fundamentals of Internet of Things-* (FIOT)

Q. What is FIOT?

* **FIOT:-** It means fundamentals of internet of things.

* **IoT:-** The electronic appliances or devices or components, or objects which are connected to internet and communicating with each other aswell as exchanging the data. over the internet. is called 'internet of things'.

* **Data:-** A raw and unprocessed data, figures or facts, which are inferred from IoT devices or Systems.

* **Information:-** which is inferred by processing the data.

* **Knowledge:-** Knowledge is interred from information by understanding it.

⊞ By using knowledge we can achieve specific goals.

* **Applications:-**

① **Smart home System :** IoT enables automation and remote control of home appliances.

② **Smart Cities:-** IoT sensors and data Analytics optimise traffic flow, waste management, energy usage, public safety, creating more livable and sustainable cities.

③ **Aggri culture Monitoring:-**

IoT sensors monitor soil moisture, temperature, and Crop health, reducing waste, and improving crop yields.

✳. Characterstics of IOT :-

①. Inter Connectedness :- Iot Systems and devices are connected each other and to the internet, enabling data exchange, communication, and colloboration.

②. Autonomy :- Iot devices can operate idependently, making decisions and taking decisions on sensor data, algorithms, and programming.

③ Real time data collection and Analysis

It will collect the data from sensors and works on it by analysing, exploring immidiate insights and taking actions.

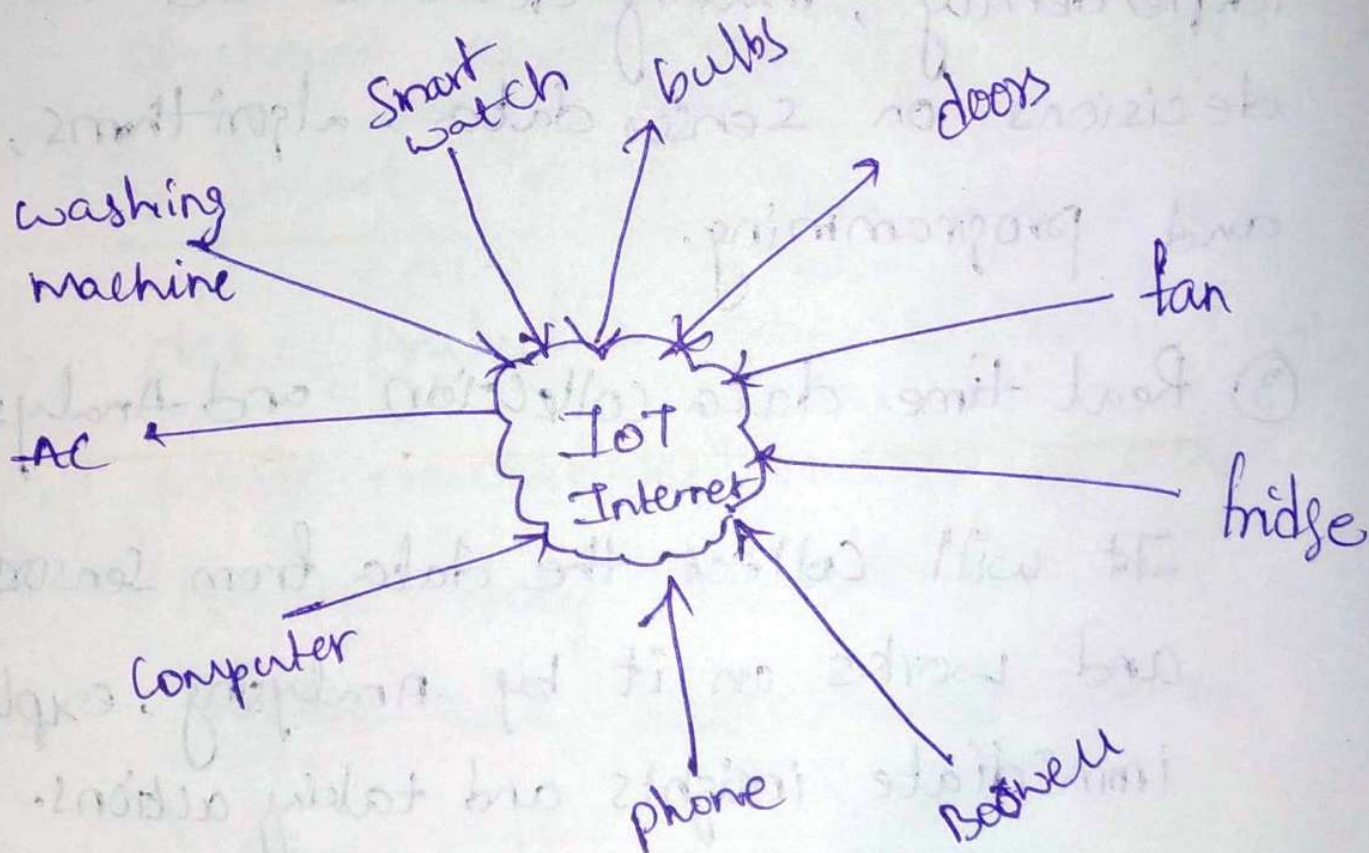④. Scalability :- Iot Systems can scale up or down to accomodate changing demands, new devices.

