Introduction to Internet of Things.

- **IOT :** It is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or external environment

- **IOT Applications :-**

1> **Disaster Monitoring :-** → Detecting forest fires - by smoke and temperature censor.
→ Detecting floods - by water level censar
→ Earthquakes, Landslides, volcanic erruptions - it senses vibrations / radiation.

2> **Structural Monitoring :-** Ex- Bridges, Buildings, Pipes - it sense vibration, stress, strain, pressure.
Pipes - it monitor deposition of dirt particles at surface.

3> **Military and Security :-** If terrorist came on border, human produce thermal senses - by thermal & infrared censor. and camera censor (to detect who is entering).

4> **Health Care :-** It have many censor to detect different body parts like nose ring censor - to check asthma, watch censor - for pulse rate and many more.
- If any prob. occur, notification goes to doctor & ambulance.

5> **Precision Agriculture :-** Censors for smart Agrigation system.
Ex- Temperature censor, humidity censor, soil moisture censor.
- Automatic irrigation by using water valve, it check disease in crops.

6> **Traffic Vigilance** - To avoid traffic Jams.
(RSU) - Road site unit → camera censor at Road side poles.
↳ it sense speed and everything of vehicle.
Ultrasonic censor → it sense distance between 2 objects.
canny edge detector → convert image into black & white and detect only edges.

- Post crash notification
- Road hazard control notification.
- Electronic toll collection.
- Parking availability.

→ Value- added Advertisements :- This censor give nearby crossing people notification about facility (advertisement)

7) Smart Home : Smart Lightening

→ Tank-level → when tanks fills up it automatically turns off and when level is low → it turns on.

8) Smart City :-
Smart Parking, smart lightening, waste management, smart Grid

- **Characteristics :-**

1) Efficient, scalable.
2) Unambiguous (unique) naming & addressing.
3) Abundance of sleeping nodes, mobile & non-IP devices
4) Intermittent connectivity → it gives connectivity sometimes not all the time.

- **IOT v/s M2M**

→ **M2M** → communication & interaction b/w machines and devices. and can occur by <u>cloud computing</u> infrastructure.

→ It offers the means for managing devices & devic. interaction & collect machine or sensor data.

→ Introduced by telecommunication services providers. & emphasize on machine interactions via (3G, 4G, satelite).

IOT → It has broader scope than M2M. It can interact b/w devices, things & people, things with application &.
                                     and people

→ Includes notion of internet connectivity; but it is not necessarily focused on the use of telecom networks.

- **Sensor** :- A sensor detects (sense) changes in ambient conditions or in the state of another device/system. & forwards/process this information in certain manner.

  → It detects/measure physical property and records, indicates, or responds to it.

  - **Exam** → Temp. sensor : It converts heat into electrical signal. and atmospheric pressure is converted to electrical signal in a barometer.

- **Transducers** : They convert energy of one kind into another. Example: In sound system, <u>microphone</u> (i/p device) converts sound wave into electrical signals for amplifier to process <u>loudspeaker</u> converts electrical signals back into sound waves.

- **Sensor v/s Transducer**

  → 'Transducer' is collective term used for both.

  → Sensor which can be used to sense wide range of diff. energy forms like movement, electrical signals, radiant, thermal, etc

  → Actuators - used to switch voltages or currents.

<u>Note:</u> (Sensor features):- 1) It is only sensitive to measured property

2) And, insensitive to any other property likely to be encountered.

3) It does not influence (change) the measured property..

- **Sensor Resolution**

1) Resolution is the smallest change it can detect in the quantity that is measuring.

2) Resolution of sensor with digital output is usually the smallest resolution.

3) The more is the resolution, the more accurate is its precision.

* Sensor & Transducer both convert 1 form of energy to other

- **Sensor Types**

Based on output	Based on Data Types
Analog Digital	Scalar Vector/multimedia

1) Analog sensor :-

→ It produce continuous o/p signal or voltage. which is generally proportional to quantity being measured.

Such physical quantity are :- Temp, Speed, pressure, displacement, etc.

Ex → Thermometer or Thermocouple → measure temp of liquid (Greysers).

2) Digital Sensor :- non-continous.

→ It produce descrete digital o/p signals or voltage

→ Digital sensor produce binary o/p signal like(0 or 1) (ON or OFF).

o/p → Single 'bit' (serial transmission) or Byte (parallel transm)

3) Scalar Sensors :- p

→ It produce o/p signal which is α to magnitude of quantity measured.

→ Physical quantities like temp, color, pressure, etc → only magnitude. (irrespective of direction). Ex→ thermometer.

4) Vector Sensor :-

→ It produce o/p which is prop. to magnitude, direction & orientation.

→ Physical quantities like sound, image, velocity, accelaration.

- **Deviations :**

1) **Sensitivity Error:** Sensitivity of sensor under real condition may differ from the value specified.

2) **Offset Error or Bias :** When o/p signal differs from the correct value by constant.

