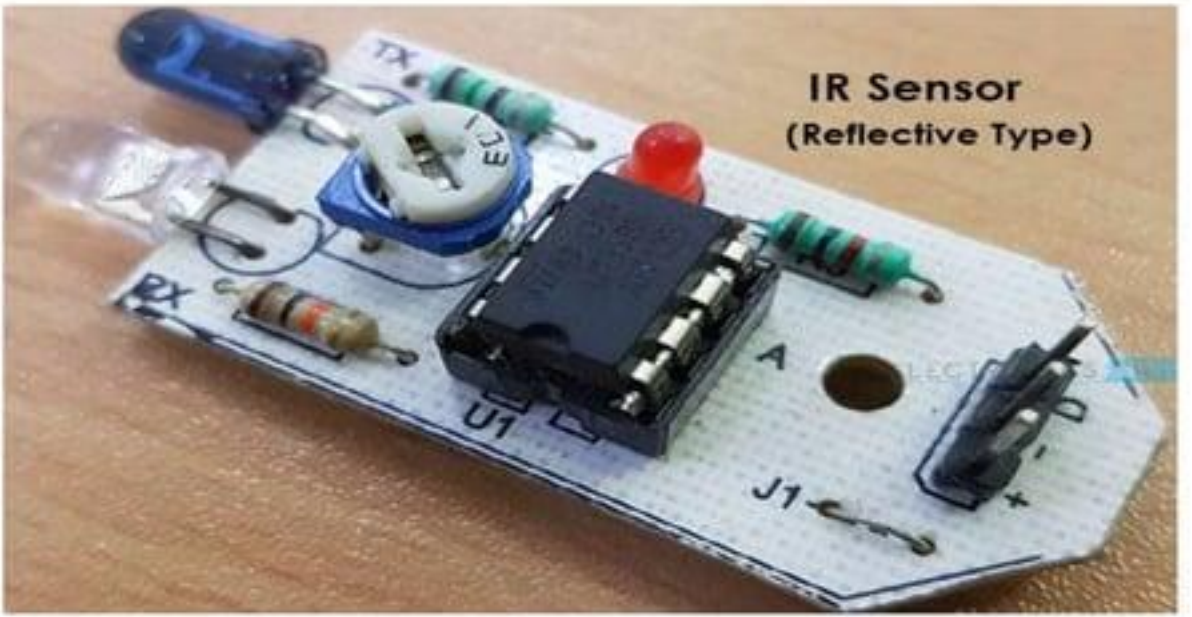
- Another component that can ***detect the variation in temperature*** **is a thermocouple.** In its construction, two different metals are joined together to form a junction
- **LM35** is a Celsius scale temperature sensor device with its output directly proportional to the temperature. LM35 can measure temperatures in the range of -55^{0}C to +150^{0}C

Proximity Sensors

- A Proximity Sensor is a non-contact type sensor that detects the presence of an object. Proximity Sensors can be implemented using different techniques like Optical (like Infrared or Laser), Ultrasonic, Hall Effect, Capacitive, etc.
- Some of the applications of Proximity Sensors are Mobile Phones, Cars (Parking Sensors), industries (object alignment), Ground Proximity in Aircrafts, etc.

Infrared Sensor (IR Sensor)

- IR Sensors or Infrared Sensor are light based sensor that are used in various applications like Proximity and Object Detection. IR Sensors are used as proximity sensors in almost all mobile phones.
- There are two types of Infrared or IR Sensors: **Transmissive Type and Reflective Type.**
- In **Transmissive Type IR Sensor**, the IR Transmitter (usually an **IR LED**) and the **IR** Detector (usually a Photo Diode) are positioned facing each other so that when an object passes between them, the sensor detects the object.
- The other type of IR Sensor is a **Reflective Type IR Sensor**. In this, the transmitter and the detector are positioned adjacent to each other facing the object. When an object comes in front of the sensor, the sensor detects the object.
- Different applications where IR Sensor is implemented are Mobile Phones, Robots, Industrial assembly, automobiles etc.