⑤. Security :- Iot device systems require robust security measure to prevent data leaks., unauthorised access.

⑥ Low Power consumption:-

Many IoT devices are designed to consume low power, enabling battery-powered operation.

⑦ Remote Management:- IoT devices can be remotely monitored, configured and updated.

washing machine → IoT Internet
Smart watch → IoT Internet
bulbs → IoT Internet
doors → IoT Internet
fan → IoT Internet
AC ← IoT Internet
fridge → IoT Internet
Computer → IoT Internet
phone → IoT Internet
Doorbell → IoT Internet

⑧ All our home appliances are connected to internet.

⑨ IoT devices uses hardware items and software gives functionality.

* physical Design of IoT:-

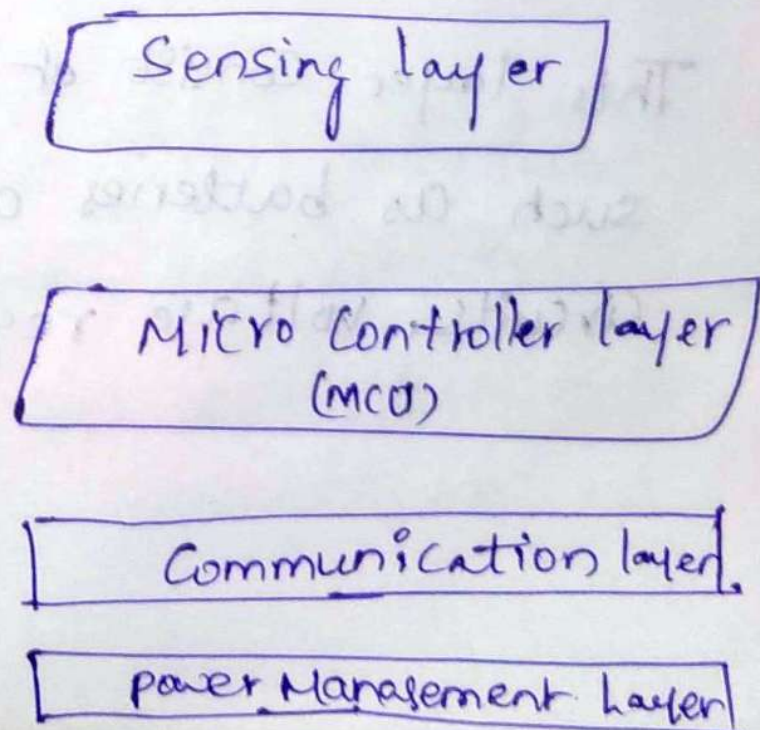*. The "things" what ever we are using or connecting to internet those will be called as "IoT devices".