3) __Drift Error__ : If o/p signal slowly changes independent of measured property. [long term drift- cause by physical changes in sensor].

4) __Noise Error__ : It is random variation of signal varies in time.

5) __Quantization Error__ : If o/p is approx. of measured property.

6) __Hysteresis Error__ : If o/p varies depending on previous input values.

• __Actuator__

Actuator is component of machine or system that moves or control the mechanism or system

→ It requires control signal and source of energy by which it acts upon environment

→ When control signal are received, actuator convert energy into mechanical motion

• __Types of Actuators :-__

1) Hydraulic   2) Pneumatic   3) Electrical
4) Thermal/magnetic   5) Mechanical.

1) __Hydraulic actuators.__

→ It consists of cylinder that uses hydraulic power to facilitate mechanical operation

→ Mechanical motion is converted to linear, rotary, oscillatory

→ liquids are nearly impossible to compress, hydraulic actuator exerts considerable force.

→ Actuator's limited acceleration restricts its usage.

- # Sensors

1) **PIR Motion Sensor :-** (Passive Infrared Detection)

→ To detect motion of human movement.

⇒ It is made up of pyroelectric sensor - detect levels of infrared radiation.

⇒ Everything emits low level radiation, more hot → more radia. Sensor in motion detector split in 2 halves :-(2 slots)

★ If one half sees more or less IR radiation than the other, the output will swing high or low.

⇒ When sensor is idle, both slots detect same amt. of IR. (ambient amt. radiated from room, walls).

⇒ When warm body (human,etc) passes by, it first intercepts one half of PIR sensor, cause +ve differential change and -ve when warm body leaves area.

Note:- It have 5V-12V i/p power supply & sense upto 6 meters and give Digital high pulse (3V when triggered.

2) **IR Sensor :-**

→ To detect object using Infrared light.

- It is good for detection b/w 100cm - 500cm.

⇒ Active Infrared sensors consist of 2 elements :-

(a) Infrared source (include LED or infrared laser diode).

(b) Infrared detector (include photo diodes or photo transistors)

⇒ Energy emitted by infrared source is reflected by an object on the infrared detector.

IR Transmitter

Object

IR Receiver
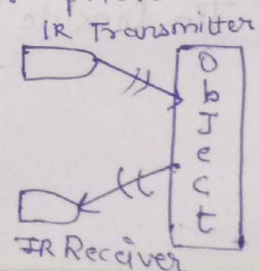
3) Ultrasonic Distance Sensor :-

→ To measure how far you from object using sound waves (echolocation).

⇒ Sensor provides very short (2 cm) to long (4m) detection and ranging.

⇒ It provides precise and stable non-contact distance measurements (2cm - 4m) with very high accuracy.

4) MQ2/3 Sensor :-

→ To detect gas leakage by the Grove - Gas sensor (MQ2)
↓
(H_2 , LPG , CH_4 , CO , Alcohol , smoke , propane).

⇒ Measurements can be taken soon due to its high sensitivity and fast response time.

⇒ The Sensor is enclosed in 2 layers of stainless steel mesh called Anti - explosion network. As we sensing flammable gas, it ensure heater element inside sensor won't cause explosion.

⇒ It also provides protection for sensor and filters out suspended particles , so that only gaseous elements are able to pass inside chamber.
The mesh is bound to rest of body via copper plated ,

⇒ The tubular sensing element is made up of (Al_2O_3) based ceramic & has coating of (SnO_2).
(Tin Dioxide is sensitive towards combustible gases).

★

Sensor Name	Gas to measure
MQ-2	Methane, Butane, LPG, smoke,
MQ-3	Alcohol, Ethanol, smoke
MQ-4	Methane, CNG Gas
MQ-5	Natural gas, LPG
MQ-6	LPG, Butane
MQ-7	Carbon Monoxide
MQ-8	Hydrogen Gas

Note :- It detect gases in conc. of range (200 - 10000 ppm) using 5 DVDC voltage to give o/p Digital / Analog

5) DHT Temperature & Humidity sensors :-

→ DHT sensor made of 2 parts :- capacitive humidity & thermistor.

→ It is very basic chip that does some analog to digital conversion and spits out digital signal with temp. & humidity

DHT11	DHT22
i) Ultra low cost	i) Low cost
ii) 3 - 5V power and I/O	ii) same,
iii) 2.5 mA → max. current use during conversion	iii) same,
iv) Good for 20-80% humidity readings with ±5% accuracy.	iv) Good for 0-100% humidity with 2-85% accuracy
v) Good for 0-50°c temp. readings ±2°c accuracy	v) Good for -40 to 125°c temp with ±0.5°c accuracy.
vi) No more than 1Hz sampling rate.	vi) No more than 0.5 Hz
vii) Body size : 15.5 mm x12 mm x5.5	vii) Body size : 15.1 mm x 25mm x 7.7
viii) 4 pins with 0.1" spacing	viii) same