IR Sensor
(Reflective Type)
TX
RX
U1
J1
A
+
-

Ultrasonic Sensor

- An Ultrasonic Sensor is a non-contact type device that can be used to measure distance as well as velocity of an object. An Ultrasonic Sensor works based on the properties of the sound waves with frequency greater than that of the human audible range.
- There are two kind of an ultrasonic sensor is, "**active ultrasonic sensor**" and "**passive ultrasonic sensors**". An active ultrasonic sensors generates the high frequency sound wave to receive back the ultrasonic sensor for evaluating the echo. But, passive ultrasonic sensors are just used for detecting ultrasonic noise which is present under specific conditions.
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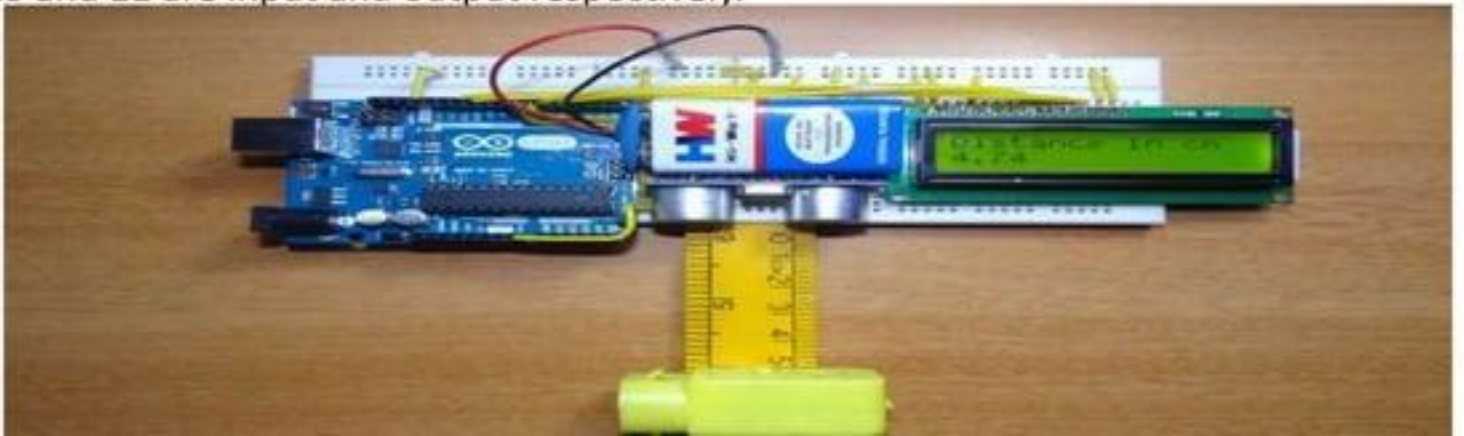
Ultrasonic Sensor

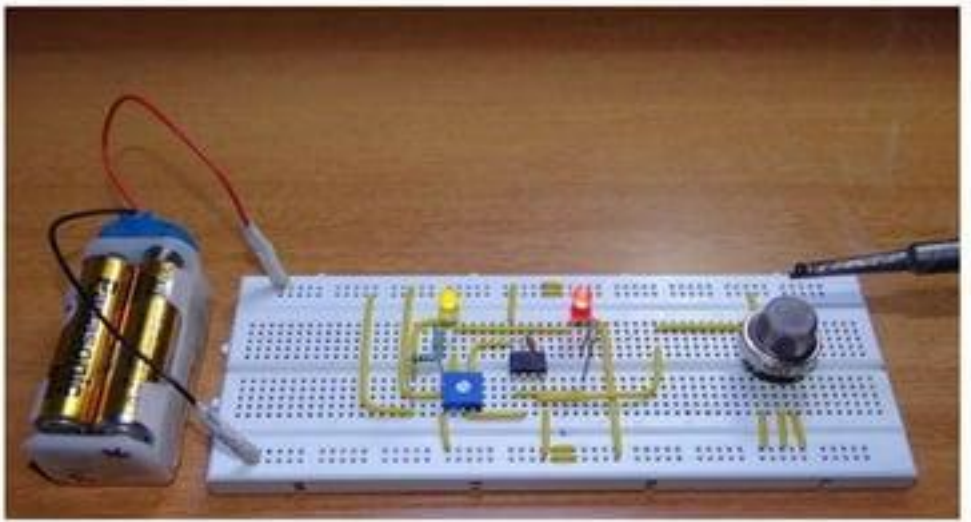
- Ultrasonic means nothing but the range of the frequencies. Its range is greater than audible range (>20 kHz)
- This ultrasonic sensor is ***used to calculate the distance between the ultrasonic transmitter and the target and also used to measure the velocity of the target.***
- **Ultrasonic sensor HC-SR04** can be used to measure distance in the range of 2cm-400cm with an accuracy of 3mm.
- The 4 pins of Ultrasonic sensor are Vcc, Gnd, Trig and Echo. Trig is connected to Pin 11 of Arduino and Echo is connected to Pin 10. With respect to Arduino, Pins 10 and 11 are input and output respectively.