* Every device can perform these things:-

1. Remote Sensing
2. Actuating and monitoring capabilities.

*. IoT devices can collect various typeof data such as temperature, humidity, light intensity, sound frequency..etc

Ex:- "relay" switch, connected, an IoT device can turn an appliance on/off based on the commands.

*. Diagram:-

| Sensing layer |

| Micro Controller layer (MCU) |

| Communication layer |

| power Management layer |

1. Sensing Layer:- This layer consist of sensors that collect data from its environment such as temperature, humidity .. etc.

2. Micro Controller Layer:-

It will collect the data from the sensors and processes the data, and performs actions based on programming stores in "MCU". (micro controller Unit)

3. Communication Layer:-

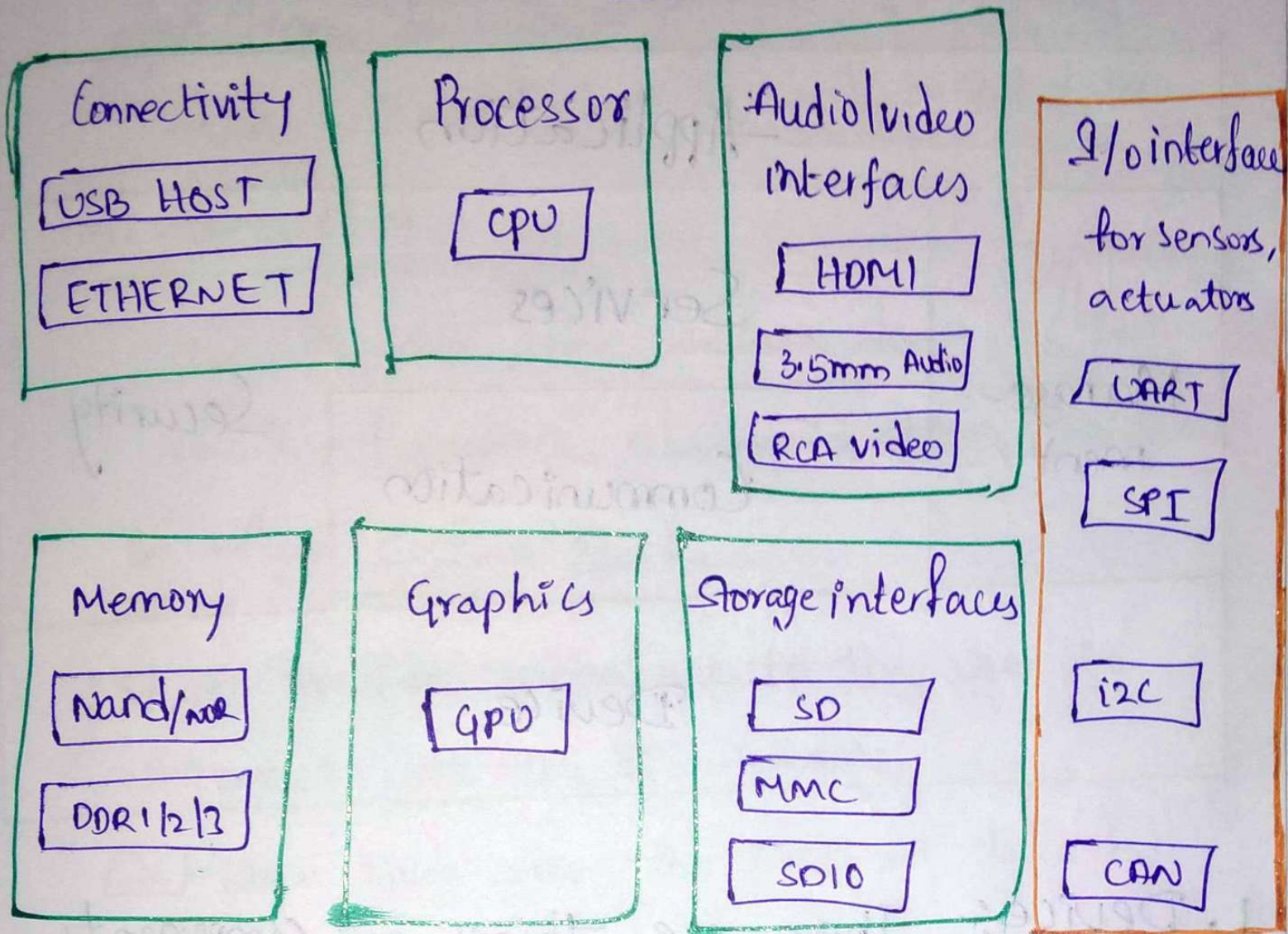This layer consists of communicating protocols used to transmit data to the cloud, other devices.

4. Power Management Layer:-

This layer consist of power sources, such as batteries and power management circuits, voltage regulators.

✳ General Block Diagram of IoT ✳
devices:-

Connectivity	Processor	Audio/video interfaces
USB HOST	CPU	HDMI
ETHERNET		3.5mm Audio
		RCA video

I/o interface for sensors, actuators
- UART
- SPI

Memory	Graphics	Storage interfaces
Nand/nor	GPU	SD
DDR1/2/3		MMC
		SDIO

- i2c
- CAN

SD → Secure Digital

MMC → Microsoft management Console

SDIO → Secure Digital input /output
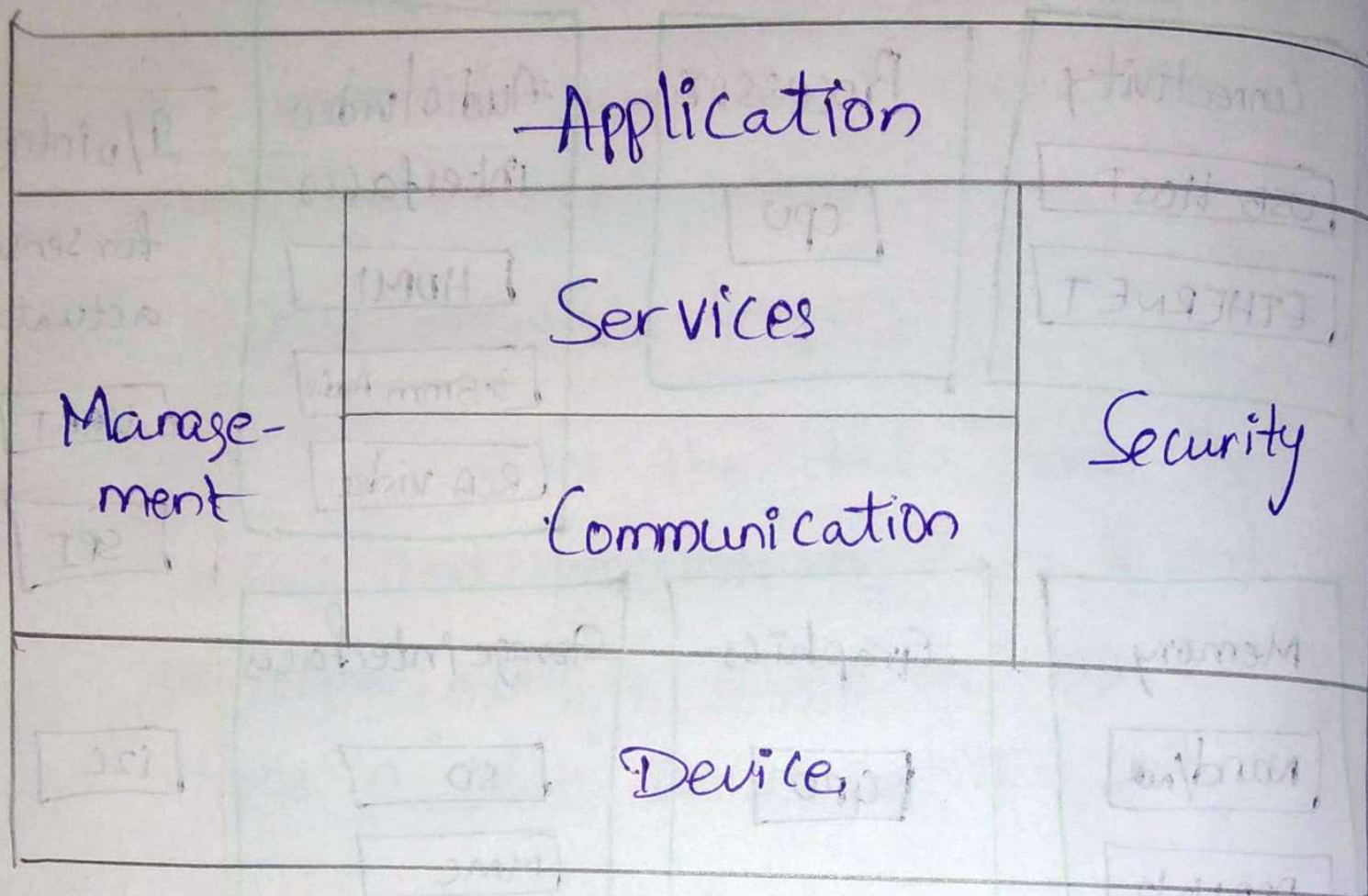
UART → Universal Asynchronous Reciever Transmission port.