Chemical/Smoke and Gas Sensor

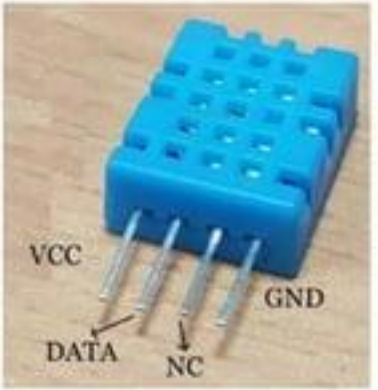
- smoke and gas detector is a gadget that sense gas, smoke and typically it's an indicator of fire. Now a days all security devices using this sensor to passing signal to fire alarm to control panel. Household smoke detector is also known as smoke alarm, most of the device manufacturer using audible or visual alarm system in security devices that detect automatically.

1 = Output
2 = Vcc (positive voltage)
3 = Gnd



humidity sensor

- A humidity sensor (or hygrometer) senses, measures and reports both **moisture and air temperature**. The ratio of moisture in the air to the highest amount of moisture at a particular air temperature is called **relative humidity(RH)**. Relative humidity becomes an important factor when looking for comfort.



LDR(LIGHT DEPENDENT RESISTOR)

- A light dependent resistor (LDR) or a photo resistor or photocell is a light controlled variable resistor . Its resistance changes with Light intensity that falls on it.
- • The resistance of a photo resistor decreases with increasing Incident light intensity . In other words , it exhibits photoconductivity.
- • The resistance range and sensitivity of a photoresistor can substantially differ among dissimilar devices.
- They are made up of semiconductor materials having high resistance.
- Photocells or LDRS are non linear devices. There sensitivity varies with the wavelength of light incident on them.
- Some photocells might not at all response to a certain range of wavelength.

Motion detection sensors

- A motion detector is an electronic device which is used to detect the physical movement (motion) in a given area and it transforms motion into an electric signal; motion of any object or motion of human beings.
- These are primarily used for intrusion detection systems, automatics door control, boom barrier, smart camera (i.e motion based capture/video recording),toll plaza, automatic parking systems, automated sinks/toilet flusher, hand dryers, energy management systems(i.e. Automated Lighting, AC, Fan, Appliances Control) etc.
- **Following are key motion sensor types widely used:**
- **Passive Infrared (PIR):** It Detects body heat (infrared energy) and the most widely used motion sensor in home security systems.
- **Ultrasonic:** Sends out pulses of ultrasonic waves and measures the reflection off a moving object by tracking the speed of sound waves.
- **Microwave:** Sends out radio wave pulses and measures the reflection off a moving object. They cover a larger area than infrared & ultrasonic sensors, but they are vulnerable to electrical interference and more expensive.

What is a Sound Sensor?

- The sound sensor is one type of module used to notice the sound. Generally, this module is used to detect the intensity of sound.
- This sensor employs a microphone to provide input to buffer, peak detector and an amplifier. This sensor notices a sound, & processes an o/p voltage signal to a microcontroller. After that, it executes required processing.
- Pin1 (VCC): 3.3V DC to 5V DC
- Pin2 (GND): This is aground pin
- Pin3 (DO): This is an output pin