SPI → Serial peripheral interface.

I2C → Inter integrated Circuits.

CAN → Control Area Networks.

* Functional Blocks of IOT:-

	Application	
Manage-ment	Services	Security
	Communication	
	Device	

1. **Device:-** These are things or components of IoT System, It Comprises the devices that provide sensing, actuation.

2. **Communication Block:** It handles the protocols to transmit the data. to Cloud or other devices.

3. **Services:-** Iot devices provide the lot of Services to control the devices and monitor the devices.

4. **Management :-** It provides the various functions to govern the IoT system.

   * It will manage the entire IoT system.

5. **Security :-** It will provides functions to handle the secure data by taking authentication, authorization message.

6. **Application Blocks**

   [*] It provide interface to the user to interact with the IOT System.

   [*] User can view the processed data by Sensors.

→. **Sensing :-** It is process of collecting the information from Sensors.

   * Sensors are devices that detect and measure physical or environmental parameters such as temperature, humidity, light, motion, pressure, sound and more.

   * The data collected from the sensors.

is then sent to the "MCU" or
processing unit for "analysis and
decision "Making".

*. Types of Sensors↓

1. Environmental Sensors↓

   These are Used to measure
   temperature, humidity, air quality

2. Motion Sensors;

   Detect movement or, vibrations.

3. Light Sensors; Measure light intensity,

   Color,

4. Acoustic Sensors↓ Detect Sound

   waves, noise levels or vibrations.

5. Pressure Sensors↓ Measure force,

   pressure, or stress.

→. Some Common technologies used in IoT :-

1. Analog -to- Digital Conversion (ADC):
   Converts analog sensor data into
   digital data.

2. Digital Signal processing (DSP): Processes
   and analyzes digital Sensor data.

* Actuation:

It is a process of performing
actions based on the data collected
by sensors.

* "Actuators" performs actuation task.

* Actuators are also devices.

Types:

1. Electrical Actuator: Control
   Electrical circuits, such as
   Switching lights or appliances on/off.

2. Mechanical Actuators: Move or
   manipulate physical objects, such

as motors, pumps.

3. **Thermal Actuators:** - Control the temperature, such as heating or cooling systems.

4. **Accoustic Actuators:** produce a sound, such as speakers.

* **Some Actuation technologies used in IoT:**

1. **Digital to Analog Conversion (DAC):-**

Converts digital control signals into analog signals for actuators.

2. **Pulse width Modulation (PWM):-**

Control the speed or intensity of actuators. Such as
- Speed of motor
- Intensity of light.

*. Basics of Networking:-

→ Networking refers to the communication between IOT devices, gateways. and other devices.

[*] IoT devices use various networking ~~devices~~ protocols and technologies to exchange data, enabling them to interact with each other.

* Gateways: These are devices that connect IoT devices to the "internet", or other networks, enabling data transmission.

* protocol: Standarized rules, and format for data transmission and communication.

* Network technologies:

1. Wired Networking:
    * Ethernet (RS-45)
    * USB
    * Serial Communication (UART, SPI)

2. Wireless Networking:-

- WIFI
- Bluetooth
- Cellular Networks (1G, 2G, 3G, 4G, 5G)

3. Near Short - Range Communication:

- NFC (Near - field Communication)
- RFID (Radio - frequency Identificatⁿ)

4. Long - Range Communication:-

- Satellite Communication

* Networking protocols:-

1. TCP / IP (Transmission Control protocol / Internet protocol)

- ☉ It is transmission control protocol used to transmit the data from source to destination and uses internet protocol to identify the destination.

☑. It is connection oriented or less protocol.

* It is reliable.

* Ip protocol used for Addressing the destination and routing.

* UDP (User Datagram protocols):

- It is unreliable protocol.
- It does not give gaurantee of delivering packets.
- It doesn't give acknowledgement
- It wireless protocol.

* CoAp (Constrained Application protocol):

- A light weight , binary protocol designed for Constraint networks. and devices such as Iot devices.

* It is very useful for data exchange and remote monitoring.

- Similar to HTTP, but for low-power low-band with networks.

* MQTT (message Queuing Telemetry Transport):-

- A lightweight, publish-subscribe protocol.
- which is designed for IoT devices and low-bandwith networks.

- Enables bi-directional communication between devices. and brokers (Servers)

- Used for real-time data exchange.

  * Ex:- Smart Home

* (Hyper Tent Transfer protocol) HTTP:-

- A web based protocol used for device management. Such as data exchanging and remote monitoring

- Enables communication between devices and servers using request + responses.

* **Sensor Networks in IoT:-**

A sensor network is a collection of sensors that communicate with each other and with other devices. to collect, process, and transmit data.

[*]. It will gather the data from the physical environment. and process it transmit it to other devices.

* **Key Components:**

① **Sensors:** Device that detects and measure physical parameters.

② **Sensor Nodes:** It is like rooter that combines sensors, micro controllers and communication interfaces. to collect and transmit data.

3. **Gateway:-** A device that connects sensor nodes to the internet: or to other networks.

→ **Types of Sensor Networks:-**

1. **Wireless Sensor Networks (WSNs):-** Use wireless communication protocols such as WIFI, Bluetooth. to connect "sensor nodes".

2. **Wired Sensor Networks:-** Use wired communication protocols, such as ethernet or USB, to connect sensor nodes.

* **Sensor Network Topologies:-**

- **Star Topology :-** A central device (gateway) connects multiple sensors or nodes.

2. **Mesh topology :-** Each node connected to every other node, enabling multiple paths for data transmissions.

→ **Challenges in Sensor N/w :-**

1. **power Consumption :** Minimizing energy usage for battery - powered Sensors. nodes.

2. **Scalability :-** Handling the large number of nodes and data.

3. **Security :-** Ensuring data inttrigity and Sensor node authentication.

4. **Interoperability :** Enabling communication between different sensor nodes and protocols.

Benfits of Sensor Network :-

1. Real time Data:-

Collect and transmit data in real-time, enabling timely decision making.

2. Increased Accuracy:-

Collect accurate data from multiple sources, reducing errors and inconsi-stencies in data.